

harman/kardon
by HARMAN



MAS 101/102/111 **AMP**

Music system

Service Manual

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System

| | |
|--------------------------------------|---|
| Power output | 65 watts per channel, 20Hz – 20kHz, THD <0.07%, into 6 ohms, both channels driven |
| Bandwidth | 20Hz – 35kHz, –3dB |
| System frequency response | 20Hz – 20kHz, ±0.5dB |
| Signal-to-noise ratio, A-weighted | 90dB (Analog inputs), 96dB (Digital inputs) |
| Channel separation | ≥65dB |
| Crosstalk between sources | ≥70dB |
| Line-level input sensitivity at 1kHz | 250mV RMS, ±1dB |
| Phono MM input sensitivity at 1kHz | 7.5mV |

Loudspeakers

| | |
|----------------------------|---|
| Low-frequency transducers | Two 130mm honeycomb composite drivers, ported |
| High-frequency transducers | Two 25mm MMD® domes, shielded |
| Nominal impedance | 8 ohms |
| Sensitivity (2.83V/1m) | 85dB |
| Frequency response | 60Hz – 25kHz (–3dB) |
| Crossover frequency | 2200Hz |

FM Tuner Section

| | |
|-----------------------|---|
| Frequency range | 87 – 108.0MHz |
| Usable sensitivity | IHF 1.3µV/13.2dBf |
| Frequency response | 10Hz to 15.3kHz |
| Signal-to-noise ratio | mono/stereo 68/65dB |
| Distortion | mono/stereo 0.15/0.3% |
| Stereo separation | 35dB @ 1kHz, 100% deviation @ 65dBf |
| Selectivity | ±300kHz; 65dBf |
| Image rejection | 80dB |
| IF rejection | 90dB |
| Tuner output level | 1kHz, ±50kHz, Dev 500mV |
| Number of presets | 30 |
| RDS capability | PS (program service), RT (dynamic radio text) |

CD Section

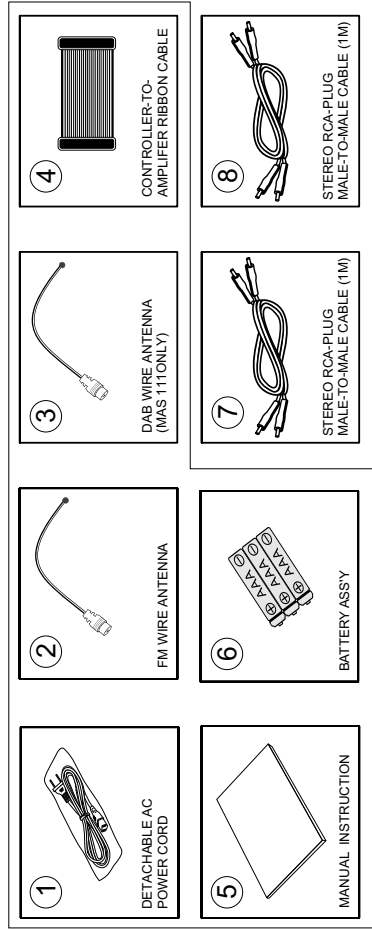
| | |
|-----------------------|------------------------------------|
| Disc compatibility | CD, CD-R, CD-RW, MP3, WMA |
| THD+N (20Hz – 20kHz) | <0.025% |
| Frequency response | 20Hz to 20kHz, 0dB \pm 0.5 |
| Channel separation | \geq 65dB |
| Signal-to-noise ratio | "A" WTG >96dB; 22kHz filter > 94dB |

General

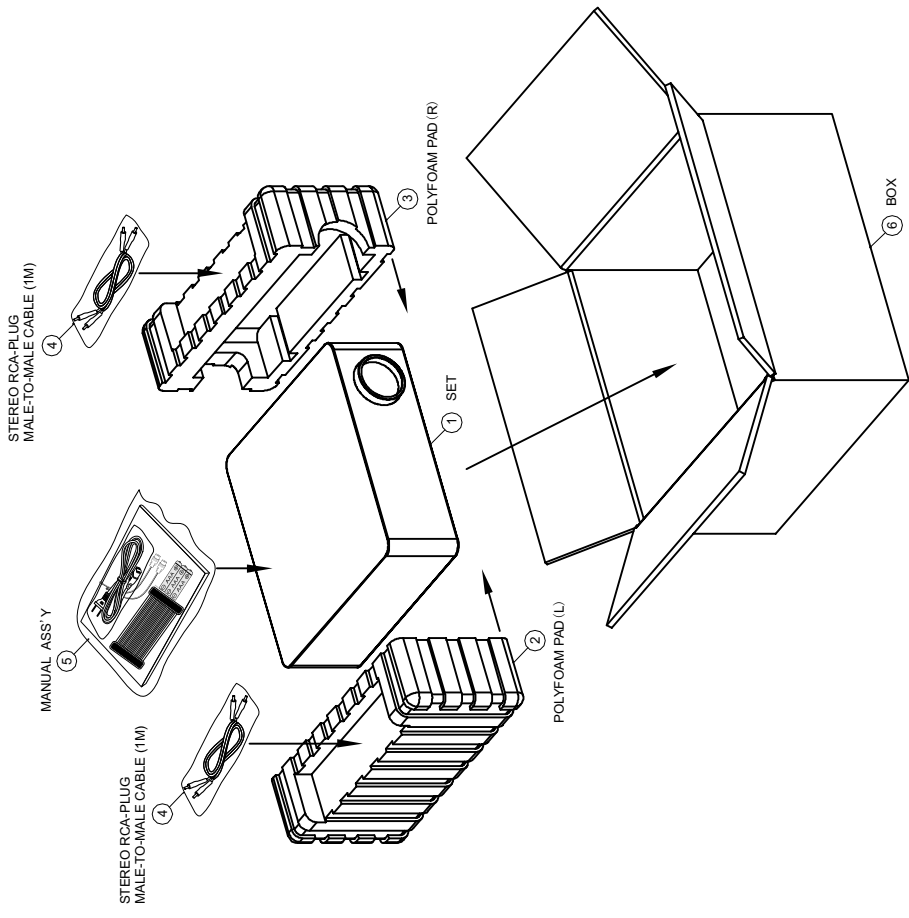
| | |
|------------------------|--|
| Power requirement | AC 230V/50Hz (MAS 101/MAS 111); AC 120V/60Hz (MAS 102) |
| Power consumption | <1W full standby (clock not activated); <2W standby (clock activated); 150W maximum (both channels driven) |
| Operating temperature | 0°C to 40°C |
| Dimensions (H x W x D) | Controller: 90mm x 240mm x 240mm (3-9/16" x 9-7/16" x 9-7/16") Amplifier: 90mm x 240mm x 240mm (3-9/16" x 9-7/16" x 9-7/16") Loudspeakers (each, with grille): 272mm x 181mm x 196mm (10-23/32" x 7-1/8" x 7-3/4") |
| Weight | System 13.9kg (30,5lb) Controller 2.0kg (4,4lb) Amplifier 2.8kg (6,3lb) Loudspeakers (each): 4.4kg (9,8lb) |



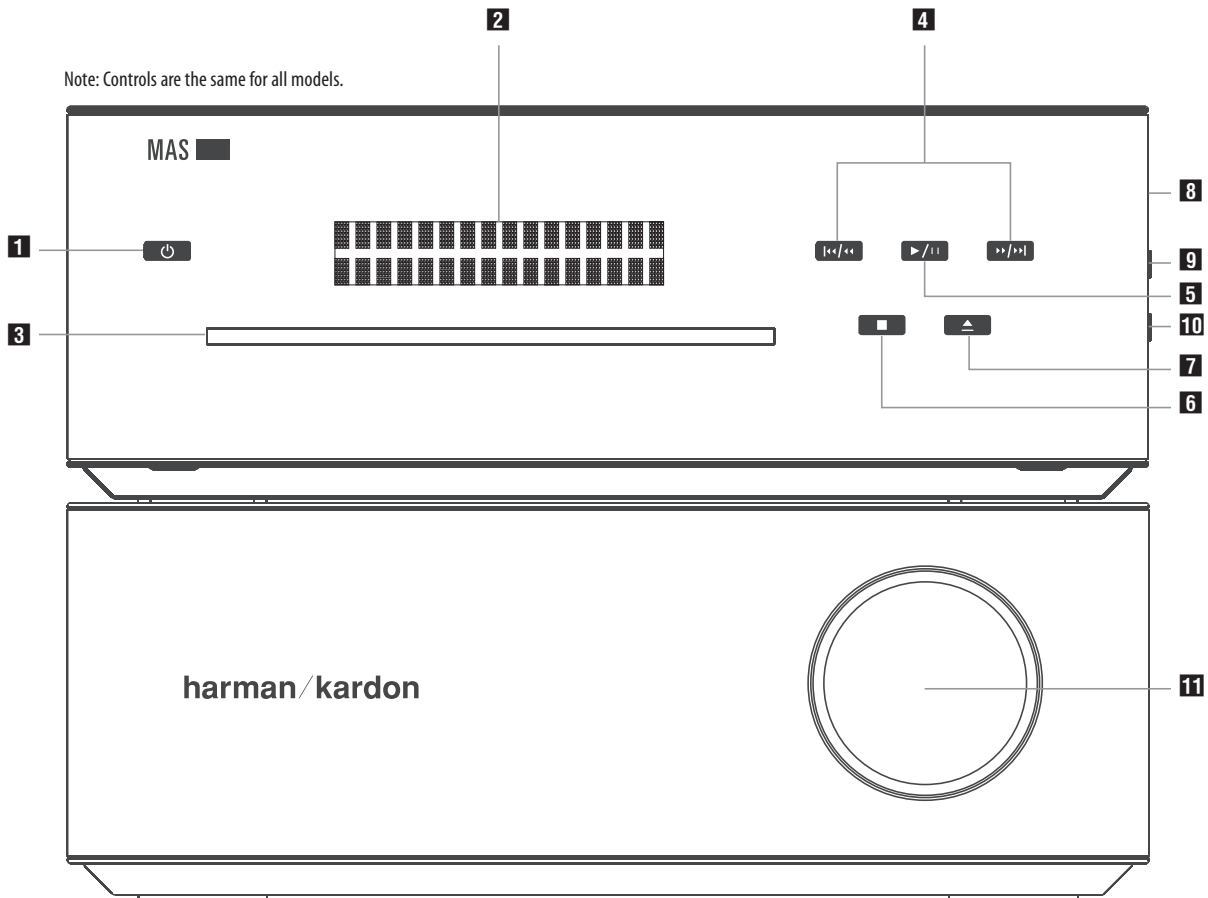
1. Instruction manual ass'y - Accessories



| NO | DESCRIPTION | PARTS NO. | Qty |
|----|---|----------------|-----|
| 1 | DETACHABLE AC POWER CORD | 3701 1011 0839 | 1 |
| 2 | FM WIRE ANTENNA | 3813 0015 0330 | 1 |
| 3 | DAB WIRE ANTENNA (MAS 111 ONLY) | 3810 0030 0011 | 1 |
| 4 | CONTROLLER-TO-AMPLIFIER RIBBON CABLE | 3320 0805 0352 | 1 |
| 5 | MANUAL INSTRUCTION | 8524 5053 3100 | 1 |
| 6 | BATTERY ASS'Y | 3006 2002 0000 | 3 |
| 7 | STEREO RCA-PLUG MALE-TO-MALE CABLE (1M) | 3820 0002 1106 | 1 |
| 8 | STEREO RCA-PLUG MALE-TO-MALE CABLE (1M) | 3820 0002 1106 | 1 |



| NO | DESCRIPTION | PARTS NO. | Qty |
|----|---|----------------|-----|
| 1 | SET | | 1 |
| 2 | POLYFOAM PAD (L) | 8250 5013 0000 | 1 |
| 3 | POLYFOAM PAD (R) | 8250 5023 0000 | 1 |
| 4 | STEREO RCA-PLUG MALE-TO-MALE CABLE (1M) | 3320 0805 0352 | 2 |
| 5 | MANUAL ASS'Y | | 1 |
| 6 | BOX | 8150 5011 0000 | 1 |

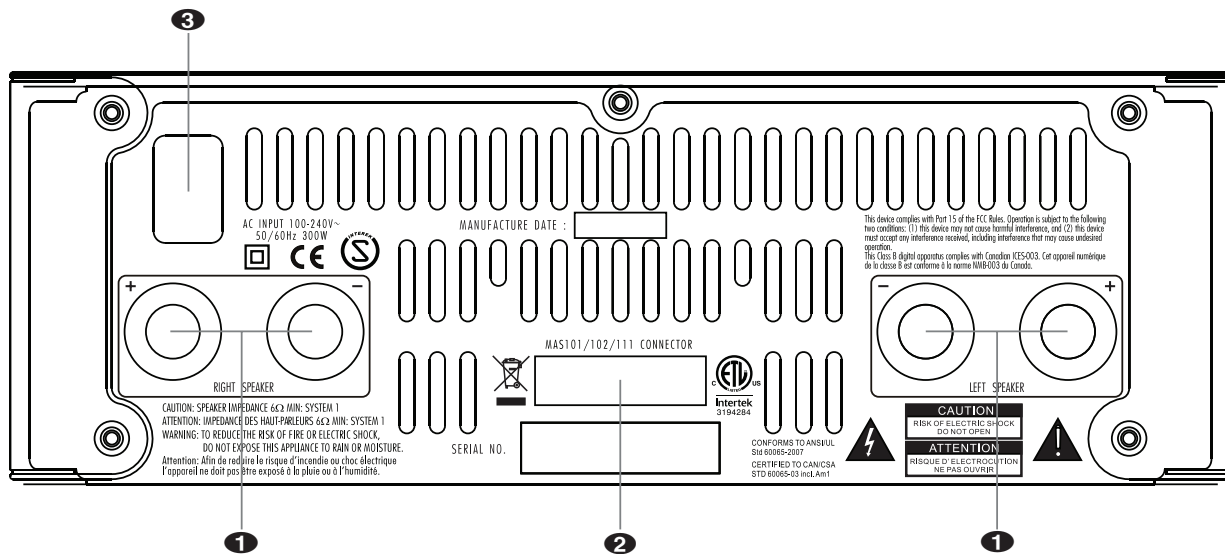


The MAS systems use touch-sensitive controls. To use a control, tap gently on its lit icon.

NOTE: Controls are the same for all models.

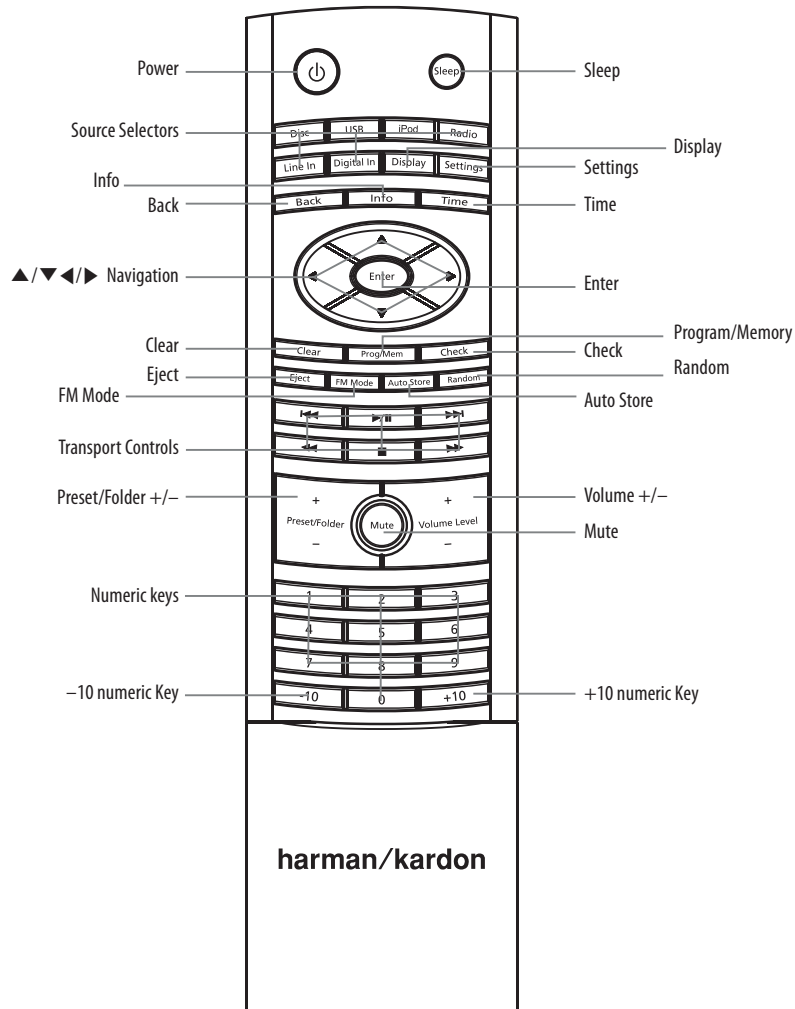
- 1 Power:** Turns the MAS system on or places it in Standby mode. To completely power off the unit, unplug the power supply.
- 2 Message Display:** The time and messages are displayed in this two-line text display.
- 3 CD Slot:** Load compatible discs here.
- 4 Skip/Scan Forward/Reverse:** These buttons function differently, depending on the current source:
 - **iPod, CD or USB:** Press and release to skip to the next track. Press the Reverse button twice to skip to the previous track. Press and hold a button to scan forward or reverse within a track.
 - **Radio:** Press and release a button to select the next higher or lower programmed preset station. Press and hold a button to scan to the next available higher or lower station. When you release the button, the tuner continues to scan until it finds a station of acceptably strong signal quality, and then it stops. To stop the scan before a station is found, press the button while the tuner is scanning.
- 5 Play/Pause:** Each tap toggles between the Play and Pause functions.
- 6 Stop:** Fully stops playback.
- 7 Eject:** When a CD is loaded, tap here to eject it.

- 8 USB Port A:** Connect a compatible USB device here to enjoy playback of audio MP3 or WMA files. Although most USB flash and hard-disk drives in the FAT32 file format, as well as many MP3 players, are compatible with the MAS system, due to the wide variety of manufacturers, playback cannot be guaranteed. Do not connect an iPod or iPhone to this port. Do not connect a personal computer or any peripherals to this port.
- 9 Line-In Jack (Line Input):** Connect a stereo 3.5mm male-to-male cable (not included) to the headphone or line-level output on a portable player or other device.
- 10 Headphone Jack:** Outputs a stereo signal for private listening through most headphones that are equipped with a stereo 3.5mm plug.
- 11 Volume Control:** Increases or decreases the volume.



- ❶ **Right and Left Speaker Output Terminals:** Use two-conductor speaker wire to connect each set of terminals to the correct speaker. Remember to observe the correct polarity (positive and negative connections).
- ❷ **Input From Controller:** Connect the included ribbon cable to this connector and to the corresponding connector on the MAS controller. This cable passes audio signals from the controller to the amplifier, and it transfers DC power from the amplifier to the controller. If this cable is ever damaged, do not use it, and contact Harman Kardon for a replacement.
- ❸ **AC Power Input:** After you have made all other connections, plug the AC power cord into this receptacle and into an unswitched wall outlet.

NOTE: MAS 101/111 systems require 230V, 50/60Hz AC current. MAS 102 systems require 120V, 60HZ AC current.



Power: Turns the MAS system on or off. To completely power off the unit, unplug the power supply.

Sleep: Each press increases the time until turn-off, from 10 to 90 minutes, in increments of 10 minutes. The next press after the 90 minutes setting turns off the Sleep function.

Source Selectors: Selects a source input. Each press of the Line In or Digital In button toggles among the available analog (Line Input on right-side panel; TV, AUX or Phono Input on rear panel) or digital audio inputs (Coaxial 1 or 2, Optical 1 or 2), respectively. Press the iPod button to select an iPod docked in The Bridge III.

Display: Adjusts the brightness of the message display. Each time the button is pressed and held for one second, the message display brightness will cycle between full, half and off. When the display is off while the system is turned on, the LEDs inside the Volume knob and behind the front-panel function buttons will remain lit to remind you that the system is still on.

Settings: Accesses menus for Speaker Setup (tone controls), Time Setup (clock), Alarm Setup, System Version and System Reset. See the Operation section for more information.

Back: Returns to previous menu level.

Info: Displays the status of the current source:

- **Radio:** When FM band is in use, each press of the button toggles between the PS (Program Service) and RT (Radio Text) RDS information, if available. When a DAB radio station is playing (MAS 111 only), press this button to access the menu system for the DAB tuner. See pages 13 and 14 for more information.

- **Audio CD:** Displays CD Text information, if available. Each press of the button displays the following items: Song, Artist, Album.

- **USB or Data CD:** Scrolls all ID3 tag information for current source, if available. Each press of the button displays the individual items Song, Artist, Album, File type and Folder, and then goes back to scrolling. If ID3 tags are not available, the file name will appear.

Time: Displays elapsed track time for the current Audio CD (no effect on data CDs or other sources). Each additional press changes the display as follows: remaining track time, elapsed disc time, remaining disc time then back to elapsed track time.

▲/▼◀▶ Navigation buttons: Use the ◀ and ▶ buttons to scroll forward and reverse through the Settings Menus, or through lists of content, and press the Enter button to make selections. Press the Back button to return to the previous menu or content level.

Enter: Selects a menu item, or saves setting changes and returns to the previous menu level.

Clear: Clears the current preset station or a playlist entry.

- **Radio:** To delete the current preset station, press the Clear button while it is playing.
- **Playlist:** While programming a playlist, press the Clear button to delete the track just entered. After the playlist has been saved by pressing the Stop button, press the Clear button to delete the entire playlist. To delete a single track, stop play, press the Check button repeatedly until the desired track appears and press the Clear button. Press the Play or Stop button to exit the Check mode.

Program/Memory: Used to program playlists and radio presets.

- **Radio:** If the current station has not been programmed into a preset, press Program/Memory and press the Enter button to store the station at the current preset number, or use the numeric keys to enter a different preset number. The new preset will overwrite the existing one.
- **USB or CD (Audio or Data):** Press the Program button to begin Program Mode. Add tracks to the playlist by using the Skip/Scan Transport Controls or the numeric keys to select the track, then press the Program button to enter the selection. Add up to 30 files. Press Play to play the playlist, or Stop to save the playlist without playing it. During playback, the order of the track in the playlist will appear on the left, with the disc's track number to the right. See page 14 and 15.

Check: After a playlist has been programmed and play has been stopped, each press of the Check button displays the tracks in the playlist.

Eject: When a CD is loaded, press this button to eject it.

FM Mode: Used with FM radio, each press toggles between Stereo and Monaural playback.

Auto Store: Scans through all frequencies, searching for stations with acceptably strong signal quality, and stores them as presets.

Random: Each press turns Random playback mode (shuffle) on or off. This mode plays the tracks of the current disc or drive in random order.

Transport Controls

Track Skip Up/Down (iPod, CD or USB): Press and release the Next/Previous skip buttons to skip to the next track, or the beginning of the current track. Press the Previous Skip button twice to skip to the previous track.

Scan Forward/Reverse: These buttons function differently, depending on which source has been selected:

- **iPod, CD or USB:** Press and hold a button to scan forward or reverse within a track.
- **Radio:** Press and release a button to tune to the next higher or lower frequency by one increment/decrement. Press and hold a button to scan quickly through the frequencies for next available station. Press the same button again to stop scanning.

Play/Pause: Each tap toggles between the Play and Pause functions.

Stop: Fully stops playback.

Preset/Folder +/-: Selects a preset station or folder on a USB or data CD.

- **Radio:** Each press changes to the next or previous preset station, if any have been programmed.
- **USB or Data CD:** Press once to open the current folder. Each additional press changes to the next or previous folder. After 3 seconds, the first track in the new folder will begin playing.

Mute: Press to temporarily silence the speakers. Press again to restore audio. Muting is also canceled if the MAS system is turned off.

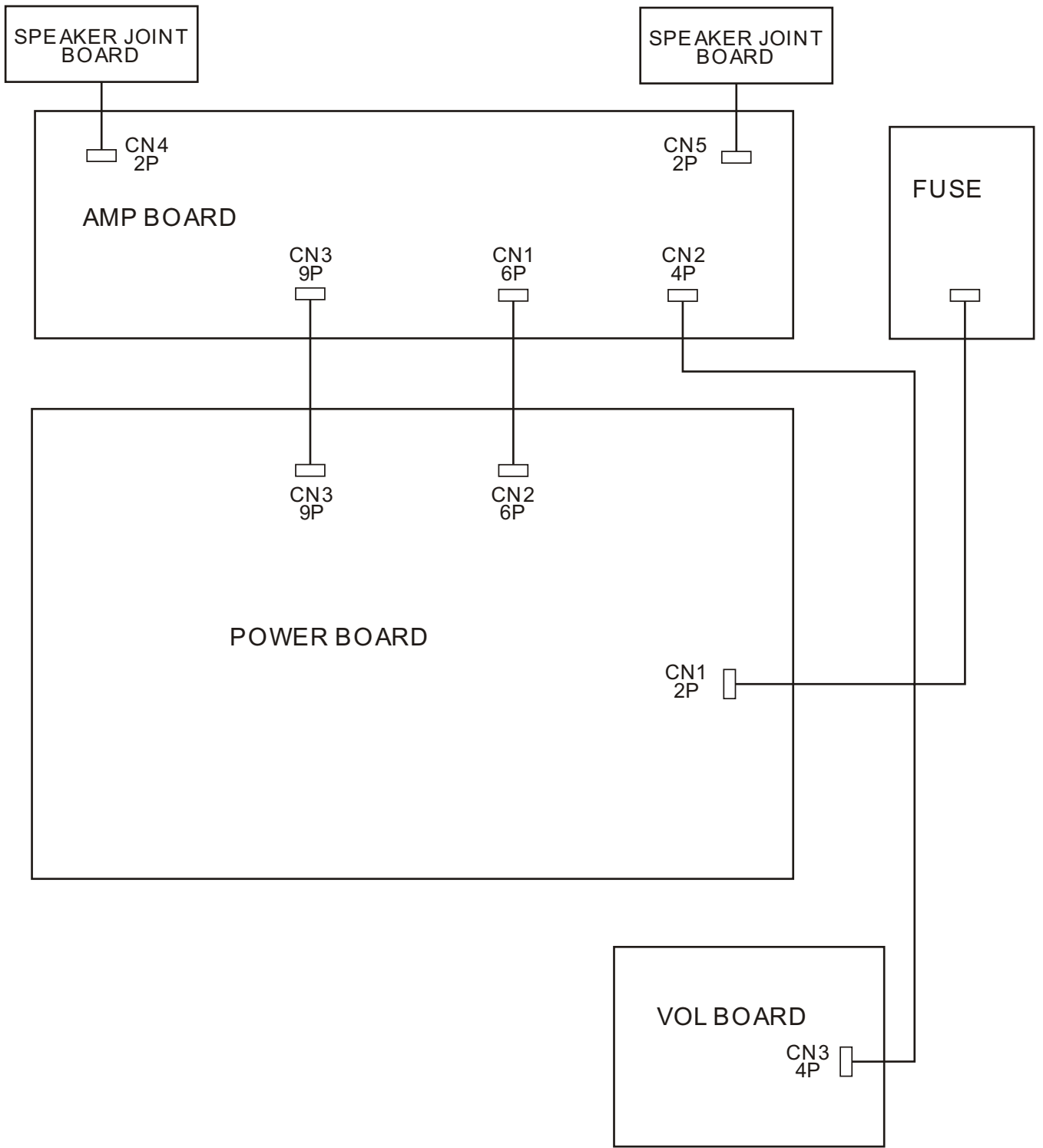
NOTE: Pressing the Mute button also mutes the Analog Audio Outputs. See page 6.

Volume +/-: Increases or decreases the volume. Press and hold to change the volume more quickly.

Numeric keys: Used to enter track numbers, radio stations or preset numbers, or while adjusting the clock and alarm times.

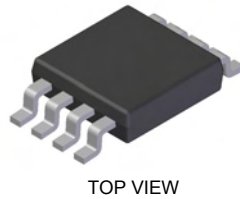
-10 and +10 numeric Key: Used with a USB device or CD to quickly advance through a large number of tracks. Each press of these keys changes to the next or previous track in increments of 10.

WIRING DIAGRAM

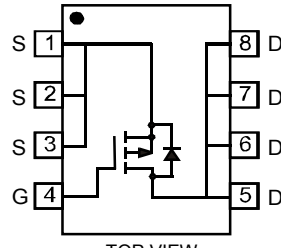


Features

- Low On-Resistance
 - 14mΩ @ V_{GS} = -10V
 - 25mΩ @ V_{GS} = -4.5V
- Low Gate Threshold Voltage
- Low Input Capacitance
- Fast Switching Speed
- Low Input/Output Leakage
- **Lead Free By Design/RoHS Compliant (Note 2)**
- **"Green" Device (Note 4)**
- **Qualified to AEC-Q101 Standards for High Reliability**



SOP-8L



Mechanical Data

- Case: SOP-8L
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminals Connections: See Diagram
- Terminals: Finish - Matte Tin annealed over Copper lead frame. Solderable per MIL-STD-202, Method 208
- Marking Information: See Page 3
- Ordering Information: See Page 3
- Weight: 0.072g (approximate)

Maximum Ratings @T_A = 25°C unless otherwise specified

| Characteristic | Symbol | Value | Units |
|-------------------------------|------------------|-----------|-------|
| Drain-Source Voltage | V _{DSS} | -30 | V |
| Gate-Source Voltage | V _{GSS} | ±20 | V |
| Drain Current (Note 1) | I _D | -12 -6 | A |
| | | | |
| Pulsed Drain Current (Note 3) | I _{DM} | -40 | A |

Thermal Characteristics

| Characteristic | Symbol | Value | Unit |
|---|-----------------------------------|-------------|------|
| Total Power Dissipation (Note 1) | P _D | 2.5 | W |
| Thermal Resistance, Junction to Ambient | R _{θJA} | 50 | °C/W |
| Operating and Storage Temperature Range | T _J , T _{STG} | -55 to +150 | °C |

Electrical Characteristics @T_A = 25°C unless otherwise specified

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|-------------------------------------|---------------------|------|--------------|----------|------|---|
| OFF CHARACTERISTICS (Note 5) | | | | | | |
| Drain-Source Breakdown Voltage | BV _{DSS} | -30 | — | — | V | V _{GS} = 0V, I _D = -250μA |
| Zero Gate Voltage Drain Current | I _{DSS} | — | — | -1 | μA | V _{DS} = -30V, V _{GS} = 0V |
| Gate-Source Leakage | I _{GSS} | — | — | ±100 | nA | V _{GS} = ±20V, V _{DS} = 0V |
| ON CHARACTERISTICS (Note 5) | | | | | | |
| Gate Threshold Voltage | V _{GS(th)} | -1 | — | -2 | V | V _{DS} = V _{GS} , I _D = -250μA |
| Static Drain-Source On-Resistance | R _{DS(ON)} | — | 11.6 18.6 | 14 25 | mΩ | V _{GS} = -10V, I _D = -8A V _{GS} = -4.5V, I _D = -5A |
| Forward Transconductance | g _{fs} | — | 12 | — | S | V _{DS} = -10V, I _D = -12A |
| Diode Forward Voltage (Note 5) | V _{SD} | -0.5 | — | -1.1 | V | V _{GS} = 0V, I _S = -2A |
| DYNAMIC CHARACTERISTICS | | | | | | |
| Input Capacitance | C _{iss} | — | 1655 | — | pF | V _{DS} = -20V, V _{GS} = 0V f = 1.0MHz |
| Output Capacitance | C _{oss} | — | 286 | — | pF | |
| Reverse Transfer Capacitance | C _{rss} | — | 240 | — | pF | |

- Notes:
1. Device mounted on 2 oz. Copper pads on FR-4 PCB with R_{θJA} = 50°C/W.
 2. No purposefully added lead.
 3. Pulse width ≤ 10μS, Duty Cycle ≤ 1%.
 4. Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.
 5. Short duration pulse test used to minimize self-heating effect.

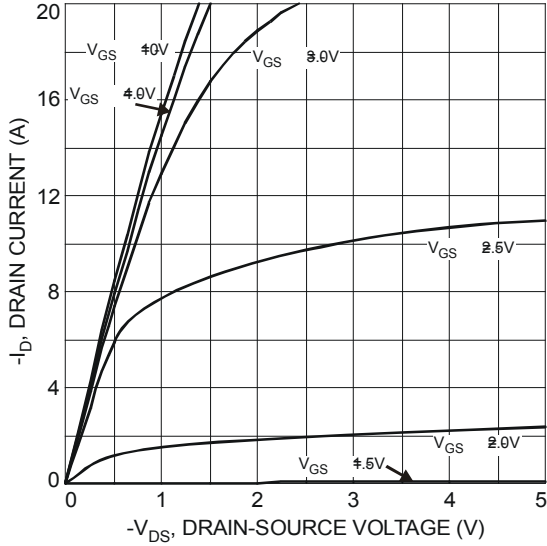


Fig. 1 Typical Output Characteristic

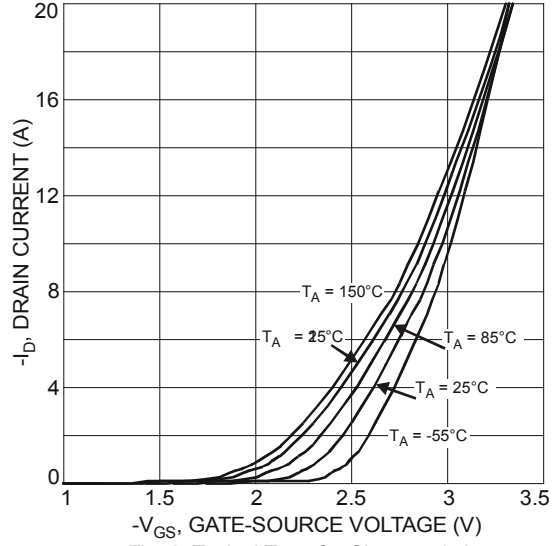


Fig. 2 Typical Transfer Characteristic

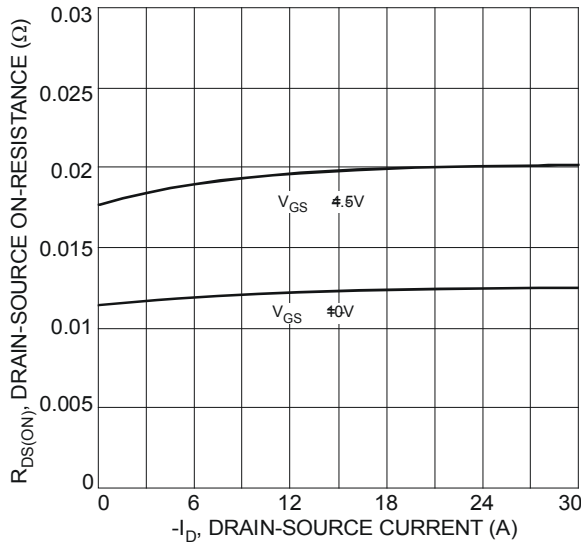


Fig. 3 Typical On-Resistance vs. Drain Current and Gate Voltage

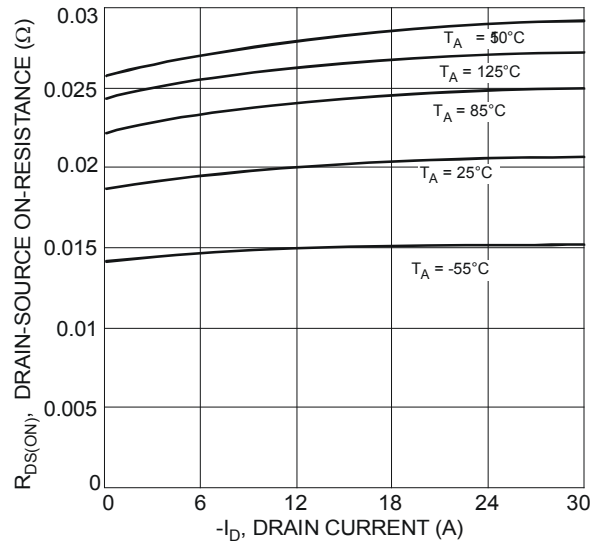


Fig. 4 Typical On-Resistance vs. Drain Current and Temperature

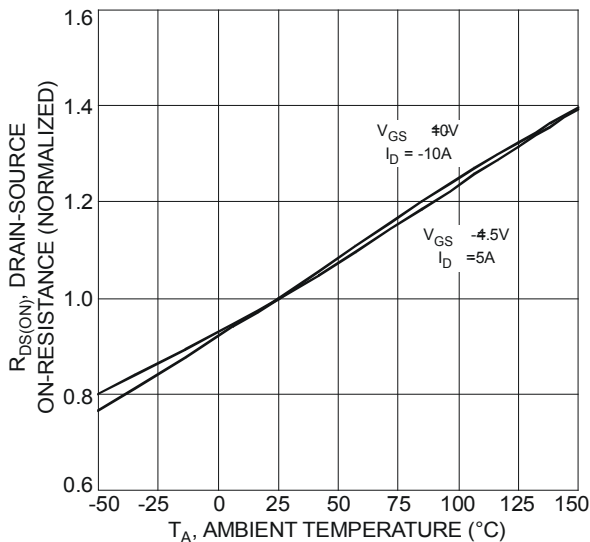


Fig. 5 Normalized On-Resistance vs. Ambient Temperature

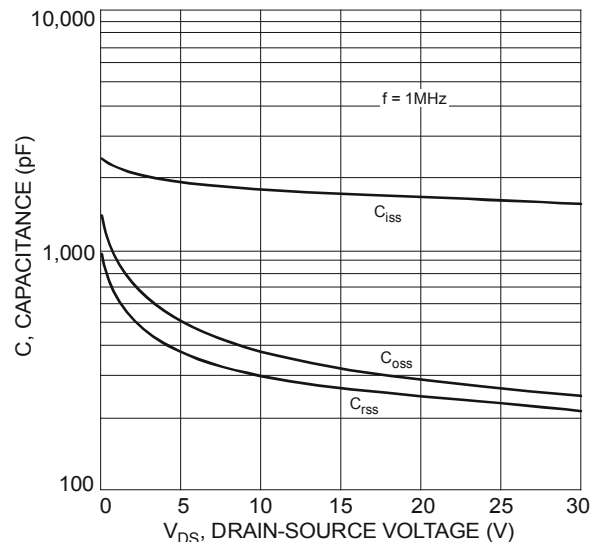


Fig. 6 Typical Total Capacitance

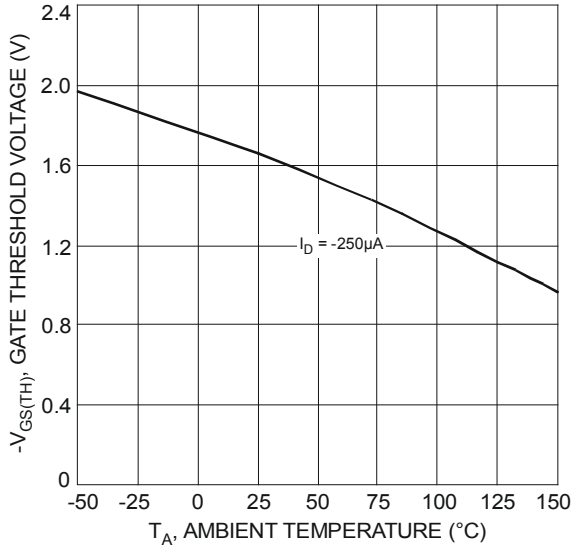


Fig. 7 Gate Threshold Variation vs. Ambient Temperature

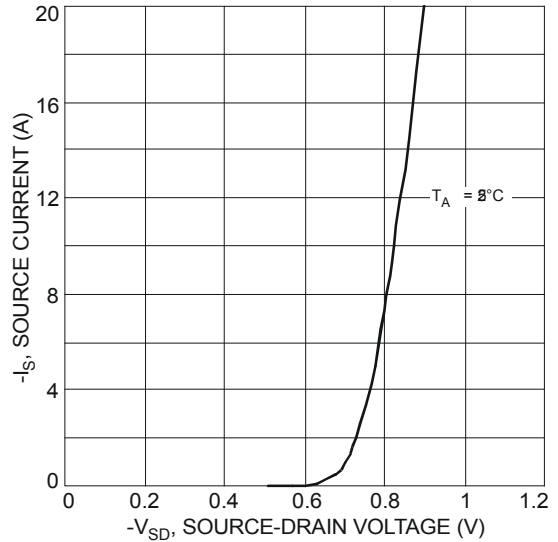


Fig. 8 Diode Forward Voltage vs. Current

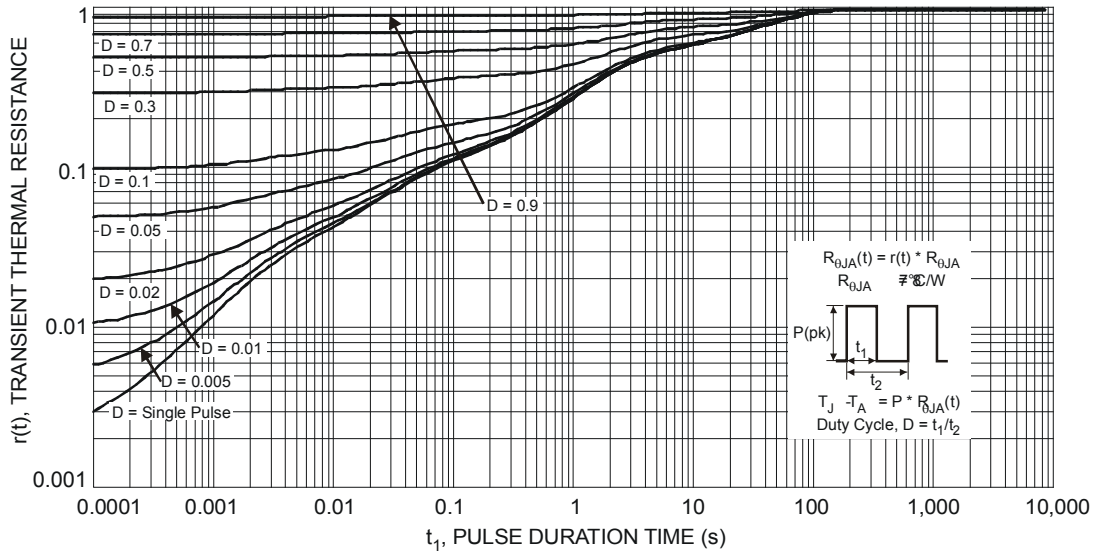


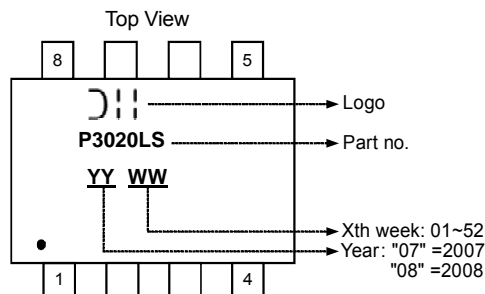
Fig. 9 Transient Thermal Response

Ordering Information (Note 6)

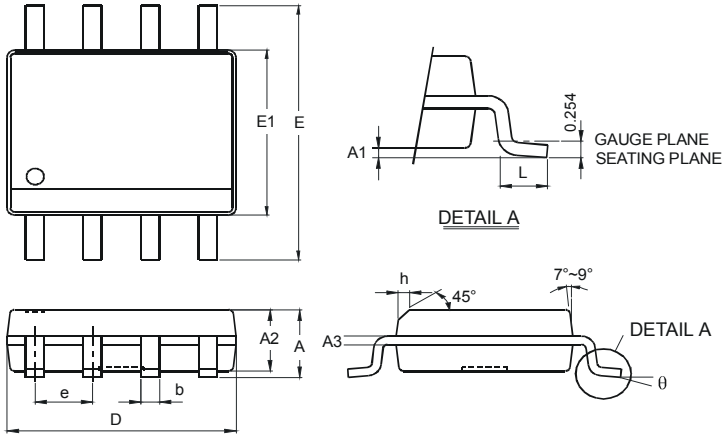
| Part Number | Case | Packaging |
|---------------|--------|------------------|
| DMP3020LSS-13 | SOP-8L | 2500/Tape & Reel |

Notes: 6. For packaging details, go to our website at <http://www.diodes.com/datasheets/ap02007.pdf>.

Marking Information

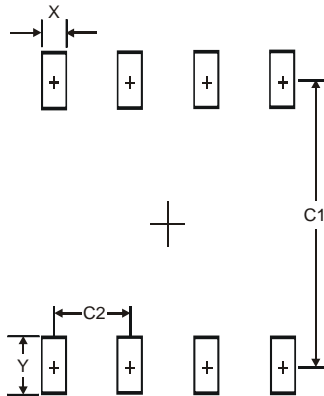


Package Outline Dimensions



| SOP-8L | | |
|-----------------------------|-----------|------|
| Dim | Min | Max |
| A | — | 1.75 |
| A1 | 0.08 | 0.25 |
| A2 | 1.30 | 1.50 |
| A3 | 0.20 Typ. | |
| b | 0.3 | 0.5 |
| D | 4.80 | 5.30 |
| E | 5.79 | 6.20 |
| E1 | 3.70 | 4.10 |
| e | 1.27 Typ. | |
| h | — | 0.35 |
| L | 0.38 | 1.27 |
| θ | 0° | 8° |
| All Dimensions in mm | | |

Suggested Pad Layout



| Dimensions | Value (in mm) |
|------------|---------------|
| X | 0.60 |
| Y | 1.55 |
| C1 | 5.4 |
| C2 | 1.27 |

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FAN7602

Green Current Mode PWM Controller

Features

- Green Current Mode PWM Control
- Fixed 65kHz Operation with Frequency Modulation
- Internal High-Voltage Start-up Switch
- Burst Mode Operation
- Line Voltage Feed Forward to Limit Maximum Power
- Line Under-Voltage Protection
- Latch Protection & Internal Soft-Start (10ms) Function
- Overload Protection
- Over Voltage Protection
- Low Operation Current: Typ. 1mA
- 8-pin DIP

Applications

- Adapter
- LCD Monitor Power
- Auxiliary Power Supply

Related Application Notes

- **AN6014** - Green Current Mode PWM Controller FAN7602

Description

The FAN7602 is a green current mode PWM controller. It is specially designed for off-line adapter application, DVDP, VCR, LCD monitor application, and auxiliary power supplies.

The internal high-voltage start-up switch and the burst mode operation reduce the power loss in standby mode. Because of the internal start-up switch and the burst mode, it is possible to supply 0.5W load limiting the input power under 1W when the input line voltage is 265Vac. On no-load condition, the input power is under 0.3W.

The maximum power can be limited constantly, regardless of the line voltage change using the power limit function.

The switching frequency is internally fixed to be 65kHz and the frequency modulation technique reduces EMI.

The FAN7602 includes various protections for the system reliability and the internal soft start prevents the output voltage over-shoot at start-up.

Ordering Information

| Part Number | Operating Temp. Range | Pb-Free | Package | Packing Method | Marking Code |
|-------------|-----------------------|---------|---------|----------------|--------------|
| FAN7602N | -25°C to +125°C | Yes | 8-DIP | Rail | FAN7602 |

Typical Application Diagram

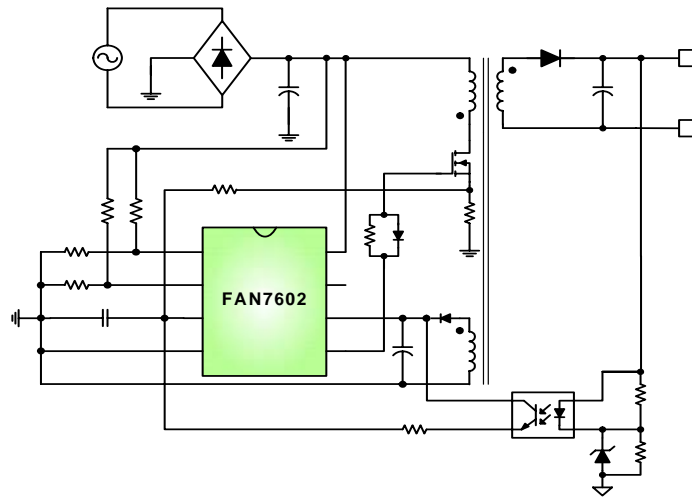


Figure 1. Typical Flyback Application

Internal Block Diagram

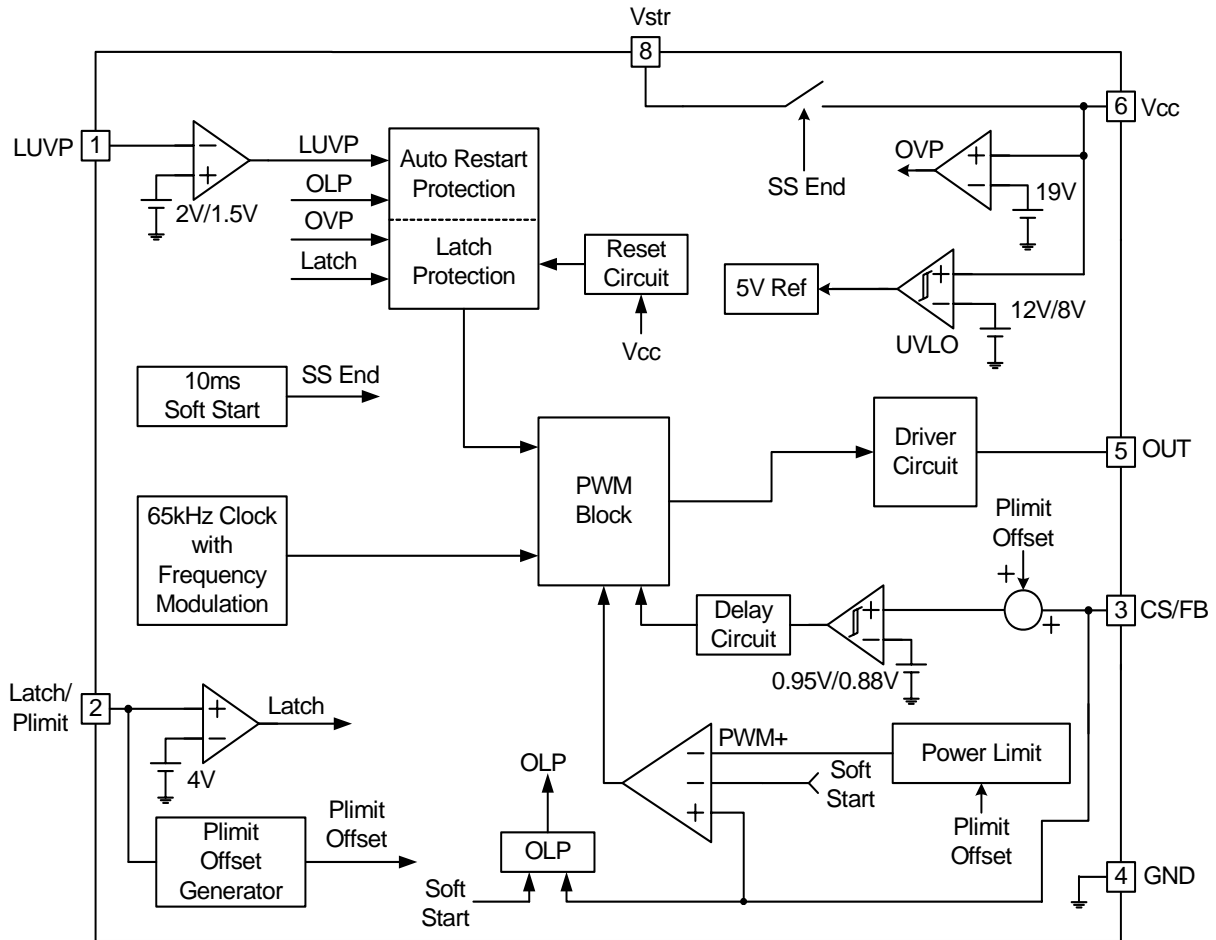


Figure 2. Functional Block Diagram of FAN7602

Pin Assignments

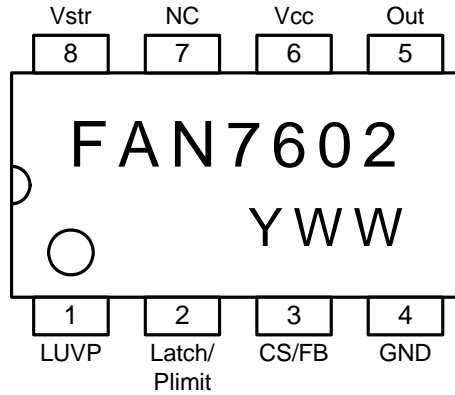


Figure 3. Pin Configuration (Top View)

Pin Definitions

| Pin Number | Pin Name | Pin Function Description |
|------------|--------------|---|
| 1 | LUVP | Line Under Voltage Protection Pin. This pin is used to protect the set when the input voltage is lower than the rated input voltage range. |
| 2 | Latch/Plimit | Latch Protection and Power Limit Pin. When the pin voltage exceeds 4V, the latch protection works and the latch protection is reset when the Vcc voltage is lower than 5V. For the power limit function, the OCP level decreases as the pin voltage increases. |
| 3 | CS/FB | Current Sense and Feedback Pin. This pin is used to sense the MOSFET current for the current mode PWM and OCP. The output voltage feedback information and the current sense information are added using external RC filter. |
| 4 | GND | Ground Pin. This pin is used for the ground potential of all the pins. For proper operation, the signal ground and the power ground should be separated. |
| 5 | OUT | Gate Drive Output Pin. This pin is an output pin to drive an external MOSFET. The peak sourcing current is 450mA and the peak sinking current is 600mA. For proper operation, the stray inductance in the gate driving path must be minimized. |
| 6 | Vcc | Supply Voltage Pin. IC operating current and MOSFET driving current are supplied using this pin. |
| 7 | NC | No Connection. |
| 8 | Vstr | Start-up Pin. This pin is used to supply IC operating current during IC start-up. After start-up, the internal JFET is turned off to reduce power loss. |



FSFR-Series — Fairchild Power Switch (FPS™) for Half-Bridge Resonant Converters

Features

- Variable Frequency Control with 50% Duty Cycle for Half-Bridge Resonant Converter Topology
- High Efficiency through Zero Voltage Switching (ZVS)
- Internal SuperFET™s with Fast-Recovery Type Body Diode ($t_{rr}=120\text{ns}$) for FSFR2100 and UniFETs with Fast-Recovery Type Body Diode ($t_{rr}<160\text{ns}$) for FSFR2100U/2000/1900/1800/1700.
- Fixed Dead Time (350ns) Optimized for MOSFETs
- Up to 300kHz Operating Frequency
- Pulse Skipping for Frequency Limit (Programmable) at Light-Load Condition
- Remote On/Off Control Using Control Pin
- Protection Functions: Over-Voltage Protection (OVP), Over-Load Protection (OLP), Over-Current Protection (OCP), Abnormal Over-Current Protection (AOCP), Internal Thermal Shutdown (TSD)

Applications

- PDP and LCD TVs
- Desktop PCs and Servers
- Adapters
- Telecom Power Supplies
- Audio Power Supplies

Description

The FSFR-series are a highly integrated power switches designed for high-efficiency half-bridge resonant converters. Offering everything necessary to build a reliable and robust resonant converter, the FSFR-series simplifies designs and improves productivity, while improving performance. The FSFR-series combines power MOSFETs with fast-recovery type body diodes, a high-side gate-drive circuit, an accurate current controlled oscillator, frequency limit circuit, soft-start, and built-in protection functions. The high-side gate-drive circuit has a common-mode noise cancellation capability, which guarantees stable operation with excellent noise immunity. The fast-recovery body diode of the MOSFETs improves reliability against abnormal operation conditions, while minimizing the effect of the reverse recovery. Using the zero-voltage-switching (ZVS) technique dramatically reduces the switching losses and efficiency is significantly improved. The ZVS also reduces the switching noise noticeably, which allows a small-sized Electromagnetic Interference (EMI) filter.

The FSFR-series can be applied to various resonant converter topologies such as series resonant, parallel resonant, and LLC resonant converters.

Related Resources

[AN4151 — Half-bridge LLC Resonant Converter Design using FSFR-series Fairchild Power Switch \(FPS™\)](#)

Ordering Information

| Part Number | Package | Eco Status | Operating Junction Temperature | $R_{DS(ON_MAX)}$ | Maximum Output Power without Heatsink ($V_{IN}=350\sim 400\text{V}$) ^(1,2) | Maximum Output Power with Heatsink ($V_{IN}=350\sim 400\text{V}$) ^(1,2) |
|-------------|---------|------------|--------------------------------|-------------------|---|--|
| FSFR2100 | 9-SIP | RoHS | -40 to +130°C | 0.38Ω | 200W | 450W |
| FSFR2100U | | | | 0.51Ω | 180W | 400W |
| FSFR2000 | | | | 0.67Ω | 160W | 350W |
| FSFR1900 | | | | 0.85Ω | 140W | 300W |
| FSFR1800 | | | | 0.95Ω | 120W | 260W |
| FSFR1700 | | | | 1.25Ω | 100W | 200W |

Notes:

- The junction temperature can limit the maximum output power.
- Maximum practical continuous power in an open-frame design at 50°C ambient.

For Fairchild's definition of Eco Status, please visit: http://www.fairchildsemi.com/company/green/rohs_green.html.

Application Circuit Diagram

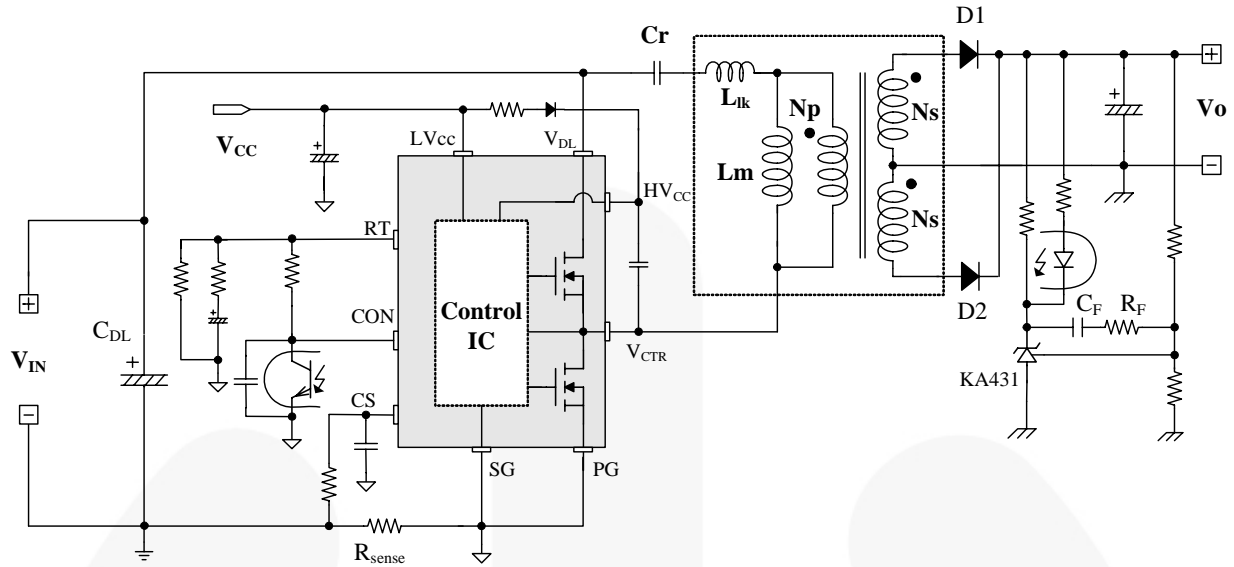


Figure 1. Typical Application Circuit (LLC Resonant Half-Bridge Converter)

Block Diagram

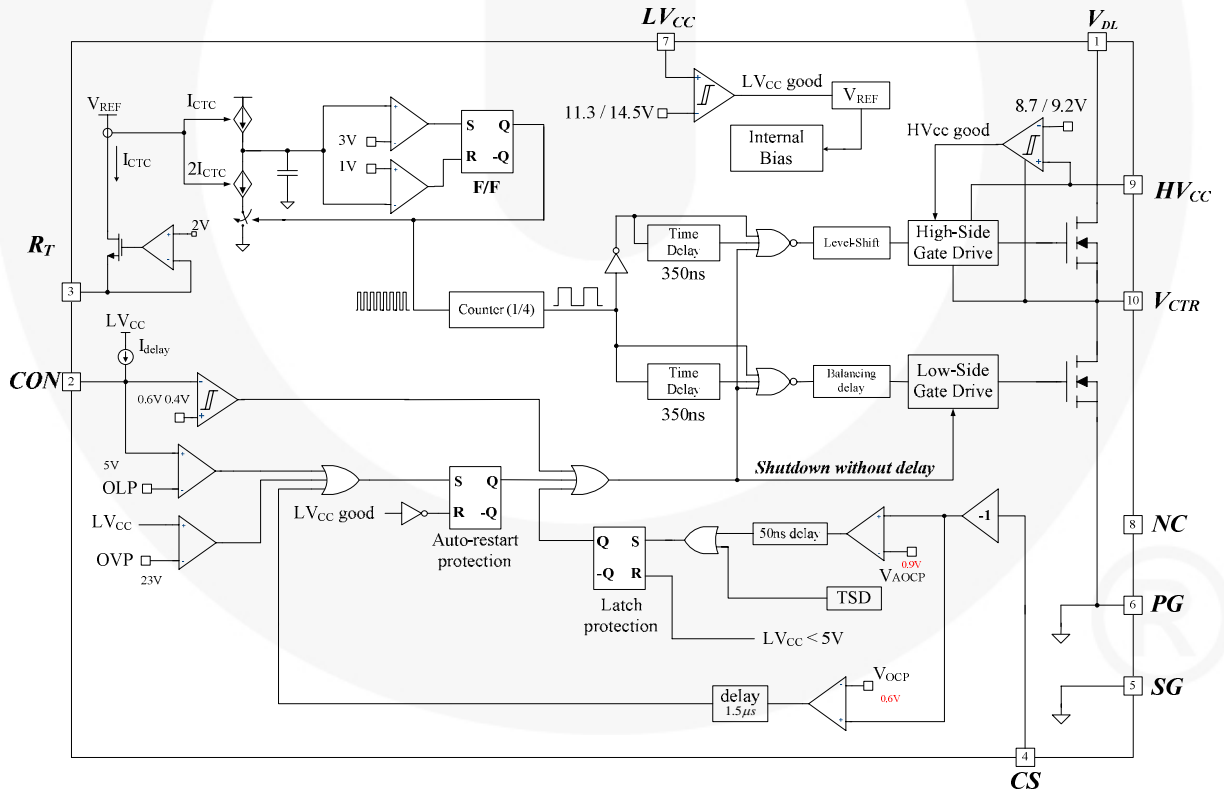


Figure 2. Internal Block Diagram

Pin Configuration

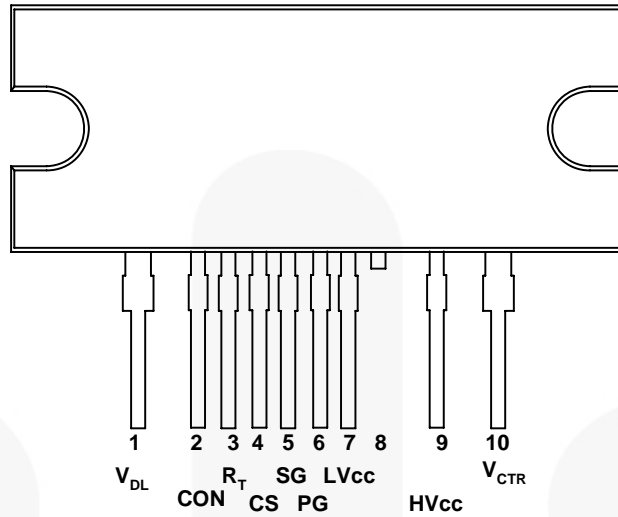


Figure 3. Package Diagram

Pin Definitions

| Pin # | Name | Description |
|-------|------------------|--|
| 1 | V _{DL} | This is the drain of the high-side MOSFET, typically connected to the input DC link voltage. |
| 2 | CON | This pin is for enable/disable and protection. When the voltage of this pin is above 0.6V, the IC operation is enabled. When the voltage of this pin drops below 0.4V, gate drive signals for both MOSFETs are disabled. When the voltage of this pin increases above 5V, protection is triggered. |
| 3 | R _T | This pin programs the switching frequency. Typically, an opto-coupler is connected to control the switching frequency for the output voltage regulation. |
| 4 | CS | This pin senses the current flowing through the low-side MOSFET. Typically, negative voltage is applied on this pin. |
| 5 | SG | This pin is the control ground. |
| 6 | PG | This pin is the power ground. This pin is connected to the source of the low-side MOSFET. |
| 7 | LV _{CC} | This pin is the supply voltage of the control IC. |
| 8 | NC | No connection. |
| 9 | HV _{CC} | This is the supply voltage of the high-side gate-drive circuit IC. |
| 10 | V _{CTR} | This is the drain of the low-side MOSFET. Typically, a transformer is connected to this pin. |

Features

- Integrated analog input Class D audio amplifier driver in a small 16 pin package
- Floating inputs enable easy half bridge implementation
- Programmable bidirectional over-current protection with self-reset function
- Programmable preset deadtime for improved THD performances
- Start and stop click noise reduction
- High noise immunity
- ± 100 V ratings deliver up to 500 W in output power
- Operates up to 800 kHz
- RoHS compliant

Product Summary

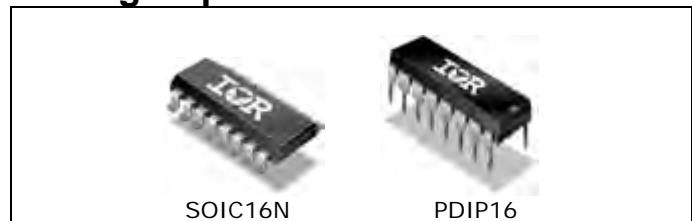
| | | |
|---------------------------------|------|-----------------|
| V_{OFFSET} (max) | | ± 100 V |
| Gate driver | lo+ | 1.0 A |
| | lo - | 1.2 A |
| Selectable Deadtime | | 25/40/65/105 ns |
| OC protection delay (max) | | 500 ns |
| DC offset | | <20 mV |
| PWM frequency | | ~800 kHz |
| Error amplifier open loop gain | | >60 dB |
| THD+N* (1kHz, 50W, 4 Ω) | | 0.01 % |
| Residual Noise* (AES-17 Filter) | | 200 μ Vrms |

* measured with recommended circuit

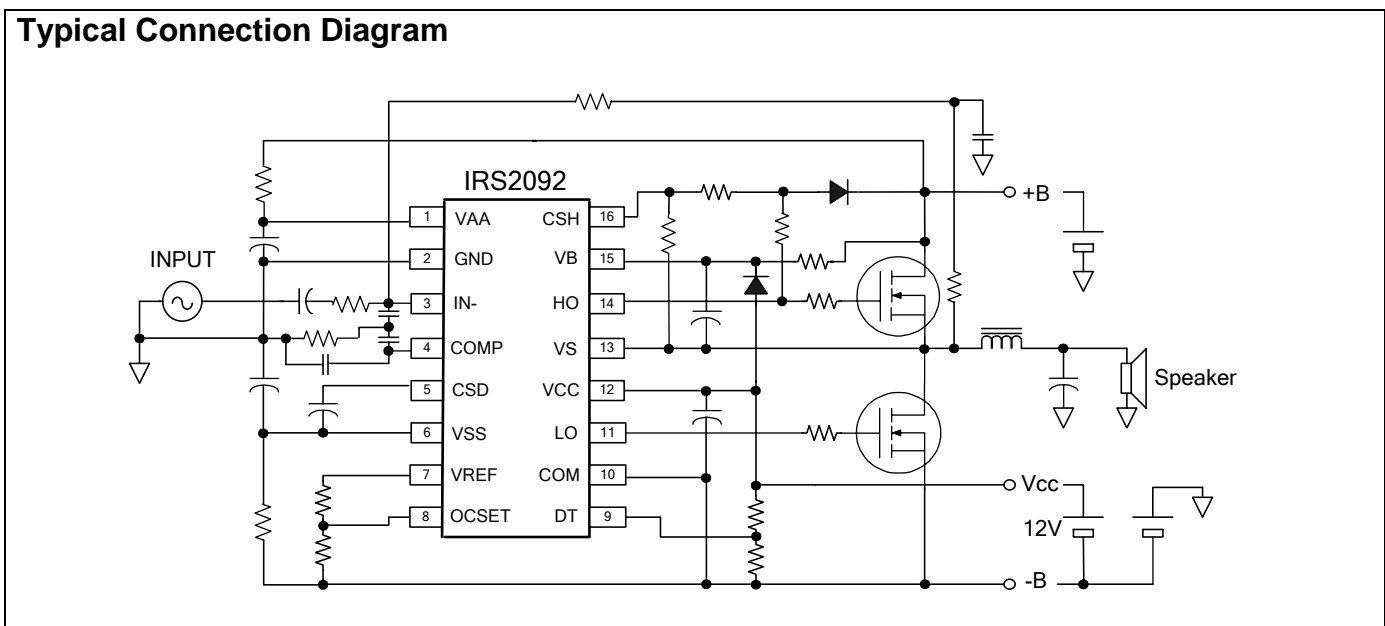
Typical Applications

- Home theater systems
- Mini component stereo systems
- Powered speaker systems
- General purpose audio power amplifiers

Package Options



Typical Connection Diagram



PRODUCT SPECIFICATION

| | | |
|---------------------------------------|--------------------------------|--------------|
| COSMO ELECTRONICS CO., LTD. | Photocoupler : K1010 | SHEET 1 OF 5 |
|---------------------------------------|--------------------------------|--------------|

High Reliability Photocoupler

● Features

1. Current transfer ratio
(CTR : MIN. 60% at $I_F=5\text{mA}$ $V_{ce}=5\text{V}$)
2. High isolation voltage between input and output (Viso : 5000Vrms).
3. Compact dual-in-line package.

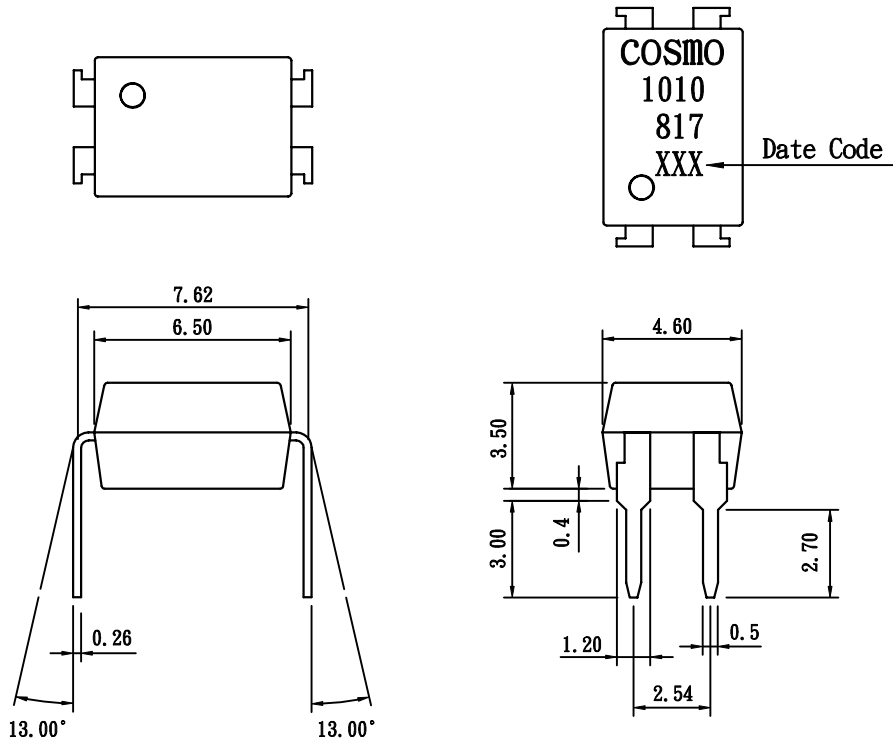
● Applications

1. Registers, copiers, automatic vending machines.
2. System appliances, measuring instruments.
3. Computer terminals, programmable controllers.
4. Communications, telephone, etc.
5. Electric home appliances, such as oil fan heaters, Microwave oven, Washer, Refrigerator, Air conditioner, etc.
6. Medical instruments, physical and chemical equipment.
7. Signal transmission between circuits of different potentials and impedances.
8. Facsimile equipment, Audio, Video.
9. Switching power supply, Laser beam printer.

PRODUCT SPECIFICATION

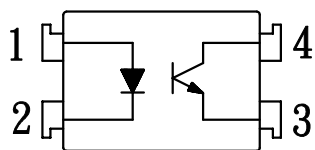
| | | |
|---------------------------------------|--------------------------------|--------------|
| COSMO ELECTRONICS CO., LTD. | Photocoupler : K1010 | SHEET 2 OF 5 |
|---------------------------------------|--------------------------------|--------------|

1. OUTSIDE DIMENSION : UNIT (mm)



TOLERANCE : $\pm 0.2\text{mm}$

2. SCHEMATIC : TOP VIEW



1. Anode
2. Cathode
3. Emitter
4. Collector

Power Factor Controller

SG6961

FEATURES

- Boundary Mode PFC Controller
- Low Input Current THD
- Controlled On-Time PWM
- Zero-Current Detection
- Cycle-by-Cycle Current Limiting
- Leading-Edge Blanking Instead of RC Filtering
- Low Start-up Current (10μA Typical)
- Low Operating Current (4.5mA Typical)
- Feedback Open-Loop Protection
- Programmable Maximum On-Time (MOT)
- Output Over-Voltage Clamping Protection
- Clamped Gate Output Voltage 16.5V

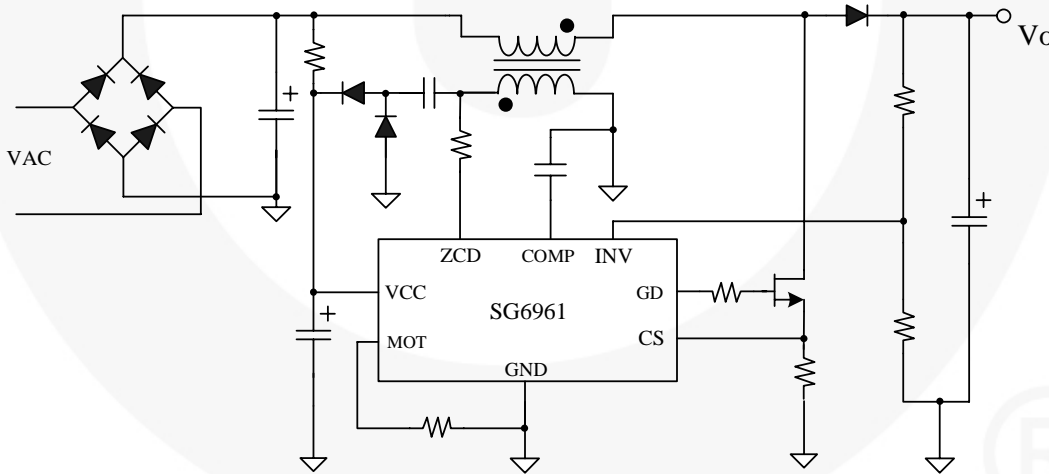
DESCRIPTION

The SG6961 is an 8-pin boundary mode PFC controller IC intended for controlling PFC pre-regulators. The SG6961 provides a controlled on-time to regulate the output DC voltage and achieve natural power factor correction. The maximum on-time of the external switch is programmable to ensure safe operation during AC brownouts. An innovative multi-vector error amplifier is built in to provide rapid transient response and precise output voltage clamping. A built-in circuit disables the controller if the output feedback loop is opened. The start-up current is lower than 20μA and the operating current is under 4.5mA. The supply voltage can be up to 20V, maximizing application flexibility.

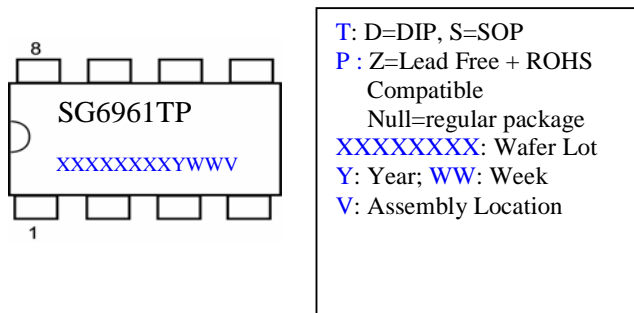
APPLICATIONS

- Electric Lamp Ballasts
- AC-DC Switching Mode Power Converter
- Open-Frame Power Supplies and Power Adapters
- Flyback Power Converters with ZCS/ZVS

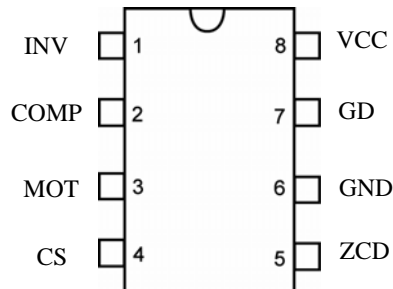
TYPICAL APPLICATION



MARKING DIAGRAMS



PIN CONFIGURATION



ORDERING INFORMATION

| Part Number | Pb-Free | Package |
|-------------|---------|-----------|
| SG6961SZ | | 8-Pin SOP |
| SG6961DZ | | 8-Pin DIP |

PIN DESCRIPTIONS

| Pin No. | Symbol | Description |
|---------|--------|--|
| 1 | INV | Inverting input of the error amplifier. INV is connected to the converter output via a resistive divider. This pin is also used for over-voltage clamping and open-loop feedback protection. |
| 2 | COMP | The output of the error amplifier. To create a precise clamping protection, a compensation network between this pin and GND is suggested. |
| 3 | MOT | A resistor from MOT to GND is used to determine the maximum on-time of the external power MOSFET. The maximum output power of the converter is a function of the maximum on-time. |
| 4 | CS | Input to the over-current protection comparator. When the sensed voltage across the sense resistor reaches the internal threshold (0.82V), the switch is turned off to activate cycle-by-cycle current limiting. |
| 5 | ZCD | Zero Current Detection. This pin is connected to an auxiliary winding via a resistor to detect the zero crossing of the switch current. When the zero crossing is detected, a new switching cycle is started. If it is connected to GND, the device is disabled. |
| 6 | GND | The power ground and signal ground. Placing a 0.1µF decoupling capacitor between the VCC and GND pins is recommended. |
| 7 | GD | Totem-pole driver output to drive the external power MOSFET. The clamped gate output voltage is 16.5V. |
| 8 | VCC | Driver and control circuit supply voltage. |

**ADJUSTABLE PRECISION SHUNT REGULATORS****AZ431-A****Description**

The AZ431-A series ICs are three-terminal adjustable shunt regulators with guaranteed thermal stability over a full operation range. These ICs feature sharp turn-on characteristics, low temperature coefficient and low output impedance, which make them ideal substitutes for Zener diodes in applications such as switching power supply, charger and other adjustable regulators.

The AZ431-A series ICs are of 40V voltage type. Its output voltage can be set to any value between $V_{REF}(2.5V)$ and 36V.

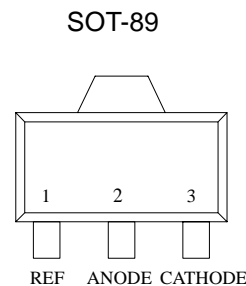
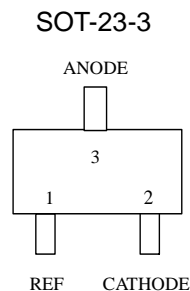
The AZ431-A precision reference is offered in two band-gap tolerance: 0.4% and 0.8%.

Features

- Programmable Precise Output Voltage from 2.5V to 36V
- Very Accurate Reference Voltage: 0.15% Typical
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Low Dynamic Output Resistance: 0.2Ω Typical
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

Applications

- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

Pin Configuration**Parametric Table**

| | AZ431A-A | AZ431B-A |
|--------------------------------------|----------|----------|
| I_{KA} (Max) (mA) | 100 | 100 |
| I_{KA} (Min) (mA) | 0.4 | 0.4 |
| V_{OUT} / V_{REF} Initial Tol. (%) | 0.4 | 0.8 |
| V_{OUT} (Max) (V) | 36 | 36 |
| V_{OUT} (Min) (V) | 2.5 | 2.5 |
| Z_{KA} (Typ) (Ω) | 0.15 | 0.15 |
| Temp Coeff. (Typ) (PPM/°C) | 20 | 20 |
| Operating Temperature (Min) (°C) | -40 | -40 |
| Operating Temperature (Max) (°C) | +125 | +125 |

Benefits

- Easier to Stabilize
- Ultra Low Temperature Coefficient
- Higher V_{REF} Accuracy
- Wider Operating Temperature Range
- Very Competitive Price

Additional Available Materials

- Samples
- Datasheet
- Reliability Report
- ESD Report

TL071, TL071A, TL071B, TL072 TL072A, TL072B, TL074, TL074A, TL074B LOW-NOISE JFET-INPUT OPERATIONAL AMPLIFIERS

SLOS080D – SEPTEMBER 1978 – REVISED AUGUST 1996

- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion
0.003% Typ
- Low Noise
 $V_n = 18 \text{ nV}/\sqrt{\text{Hz}}$ Typ at $f = 1 \text{ kHz}$
- High Input Impedance . . . JFET Input Stage
- Internal Frequency Compensation
- Latch-Up-Free Operation
- High Slew Rate . . . $13 \text{ V}/\mu\text{s}$ Typ
- Common-Mode Input Voltage Range
Includes V_{CC+}

description

The JFET-input operational amplifiers in the TL07_ series are designed as low-noise versions of the TL08_ series amplifiers with low input bias and offset currents and fast slew rate. The low harmonic distortion and low noise make the TL07_ series ideally suited for high-fidelity and audio preamplifier applications. Each amplifier features JFET inputs (for high input impedance) coupled with bipolar output stages integrated on a single monolithic chip.

The C-suffix devices are characterized for operation from 0°C to 70°C. The I-suffix devices are characterized for operation from –40°C to 85°C. The M-suffix devices are characterized for operation over the full military temperature range of –55°C to 125°C.

AVAILABLE OPTIONS

| T _A | V _{IO} max AT 25°C | PACKAGE | | | | | | | |
|-------------------|--------------------------------|---------------------------------|----------------------------------|-----------------------|---------------------------|---------------------------------|---------------------------------|--------------------------|------------------------|
| | | SMALL OUTLINE (D)† | CHIP CARRIER (FK) | CERAMIC DIP (J) | CERAMIC DIP (JG) | PLASTIC DIP (N) | PLASTIC DIP (P) | TSSOP PACKAGE (PW) | FLAT PACKAGE (W) |
| 0°C to 70°C | 10 mV 6 mV 3 mV | TL071CD TL071ACD TL071BCD | — | — | — | — | TL071CP TL071ACP TL071BCP | TL071CPWLE — — | — |
| | 10 mV 6 mV 3 mV | TL072CD TL072ACD TL072BCD | — | — | — | — | TL072CP TL072ACP TL072BCP | TL072CPWLE — — | — |
| | 10 mV 6 mV 3 mV | TL074CD TL074ACD TL074BCD | — | — | — | TL074CN TL074ACN TL074BCN | — | TL074CPWLE — — | — |
| –40°C to 85°C | 6 mV | TL071ID TL072ID TL074ID | — | — | — | — — TL074IN | TL071IP TL072IP — | — | — |
| –55°C to 125°C | 6 mV 6 mV 9 mV | — | TL071MFK TL072MFK TL074MFK | — — TL074MJ | TL071MJG TL072MJG — | — — TL074MN | — TL072MP — | — | — — TL074MW |

† The D package is available taped and reeled. Add the suffix R to the device type (e.g., TL071CDR). The PW package is only available left-ended taped and reeled (e.g., TL072CPWLE).



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TOSHIBA TRANSISTOR SILICON PNP EPITAXIAL TYPE (PCT PROCESS)

2SA1048

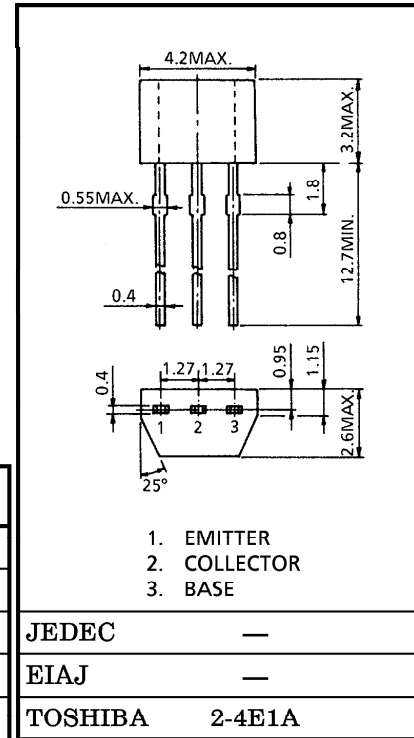
AUDIO FREQUENCY AMPLIFIER APPLICATIONS

Unit in mm

- Small Package
- High Voltage : $V_{CEO} = -50V$ (Min.)
- High h_{FE} : $h_{FE} = 70 \sim 400$
- Excellent h_{FE} Linearity
: $h_{FE}(I_C = -0.1mA) / h_{FE}(I_C = -2mA) = 0.95$ (Typ.)
- Low Noise : $NF = 1dB$ (Typ.), $10dB$ (Max.)
- Complementary to 2SC2458

MAXIMUM RATINGS ($T_a = 25^\circ C$)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------------|-----------|---------|------------|
| Collector-Base Voltage | V_{CBO} | -50 | V |
| Collector-Emitter Voltage | V_{CEO} | -50 | V |
| Emitter-Base Voltage | V_{EBO} | -5 | V |
| Collector Current | I_C | -150 | mA |
| Base Current | I_B | -50 | mA |
| Collector Power Dissipation | P_C | 200 | mW |
| Junction Temperature | T_j | 125 | $^\circ C$ |
| Storage Temperature Range | T_{stg} | -55~125 | $^\circ C$ |



Weight : 0.13g

ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ C$)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------|-----------------|---|------|------|------|---------|
| Collector Cut-off Current | I_{CBO} | $V_{CB} = -50V, I_E = 0$ | — | — | -0.1 | μA |
| Emitter Cut-off Current | I_{EBO} | $V_{EB} = -5V, I_C = 0$ | — | — | -0.1 | μA |
| DC Current Gain | h_{FE} (Note) | $V_{CE} = -6V, I_C = -2mA$ | 70 | — | 400 | |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C = -100mA, I_B = -10mA$ | — | -0.1 | -0.3 | V |
| Transition Frequency | f_T | $V_{CE} = -10V, I_C = -1mA$ | 80 | — | — | MHz |
| Collector Output Capacitance | C_{ob} | $V_{CB} = -10V, I_E = 0, f = 1MHz$ | — | 4 | 7 | pF |
| Noise Figure | NF | $V_{CE} = -6V, I_C = -0.1mA$ $f = 1kHz, R_G = 10k\Omega$ | — | 1.0 | 10 | dB |

Note : h_{FE} Classification 0 : 70~140, Y : 120~240, GR : 200~400

961001EAA2

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TOSHIBA TRANSISTOR SILICON NPN EPITAXIAL TYPE (PCT PROCESS)

2SC2235

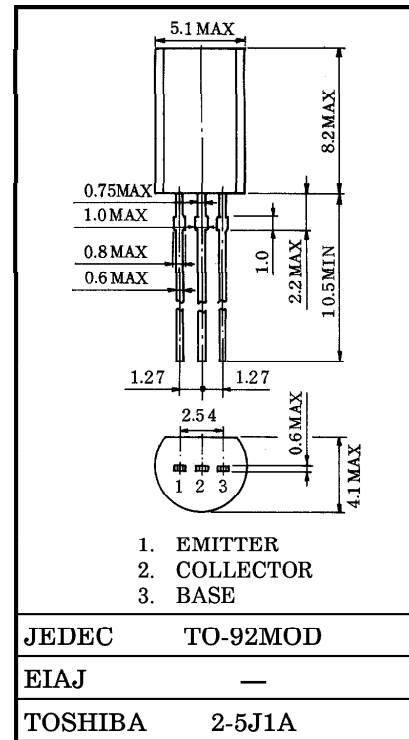
AUDIO POWER AMPLIFIER APPLICATIONS.
DRIVER STAGE AMPLIFIER APPLICATIONS.

Unit in mm

- Complementary to 2SA965.

MAXIMUM RATINGS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------------|------------------|---------|------|
| Collector-Base Voltage | V _{CB0} | 120 | V |
| Collector-Emitter Voltage | V _{CEO} | 120 | V |
| Emitter-Base Voltage | V _{EBO} | 5 | V |
| Collector Current | I _C | 800 | mA |
| Emitter Current | I _E | -800 | mA |
| Collector Power Dissipation | P _C | 900 | mW |
| Junction Temperature | T _j | 150 | °C |
| Storage Temperature Range | T _{stg} | -55~150 | °C |



Weight : 0.36g

ELECTRICAL CHARACTERISTICS (Ta = 25°C)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------|------------------------|---|------|------|------|------|
| Collector Cut-off Current | I _{CB0} | V _{CB} = 120V, I _E = 0 | — | — | 100 | nA |
| Emitter Cut-off Current | I _{EBO} | V _{EB} = 5V, I _C = 0 | — | — | 100 | nA |
| Collector-Emitter Breakdown Voltage | V _{(BR)CEO} | I _C = 10mA, I _B = 0 | 120 | — | — | V |
| Emitter-Base Breakdown Voltage | V _{(BR)EBO} | I _E = 1mA, I _C = 0 | 5 | — | — | V |
| DC Current Gain | h _{FE} (Note) | V _{CE} = 5V, I _C = 100mA | 80 | — | 240 | |
| Collector-Emitter Saturation Voltage | V _{CE(sat)} | I _C = 500mA, I _B = 50mA | — | — | 1.0 | V |
| Base-Emitter Voltage | V _{BE} | V _{CE} = 5V, I _C = 500mA | — | — | 1.0 | V |
| Transition Frequency | f _T | V _{CE} = 5V, I _C = 100mA | — | 120 | — | MHz |
| Collector Output Capacitance | C _{ob} | V _{CB} = 10V, I _E = 0, f = 1MHz | — | — | 30 | pF |

Note : h_{FE} Classification O : 80~160, Y : 120~240

961001EAA2

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TOSHIBA TRANSISTOR SILICON NPN EPITAXIAL TYPE (PCT PROCESS)

2SC2458

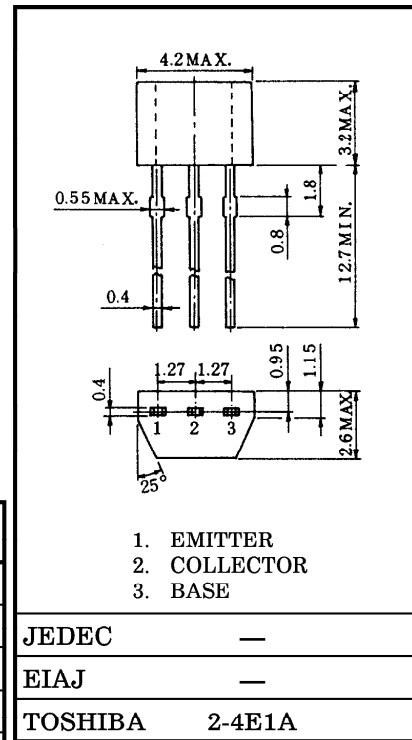
AUDIO AMPLIFIER APPLICATIONS.

Unit in mm

- High Current Capability : $I_C = 150\text{mA}$ (Max.)
- High DC Current Gain : $h_{FE} = 70 \sim 700$
- Excellent h_{FE} Linearity
: $h_{FE}(I_C = 0.1\text{mA}) / h_{FE}(I_C = 2\text{mA}) = 0.95$ (Typ.)
- Low Noise : $NF(2) = 1\text{dB}$ (Typ.), 10dB (Max.)
- Complementary to 2SA1048.
- Small Package.

MAXIMUM RATINGS ($T_a = 25^\circ\text{C}$)

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|-----------------------------|-----------|---------|------------------|
| Collector-Base Voltage | V_{CBO} | 50 | V |
| Collector-Emitter Voltage | V_{CEO} | 50 | V |
| Emitter-Base Voltage | V_{EBO} | 5 | V |
| Collector Current | I_C | 150 | mA |
| Base Current | I_B | 50 | mA |
| Collector Power Dissipation | P_C | 200 | mW |
| Junction Temperature | T_j | 125 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -55~125 | $^\circ\text{C}$ |



Weight : 0.13g

ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$)

| CHARACTERISTIC | SYMBOL | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--------------------------------------|-----------------|---|------|------|------|---------------|
| Collector Cut-off Current | I_{CBO} | $V_{CB} = 50\text{V}, I_E = 0$ | — | — | 0.1 | μA |
| Emitter Cut-off Current | I_{EBO} | $V_{EB} = 5\text{V}, I_C = 0$ | — | — | 0.1 | μA |
| DC Current Gain | h_{FE} (Note) | $V_{CE} = 6\text{V}, I_C = 2\text{mA}$ | 70 | — | 700 | |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C = 100\text{mA}, I_B = 10\text{mA}$ | — | 0.1 | 0.25 | V |
| Transition Frequency | f_T | $V_{CE} = 10\text{V}, I_C = 1\text{mA}$ | 80 | — | — | MHz |
| Collector Output Capacitance | C_{ob} | $V_{CB} = 10\text{V}, I_E = 0, f = 1\text{MHz}$ | — | 2.0 | 3.5 | pF |
| Noise Figure | NF | $V_{CE} = 6\text{V}, I_C = 0.1\text{mA}, f = 1\text{kHz}, R_g = 10\text{k}\Omega$ | — | 1.0 | 10 | dB |

Note : h_{FE} Classification O : 70~140, Y : 120~240, GR : 200~400, BL : 350~700

961001EAA2

● TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

FDP20N50 / FDPF20N50

500V N-Channel MOSFET

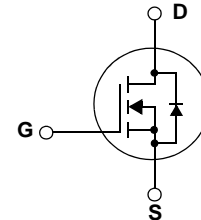
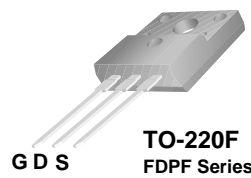
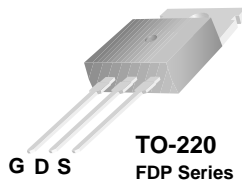
Features

- 20A, 500V, $R_{DS(on)} = 0.23\Omega @ V_{GS} = 10V$
- Low gate charge (typical 45.6 nC)
- Low C_{iss} (typical 27 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology.

This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficient switched mode power supplies and active power factor correction.



Absolute Maximum Ratings

| Symbol | Parameter | FDP20N50 | FDPF20N50 | Unit |
|----------------|--|-------------|----------------|--------------------------|
| V_{DSS} | Drain-Source Voltage | 500 | | V |
| I_D | Drain Current - Continuous ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$) | 20 12.9 | 20 * 12.9 * | A A |
| I_{DM} | Drain Current - Pulsed (Note 1) | 80 | 80 * | A |
| V_{GSS} | Gate-Source voltage | ± 30 | | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 1110 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | 20 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 25 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | | V/ns |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) - Derate above 25°C | 250 2.0 | 62 0.5 | W W/ $^\circ\text{C}$ |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +150 | | $^\circ\text{C}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds | 300 | | $^\circ\text{C}$ |

* Drain current limited by maximum junction temperature

Thermal Characteristics

| Symbol | Parameter | FDP20N50 | FDPF20N50 | Unit |
|-----------------|---|----------|-----------|--------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.5 | 2.0 | $^\circ\text{C/W}$ |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink Typ. | 0.5 | -- | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5 | 62.5 | $^\circ\text{C/W}$ |

FQP7N80C/FQPF7N80C

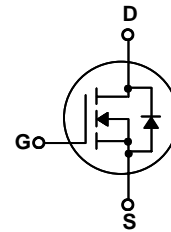
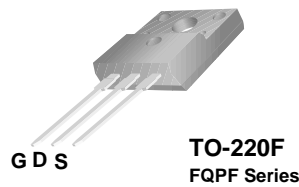
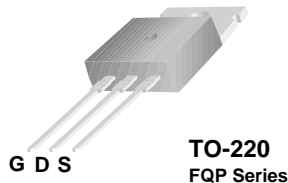
800V N-Channel MOSFET

General Description

These N-Channel enhancement mode power field effect transistors are produced using Fairchild's proprietary, planar stripe, DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switch mode power supplies.

Features

- 6.6A, 800V, $R_{DS(on)} = 1.9\Omega @ V_{GS} = 10V$
- Low gate charge (typical 27 nC)
- Low Crss (typical 10 pF)
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | FQP7N80C | FQPF7N80C | Units |
|----------------|---|-------------|-----------|---------------------|
| V_{DSS} | Drain-Source Voltage | 800 | | V |
| I_D | Drain Current - Continuous ($T_C = 25^\circ\text{C}$) - Continuous ($T_C = 100^\circ\text{C}$) | 6.6 | 6.6 * | A |
| | | 4.2 | 4.2 * | A |
| I_{DM} | Drain Current - Pulsed (Note 1) | 26.4 | 26.4 * | A |
| V_{GSS} | Gate-Source Voltage | ± 30 | | V |
| E_{AS} | Single Pulsed Avalanche Energy (Note 2) | 580 | | mJ |
| I_{AR} | Avalanche Current (Note 1) | 6.6 | | A |
| E_{AR} | Repetitive Avalanche Energy (Note 1) | 16.7 | | mJ |
| dv/dt | Peak Diode Recovery dv/dt (Note 3) | 4.5 | | V/ns |
| P_D | Power Dissipation ($T_C = 25^\circ\text{C}$) - Derate above 25°C | 167 | 56 | W |
| | | 1.33 | 0.44 | W/ $^\circ\text{C}$ |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to +150 | | $^\circ\text{C}$ |
| T_L | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300 | | $^\circ\text{C}$ |

* Drain current limited by maximum junction temperature.

Thermal Characteristics

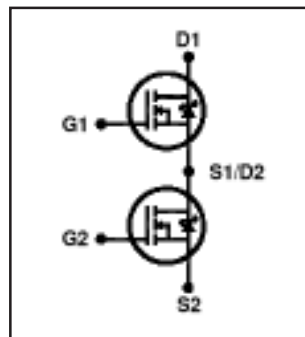
| Symbol | Parameter | FQP7N80C | FQPF7N80C | Units |
|-----------------|---|----------|-----------|---------------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.75 | 2.25 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JS}$ | Thermal Resistance, Case-to-Sink Typ. | 0.5 | -- | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5 | 62.5 | $^\circ\text{C}/\text{W}$ |

IRFI4212H-117P

Features

- Integrated half-bridge package
- Reduces the part count by half
- Facilitates better PCB layout
- Key parameters optimized for Class-D audio amplifier applications
- Low $R_{DS(ON)}$ for improved efficiency
- Low Q_g and Q_{sw} for better THD and improved efficiency
- Low Q_{rr} for better THD and lower EMI
- Can delivery up to 150W per channel into 4Ω load in half-bridge configuration amplifier
- Lead-free package

| Key Parameters ⑤ | | |
|-------------------------|-----|----|
| V_{DS} | 100 | V |
| $R_{DS(ON)}$ typ. @ 10V | 58 | mΩ |
| Q_g typ. | 12 | nC |
| Q_{sw} typ. | 6.9 | nC |
| $R_{G(int)}$ typ. | 3.4 | Ω |
| T_J max | 150 | °C |



| G1, G2 | D1, D2 | S1, S2 |
|--------|--------|--------|
| Gate | Drain | Source |

Description

This Digital Audio MosFET Half-Bridge is specifically designed for Class D audio amplifier applications. It consists of two power MosFET switches connected in half-bridge configuration. The latest process is used to achieve low on-resistance per silicon area. Furthermore, Gate charge, body-diode reverse recovery, and internal Gate resistance are optimized to improve key Class D audio amplifier performance factors such as efficiency, THD and EMI. These combine to make this Half-Bridge a highly efficient, robust and reliable device for Class D audio amplifier applications.

Absolute Maximum Ratings ⑤

| | Parameter | Max. | Units |
|-----------------------------------|--|------------------|-------|
| V_{DS} | Drain-to-Source Voltage | 100 | V |
| V_{GS} | Gate-to-Source Voltage | ±20 | |
| I_D @ $T_C = 25^\circ\text{C}$ | Continuous Drain Current, V_{GS} @ 10V | 11 | A |
| I_D @ $T_C = 100^\circ\text{C}$ | Continuous Drain Current, V_{GS} @ 10V | 6.8 | |
| I_{DM} | Pulsed Drain Current ① | 44 | |
| P_D @ $T_C = 25^\circ\text{C}$ | Power Dissipation ④ | 18 | W |
| P_D @ $T_C = 100^\circ\text{C}$ | Power Dissipation ④ | 7.0 | |
| | Linear Derating Factor | 0.14 | W/°C |
| E_{AS} | Single Pulse Avalanche Energy② | 41 | mJ |
| T_J | Operating Junction and | -55 to + 150 | °C |
| T_{STG} | Storage Temperature Range | | |
| | Soldering Temperature, for 10 seconds (1.6mm from case) | | |
| | Mounting torque, 6-32 or M3 screw | 10lb·in (1.1N·m) | |

Thermal Resistance ⑤

| | Parameter | Typ. | Max. | Units |
|-----------------|--------------------------------|------|------|-------|
| $R_{\theta JC}$ | Junction-to-Case ④ | — | 7.1 | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient (free air) | — | 65 | |

ISL9R1560PF2

15A, 600V Stealth™ Diode

General Description

The ISL9R1560PF2 is a Stealth™ diode optimized for low loss performance in high frequency hard switched applications. The Stealth™ family exhibits low reverse recovery current ($I_{RM(REC)}$) and exceptionally soft recovery under typical operating conditions.

This device is intended for use as a free wheeling or boost diode in power supplies and other power switching applications. The low $I_{RM(REC)}$ and short t_a phase reduce loss in switching transistors. The soft recovery minimizes ringing, expanding the range of conditions under which the diode may be operated without the use of additional snubber circuitry. Consider using the Stealth™ diode with an SMPS IGBT to provide the most efficient and highest power density design at lower cost.

Formerly developmental type TA49410.

Features

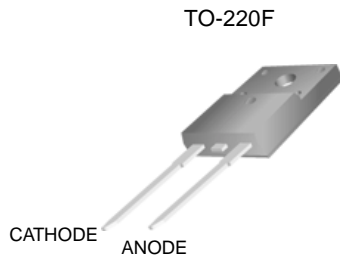
- Soft Recovery $t_b / t_a > 1.2$
- Fast Recovery $t_{rr} < 30ns$
- Operating Temperature 150°C
- Reverse Voltage 600V
- Internally Isolated 1kV
- Avalanche Energy Rated

Applications

- Switch Mode Power Supplies
- Hard Switched PFC Boost Diode
- UPS Free Wheeling Diode
- Motor Drive FWD
- SMPS FWD
- Snubber Diode

Package

Symbol



Device Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

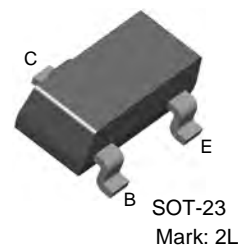
| Symbol | Parameter | Ratings | Units |
|----------------|---|------------|-------|
| V_{RRM} | Repetitive Peak Reverse Voltage | 600 | V |
| V_{RWM} | Working Peak Reverse Voltage | 600 | V |
| V_R | DC Blocking Voltage | 600 | V |
| $I_{F(AV)}$ | Average Rectified Forward Current ($T_C = 25^\circ\text{C}$) | 15 | A |
| I_{FRM} | Repetitive Peak Surge Current (20kHz Square Wave) | 30 | A |
| I_{FSM} | Nonrepetitive Peak Surge Current (Halfwave 1 Phase 60Hz) | 200 | A |
| P_D | Power Dissipation | 30 | W |
| E_{AVL} | Avalanche Energy (1A, 40mH) | 20 | mJ |
| T_J, T_{STG} | Operating and Storage Temperature Range | -55 to 150 | °C |
| T_L | Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10s | 300 | °C |

CAUTION: Stresses above those listed in "Device Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

MMBT5401

PNP General Purpose Amplifier

- This device is designed as a general purpose amplifier and switch for applications requiring high voltage.



PNP Epitaxial Silicon Transistor

Absolute Maximum Ratings* $T_a=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Value | Units |
|----------------|--|-----------|------------------|
| V_{CEO} | Collector-Emitter Voltage | -150 | V |
| V_{CBO} | Collector-Base Voltage | -160 | V |
| V_{EBO} | Emitter-Base Voltage | -5.0 | V |
| I_C | Collector Current - Continuous | -600 | mA |
| T_J, T_{STG} | Operating and Storage Junction Temperature Range | -55 ~ 150 | $^\circ\text{C}$ |

* These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

Notes:

- These ratings are based on a maximum junction temperature of 150 degrees C.
- These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Electrical Characteristics $T_a=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Test Condition | Min. | Max. | Units |
|-------------------------------------|---------------------------------------|--|----------------|--------------|---------------------|
| Off Characteristics | | | | | |
| BV_{CEO} | Collector-Emitter Breakdown Voltage * | $I_C = -1.0\text{mA}, I_B = 0$ | -150 | | V |
| BV_{CBO} | Collector-Base Breakdown Voltage | $I_C = -100\mu\text{A}, I_E = 0$ | -160 | | V |
| BV_{EBO} | Emitter-Base Breakdown Voltage | $I_E = -10\mu\text{A}, I_C = 0$ | -5.0 | | V |
| I_{CBO} | Collector Cutoff Current | $V_{CB} = -120\text{V}, I_E = 0$ $V_{CB} = -120\text{V}, I_E = 0, T_a = 100^\circ\text{C}$ | | -50 | nA μA |
| I_{EBO} | Emitter Cutoff Current | $V_{EB} = -3.0\text{V}, I_C = 0$ | | -50 | nA |
| On Characteristics * | | | | | |
| h_{FE} | DC Current Gain | $I_C = -1.0\text{mA}, V_{CE} = -5.0\text{V}$ $I_C = -10\text{mA}, V_{CE} = -5.0\text{V}$ $I_C = -50\text{mA}, V_{CE} = -5.0\text{V}$ | 50 60 50 | 240 | |
| $V_{CE}(\text{sat})$ | Collector-Emitter Saturation Voltage | $I_C = -10\text{mA}, I_B = -1.0\text{mA}$ $I_C = -50\text{mA}, I_B = -5.0\text{mA}$ | | -0.2 -0.5 | V V |
| $V_{BE}(\text{sat})$ | Base-Emitter Saturation Voltage | $I_C = -10\text{mA}, I_B = -1.0\text{mA}$ $I_C = -50\text{mA}, I_B = -5.0\text{mA}$ | | -1.0 -1.0 | V V |
| Small Signal Characteristics | | | | | |
| f_T | Current Gain Bandwidth Product | $I_C = -10\text{mA}, V_{CE} = -10\text{V},$ $f = 100\text{MHz}$ | 100 | 300 | MHz |
| C_{ob} | Output Capacitance | $V_{CB} = -10\text{V}, I_E = 0, f = 1\text{MHz}$ | | 6.0 | pF |
| N_F | Noise Figure | $I_C = -250\mu\text{A}, V_{CE} = -5.0\text{V}, R_S = 1.0\text{K}\Omega$ $f = 10\text{Hz to } 15.7\text{KHz}$ | | 8.0 | dB |

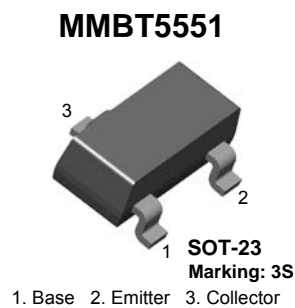
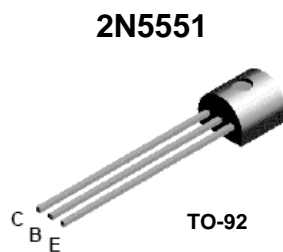
* Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2.0\%$

2N5551 / MMBT5551

NPN General Purpose Amplifier

Features

- This device is designed for general purpose high voltage amplifiers and gas discharge display drivers.
- Suffix “-C” means Center Collector in 2N5551 (1. Emitter 2. Collector 3. Base)
- Suffix “-Y” means h_{FE} 180~240 in 2N5551 (Test condition : $I_C = 10\text{mA}$, $V_{CE} = 5.0\text{V}$)



Absolute Maximum Ratings * $T_A = 25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Value | Units |
|----------------|----------------------------------|-------------|------------------|
| V_{CEO} | Collector-Emitter Voltage | 160 | V |
| V_{CBO} | Collector-Base Voltage | 180 | V |
| V_{EBO} | Emitter-Base Voltage | 6.0 | V |
| I_C | Collector current - Continuous | 600 | mA |
| T_J, T_{stg} | Junction and Storage Temperature | -55 to +150 | $^\circ\text{C}$ |

* These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

NOTES:

1. These ratings are based on a maximum junction temperature of 150 degrees C.
2. These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Thermal Characteristics $T_A=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Max | | Units |
|-----------------|---|--------|-----------|----------------------------|
| | | 2N5551 | *MMBT5551 | |
| P_D | Total Device Dissipation | 625 | 350 | mW |
| | Derate above 25°C | 5.0 | 2.8 | $\text{mW}/^\circ\text{C}$ |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Case | 83.3 | | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient | 200 | 357 | $^\circ\text{C}/\text{W}$ |

* Device mounted on FR-4 PCB 1.6" × 1.6" × 0.06."

MUR1610CT, MUR1615CT, MUR1620CT, MUR1640CT, MUR1660CT

SWITCHMODE™ Power Rectifiers

... designed for use in switching power supplies, inverters and as free wheeling diodes, these state-of-the-art devices have the following features:

- Ultrafast 35 and 60 Nanosecond Recovery Times
- 175°C Operating Junction Temperature
- Popular TO-220 Package
- Epoxy Meets UL94, V_O @ 1/8"
- High Temperature Glass Passivated Junction
- High Voltage Capability to 600 Volts
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: 1.9 grams (approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Shipped 50 units per plastic tube
- Marking: U1610, U1615, U1620, U1640, U1660

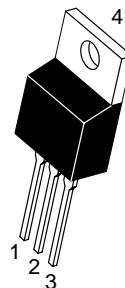
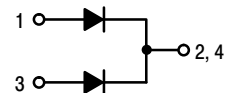
MAXIMUM RATINGS

Please See the Table on the Following Page



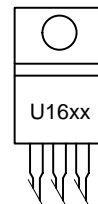
<http://onsemi.com>

**ULTRAFAST
RECTIFIERS
8.0 AMPERES
100-600 VOLTS**



**TO-220AB
CASE 221A
PLASTIC**

MARKING DIAGRAM



U16xx = Device Code
xx = 10, 15, 20, 40 or 60

ORDERING INFORMATION

| Device | Package | Shipping |
|-----------|---------|---------------|
| MUR1610CT | TO-220 | 50 Units/Rail |
| MUR1615CT | TO-220 | 50 Units/Rail |
| MUR1620CT | TO-220 | 50 Units/Rail |
| MUR1640CT | TO-220 | 50 Units/Rail |
| MUR1660CT | TO-220 | 50 Units/Rail |

MUR1620CTR, MURB1620CTR

Preferred Device

SWITCHMODE™ Power Rectifier

These state-of-the-art devices are designed for use in negative switching power supplies, inverters and as free wheeling diodes. Also, used in conjunction with common cathode dual Ultrafast Rectifiers, makes a single phase full-wave bridge.

Features

- Common Anode Dual Rectifier (8.0 A per Leg or 16 A per Package)
- Ultrafast 35 Nanosecond Reverse Recovery Times
- Exhibits Soft Recovery Characteristics
- High Temperature Glass Passivated Junction
- Low Leakage Specified @ 150°C Case Temperature
- Current Derating @ Both Case and Ambient Temperatures
- Epoxy Meets UL 94 V-0 @ 0.125 in
- Complement to MUR1620CT and MURB1620CT Common Cathode Device
- Pb-Free Packages are Available

Mechanical Characteristics:

- Case: Epoxy, Molded
- Weight: MUR1620CTR: 1.9 Grams (Approximately)
MURB1620CTR: 1.7 Grams (Approximately)
- Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable
- Lead Temperature for Soldering Purposes:
260°C Max. for 10 Seconds

MAXIMUM RATINGS (Per Leg)

| Rating | Symbol | Value | Unit |
|--|---------------------------------|-------------|------|
| Peak Repetitive Reverse Voltage Working Peak Reverse Voltage DC Blocking Voltage | V_{RRM} V_{RWM} V_R | 200 | V |
| Average Rectified Forward Voltage (Rated V_R , $T_C = 160^\circ\text{C}$) Per Leg Per Total Device | $I_{F(AV)}$ | 8.0 16 | A |
| Peak Repetitive Surge Current (Rated V_R , Square Wave, 20 kHz, $T_C = 140^\circ\text{C}$) Per Diode | I_{FM} | 16 | A |
| Non-Repetitive Peak Surge Current (Surge Applied at Rated Load Conditions Halfwave, Single Phase, 60 Hz) | I_{FSM} | 100 | A |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | -65 to +175 | °C |

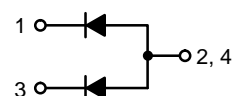
Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.



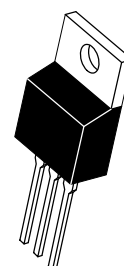
ON Semiconductor®

<http://onsemi.com>

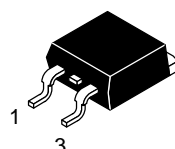
ULTRAFAST RECTIFIER 16 AMPERES, 200 VOLTS



MARKING DIAGRAMS



TO-220AB
CASE 221A
STYLE 7



D²PAK
CASE 418B
STYLE 5



U1620R = Device Code
KAK = Diode Polarity
A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

Preferred devices are recommended choices for future use and best overall value.

S8050LT1 TRANSISTOR (NPN)

FEATURES

Power dissipation

P_{CM} : 0.3 W ($T_{amb}=25^{\circ}C$)

Collector current

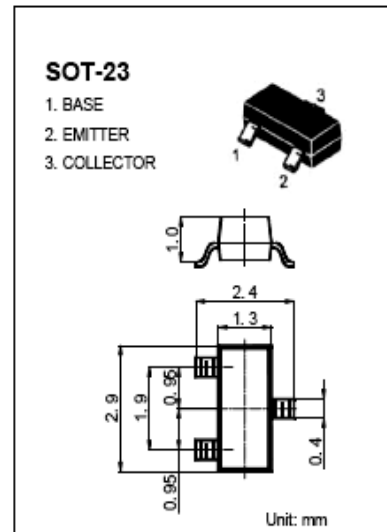
I_{CM} : 0.5 A

Collector-base voltage

$V_{(BR)CBO}$: 40 V

Operating and storage junction temperature range

T_J, T_{stg} : $-55^{\circ}C$ to $+150^{\circ}C$



ELECTRICAL CHARACTERISTICS ($T_{amb}=25^{\circ}C$ unless otherwise specified)

| Parameter | Symbol | Test conditions | MIN | TYP | MAX | UNIT |
|--------------------------------------|---------------|------------------------------------|-----|-----|-----|---------|
| Collector-base breakdown voltage | $V_{(BR)CBO}$ | $I_C=100\mu A, I_E=0$ | 40 | | | V |
| Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | $I_C=1mA, I_B=0$ | 25 | | | V |
| Emitter-base breakdown voltage | $V_{(BR)EBO}$ | $I_E=100\mu A, I_C=0$ | 5 | | | V |
| Collector cut-off current | I_{CBO} | $V_{CB}=40V, I_E=0$ | | | 0.1 | μA |
| Collector cut-off current | I_{CEO} | $V_{CB}=20V, I_E=0$ | | | 0.1 | μA |
| Emitter cut-off current | I_{EBO} | $V_{EB}=5V, I_C=0$ | | | 0.1 | μA |
| DC current gain | $h_{FE(1)}$ | $V_{CE}=1V, I_C=50mA$ | 120 | | 350 | |
| | $h_{FE(2)}$ | $V_{CE}=1V, I_C=500mA$ | 50 | | | |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C=500mA, I_B=50mA$ | | | 0.6 | V |
| Base-emitter saturation voltage | $V_{BE(sat)}$ | $I_C=500mA, I_B=50mA$ | | | 1.2 | V |
| Transition frequency | f_T | $V_{CE}=6V, I_C=20mA$ $f=30MHz$ | 150 | | | MHz |

CLASSIFICATION OF $h_{FE(1)}$

| Rank | L | H |
|-------|---------|---------|
| Range | 120-200 | 200-350 |

S8550LT1 TRANSISTOR (PNP)

FEATURES

Power dissipation

$$P_{CM}: 0.3 \text{ W (Tamb=25}^\circ\text{C)}$$

Collector current

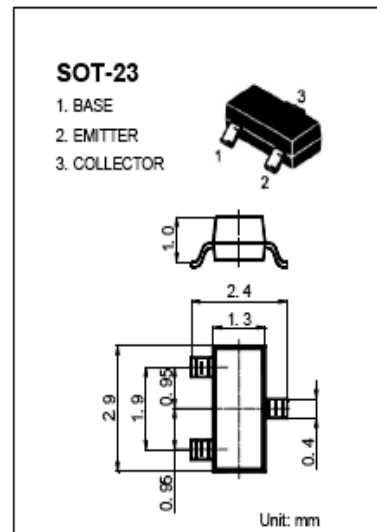
$$I_{CM}: -0.5 \text{ A}$$

Collector-base voltage

$$V_{(BR)CBO}: -40 \text{ V}$$

Operating and storage junction temperature range

$$T_J, T_{stg}: -55^\circ\text{C to } +150^\circ\text{C}$$



ELECTRICAL CHARACTERISTICS (Tamb=25°C unless otherwise specified)

| Parameter | Symbol | Test conditions | MIN | MAX | UNIT |
|--------------------------------------|---------------|---|-----|------|---------------|
| Collector-base breakdown voltage | $V_{(BR)CBO}$ | $I_C = -100\mu\text{A}, I_E = 0$ | -40 | | V |
| Collector-emitter breakdown voltage | $V_{(BR)CEO}$ | $I_C = -1\text{mA}, I_B = 0$ | -25 | | V |
| Emitter-base breakdown voltage | $V_{(BR)EBO}$ | $I_E = -100\mu\text{A}, I_C = 0$ | -5 | | V |
| Collector cut-off current | I_{CBO} | $V_{CB} = -40\text{V}, I_E = 0$ | | -0.1 | μA |
| Collector cut-off current | I_{CEO} | $V_{CE} = -20\text{V}, I_B = 0$ | | -0.1 | μA |
| Emitter cut-off current | I_{EBO} | $V_{EB} = -3\text{V}, I_C = 0$ | | -0.1 | μA |
| DC current gain | $h_{FE(1)}$ | $V_{CE} = -1\text{V}, I_C = -50\text{mA}$ | 120 | 350 | |
| | $h_{FE(2)}$ | $V_{CE} = -1\text{V}, I_C = -500\text{mA}$ | 50 | | |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C = -500 \text{mA}, I_B = -50\text{mA}$ | | -0.6 | V |
| Base-emitter saturation voltage | $V_{BE(sat)}$ | $I_C = -500 \text{mA}, I_B = -50\text{mA}$ | | -1.2 | V |
| Transition frequency | f_T | $V_{CE} = -6\text{V}, I_C = -20\text{mA}$ $f = 30\text{MHz}$ | 150 | | MHz |

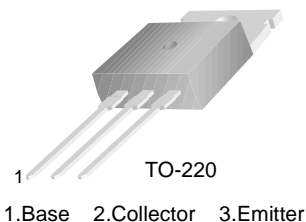
CLASSIFICATION OF $h_{FE(1)}$

| Rank | L | H |
|-------|---------|---------|
| Range | 120-200 | 200-350 |

TIP31 Series(TIP31/31A/31B/31C)

Medium Power Linear Switching Applications

- Complementary to TIP32/32A/32B/32C



NPN Epitaxial Silicon Transistor

Absolute Maximum Ratings $T_C=25^\circ\text{C}$ unless otherwise noted

| Symbol | Parameter | Value | Units |
|-----------|--|------------|------------------|
| V_{CBO} | Collector-Base Voltage : TIP31 | 40 | V |
| | : TIP31A | 60 | V |
| | : TIP31B | 80 | V |
| | : TIP31C | 100 | V |
| V_{CEO} | Collector-Emitter Voltage : TIP31 | 40 | V |
| | : TIP31A | 60 | V |
| | : TIP31B | 80 | V |
| | : TIP31C | 100 | V |
| V_{EBO} | Emitter-Base Voltage | 5 | V |
| I_C | Collector Current (DC) | 3 | A |
| I_{CP} | Collector Current (Pulse) | 5 | A |
| I_B | Base Current | 1 | A |
| P_C | Collector Dissipation ($T_C=25^\circ\text{C}$) | 40 | W |
| P_C | Collector Dissipation ($T_a=25^\circ\text{C}$) | 2 | W |
| T_J | Junction Temperature | 150 | $^\circ\text{C}$ |
| T_{STG} | Storage Temperature | - 65 ~ 150 | $^\circ\text{C}$ |

Electrical Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

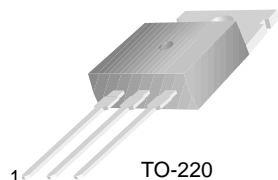
| Symbol | Parameter | Test Condition | Min. | Max. | Units |
|----------------|--|---|------|------|---------------|
| $V_{CEO(sus)}$ | * Collector-Emitter Sustaining Voltage : TIP31 | $I_C = 30\text{mA}, I_B = 0$ | 40 | | V |
| | : TIP31A | | | | V |
| | : TIP31B | | | | V |
| | : TIP31C | | | | V |
| I_{CEO} | Collector Cut-off Current : TIP31/31A | $V_{CE} = 30\text{V}, I_B = 0$ | | 0.3 | mA |
| | : TIP31B/31C | $V_{CE} = 60\text{V}, I_B = 0$ | | 0.3 | mA |
| I_{CES} | Collector Cut-off Current : TIP31 | $V_{CE} = 40\text{V}, V_{EB} = 0$ | | 200 | μA |
| | : TIP31A | $V_{CE} = 60\text{V}, V_{EB} = 0$ | | 200 | μA |
| | : TIP31B | $V_{CE} = 80\text{V}, V_{EB} = 0$ | | 200 | μA |
| | : TIP31C | $V_{CE} = 100\text{V}, V_{EB} = 0$ | | 200 | μA |
| I_{EBO} | Emitter Cut-off Current | $V_{EB} = 5\text{V}, I_C = 0$ | | 1 | mA |
| h_{FE} | * DC Current Gain | $V_{CE} = 4\text{V}, I_C = 1\text{A}$ | 25 | | |
| | | $V_{CE} = 4\text{V}, I_C = 3\text{A}$ | 10 | 50 | |
| $V_{CE(sat)}$ | * Collector-Emitter Saturation Voltage | $I_C = 3\text{A}, I_B = 375\text{mA}$ | | 1.2 | V |
| $V_{BE(sat)}$ | * Base-Emitter Saturation Voltage | $V_{CE} = 4\text{V}, I_C = 3\text{A}$ | | 1.8 | V |
| f_T | Current Gain Bandwidth Product | $V_{CE} = 10\text{V}, I_C = 500\text{mA}$ | 3.0 | | MHz |

* Pulse Test: $PW \leq 300\mu\text{s}$, Duty Cycles $\leq 2\%$

TIP32 Series(TIP32/32A/32B/32C)

Medium Power Linear Switching Applications

- Complement to TIP31/31A/31B/31C



TO-220
1.Base 2.Collector 3.Emitter

PNP Epitaxial Silicon Transistor

Absolute Maximum Ratings $T_C=25^\circ\text{C}$ unless otherwise noted

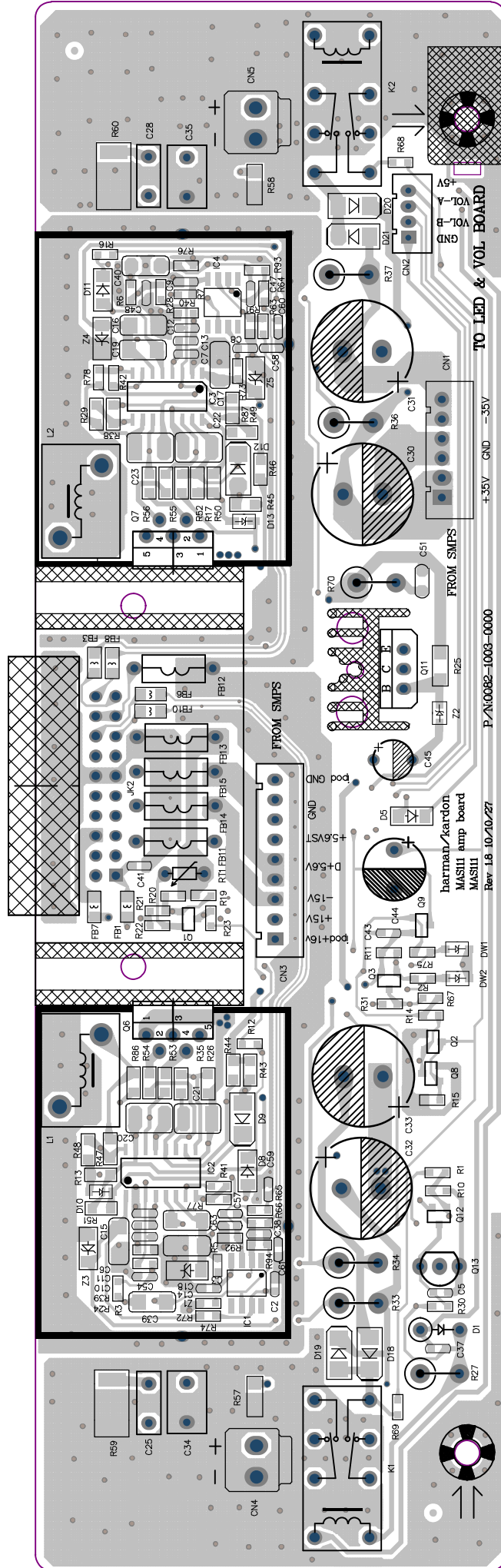
| Symbol | Parameter | Value | Units |
|-----------|---|------------|------------------|
| V_{CBO} | Collector-Base Voltage : TIP32 : TIP32A : TIP32B : TIP32C | - 40 | V |
| | | - 60 | V |
| | | - 80 | V |
| | | - 100 | V |
| V_{CEO} | Collector-Emitter Voltage : TIP32 : TIP32A : TIP32B : TIP32C | - 40 | V |
| | | - 60 | V |
| | | - 80 | V |
| | | -100 | V |
| V_{EBO} | Emitter-Base Voltage | - 5 | V |
| I_C | Collector Current (DC) | - 3 | A |
| I_{CP} | Collector Current (Pulse) | - 5 | A |
| I_B | Base Current | - 3 | A |
| P_C | Collector Dissipation ($T_C=25^\circ\text{C}$) | 40 | W |
| P_C | Collector Dissipation ($T_a=25^\circ\text{C}$) | 2 | W |
| T_J | Junction Temperature | 150 | $^\circ\text{C}$ |
| T_{STG} | Storage Temperature | - 65 ~ 150 | $^\circ\text{C}$ |

Electrical Characteristics $T_C=25^\circ\text{C}$ unless otherwise noted

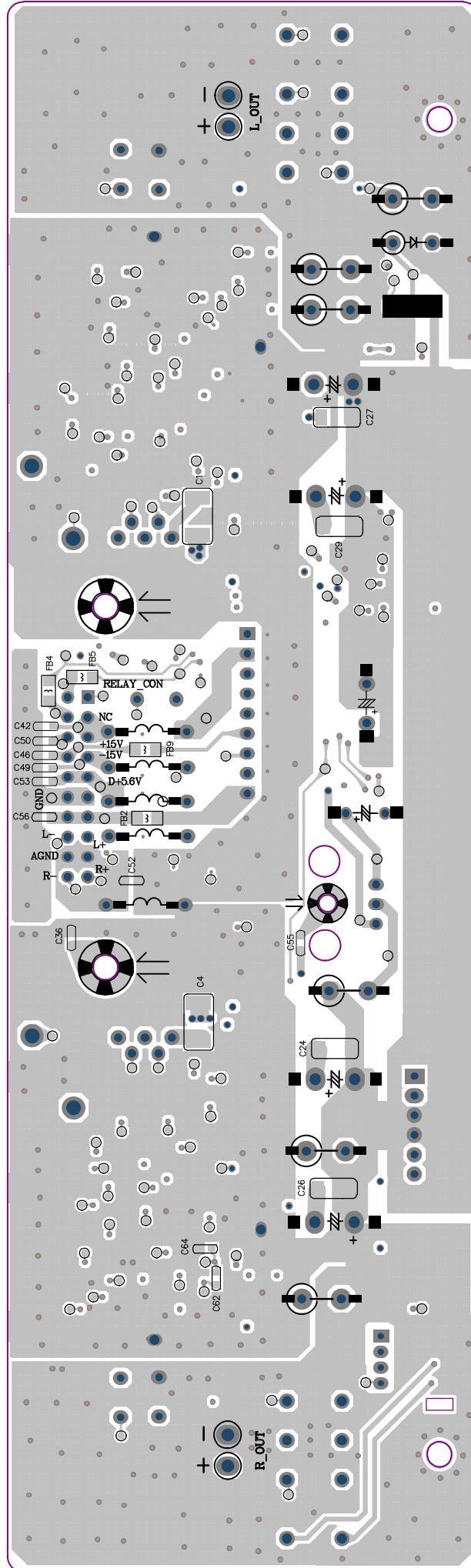
| Symbol | Parameter | Test Condition | Min. | Max. | Units |
|----------------|---|---|------|-------|---------------|
| $V_{CEO(sus)}$ | * Collector-Emitter Sustaining Voltage : TIP32 : TIP32A : TIP32B : TIP32C | $I_C = - 30\text{mA}, I_B = 0$ | -40 | | V |
| | | | -60 | | V |
| | | | -80 | | V |
| | | | -100 | | V |
| I_{CEO} | Collector Cut-off Current : TIP32/32A : TIP32B/32C | $V_{CE} = - 30\text{V}, I_B = 0$ | | - 0.3 | mA |
| | | $V_{CE} = - 60\text{V}, I_B = 0$ | | - 0.3 | mA |
| I_{CES} | Collector Cut-off Current : TIP32 : TIP32A : TIP32B : TIP32C | $V_{CE} = - 40\text{V}, V_{EB} = 0$ | | - 200 | μA |
| | | $V_{CE} = - 60\text{V}, V_{EB} = 0$ | | - 200 | μA |
| | | $V_{CE} = - 80\text{V}, V_{EB} = 0$ | | - 200 | μA |
| | | $V_{CE} = - 100\text{V}, V_{CE} = 0$ | | - 200 | μA |
| I_{EBO} | Emitter Cut-off Current | $V_{EB} = - 5\text{V}, I_C = 0$ | | - 1 | mA |
| h_{FE} | * DC Current Gain | $V_{CE} = - 4\text{V}, I_C = - 1\text{A}$ | 25 | | |
| | | $V_{CE} = - 4\text{V}, I_C = - 3\text{A}$ | 10 | 50 | |
| $V_{CE(sat)}$ | * Collector-Emitter Saturation Voltage | $I_C = - 3\text{A}, I_B = - 375\text{mA}$ | | - 1.2 | V |
| $V_{BE(sat)}$ | * Base-Emitter Saturation Voltage | $V_{CE} = - 4\text{V}, I_C = - 3\text{A}$ | | - 1.8 | V |
| f_T | Current Gain Bandwidth Product | $V_{CE} = - 10\text{V}, I_C = - 500\text{mA}$ | 3.0 | | MHz |

* Pulse Test: $PW \leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$

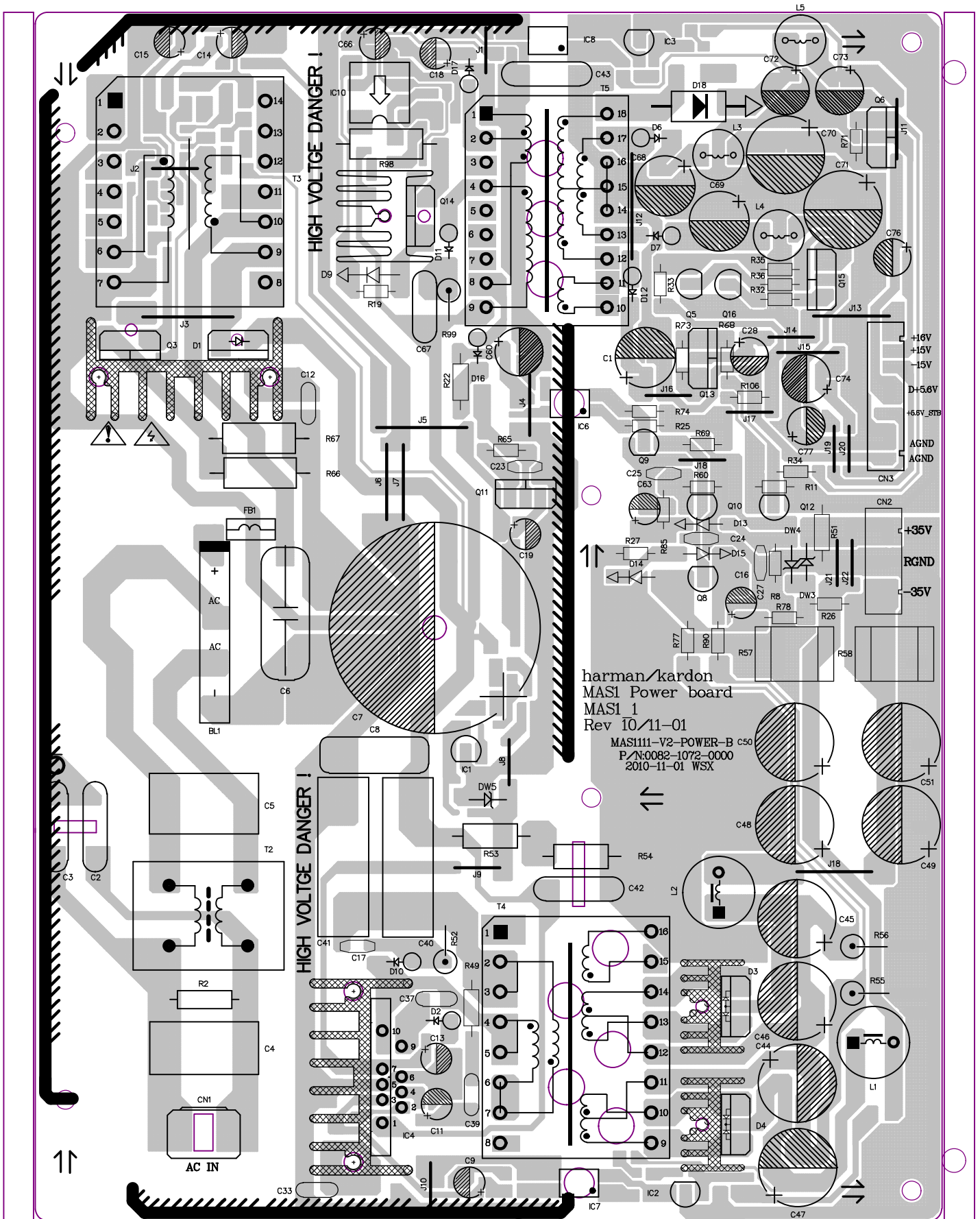
AMP PCB 1/2



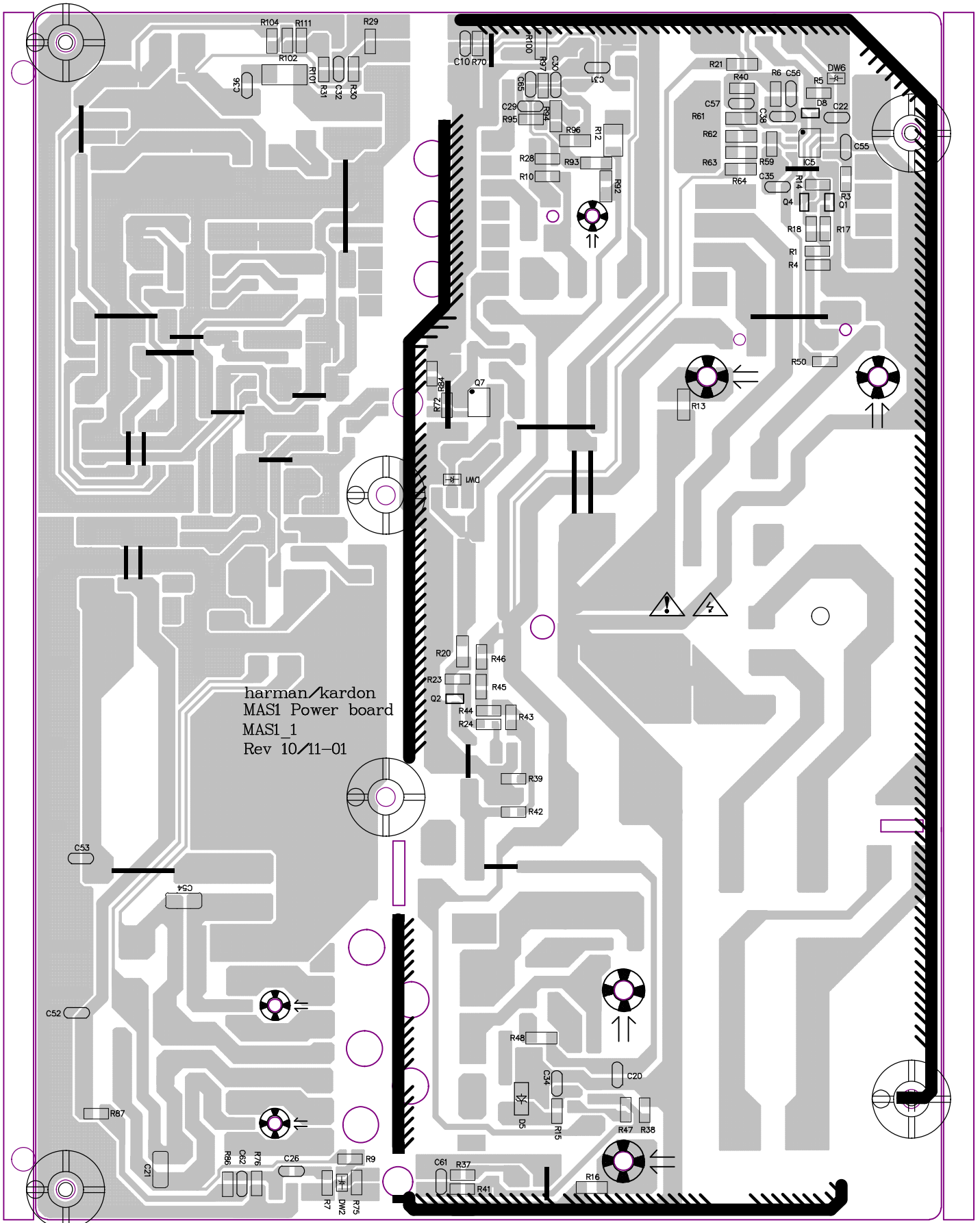
AMP PCB 2/2



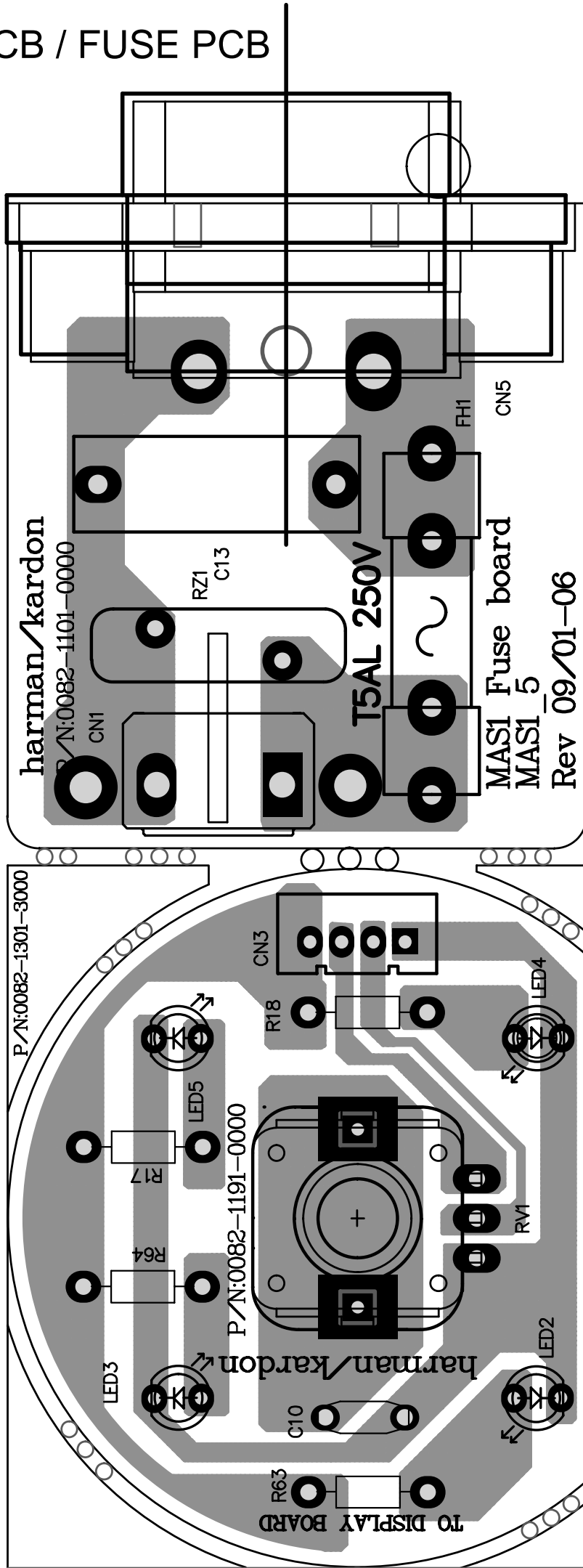
POWER PCB 1/2



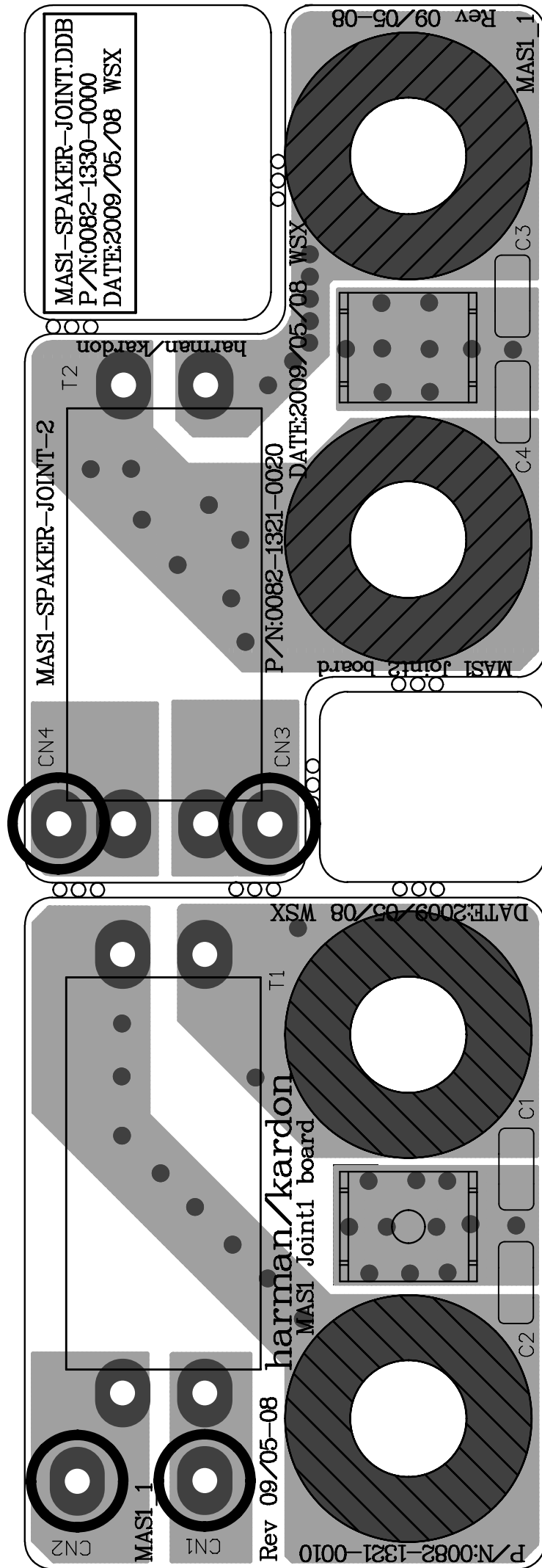
POWER PCB 2/2



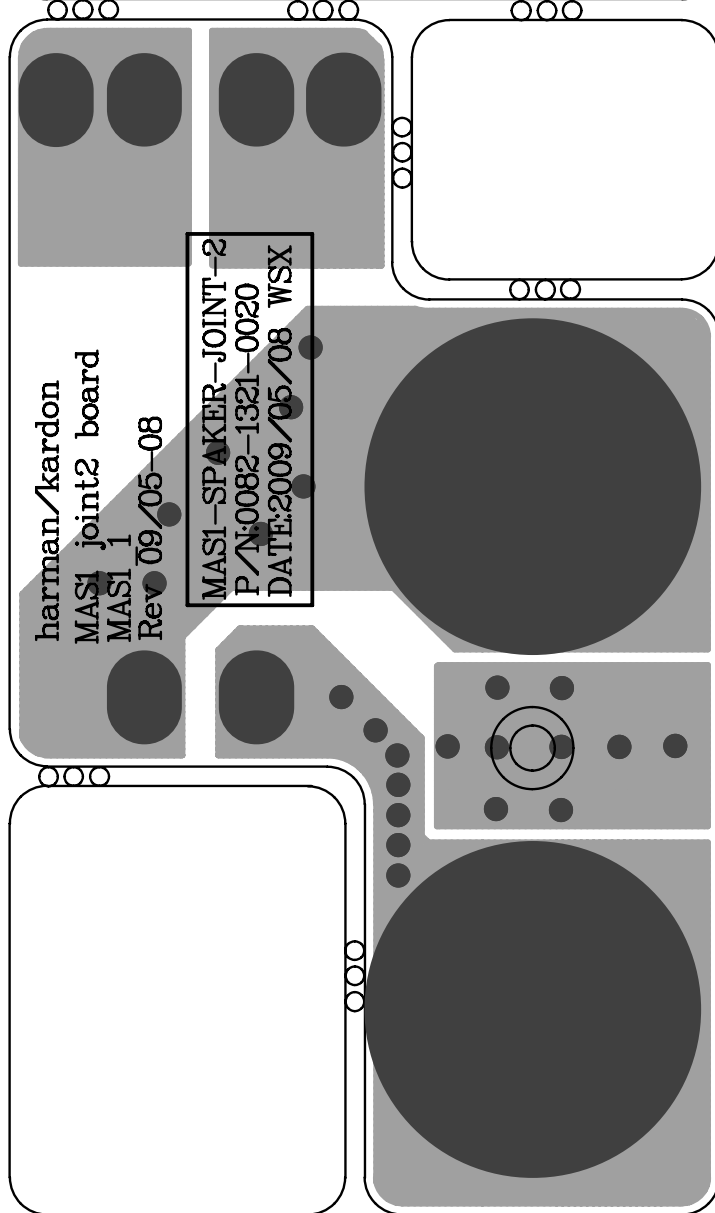
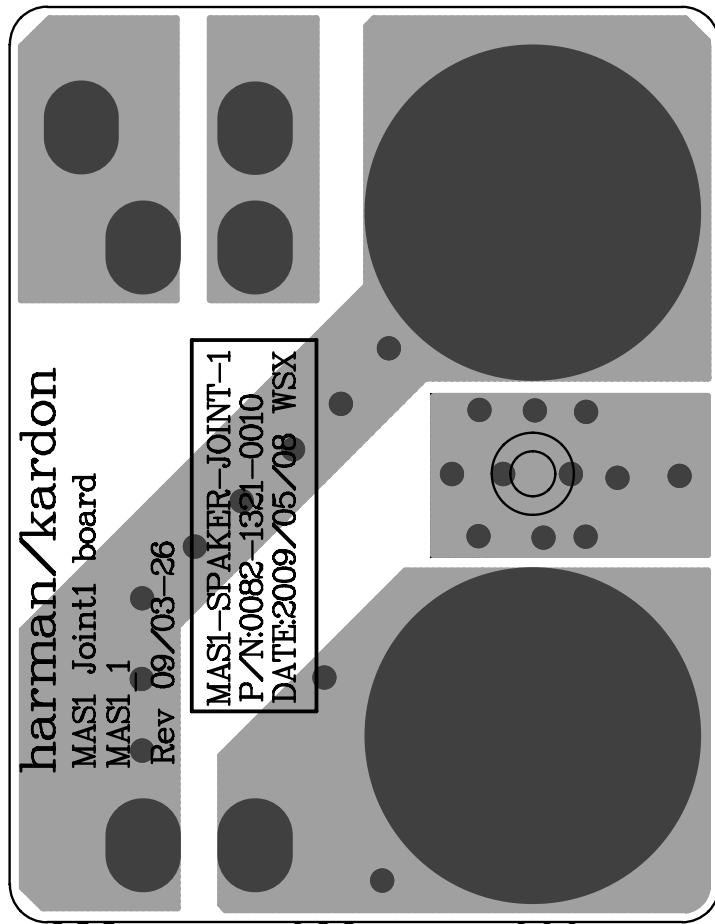
LED & VOL PCB / FUSE PCB



SPEAKER JOINT
PCB (1/2)

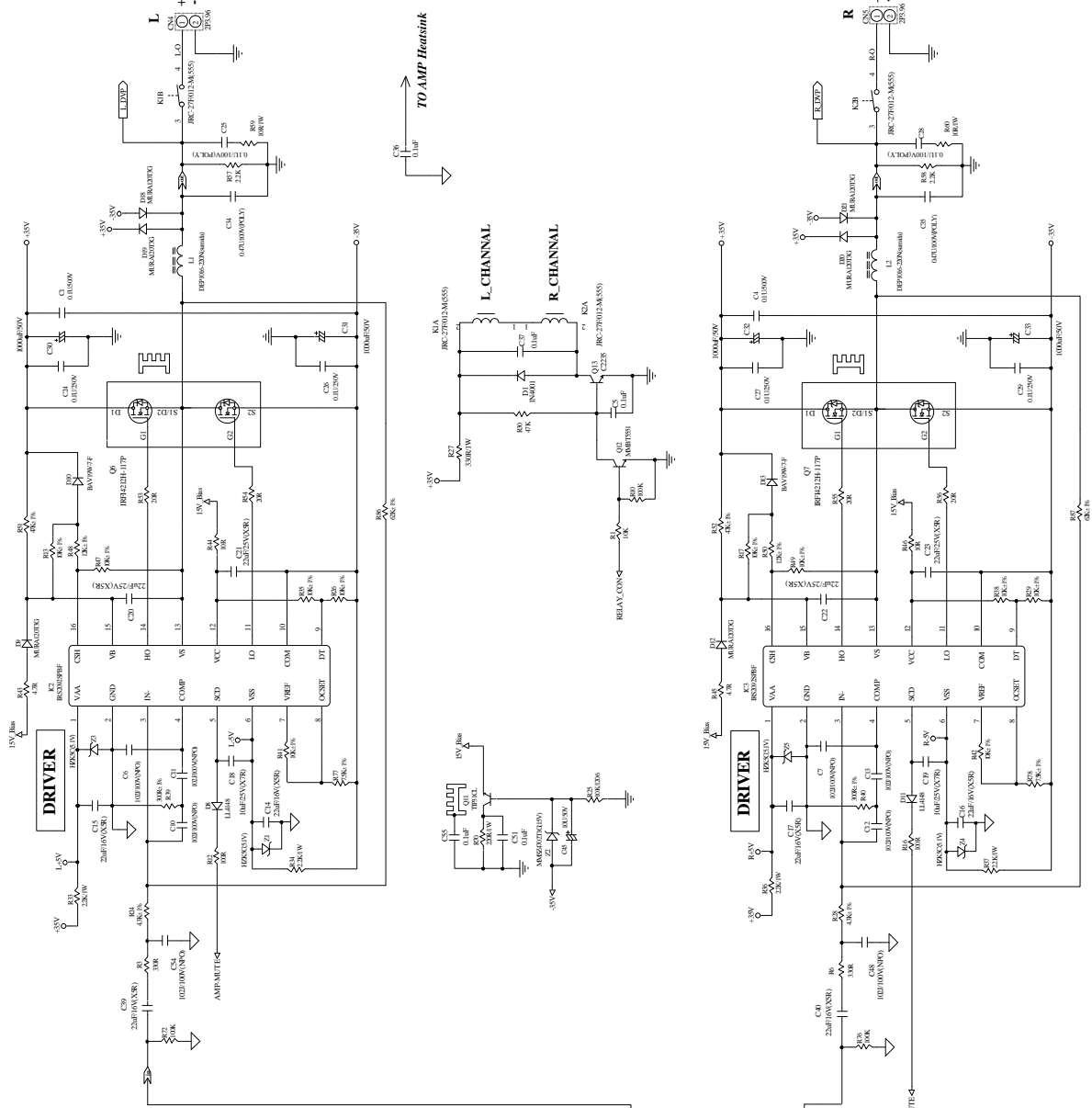


SPEAKER JOINT
PCB(2/2)

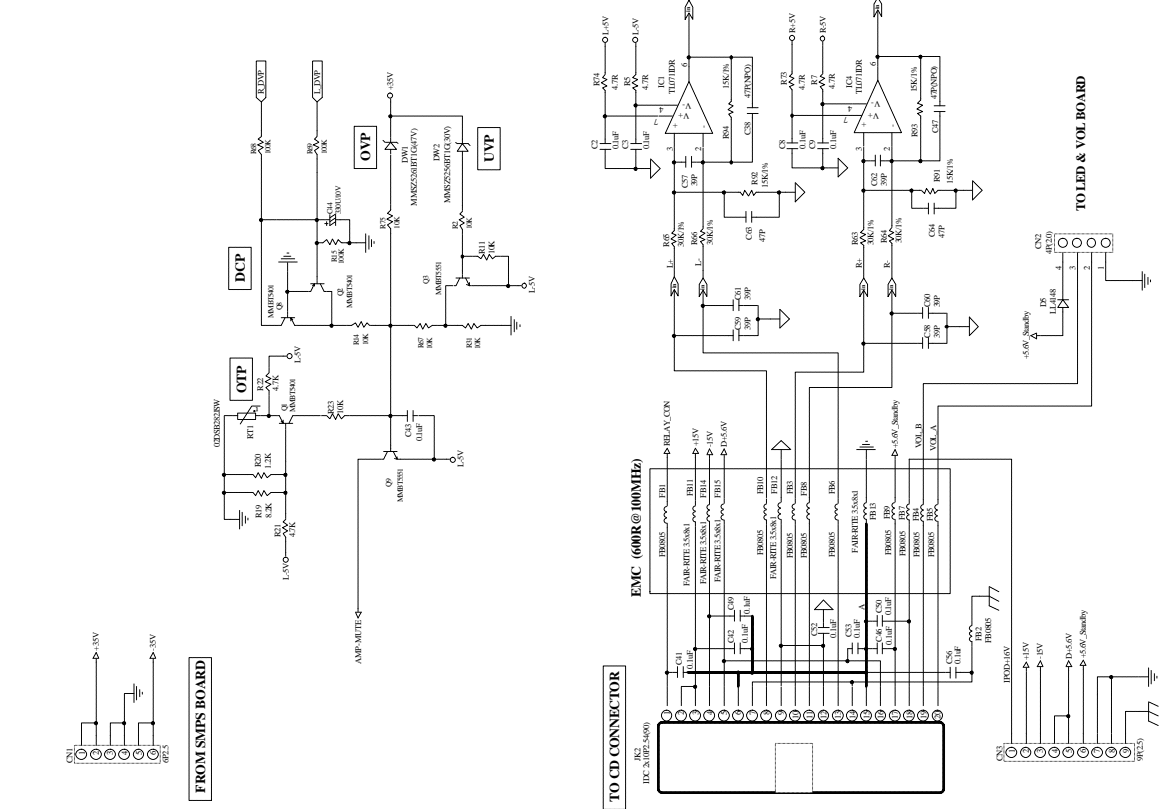
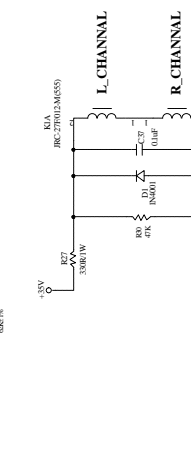


AMP SCH

KF-YL-03



TO AMP HeatSink



FROM SMPS BOARD

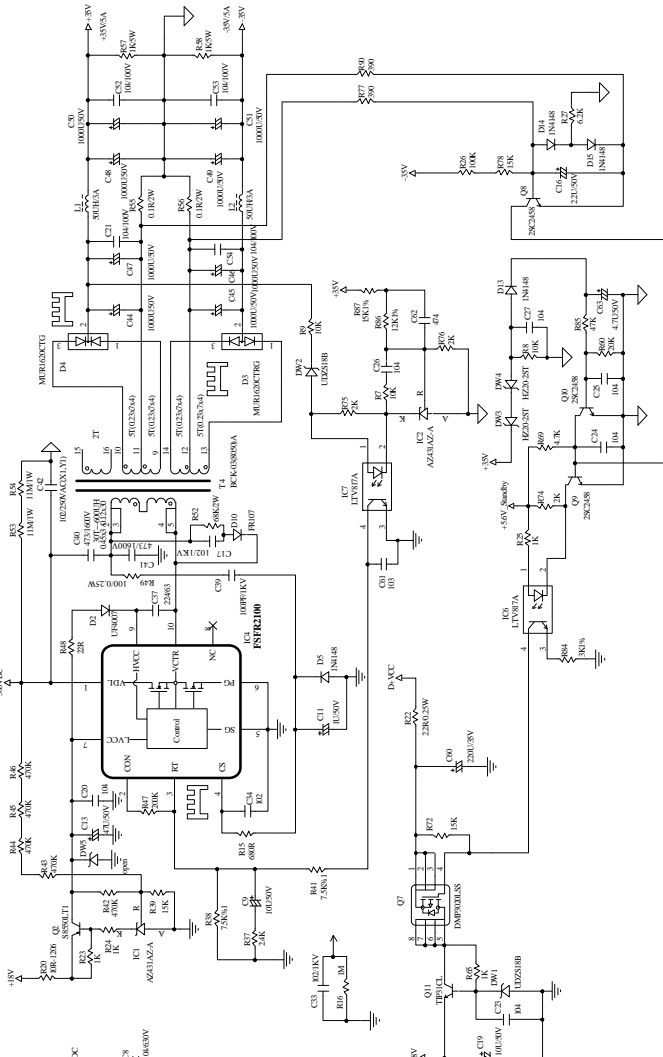
TO CD CONNECTOR

TO LED & VOL BOARD

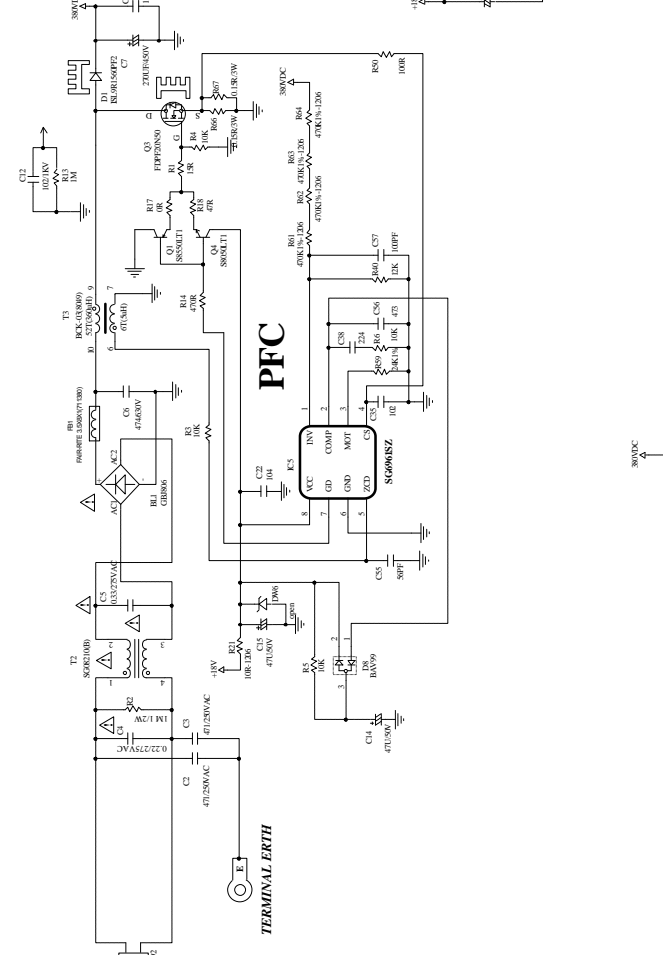
FROM SMPS BOARD

POWER SCH

AMP-SMPS



CD-SMPS

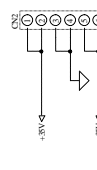


PFC

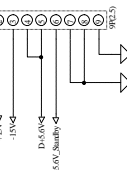
SGM6512

TERMINAL ERTH

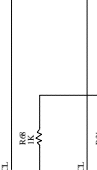
TO AMP BOARD



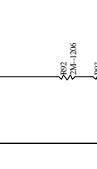
TO AMP BOARD



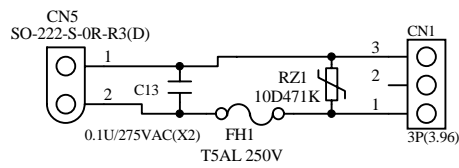
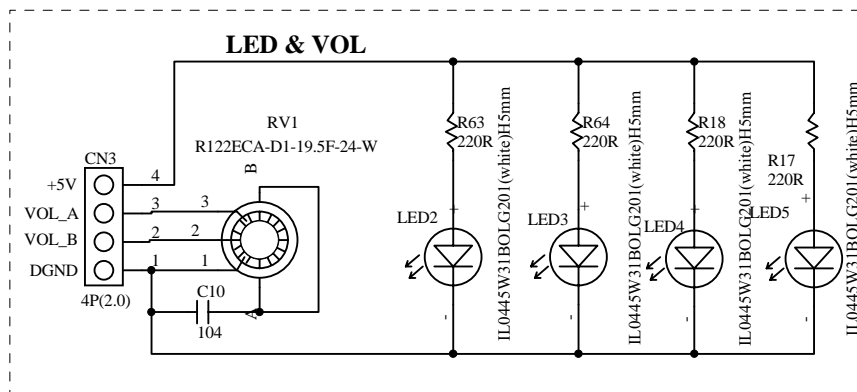
TO AMP BOARD



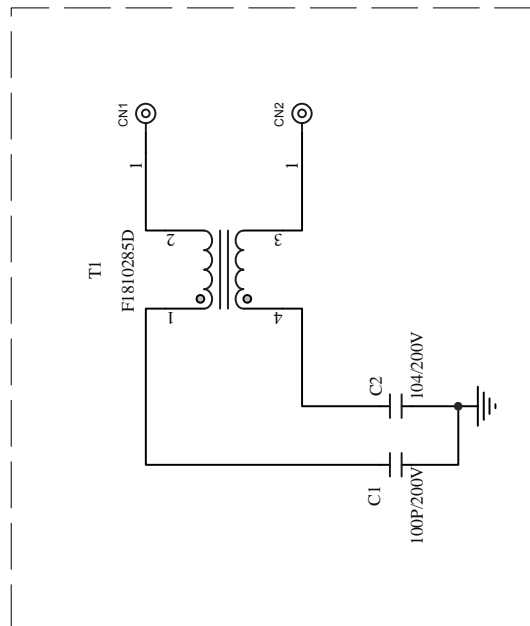
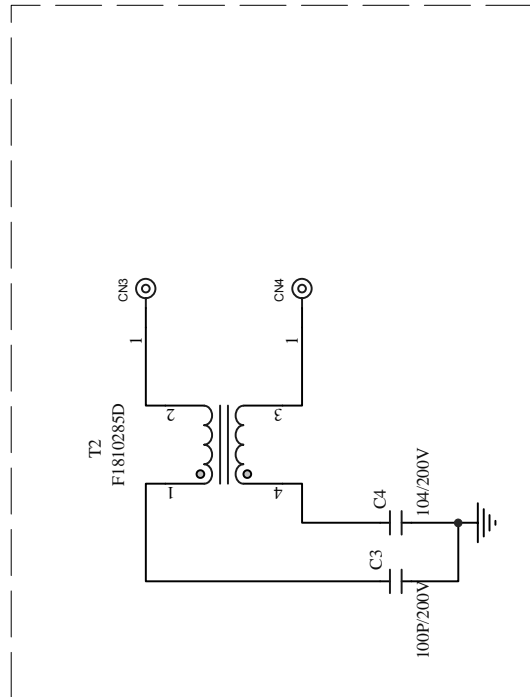
TO AMP BOARD

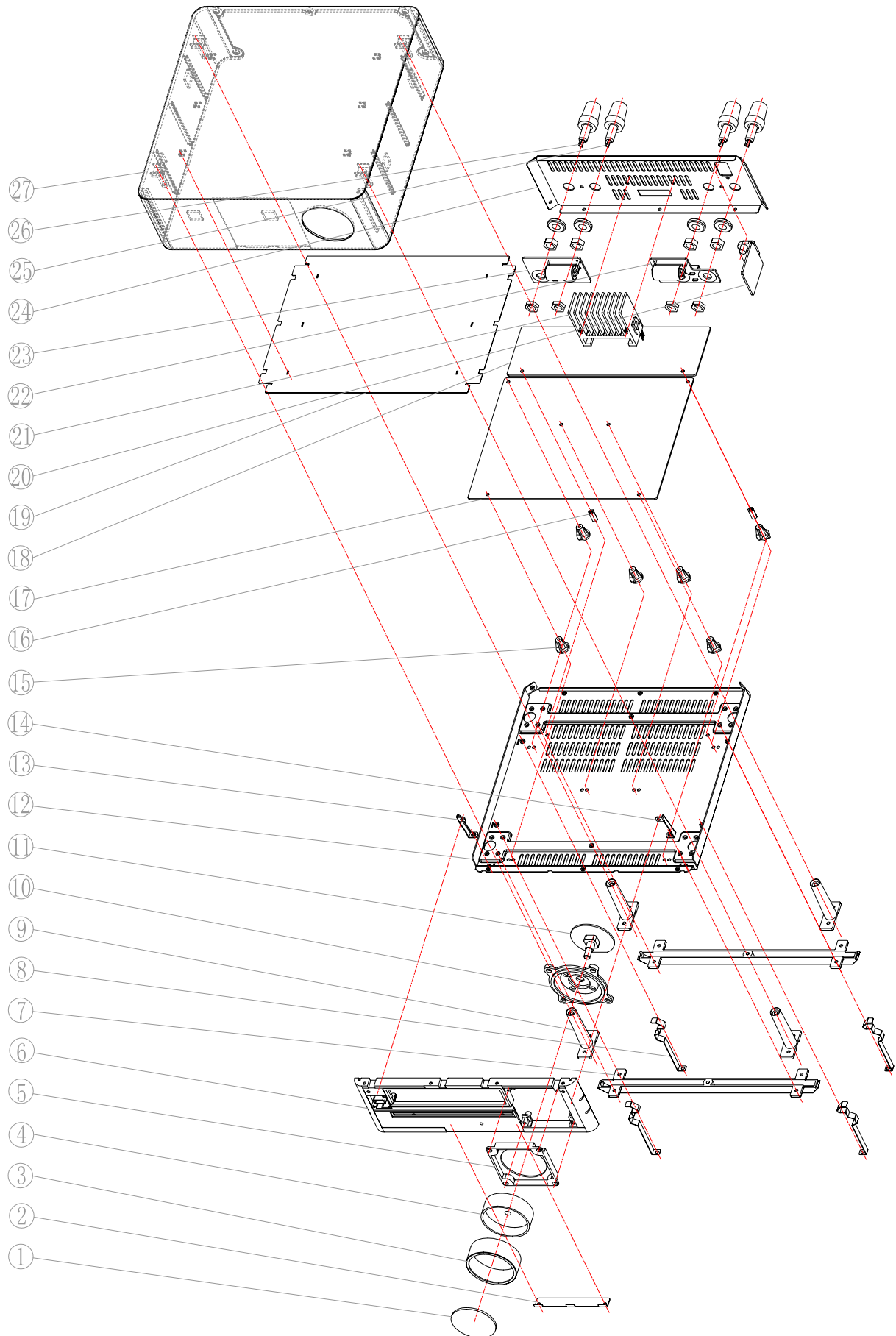


LED & VOL SCH / FUSE SCH



SPEAKER JIONT SCH





MAS AMP Explode List

| NO | PART.NO | DESCRIPTION | QTY |
|-----------|----------------|---------------------------|------------|
| 1 | 7448 1020 0000 | VOLUME KNOB LENS | 1 |
| 2 | 6950 102A 0000 | LOCK SHEET | 1 |
| 3 | 7548 101C 0000 | VOLUME PASTEM | 1 |
| 4 | 7648 1010 0000 | VOLUME KNOB COVER | 1 |
| 5 | 7550 1020 0000 | VOLUME KNOB BRACKET | 1 |
| 6 | 7550 501A 0000 | SUB PANEL | 1 |
| 7 | 7950 5020 0000 | FOOT | 2 |
| 8 | 5550 102D 0000 | GROUNDING COPPER SHEET | 4 |
| 9 | 7550 502A 0000 | PLASTIC POST | 4 |
| 10 | 7549 102B 0000 | LAMPSHADE | 1 |
| 11 | 0082 1191 0000 | LED PCB | 1 |
| 12 | 6250 1010 0011 | BUTTOM COVER | 1 |
| 13 | 5350 5020 0000 | SUB PANEL RIGHT BRACKET | 1 |
| 14 | 5350 503A 0000 | SUB PANEL LEFT BRACKET | 1 |
| 15 | 7900 0040 0000 | PCB PLASTIC POST | 6 |
| 16 | 5350 1010 0000 | M3x12 COPPER POST | 2 |
| 17 | 0082 1072 0000 | POWER PCB | 1 |
| 18 | 0082 1003 0000 | AMP PCB | 1 |
| 19 | 5650 101A 0000 | POWER PCB SHIELDING SHEET | 1 |
| 20 | 0082 1101 0000 | FUSE PCB | 1 |
| 21 | 5150 1010 0000 | HEATSINK | 1 |
| 22 | 0082 1321 0020 | SPEAKER JOINT PCB-1 | 1 |
| 23 | 0082 1321 0010 | SPEAKER JOINT PCB-1 | 1 |
| 24 | 6350 101C 0011 | BACK COVER | 1 |
| 25 | 2920 0290 6003 | SPEAKER Terminal | 2 |
| 26 | 2920 0300 6003 | SPEAKER Terminal | 2 |
| 27 | 7950 1010 0000 | TOP COVER | 1 |

| Qty | Part Type | Ref. Designator | Part Number |
|-----|---|-------------------------------------|----------------|
| | AMP.Bom P/N: 0082-1003-0000 | | |
| 2 | IRS2092SPBF (IRF) Protected Digital Audio amplifier | IC2 IC3 | 1002 0920 3038 |
| 2 | TL071IDR (TI) Low Noise OP Amp | IC1 IC4 | 1002 0920 3038 |
| 1 | 2SC2235 - TRANSISTOR | Q13 | 1132 2350 0162 |
| 2 | IRFI4212H-117P (IRF) Digital Audio Mosfet | Q6 Q7 | 1194 2120 1630 |
| 3 | MMBT5401 - TRANSISTOR | Q1 Q2 Q8 | 1185 4015 1011 |
| 3 | MMBT5551 - TRANSISTOR | Q3 Q9 Q12 | 1185 5515 1011 |
| 1 | TIP31CL - TRANSISTOR | Q11 | 1110 0310 6000 |
| 2 | BAV19W-7-F - DIODE | D10 D13 | 1321 0005 0100 |
| 3 | LL4148 - DIODE | D5 D8 D11 | 1301 4148 0100 |
| 1 | 1N4001 - DIODE , RECT | D1 | 1360 1400 1005 |
| 1 | MMSZ4702T1G(15V) - DIODE ZENER | Z2 | 1301 5002 0100 |
| 1 | MMSZ5256BT1G(30V) - DIODE ZENER | DW2 | 1303 0002 0100 |
| 1 | MMSZ5261BT1G(47V) - DIODE ZENER | DW1 | 1304 7002 0100 |
| 6 | MURA120T3G - DIODE ULTRA FAST | D9 D12 D18 D19 D20 D21 | 1301 2035 0100 |
| 4 | HZK5C(5.1V) - DIODE ZENER | Z1 Z3 Z4 Z5 | 1300 5100 0000 |
| 2 | DEP1016-220N(sumida) | L1 L2 | 1842 2010 0001 |
| 1 | 02DSB282JSW | RT1 | 1609 0002 8225 |
| 5 | FAIR-RITE 3.5x8x1 | FB11 FB12 FB13 FB14 FB15 | 1893 8780 0001 |
| 10 | FB0805 | FB1 FB2 FB3 FB4 FB5 FB6 FB7 FB8 FB9 | 1852 0120 9100 |
| | | FB10 | |
| 2 | JRC-27F/012-M(555) | K1 K2 | 4712 2027 0006 |
| 2 | 2P3.96 | CN4 CN5 | 3101 6030 0200 |
| 1 | 4P(2.0) | CN2 | 3100 4040 0200 |
| 1 | 6P2.5 | CN1 | 3100 4060 0250 |
| 1 | 9P(2.5) | CN3 | 3100 5090 0200 |
| 1 | IDC 2x10P2.54(90) | JK2 | 3109 0520 4632 |
| 2 | 300R±1% - RES, CHIP | R39 R40 | 2401 1213 0103 |
| 2 | 4.3K±1% - RES, CHIP | R24 R28 | 2401 1214 3203 |
| 2 | 7.5K±1% - RES, CHIP | R77 R78 | 2401 1217 5203 |
| 2 | 10K±1% - RES, CHIP | R41 R42 | 2401 1211 0303 |
| 4 | 15K/1% - RES, CHIP | R91 R92 R93 R94 | 2401 1211 5303 |
| 4 | 30K/1% - RES, CHIP | R63 R64 R65 R66 | 2401 1213 0303 |
| 4 | 4.7R - RES, CHIP | R5 R7 R73 R74 | 2401 1224 7003 |
| 2 | 100R - RES, CHIP | R12 R16 | 2401 1221 0103 |
| 2 | 330R - RES, CHIP | R3 R6 | 2401 1223 3103 |
| 1 | 1.2K - RES, CHIP | R20 | 2401 1221 2203 |
| 2 | 4.7K - RES, CHIP | R21 R22 | 2401 1224 7203 |
| 1 | 8.2K - RES, CHIP | R19 | 2401 1228 2203 |
| 8 | 10K - RES, CHIP | R1 R2 R11 R14 R23 R31 R67 R75 | 2401 1221 0303 |
| 1 | 47K - RES, CHIP | R30 | 2401 1224 7303 |
| 6 | 100K - RES, CHIP | R10 R15 R68 R69 R72 R76 | 2401 1221 0403 |
| 8 | 10K±1% - RES, CHIP | R13 R17 R26 R29 R35 R38 R47 R49 | 2401 0811 0304 |
| 2 | 12K±1% - RES, CHIP | R48 R50 | 2401 0811 2204 |
| 2 | 47K±1% - RES, CHIP | R51 R52 | 2401 7147 3400 |
| 2 | 62K±1% - RES, CHIP | R86 R87 | 2401 0816 2304 |
| 2 | 4.7R - RES, CHIP | R43 R45 | 2401 8247 9400 |
| 2 | 10R - RES, CHIP | R44 R46 | 2401 8210 0400 |
| 4 | 20R - RES, CHIP | R53 R54 R55 R56 | 2401 8220 0400 |
| 2 | 2.2K - RES, CHIP | R57 R58 R36 R37 | 2401 0922 2305 |
| 1 | 10K/1206 - RES, CHIP | R25 | 2401 0921 0306 |
| 2 | 10R/1W - RES, CARBON | R59 R60 | 2401 0521 0020 |

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| 1 | 220R/1W - RES, CARBON | R70 | 2413 0322 2112 |
| 1 | 330R/1W - RES, CARBON | R27 | 2413 0523 3112 |
| 4 | 2.2K/1W - RES, CARBON | R33 R34 | 2413 0522 2212 |
| 6 | 39P | C57 C58 C59 C60 C61 C62 | 2103 5390 0130 |
| 2 | 47P(NPO) | C38 C47 | 2103 5470 0130 |
| 2 | 47P | C63 C64 | 2103 5470 0130 |
| 17 | 0.1uF | C2 C3 C5 C8 C9 C36 C37 C41 C42 C43 C46 | 2115 6104 0130 |
| | | C49 C50 C52 C53 C55 C56 | |
| 8 | 102J/100V(NPO) - CAP , CHIP | C6 C7 C10 C11 C12 C13 C48 C54 | 2103 5102 0235 |
| 1 | 0.1uF - CAP , CHIP | C51 | 2115 6104 0145 |
| 4 | 0.1U/250V - CAP , | C24 C26 C27 C29 | 2103 5102 0235 |
| 2 | 10uF/25V(X7R) - CAP , CHIP | C18 C19 | 2115 6104 1755 |
| 6 | 22uF/16V(X5R) - CAP , CHIP | C14 C15 C16 C17 C39 C40 | 2103 5226 1355 |
| 4 | 22uF/25V(X5R) - CAP , CHIP | C20 C21 C22 C23 | 2103 5226 0925 |
| 2 | 0.1U/500V - CAP , CHIP | C1 C4 | 2115 6104 0395 |
| 2 | 0.1U/100V(POLY) | C25 C28 | 2207 2104 0200 |
| 2 | 0.47U/100V(POLY) | C34 C35 | 2207 2474 0200 |
| 1 | 330U/10V - CAP , ELECT | C44 | 2331 0210 1000 |
| 1 | 10U/50V - CAP , ELECT | C45 | 2310 0610 1015 |
| 4 | 1000uF/50V - CAP , ELECT | C30 C31 C32 C33 | 2312 0610 5050 |
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| | Power.Bom P/N: 0082-1072-0000 | | |
| Qty | Part Type | Ref. Designator | Part Number |
| 3 | AZ431AZ-A | IC1 IC2 IC3 | 1709 0004 3100 |
| 1 | FAN7602N (FAIRCHILD) PWM CONTROLLER | IC10 | 1007 6020 1901 |
| 1 | FSFR2100 (FAIRCHILD)HALF-BRIDGE RESONANT CONVERTERS | IC4 | 1002 1002 1006 |
| 3 | K1010 (COSMO) PHOTOCOULER | IC6 IC7 IC8 | 1000 8172 1901 |
| 1 | SG6961SZ (SYSTEM GENERAL) POWER FACTOR CONTROLLER | IC5 | 1006 9610 1913 |
| 2 | 2SA1048 - TRANSISTOR | Q5 Q16 | 1111 0480 0002 |
| 4 | 2SC2458 - TRANSISTOR | Q8 Q9 Q10 Q12 | 1132 4580 5002 |
| 1 | DMP3020LSS (DIODES) ENHANCEMENT MODE FILELD EFFECT TRANSISTOR | Q7 | 1153 0200 1900 |
| 1 | FDPF20N50 (FAIRCHILD) MOSFET | Q3 | 1172 0500 1000 |
| 1 | FQPF7N80C (FAIRCHILD) MOSFET | Q14 | 1170 7800 1030 |
| 1 | S8050LT1 - TRANSISTOR | Q4 | 1108 0502 1828 |
| 2 | S8550LT1 - TRANSISTOR | Q1 Q2 | 1108 5502 1828 |
| 2 | TIP31CL - TRANSISTOR | Q11 Q15 | 1110 0310 6000 |
| 2 | TIP32CL - TRANSISTOR | Q6 Q13 | 1110 0320 6000 |
| 3 | 1N4148 - DIODE | D13 D14 D15 | 1310 1414 8000 |
| 1 | 1N4148 - DIODE | D5 | 1310 4414 8000 |
| 1 | 1N5819 - DIODE | D9 | 1320 1005 8192 |
| 1 | BAV99 - DIODE | D8 | 1310 5009 9000 |
| 7 | FR107 - DIODE RECT | D6 D7 D10 D11 D12 D16 D17 | 1360 7000 1075 |
| 2 | HZ20-2ST - DIODE ZENER | DW3 DW4 | 1300 0205 0102 |
| 1 | ISL9R1560PF2 - DIODE | D1 | 1191 5600 1000 |
| 1 | MUR1620CTG - DIODE RECT | D4 | 1311 6200 0000 |
| 1 | MUR1620CTRG - DIODE RECT | D3 | 1311 6200 0020 |
| 1 | SR360 - DIODE RECT | D18 | 1360 7000 3602 |
| 2 | UDZS18B - DIODE ZENER | DW1 DW2 | 1300 0185 0100 |
| 1 | UF4007 - DIODE RECT | D2 | 1360 0004 0075 |
| 1 | GBJ806 - DIODE RECT | BL1 | 1360 0000 8060 |
| 1 | FAIR-RITE 3.5X8X1(711380) | FB1 | 1893 8780 0001 |

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| 3 | 15UH/2A | L3 L4 L5 | 1702 0155 0000 |
| 2 | 50UH/3A | L1 L2 | 1703 0500 0000 |
| 1 | BCK-03(8048)D | T5 | 1709 8048 0000 |
| 1 | BCK-03(8049) | T3 | 1709 8049 0000 |
| 1 | BCK-03(8050)A | T4 | 1709 8050 0000 |
| 1 | SG08210(B) | T2 | 1891 0700 0001 |
| 1 | 2P7.92 | CN1 | 3101 6030 0200 |
| 1 | 6P2.5 | CN2 | 3100 4060 0250 |
| 1 | 9P(2.5) | CN3 | 3100 5090 0200 |
| 1 | 150Ω1/8W ±5% - RES, CARBON | R19 | 2401 0221 5111 |
| 2 | 390Ω1/8W ±5% - RES, CARBON | R77 R90 | 2401 0223 9111 |
| 4 | 1KΩ1/8W ±5% - RES, CARBON | R25 R34 | 2401 0221 0211 |
| 1 | 2KΩ1/8W ±5% - RES, CARBON | R74 | 2401 0222 0211 |
| 2 | 2.2KΩ1/8W ±5% - RES, CARBON | R32 R36 | 2401 0222 2211 |
| 4 | 4.7KΩ1/8W ±5% - RES, CARBON | R69 R71 R73 R106 | 2401 0224 7211 |
| 1 | 6.2KΩ1/8W ±5% - RES, CARBON | R27 | 2401 0226 2211 |
| 3 | 10KΩ1/8W ±5% - RES, CARBON | R8 R11 R33 | 2401 0221 0311 |
| 1 | 15KΩ1/8W ±5% - RES, CARBON | R78 | 2401 0221 5311 |
| 1 | 20KΩ1/8W ±5% - RES, CARBON | R60 | 2401 0222 0311 |
| 1 | 47KΩ1/8W ±5% - RES, CARBON | R85 | 2401 0224 7311 |
| 1 | 100KΩ1/8W ±5% - RES, CARBON | R26 | 2401 0221 0411 |
| 1 | 120KΩ1/8W ±5% - RES, CARBON | R35 | 2401 0221 2411 |
| 1 | 2.2R/0.25W - RES, CARBON | R22 | 2401 0322 2911 |
| 1 | 100/0.25W - RES, CARBON | R49 | 2413 0321 0111 |
| 1 | 120(0.25W) - RES, CARBON | R51 | 2401 0321 2111 |
| 1 | 10R/0.5W - RES, CARBON | R101 | 2401 0421 0011 |
| 1 | 1M 1/2W - RES, CARBON | R2 | 2413 0421 0511 |
| 1 | 0.5R/1W - RES, CARBON | R98 | 2413 0525 0911 |
| 1 | 68K/1W - RES, CARBON | R99 | 2413 0526 8312 |
| 2 | 11M/1W - RES, CARBON | R53 R54 | 2413 0521 1611 |
| 2 | 0.1R/2W - RES, CARBON | R55 R56 | 2413 0621 0812 |
| 1 | 68K/2W - RES, CARBON | R52 | 2413 0626 8312 |
| 2 | 0.15R/3W - RES, CARBON | R66 R67 | 2413 0721 5823 |
| 2 | 1K/5W - RES, CARBON | R57 R58 | 2413 1021 0210 |
| 2 | 3K1% - RES, CHIP | R84 R111 | 2401 0813 0204 |
| 1 | 3.6K1% - RES, CHIP | R104 | 2401 0813 6204 |
| 2 | 7.5K%1 - RES, CHIP | R38 R41 | 2401 0817 5204 |
| 1 | 12K1% - RES, CHIP | R86 | 2401 0811 2204 |
| 1 | 15K1% - RES, CHIP | R87 | 2401 0811 5304 |
| 1 | 24K1% - RES, CHIP | R59 | 2402 0812 4304 |
| 1 | 0R - RES, CHIP | R17 | 2401 0820 0004 |
| 1 | 15R - RES, CHIP | R1 | 2401 0821 5004 |
| 1 | 47R - RES, CHIP | R18 | 2401 0824 7004 |
| 1 | 100R - RES, CHIP | R50 | 2401 0821 0104 |
| 1 | 270R - RES, CHIP | R102 | 2401 0822 7104 |
| 1 | 470R - RES, CHIP | R14 | 2401 0824 7104 |
| 1 | 680R - RES, CHIP | R15 | 2401 0826 8104 |
| 6 | 1K - RES, CHIP | R23 R24 R28 R29 R65 R68 | 2401 0821 0204 |
| 2 | 2K - RES, CHIP | R75 R76 | 2401 0822 0204 |
| 1 | 2.4K - RES, CHIP | R37 | 2401 0822 4204 |
| 1 | 5.6K - RES, CHIP | R70 | 2401 0825 6204 |
| 6 | 10K - RES, CHIP | R3 R4 R5 R6 R7 R9 | 2401 0821 0304 |
| 1 | 12K - RES, CHIP | R40 | 2401 0821 2304 |

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| 2 | 15K - RES, CHIP | R39 R72 | 2401 0821 5304 |
| 1 | 27K - RES, CHIP | R97 | 2401 0822 7304 |
| 1 | 180K - RES, CHIP | R95 | 2401 0821 8404 |
| 1 | 200K - RES, CHIP | R47 | 2401 0822 0404 |
| 5 | 470K - RES, CHIP | R42 R43 R44 R45 R46 | 2401 0824 7404 |
| 4 | 470K1%-1206 - RES, CHIP | R61 R62 R63 R64 | 2401 0914 7405 |
| 2 | 10R-1206 - RES, CHIP | R20 R21 | 2401 0921 0005 |
| 1 | 15R--1206 - RES, CHIP | R100 | 2401 0921 5905 |
| 1 | 22R - RES, CHIP | R48 | 2401 0922 2005 |
| 1 | 1M--1206 - RES, CHIP | R94 | 2401 0921 0505 |
| 2 | 1M - RES, CHIP | R13 R16 | 2401 0921 0505 |
| 2 | 2M--1206 - RES, CHIP | R92 R93 | 2401 0922 0505 |
| 1 | 3M--1206 - RES, CHIP | R96 | 2401 0923 0505 |
| 1 | 51K---1210 - RES, CHIP | R12 | 2401 1725 1318 |
| 1 | 56PF - CAP , CHIP | C55 | 2115 6560 0145 |
| 1 | 100PF - CAP , CHIP | C57 | 2115 6101 0145 |
| 4 | 102(1000PF) - CAP , CHIP | C34 C35 C36 C65 | 2115 6102 0145 |
| 1 | 103(0.01UF) - CAP , CHIP | C61 | 2115 6103 0145 |
| 1 | 473(0.047UF) - CAP , CHIP | C56 | 2115 6473 0145 |
| 8 | 104(0.1UF) - CAP , CHIP | C10 C20 C22 C26 C29 C30 C31 C32 | 2115 6104 0145 |
| 1 | 224(0.22UF) - CAP , CHIP | C38 | 2115 6224 0145 |
| 1 | 474(0.47UF) - CAP , CHIP | C62 | 2115 6474 0145 |
| 2 | 104/100V(0.1UF/100V) - CAP , CHIP | C52 C53 | 2115 6104 0245 |
| 2 | 104/100V(0.1UF/100V) - CAP , CHIP | C21 C54 | 2115 6104 0255 |
| 1 | 0.22/275VAC | C4 | 2210 3224 0604 |
| 1 | 0.33/275VAC | C5 | 2210 3334 0604 |
| 1 | 100PF/1KV | C39 | 2115 6101 0413 |
| 2 | 102/1KV(1000PF/1KV) | C12 C33 | 2118 6102 0413 |
| 1 | 102/1KV(1000PF/1KV) | C17 | 2118 6102 0413 |
| 4 | 104(0.1UF/50V) | C23 C24 C25 C27 | 2115 6104 0113 |
| 2 | 471/250VAC(470PF/250VAC) | C2 C3 | 2115 7471 1015 |
| 1 | 102/250VAC(1000PF/25VAC) | C43 | 2115 7102 1015 |
| 1 | 102/250VAC(X1, Y1) | C42 | 2115 7102 1015 |
| 1 | 472/630V(4700PF/630V) | C67 | 2207 2472 0700 |
| 1 | 104/630V(0.1UF/630V) | C8 | 2207 2106 0700 |
| 1 | 474/630V(0.47UF/630V) | C6 | 2207 2474 0700 |
| 2 | 473/1600V(0.047UF/1600V) | C40 C41 | 2207 2473 1500 |
| 1 | 1U/50V - CAP , ELECT | C11 | 2319 0610 1015 |
| 1 | 2.2U/50V - CAP , ELECT | C16 | 2329 0610 1015 |
| 1 | 4.7U/50V - CAP , ELECT | C63 | 2349 0610 1015 |
| 3 | 10U/50V - CAP , ELECT | C9 C18 C19 | 2310 0610 1015 |
| 3 | 47U/50V - CAP , ELECT | C13 C14 C15 | 2340 0610 2015 |
| 1 | 224/63(0.22UF/63V) - CAP , ELECT | C37 | 2207 2223 0843 |
| 1 | 470U/10V - CAP , ELECT | C74 | 2341 0210 3025 |
| 2 | 1000U/10V - CAP , ELECT | C72 C73 | 2312 2101 4000 |
| 1 | 47U/25V - CAP , ELECT | C66 | 2340 0410 1015 |
| 3 | 100U/25V - CAP , ELECT | C28 C76 C77 | 2311 0410 2015 |
| 3 | 1000U/25V - CAP , ELECT | C1 C68 C69 | 2312 4105 4000 |
| 2 | 1000U/25V - CAP , ELECT | C70 C71 | 2312 4105 4000 |
| 1 | 220U/35V - CAP , ELECT | C60 | 2321 0510 3025 |
| 8 | 1000U/50V - CAP , ELECT | C44 C45 C46 C47 C48 C49 C50 C51 | 2312 0610 5050 |
| 1 | 270UF/450V - CAP , ELECT | C7 | 2371 1711 0075 |
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| LED.Bom P/N: 0082-1191-0000 | | | |
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| Qty | Part Type | Ref. Designator | Part Number |
| 4 | IL0445W31BOLG201(white)H5mm | LED2 LED3 LED4 LED5 | 1402 0705 0006 |
| 1 | R122ECA-D1-19.5F-24-W | RV1 | 4401 2211 9524 |
| 1 | 4P(2.0) JEDEC | CN3 | 3100 4040 0200 |
| 4 | 220R±5% | R17 R18 R63 R64 | 2401 0222 2111 |
| 1 | 0.1uF/50V±5% | C10 | 2115 6104 0113 |
| FUSE.Bom P/N: 0082-1101-0000 | | | |
| Qty | Part Type | Ref. Designator | Part Number |
| 1 | T5AL 250V | FH1 | 1601 0515 0120 |
| 1 | SO-222-S-0R-R3(D) | CN5 | 2810 0302 2203 |
| 1 | 3P(3.96) JEDEC | CN1 | 3100 0702 0050 |
| 1 | 0.1U/275VAC(X2) | C13 | 2210 3104 0604 |
| 1 | 10D471K | RZ1 | 2416 2000 0008 |
| SPEAKER JOINT-LEFT PCB P/N: 0082-1321-0010 | | | |
| Qty | Part Type | Ref. Designator | Part Number |
| 1 | F1810285 | T1 | 1875 1802 8500 |
| 1 | 1000PF/200V±10% 1206 | C2 | 2103 5102 0150 |
| 1 | 0.1UF/200V±10% 1206 | C1 | 2103 5104 0150 |
| SPEAKER JOINT-RIGHT PCB P/N: 0082-1321-0020 | | | |
| Qty | Part Type | Ref. Designator | Part Number |
| 1 | F1810285 | T2 | 1875 1802 8500 |
| 1 | 1000PF/200V±10% 1206 | C3 | 2103 5102 0150 |
| 1 | 0.1UF/200V±10% 1206 | C4 | 2103 5104 0150 |