

SANYO Semiconductors **DATA SHEET**

STK415-090-E 2-Channel Power Switching Audio Power IC, 50W+50W

Overview

The STK415-090-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

- Pin-to-pin compatible outputs ranging from 80W to 180W.
- Can be used to replace the STK416-100 series (3-channel models) and the class-AB series (2, 3-channel models) due to its pin compatibility.
- Pure complementary construction by new Darlington power transistors
- Output load impedance: $R_L = 8\Omega$ to 4Ω supported
- Using insulated metal substrate that features superlative heat dissipation characteristics that are among the highest in the industry.

Series Models

| | STK415-090-E | STK415-100-E | STK415-120-E | STK415-130-E | STK415-140-E | | | | | | |
|---|---------------------|----------------|-----------------|-----------------|-----------------|--|--|--|--|--|--|
| Output 1 (10%/1kHz) | 80W×2 channels | 90W×2 channels | 120W×2 channels | 150W×2 channels | 180W×2 channels | | | | | | |
| Output 2 (0.8%/20Hz to 20kHz) | 50W×2 channels | 60W×2 channels | 80W×2 channels | 100W×2 channels | 120W×2 channels | | | | | | |
| Max. rated V _H (quiescent) | ±60V | ±65V | ±73V | ±80V | ±80V | | | | | | |
| Max. rated V _L (quiescent) | ±41V | ±42V | ±45V | ±46V | ±51V | | | | | | |
| Recommended operating V _H (8Ω) | ±37V | ±39V | ±46V | ±51V | ±52V | | | | | | |
| Recommended operating V _L (8Ω) | ±27V | ±29V | ±32V | ±34V | ±32V | | | | | | |
| Dimensions (excluding pin height) | 64.0mm×31.1mm×9.0mm | | | | | | | | | | |

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Specifications

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

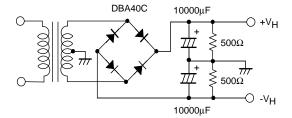
| Parameter | Symbol | Conditions | Ratings | Unit |
|--|------------------------------------|--|--------------|------|
| V _H maximum quiescent supply voltage 1 | V _H max (1) | When no signal | ±60 | V |
| V _H maximum supply voltage 2 | V _H max (2) | R _L ≥6Ω | ±53 | V |
| V _H maximum supply voltage 3 | V _H max (3) | R _L ≥4Ω | ±43 | V |
| V _L maximum quiescent supply voltage 1 | V _L max (1) | When no signal | ±41 | V |
| V _L maximum supply voltage 2 | V _L max (2) | R _L ≥6Ω | ±36 | V |
| V _L maximum supply voltage 3 | V _L max (3) | R _L ≥4Ω | ±29 | V |
| Maximum voltage between V _{H and} V _L *4 | V _H -V _L max | No loading | 60 | V |
| Standby pin maximum voltage | Vst max | | -0.3 to +5.5 | V |
| Thermal resistance | θј-с | Per power transistor | 2.1 | °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 =±37V, V_L =±27V, R_L =8 Ω , f=50Hz, P_O =50W, 1-channel active | 0.3 | S |

Electrical Characteristics at Tc=25°C, RL=8Ω (non-inductive load), Rg=600Ω, VG=40dB, VZ=15V

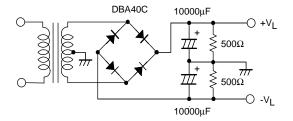
| | | | | Conc | | | | | | | |
|------------------------------------|--------------------|--|------------|-----------|-----------------------|-------------|--------------------|-----|-----------|-----|-------|
| Parameter | Symbol | | V (V) | f (Hz) | P _O (W) | THD (%) | | min | typ | max | unit |
| Output power | P _O (1) | V _H V _L | ±37 ±27 | 20 to 20k | | 0.8 | | 50 | | | |
| | P _O (2) | VH VL | ±30 ±23 | 1k | | 0.8 | R _L =4Ω | | 50 | | W |
| Total harmonic distortion | THD | VH VL | ±37 ±27 | 20 to 20k | 50 | 50 | | | 0.4 | | % |
| Frequency characteristics | fL, fH | V _H ±37 V _L ±27 | | | 1.0 | 1.0 +0 -3dB | | | 20 to 50k | (| Hz |
| Input impedance | ri | V _H V _L | ±37 ±27 | 1k | 1.0 | | | | 55 | | kΩ |
| Output noise voltage *2 | VNO | V _H V _L | ±45 ±30 | | | | Rg=2.2kΩ | | | 1.0 | mVrms |
| Quiescent current | Icco | ٧ _H | ±45 | | | | R _L =∞ | | | 30 | mA |
| | | ٧L | ±30 | | | | 11, | | | 100 | IIIA |
| Output neutral voltage | VN | ∨ _H ∨ _L | ±45 ±30 | | | | | -70 | 0 | +70 | mV |
| Pin 17 voltage when standby ON *7 | VST ON | V _H V _L | ±37 ±27 | | | | Standby | | 0 | 0.6 | V |
| Pin 17 voltage when standby OFF *7 | VST OFF | V _H V _L | ±37 ±27 | | | | Operating | 2.5 | 3.0 | | V |

[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 (|VH|-|VI|) is always less than 40V when switching the power supply with the load connected.
- *5: Set up the VL power supply with an offset voltage at power supply switching (VL-VO) of about 8V as an initial target.
- *6: Please connect –Pre V_{CC} pin (#5 pin) with the stable minimum voltage and connect so that current does not flow in by reverse bias.
- *7: Use the standby pin (pin 17) so that the applied voltage never exceeds the maximum rating. The power amplifier is turned on by applying +2.5V to +5.5V to the standby pin (pin 17).
- *8: Thermal design must be implemented based on the conditions under which the customer's end products are expected to operate on the market.
- *9: A thermoplastic adhesive resin is used for this hybrid IC.



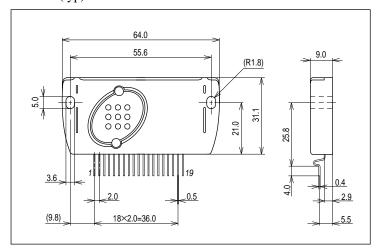
Designated transformer power supply (MG-250 equivalent)



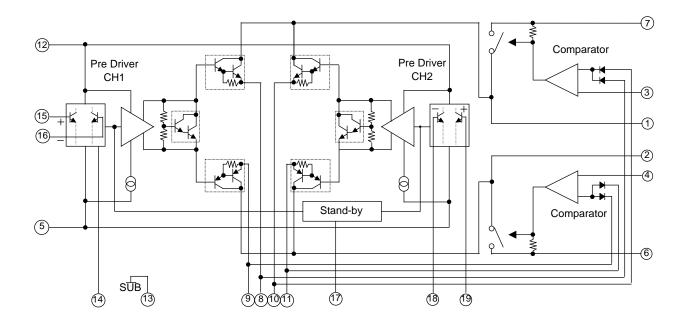
Designated transformer power supply (MG-200 equivalent)

Package Dimensions

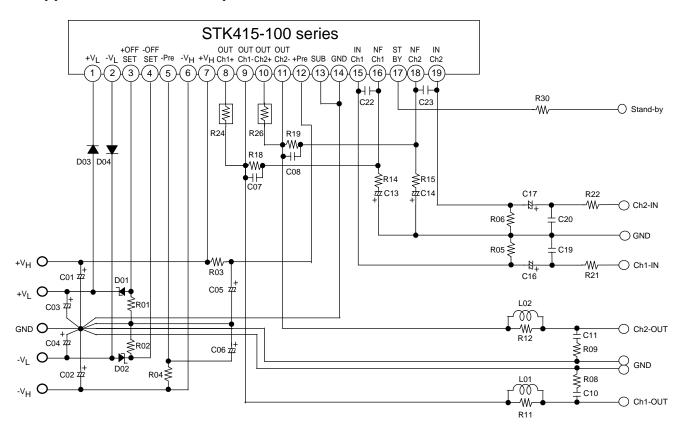
unit:mm (typ)



Internal Equivalent Circuit



Application Circuit Example

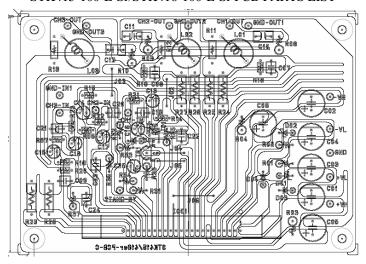


Recommended Values for Application Parts (for the test circuit)

| Cumbal | Recommended | Description | Larger than Recommended | Smaller than |
|----------|--------------|---|-----------------------------------|---------------------------------|
| Symbol | Value | Description | Value | Recommended Value |
| R01, R02 | 1.5kΩ | Determine the current flowing into the power switching | Power holding circuit | Power switching circuit |
| | | circuit (comparator), (3mA to 10mA at V _H power | remains active at lower | activates at higher |
| | | switching) | frequencies. | frequencies. |
| R03, R04 | 100Ω/1W | Ripple filtering resistors | Decreased pass-through | Increased pass-through |
| | | (Used with C05 and C06 to form a ripple filter.) | current at high frequencies. | current at high frequencies. |
| R05, R06 | 56kΩ | Input bias resistors | VN offset | |
| | | (Virtually determine the input impedance.) | (Ensure R05=R18, R06=R19 | when changing.) |
| R08, R09 | 4.7Ω/1W | Oscillation prevention resistor | - | - |
| R11, R12 | 4.7Ω | Oscillation prevention resistor | - | - |
| R14,R15 | 560Ω | Used with R18 and R19 to determine the voltage gain | Likely to oscillate | None |
| | | VG. (VG should desirably be determined by the R14 | (VG<40dB) | |
| | | and R15 value.) | | |
| R18, R19 | 56kΩ | Used with R14 and R15 to determine the voltage gain | - | - |
| | | VG. | | |
| R21, R22 | 1kΩ | Input filtering resistor | - | - |
| R24, R26 | 0.22Ω±10%, | Output emitter resistors | Decrease in maximum | Likely to cause thermal- |
| | 5W | (Use of cement resistor is desirable) | output power | runaway. |
| R30 | Remarks *7 | Use a limiting resistor according to the voltage applied to | the standby pin so that it remain | ns within the rating. |
| C01, C02 | 100μF/ | Oscillation prevention capacitors. | | |
| | 100V | Insert the capacitors as close to the IC as possible to | | |
| | | decrease the power impedance for reliable IC | - | - |
| | | operation (use of electrolytic capacitors are | | |
| | | desirable). | | |
| C03, C04 | 100μF/ | Oscillation prevention capacitors. | | |
| | 50V | Insert the capacitors as close to the IC as possible to | | |
| | | decrease the power impedance for reliable IC | - | - |
| | | operation (use of electrolytic capacitors are | | |
| | | desirable). | | |
| C05, C06 | 100μF/ | Decoupling capacitors. | Increase in ripple component | s that pass into the input side |
| | 100V | Eliminate ripple components that pass into the input | from the power line. | |
| | | side from the power line. | | |
| C07 C09 | 3pF | (Used with R03 and R04 to form a ripple filter.) | Likely to oscillate | |
| C07, C08 | | Oscillation prevention capacitor | - | |
| C10, C11 | 0.1μF | Oscillation prevention capacitor | Likely to oscillate | |
| C13, C14 | 22 🗆 / | (Mylar capacitors are recommended.) | Increase in low-frequency | Decrease in low-frequency |
| C13, C14 | 22μF/ 10V | NF capacitor | voltage gain, with higher | |
| | 100 | (Changes the low cutoff frequency; ex/f _L =1/2π •C13•R14) | pop noise at power-on. | voltage gain |
| C16 C17 | 2.2 | | pop noise at power on. | |
| C16, C17 | 2.2μF/ | Input coupling capacitor (block DC current) | - | - |
| C19, C20 | 50V 470pF | Input filter capacitor | | |
| 013, 020 | 470pF | (Used with R21 and R22 to form a filter that suppresses | _ | _ |
| | | high-frequency noises.) | | |
| C22, C23 | 100pF | Oscillation prevention capacitor | Likely to oscillate. | <u> </u> |
| D01, D02 | 15V | | Decreased distortion at | Increased distortion at |
| שטו, שטע | 157 | Determine the offset voltage at $V_L \leftrightarrow V_H$ power. | power switching time | power switching time. |
| D03, D04 | 3A/60V | Reverse current prevention diodes | power switching time | power switching time. |
| D00, D04 | 3A/00V | (FRD is recommended.) | - | - |
| L01, L02 | 3μΗ | Oscillation prevention inductance | None | Likely to oscillate. |
| _0., _0_ | ا الم | | | |

Sample PCB Trace Pattern

STK415-100-E-Sr/STK416-100-E-Sr PCB PARTS LIST



Parts List

STK415, 416-100Sr PCB Parts List

| R01, R02 FRX1SJ*** 1.5kΩ, 1W 1.5kΩ, 1W R03, R04 100Ω, 1W ERG1SJ101 enabled enabled R05, R06, (R07), R18, R19, (R20) 56kΩ, 1/6W RN16S563FK enabled enabled R08, R09, (R10) 4.7Ω, 1/W ERX1SJ4R7 enabled enabled R11, R12, (R13) 4.7Ω, 1/4W RN14S4R7FK enabled enabled R11, R12, (R21) 1kΩ, 1/6W RN16S***FK 560Ω, 1/6W 560Ω, 1/6W R21, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R22, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R25, R27, (R23)* 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28)* 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R35, R36, R37 - - Short Short C01, C02, C05, C08 100µF, 100V 100MV100HC enabled enabled C01, C01, (C11, (C12)* 0.1µF, 100V EC0-V1H104JZ enabled enabled | PCB No. | | PARTS | RATING | STK415 (416) -090-E, -100-E, -120-E, 130-E | STK415-140-E |
|--|--------------------|------|----------------|-----------------|--|----------------|
| R05, R06, (R07), R18, R19, (R20) 56kΩ, 1/6W RN16S563FK enabled enabled R08, R09, (R10) 4.7Ω, 1W ERX1SJ4R7 enabled enabled R11, R12, (R13) 4.7Ω, 1/4W RN14S4R7FK enabled enabled R14, R15, (R16) - RN16S***FK 560Ω, 1/6W 560Ω, 1/6W R21, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R25, R27, (R29) 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R33, R36, R37 - - Short Short Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled enabled C03, C04 100µF, 50V 50MV100HC enabled enabled enabled C11, C11, (C12) 0.1µF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 2.2µF, 50V 50MV2R2HC enabled enabled C16, C17, (C18) 2.2µF, 50 | R01, R02 | | - | ERX1SJ*** | 1.5kΩ, 1W | 1.5kΩ, 1W |
| R19, (R20) SOKI, 1/6W RN165803FK enabled enabled R08, R09, (R10) 4.7Ω, 1/W ERX15J4R7 enabled enabled R11, R12, (R13) 4.7Ω, 1/4W RN14S4R7FK enabled enabled R11, R12, (R13) - RN16S***FK 560Ω, 1/6W 560Ω, 1/6W R21, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R24, R26, (R29) 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R35, R36, R37 - - Short Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled C03, C04 10µF, 100V 50MV10HC enabled enabled C10, C11, (C12) 0.1µF, 100V ECQ+V1H104JZ enabled enabled C10, C11, (C18) 2.2µF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF D0104-63B471K50 enabled enabled | R03, R04 | | 100Ω, 1W | ERG1SJ101 | enabled | enabled |
| R11, R12, (R13) 4.7Ω, 1/4W RN14S4R7FK enabled enabled R14, R15, (R16) - RN16S***FK 560Ω, 1/6W 560Ω, 1/6W R21, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R25, R27, (R29) 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R35, R36, R37 - - Short Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled C03, C04 100µF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1µF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22µF, 50V 50MV2R2HC enabled enabled C16, C17, (C18) 2.2µF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B410K50 enabled enabled </td <td colspan="2"></td> <td>56kΩ, 1/6W</td> <td>RN16S563FK</td> <td>enabled</td> <td>enabled</td> | | | 56kΩ, 1/6W | RN16S563FK | enabled | enabled |
| R14, R15, (R16) - RN16S***FK 560Ω, 1/6W 560Ω, 1/6W R21, R22, (R23) 1kΩ, 1/6W RN16S102FK enabled enabled R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J Short Short R35, R36, R37 - - Short Short C01, C02, C05, C06 100μF, 100V 100MV100HC enabled enabled C03, C04 100μF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1μF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C101, D2, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled C | R08, R09, (F | R10) | 4.7Ω, 1W | ERX1SJ4R7 | enabled | enabled |
| R21, R22, (R23) 1 kΩ, 1/6W RN16S102FK enabled enabled R25, R27, (R29) 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R35, R36, R37 - Short Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled C03, C04 100µF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1µF, 100V ECQ-V1H104JZ enabled enabled C10, C11, (C14) 22µF, 10V 10MV220HC enabled enabled C13, C14, (C15) 22µF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C33, (C24) 100pF DD104-63B471K50 enabled enabled D1, D02 - GZA15X (SANYO) GZA18X (SANYO) D3, D04 | R11, R12, (R13) | | 4.7Ω, 1/4W | RN14S4R7FK | enabled | enabled |
| R25, R27, (R29) 0.22Ω±10%, 5W BPR56CFR22J Short Short R24, R26, (R28) 0.22Ω±10%, 5W BPR56CFR22J enabled enabled R35, R36, R37 - - Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled C03, C04 100µF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1µF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22µF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2µF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA15X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled Stand-By R30 | R14, R15, (R16) | | - | RN16S***FK | 560Ω, 1/6W | 560Ω, 1/6W |
| R24, R26, (R28) 0.22Ω±10%, 5W BPRS6CFR22J enabled enabled R35, R36, R37 - - Short Short C01, C02, C05, C06 100µF, 100V 100MV100HC enabled enabled C03, C04 100µF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1µF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22µF, 10V 10MV220HC enabled enabled C15, C17, (C18) 2.2µF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled enabled L01, L02, (L03) 3µH enabled enabled enabled R33 <td< td=""><td colspan="2">R21, R22, (R23)</td><td>1kΩ, 1/6W</td><td>RN16S102FK</td><td>enabled</td><td>enabled</td></td<> | R21, R22, (R23) | | 1kΩ, 1/6W | RN16S102FK | enabled | enabled |
| R35, R36, R37 - - Short Short C01, C02, C05, C06 100μF, 100V 100MV100HC enabled enabled C03, C04 100μF, 50V 50MV100HC enabled enabled C07, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1μF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA16X (SANYO) D3, D04 IF (AV)=3A/60V enabled enabled enabled L01, L02, L03) 3μH enabled enabled enabled R33 33kΩ, 1/6W RN16S332FK enabled enabled R34 2kΩ, 1/6W | R25, R27, (R29) | | 0.22Ω±10%, 5W | BPR56CFR22J | Short | Short |
| CO1, CO2, CO5, CO6 100μF, 100V 100MV100HC enabled enabled CO3, CO4 100μF, 50V 50MV100HC enabled enabled CO7, CO8, (CO9) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1μF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled enabled L01, L02, (L03) 3μH enabled enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R33 33kΩ, 1/6W RN16S333FK enabled enabled < | R24, R26, (F | R28) | 0.22Ω±10%, 5W | BPR56CFR22J | enabled | enabled |
| CO3, CO4 100μF, 50V 50MV100HC enabled enabled CO7, CO8, (CO9) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1μF, 100V ECQ-VH104JZ enabled enabled C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled L01, L02, (L03) 3μH enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R33 33kΩ, 1/6W RN16S333FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC | R35, R36, R37 | | - | - | Short | Short |
| CO7, C08, (C09) 3pF DD104-63B3ROK50 enabled enabled C10, C11, (C12) 0.1μF, 100V ECQ-V1H104JZ enabled enabled C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled L01, L02, (L03) 3μH enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R32 1kΩ, 1/6W RN16S102FK enabled enabled R33 33kΩ, 1/6W RN16S202FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC | C01, C02, C05, C06 | | 100μF, 100V | 100MV100HC | enabled | enabled |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | C03, C04 | | 100μF, 50V | 50MV100HC | enabled | enabled |
| C13, C14, (C15) 22μF, 10V 10MV220HC enabled enabled C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled L01, L02, (L03) 3μH enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R32 1kΩ, 1/6W RN16S102FK enabled enabled R33 33kΩ, 1/6W RN16S333FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC enabled enabled D05 - GMB01 (Ref.) enabled enabled Jumper 20mm enabled enabled | C07, C08, (C09) | | 3pF | DD104-63B3ROK50 | enabled | enabled |
| C16, C17, (C18) 2.2μF, 50V 50MV2R2HC enabled enabled C19, C20, (C21) 470pF DD104-63B471K50 enabled enabled C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled L01, L02, (L03) 3μH enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R32 1kΩ, 1/6W RN16S102FK enabled enabled R33 33kΩ, 1/6W RN16S33FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC enabled enabled D05 - GMB01 (Ref.) enabled enabled TR1 - 2SC2274 (Ref.) enabled enabled Jumper 20mm enabled enabled | C10, C11, (C12) | | 0.1μF, 100V | ECQ-V1H104JZ | enabled | enabled |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | C13, C14, (C15) | | 22μF, 10V | 10MV220HC | enabled | enabled |
| C22, C23, (C24) 100pF DD104-63B101K50 enabled enabled D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled L01, L02, (L03) 3μH enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R32 1kΩ, 1/6W RN16S102FK enabled enabled R33 33kΩ, 1/6W RN16S333FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC enabled enabled D05 - GMB01 (Ref.) enabled enabled Jumper 20mm enabled enabled J01 Jumper 10mm enabled enabled | C16, C17, (C | C18) | 2.2μF, 50V | 50MV2R2HC | enabled | enabled |
| D01, D02 - - GZA15X (SANYO) GZA18X (SANYO) D03, D04 IF (AV)=3A/60V enabled enabled enabled L01, L02, (L03) 3μH enabled enabled enabled Stand-By R30 3.3kΩ, 1/6W RN16S332FK enabled enabled R32 1kΩ, 1/6W RN16S102FK enabled enabled R33 33kΩ, 1/6W RN16S333FK enabled enabled R34 2kΩ, 1/6W RN16S202FK enabled enabled C25 47μF, 10V 10MV47HC enabled enabled D05 - GMB01 (Ref.) enabled enabled J01 Jumper 20mm enabled enabled J02, J03, J06 Jumper 10mm enabled enabled | C19, C20, (C | 221) | 470pF | DD104-63B471K50 | enabled | enabled |
| D03, D04IF (AV)=3A/60VenabledenabledL01, L02, (L03) $3\mu H$ enabledenabledStand-ByR30 $3.3k\Omega$, 1/6WRN16S332FKenabledenabledR32 $1k\Omega$, 1/6WRN16S102FKenabledenabledR33 $33k\Omega$, 1/6WRN16S333FKenabledenabledR34 $2k\Omega$, 1/6WRN16S202FKenabledenabledC25 47μ F, 10V $10MV47HC$ enabledenabledD05-GMB01 (Ref.)enabledenabledJ01Jumper $2SC2274$ (Ref.)enabledenabledJ02, J03, J06Jumper $10mm$ enabledenabled | C22, C23, (C | 224) | 100pF | DD104-63B101K50 | enabled | enabled |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | D01, D02 | | - | - | GZA15X (SANYO) | GZA18X (SANYO) |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | D03, D04 | | IF (AV)=3A/60V | | enabled | enabled |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | L01, L02, (L0 | 03) | 3μΗ | | enabled | enabled |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | Stand-By | R30 | 3.3kΩ, 1/6W | RN16S332FK | enabled | enabled |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | R32 | 1kΩ, 1/6W | RN16S102FK | enabled | enabled |
| C25 47μF, 10V 10MV47HC enabled enabled D05 - GMB01 (Ref.) enabled enabled TR1 - 2SC2274 (Ref.) enabled enabled J01 Jumper 20mm enabled enabled J02, J03, J06 Jumper 10mm enabled enabled | | R33 | 33kΩ, 1/6W | RN16S333FK | enabled | enabled |
| D05 - GMB01 (Ref.) enabled enabled TR1 - 2SC2274 (Ref.) enabled enabled J01 Jumper 20mm enabled enabled J02, J03, J06 Jumper 10mm enabled enabled | | R34 | 2kΩ, 1/6W | RN16S202FK | enabled | enabled |
| TR1 - 2SC2274 (Ref.) enabled enabled J01 Jumper 20mm enabled enabled J02, J03, J06 Jumper 10mm enabled enabled | | C25 | 47μF, 10V | 10MV47HC | enabled | enabled |
| J01 Jumper 20mm enabled enabled J02, J03, J06 Jumper 10mm enabled enabled | | D05 | - | GMB01 (Ref.) | enabled | enabled |
| J02, J03, J06 Jumper 10mm enabled enabled | | TR1 | - | 2SC2274 (Ref.) | enabled | enabled |
| | J01 | | Jumper | 20mm | enabled | enabled |
| J04, J05 Jumper 7mm enabled enabled | J02, J03, J06 | 6 | Jumper | 10mm | enabled | enabled |
| | J04, J05 | | Jumper | 7mm | enabled | enabled |

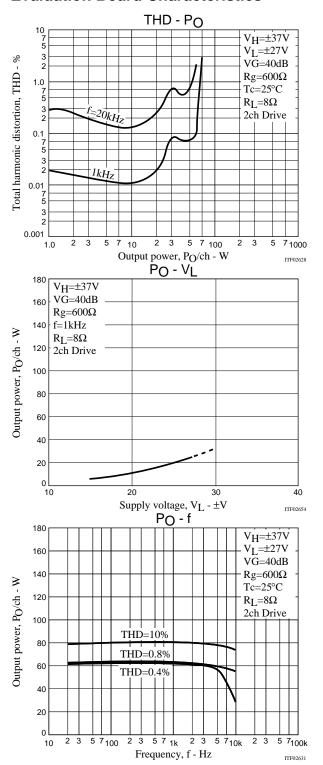
(*1) STK416-100Sr (3ch AMP) doesn't mount parts of ().

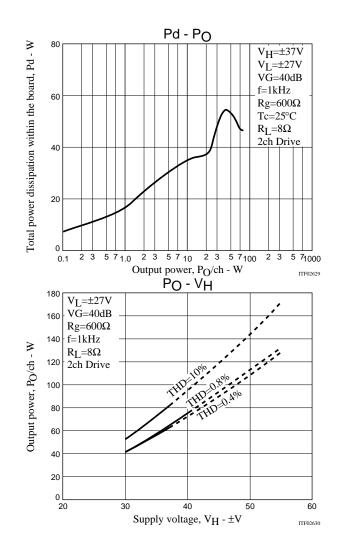
Pin Assignments

[STK433-000/-100/-200 Sr & STK415/416-100 Sr Pin Layout]

| [STK433-000/-100/-200 Sr & S |) I K ² | +13/ | 410 | -100 |) Sr | Pin | Lay | out | | | | | | | | | | | | | | | |
|------------------------------|--------------------|------|-----|------|------|-----|-----|-----|---|-----|--------|-------|-------|----|----|----|----|----|----|----|----|----|----|
| 2ch class-AB | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | | | |
| ZUII Class-AB | | | | | | | | | | 2ch | clas | sAB/ | 2.00r | nm | | | | | | | | | |
| STK433-030-E 30W/JEITA | | | | | - | - | + | 0 | 0 | 0 | 0 | + | | | I | N | S | N | ı | | | | |
| STK433-040-E 40W/JEITA | | | | | Р | ٧ | ٧ | U | U | U | U | Р | S | G | N | F | Т | F | Ν | | | | |
| STK433-060-E 50W/JEITA | | | | | R | С | С | Т | Т | Т | Т | R | U | N | / | / | Α | / | / | | | | |
| STK433-070-E 60W/JEITA | | | | | Е | С | С | / | / | / | / | Е | В | D | С | С | Ν | С | С | | | | |
| | | | | | | | | С | С | С | С | | • | | Н | Н | D | Н | Н | | | | |
| STK433-090-E 80W/JEITA | | | | | | | | Н | Н | Н | Н | | G | | 1 | 1 | 1 | 2 | 2 | | | | |
| STK433-100-E 100W/JEITA | | | | | | | | 1 | 1 | 2 | 2 | | N | | | | В | | | | | | |
| STK433-120-E 120W/JEITA | | | | | | | | + | - | + | - | | D | | | | Υ | | | | | | |
| STK433-130-E 150W/JEITA | | | | | | | | | | | | | | | | | | | | | | | |
| 0.1.145 | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 3ch class-AB | | | | | | • | | | | 3ch | clas | sAB/ | 2.00n | nm | | | | | | | | | |
| STK433-230A-E 30W/JEITA | 1 | | | | - | - | + | 0 | 0 | 0 | 0 | + | | | I | N | S | N | 1 | Ι | N | 0 | 0 |
| STK433-240A-E 40W/JEITA | | | | | Р | ٧ | ٧ | U | U | U | U | Р | S | G | N | F | Т | F | Ν | N | F | U | U |
| STK433-260A-E 50W/JEITA | | | | | R | С | С | Т | Т | Т | Т | R | U | N | / | / | Α | / | / | / | / | Т | Т |
| STK433-270-E 60W/JEITA | | | | | Е | С | С | / | / | / | / | Е | В | D | С | С | N | С | С | С | С | / | / |
| STK433-290-E 80W/JEITA | | | | | | | | С | С | С | С | | • | | Н | Н | D | Н | Н | Н | Н | С | С |
| STK433-300-E 100W/JEITA | | | | | | | | Н | Н | Н | Н | | G | | 1 | 1 | | 2 | 2 | 3 | 3 | Н | Н |
| STK433-320-E 120W/JEITA | | | | | | | | 1 | 1 | 2 | 2 | | N | | | | В | | | | | 3 | 3 |
| STK433-330-E 150W/JEITA | | | | | | | | + | - | + | - | | D | | | | Υ | | | | | + | - |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | | , | | |
| 2ch class-H | 2ch classH/2.00mm | | | | | | | | | | | | | | | | | | | | | | |
| STK415-090-E 80W/JEITA | + | - | + | - | - | - | + | 0 | 0 | 0 | 0 | + | | | ı | N | S | N | 1 | | | | |
| STK415-100-E 90W/JEITA | V | ٧ | 0 | 0 | Р | ٧ | ٧ | U | U | U | U | Р | S | G | N | F | Т | F | N | | | | |
| STK415-120-E 120W/JEITA | L | L | F | F | R | Н | Н | Т | Т | Т | Т | R | U | N | / | / | Α | / | / | | | | |
| STK415-130-E 150W/JEITA | | | F | F | Е | | | / | / | / | / | Е | В | D | С | С | N | С | С | | | | |
| STK415-140-E 180W/JEITA | | | s | s | | | | С | С | С | С | | • | | Н | Н | D | Н | Н | | | | |
| | | | Е | Е | | | | Н | Н | Н | Н | | G | | 1 | 1 | ı | 2 | 2 | | | | |
| | | | Т | Т | | | | 1 | 1 | 2 | 2 | | Ν | | | | В | | | | | | |
| | | | | | | | | + | - | + | - | | D | | | | Υ | | | | | | |
| 0.1.1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 3ch class-H | | | | | | | | | | 3с | h clas | ssH/2 | 2.00m | ım | | | | | | | | | |
| STK416-090-E 80W/JEITA | + | - | + | - | - | - | + | 0 | 0 | 0 | 0 | + | | | I | N | S | N | 1 | 1 | N | 0 | 0 |
| STK416-100-E 90W/JEITA | V | ٧ | 0 | 0 | Р | ٧ | ٧ | U | U | U | U | Р | S | G | N | F | Т | F | Ν | Ν | F | U | U |
| STK416-120-E 120W/JEITA | L | L | F | F | R | Н | Н | Т | Т | Т | Т | R | U | Ν | / | / | Α | / | / | / | / | Т | Т |
| STK416-130-E 150W/JEITA | | | F | F | Е | | | / | / | / | / | Ε | В | D | С | С | Ν | С | С | С | С | / | / |
| | | | S | S | | | | С | С | С | С | | • | | Н | Н | D | Н | Н | Н | Н | С | С |
| | | | Е | Е | | | | Н | Н | Н | Н | | G | | 1 | 1 | | 2 | 2 | 3 | 3 | Н | Н |
| | | | Т | Т | | | | 1 | 1 | 2 | 2 | | N | | | | В | | | | | 3 | 3 |
| | | | | | | | | + | | + | _ | | D | | | | Υ | | | | | + | |
| | | | | | | | | | | | | | | | | | | | | | | | |

Evaluation Board Characteristics





[Thermal Design Example for STK415-090-E ($R_L = 8\Omega$)]

The thermal resistance, θ c-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.

$$Pd \times \theta c - a + Ta < 125^{\circ}C \qquad (1)$$

Ta: Guaranteed ambient temperature for the end product

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

$$Pd \times \theta c - a + Pd/N \times \theta j - c + Ta < 150^{\circ}C \qquad (2)$$

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 θ c-a.

$$\theta c-a < (125 - Ta)/Pd$$
 (1)' $\theta c-a < (150 - Ta)/Pd - \theta j-c/N$ (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
 Load resistance
 Guaranteed ambient temperature
 Ta

[Example]

When the IC supply voltage, V_H =±37V, V_L =±27V and R_L is 8Ω , the total power dissipation, Pd, within the hybrid IC, will be a maximum of 55W 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 1/8Po 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
$$\approx 32.0$$
W (when 1/8PO max. = 6.3W, PO max. = 50W).

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

From formula (1)'
$$\theta c\text{-a} < (125 - 50)/32.0$$

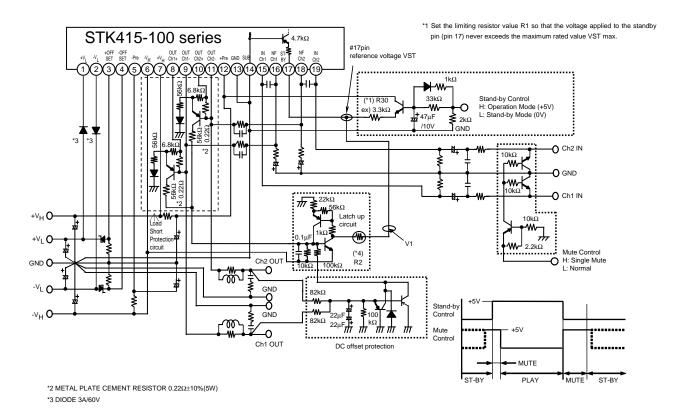
$$< 2.34$$
 From formula (2)'
$$\theta c\text{-a} < (150 - 50)/32.0 - 2.1/4$$

$$< 2.60$$

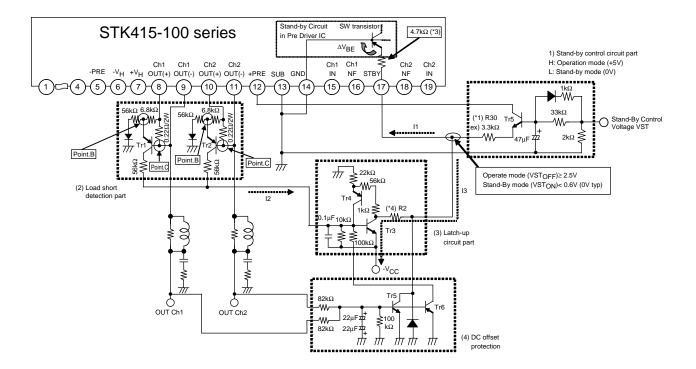
Therefore, the value of 2.34°C/W, which satisfies both of these formulae, is the required thermal resistance of the heat sink.

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.

STK415-100 Series Stand-by control, Mute control, Load-short protection & DC offset protection application



STK415-100 Series Application explanation



The protection circuit application for the STK415-100sr consists of the following blocks (blocks (1) to (4)).

- (1) Standby control circuit block
- (2) Load short-circuit detection block
- (3) Latch-up circuit block
- (4) DC voltage protection block

1) Standby control circuit block

Concerning pin 17 reference voltage VST

<1> Operation mode

The switching transistor of the predriver IC turns on when the pin 17 reference voltage, VST, becomes greater than or equal to 2.5V, placing the amplifier into the operation mode.

Example: When VST (min.) = 2.5V

I1 is approximately equal to 0.40mA since VST = (*2) × IST + 0.6V \rightarrow 2.5V = 4.7k Ω × IST + 0.6V.

<2> Standby mode

The switching transistor of the predriver IC turns off when the pin 17 reference voltage, VST, becomes lower than or equal to 0.6V (typ. 0V), placing the amplifier into the standby mode.

Example: When VST = 0.6V

I1 is approximately equal to 0mA since VST = (*2) × IST + 0.6V \rightarrow 0.6V = 4.7k Ω × IST + 0.6V.

(*1) Limiting resistor

Determine the value of R1 so that the voltage VST applied to the standby pin (pin 17) falls within the rating (+2.5V to 5.5V (typ. 3.0V)).

- (*2) The standby control voltage must be supplied from the host including microcontrollers.
- (*3) A $4.7k\Omega$ limiting resistor is also incorporated inside the hybrid IC (at pin 17).

2) Load short-circuit detection block

Since the voltage between point B and point C is less than 0.6V in normal operation mode ($V_{BE} < 0.6V$) and TR1 (or TR2) is not activated, the load short-circuit detection block does not operate.

When a load short-circuit occurs, however, the voltage between point B and point C becomes larger than 0.6V, causing TR1 (or TR2) to turn on $(V_{BE} > 0.6V)$, and current I2 to flows.

3) Latch-up circuit block

TR3 is activated when I2 is supplied to the latch-up circuit.

When TR3 turns on and current I3 starts flowing, VST goes down to 0V (standby mode), protecting the power amplifier.

Since TR3 and TR4 configure a thyristor, once TR3 is activated, the IC is held in the standby mode.

To release the standby mode and reactivate the power amplifier, it is necessary to set the standby control voltage (*2) temporarily low (0V). Subsequently, when the standby control is returned to high, the power amplifier will become active again.

(*4) The I3 value varies depending on the supply voltage. Determine the value of R2 using the formula below, so that I1 is equal to or less than I3.

 $I1 \le I3 = V_{CC}/R2$

4) DC offset protection block

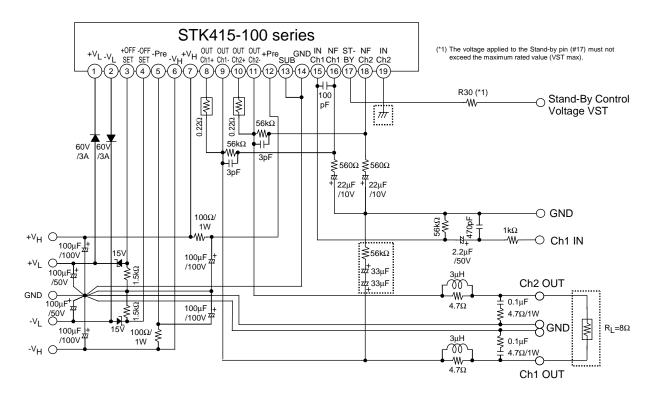
The DC offset protection circuit is activated when $\pm 0.5 V$ (typ) voltage is applied to either "OUT CH1" or "OUT CH2," and the hybrid IC is shut down (standby mode).

To release the IC from the standby mode and reactivate the power amplifier, it is necessary to set the standby control voltage temporarily low (0V).

Subsequently, when the standby control is returned to high (+5V), for example, the power amplifier will become active again.

The protection level must be set using the $82k\Omega$ resistor. Furthermore, the time constant must be determined using $22\mu//22\mu$ capacitors to prevent the amplifier from malfunctioning due to the audio signal.

STK415-100 Series BTL Application



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