# SGM8910
# 4Vrms High Performance Audio Line and Headphone Driver with Click-Pop Noise Cancellation

## GENERAL DESCRIPTION

The SGM8910 is a high performance 4Vrms stereo audio line driver with click-pop noise cancellation. The device is ideal for single supply applications. The SGM8910 can drive 32Ω impedance headphone directly, so it can be used as the high performance driver of line out and headphone in different applications. Capless design can eliminate output DC-blocking capacitors for less-component count and low-cost.

The SGM8910 is capable of driving 4Vrms into a 600Ω load when $V_{DD}$ is 10V or 20mW into a 32Ω headphone when $V_{DD}$ is 3.3V. An integrated charge pump generates a negative power rail that provides a clean, pop-free ground offset.

For some special applications where AC coupling output is necessary, the SGM8910 provides MUTEOUT driver to drive external click-pop noise cancellation circuit during power-on and power-off.

The SGM8910 will be in mute status during power-on blanking time. External mute control signal can take over the mute status before power-on blanking time is over. The SGM8910 can eliminate power-up click-pop noise perfectly. Using under-voltage protection (UVP), the SGM8910 will suppress the turn-off click-pop noise.

The SGM8910 is available in Green TSSOP-20 and TQFN-4×4-20L packages. It operates over an ambient temperature range of -40℃ to +85℃.

## FEATURES

- **Supply Voltage: 2.8V to 12V**
- **Capless Structure to Eliminate Pop-Clicks and Output DC-Blocking Capacitors**
- **Low Noise, Low THD and Low Crosstalk:**
  - **Typical $V_N$ = 6μ$V_{RMS}$ from 22Hz to 22kHz at Gain = -1**
  - **THD+N = 0.0008% for 10kΩ Load and Gain = -1 at 1kHz**
  - **Crosstalk = -89dB at 1kHz**
- **4Vrms Output Voltage into 600Ω Load for 10V $V_{DD}$**
- **1Vrms Output Voltage into 600Ω Load for 3.3V $V_{DD}$**
- **Supports to Drive 32Ω to 600Ω Headphone: THD+N = 0.006% for 32Ω Headphone and $P_O$ = 20mW at $V_{DD}$ = 3.3V**
- **Single-Ended Output**
- **Differential or Single-Ended Input**
- **UVP Function to Cancel Turn-Off Click-Pop Noise**
- **Adjustable Power-On Blanking Time to Eliminate Turn-On Click-Pop Noise**
- **Short-Circuit and Thermal Protection for Audio Driver**
- **Negative LDO with Output Auto-Discharge Function in Disable Status**
- **1.8V Logical Control for EN and $\overline{\text{MUTE}}$**
- **-40℃ to +85℃ Operating Temperature Range**
- **Available in Green TSSOP-20 and TQFN-4×4-20L Packages**

## APPLICATIONS

LCD TVs

Mini/Micro Combo Systems

Soundcards

DVD Players

# PACKAGE/ORDERING INFORMATION

| MODEL | PACKAGE DESCRIPTION | SPECIFIED TEMPERATURE RANGE | ORDERING NUMBER | PACKAGE MARKING | PACKING OPTION |
|---|---|---|---|---|---|
| SGM8910 | TSSOP-20 | -40℃ to +85℃ | SGM8910YTS20G/TR | SGM8910YTS20<br>XXXXX | Tape and Reel, 4000 |
| | TQFN-4×4-20L | -40℃ to +85℃ | SGM8910YTQI20G/TR | SGM8910<br>YTQI20<br>XXXXX | Tape and Reel, 3000 |

NOTE: XXXXX = Date Code and Vendor Code.

Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

## ABSOLUTE MAXIMUM RATINGS

Supply Voltage Range ..... -0.3V to 13.2V
Input Voltage Range ..... $V_{SS}$ - 0.3V to $V_{DD}$ + 0.3V
$\overline{MUTE}$, EN and UVP to GND ..... -0.3V to 6V
Junction Temperature .....+150℃
Storage Temperature Range.....-65℃ to +150℃
Lead Temperature (Soldering, 10s) .....+260℃
ESD Susceptibility
HBM.....4000V
MM.....250V
CDM .....1000V

## RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range .....2.8V to 12V
Operating Temperature Range .....-40℃ to +85℃

## OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

## ESD SENSITIVITY CAUTION

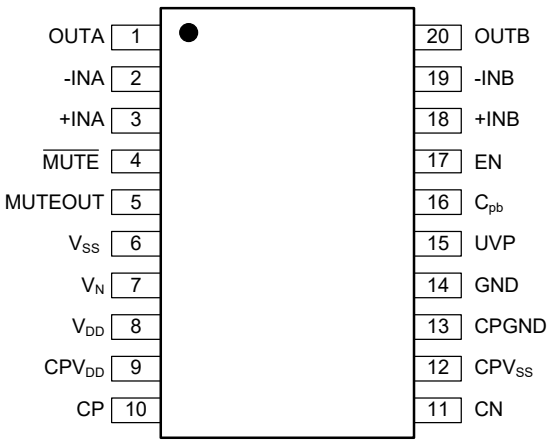
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

## DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

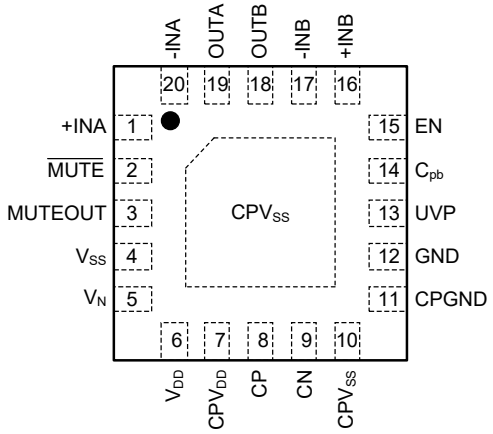
## PIN CONFIGURATIONS

(TOP VIEW)




TSSOP-20

(TOP VIEW)




TQFN-4×4-20L

## PIN DESCRIPTION

| PIN | | NAME | FUNCTION |
|---|---|---|---|
| TSSOP-20 | TQFN-4×4-20L | | |
| 1 | 19 | OUTA | Output of driver A. |
| 2 | 20 | -INA | Negative input of driver A. |
| 3 | 1 | +INA | Positive input of driver A. |
| 4 | 2 | $\overline{MUTE}$ | Mute control input, active low. When $\overline{MUTE}$ = "Low", chip enters into mute status; when $\overline{MUTE}$ = "High", chip works normally. There is a 5MΩ pull-low resistor at $\overline{MUTE}$ pin. |
| 5 | 3 | MUTEOUT | Open drain output of mute. When the SGM8910 is in mute status, MUTEOUT will be in high-impedance state; when the SGM8910 is not in mute status, MUTEOUT will be in low logical output to drive external mute circuit. |
| 6 | 4 | $V_{SS}$ | Negative power supply of drivers. |
| 7 | 5 | $V_N$ | Output of negative low dropout regulator. |
| 8 | 6 | $V_{DD}$ | Positive supply voltage of drivers. When $V_{DD}$ under-voltage event happens, chip will enter into mute status. |
| 9 | 7 | $CPV_{DD}$ | Power supply of negative charge pump. |
| 10 | 8 | CP | Positive terminal for charge pump flying capacitor. |
| 11 | 9 | CN | Negative terminal for charge pump flying capacitor. |
| 12 | 10 | $CPV_{SS}$ | Output of negative charge pump. |
| 13 | 11 | CPGND | Ground of charge pump. |
| 14 | 12 | GND | Ground. |
| 15 | 13 | UVP | Under-voltage protection input. When UVP event happens, chip will be in mute status. |
| 16 | 14 | $C_{pb}$ | Power-on blanking time adjusting. Connect a capacitor from $C_{pb}$ pin to GND to program the power-on blanking time. Chip is in mute status during power-on blanking time. |
| 17 | 15 | EN | Enable control input of chip. EN = "High" to enable chip, the SGM8910 is in active status; EN = "Low" to disable chip, the SGM8910 is in shutdown status. |
| 18 | 16 | +INB | Positive input of driver B. |
| 19 | 17 | -INB | Negative input of driver B. |
| 20 | 18 | OUTB | Output of driver B. |
| – | Thermal Pad | $CPV_{SS}$ | Output of negative charge pump. |

# ELECTRICAL CHARACTERISTICS

(At $T_A$ = +25℃ and $V_{DD}$ = 2.8V to 12V, unless otherwise noted.)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| **Recommended Operating Conditions** | | | | | |
| Supply Voltage ($V_{DD}$) | | 2.8 | | 12 | V |
| $R_{LOAD}$ | | 32 | | | Ω |
| $\overline{MUTE}$, EN Low-Level Input Voltage ($V_{IL}$) | | | | 0.6 | V |
| $\overline{MUTE}$, EN High-Level Input Voltage ($V_{IH}$) | | 1.4 | | | V |
| **Electrical Characteristics ($V_{DD}$ = 2.8V to 12V, $R_{LOAD}$ = 10kΩ, $C_{FLY}$ = 1μF)** | | | | | |
| Output Offset Voltage ($\lvert V_{OS} \rvert$) | Input AC-coupled | | 100 | 550 | μV |
| Power Supply Rejection Ratio (PSRR) | | | 1 | 5 | μV/V |
| High-Level Output Voltage ($V_{OH}$) | $V_{DD}$ = 3.3V | 3.27 | 3.29 | | V |
| | $V_{DD}$ = 12V | 11.9 | 11.95 | | V |
| Low-Level Output Voltage ($V_{OL}$) | $V_{DD}$ = 3.3V | | -1.75 | -1.6 | V |
| | $V_{DD}$ = 12V | | -10.65 | -10.3 | V |
| External Under-Voltage Detection ($V_{UVP}$) | | 1.12 | 1.21 | 1.29 | V |
| Charge Pump Switching Frequency ($f_{CP}$) | | 315 | 495 | 700 | kHz |
| High-Level Input Current, $\overline{MUTE}$ ($\lvert I_{IH} \rvert$) | $V_{DD}$ = 3.3V, $V_{IH}$ = $V_{DD}$ | | | 1 | μA |
| Low-Level Input Current, $\overline{MUTE}$ ($\lvert I_{IL} \rvert$) | $V_{DD}$ = 3.3V, $V_{IL}$ = 0V | | | 1 | μA |
| High-Level Input Current, EN ($\lvert I_{IH} \rvert$) | $V_{DD}$ = 3.3V, $V_{IH}$ = $V_{DD}$ | | | 1 | μA |
| Low-Level Input Current, EN ($\lvert I_{IL} \rvert$) | $V_{DD}$ = 3.3V, $V_{IL}$ = 0V | | | 1 | μA |
| Supply Current ($I_{VDD}$) | $\overline{MUTE}$ = 3.3V, EN = 3.3V, no load | | 17 | 21 | mA |
| | $\overline{MUTE}$ = 0V, EN = 3.3V, no load | | 5.2 | 6.5 | mA |
| | $\overline{MUTE}$ = 3.3V, EN = 0V, no load | | 470 | | μA |
| Thermal Shutdown ($T_{TSD}$) | | | 155 | | ℃ |
| Thermal Shutdown Hysteresis ($T_{HYS}$) | | | 25 | | ℃ |
| **Operating Characteristics (Gain = -1, $R_{IN}$ = 10kΩ, $R_F$ = 10kΩ, $C_{FLY}$ = 1μF)** | | | | | |
| Output Voltage, Outputs in Phase ($V_O$) | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 10kΩ, THD+N = 1% | | 1.2 | | Vrms |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 10kΩ, THD+N = 1% | | 7.2 | | Vrms |
| Total Harmonic Distortion Plus Noise (THD+N) | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 1Vrms, BW = 22Hz to 22kHz | | 0.0008 | | % |
| | | | -102 | | dB |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 2Vrms, BW = 22Hz to 22kHz | | 0.0005 | | % |
| | | | -106 | | dB |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 4Vrms, BW = 22Hz to 22kHz | | 0.0003 | | % |
| | | | -110 | | dB |
| Output Power ($P_O$) | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 32Ω, THD+N < 0.01%, BW = 22Hz to 22kHz | | 20 | | mW |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 32Ω, THD+N < 0.01%, BW = 22Hz to 22kHz | | 50 | | mW |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 32Ω, THD+N < 0.01%, BW = 22Hz to 22kHz | | 80 | | mW |
| Dynamic Range (DNR) | $V_{DD}$ = 3.3V, $R_{LOAD}$ = 10kΩ, $V_O$ = 1Vrms, A-weighted, AES17 filter | | 104 | | dB |
| | $V_{DD}$ = 5V, $R_{LOAD}$ = 10kΩ, $V_O$ = 2Vrms, A-weighted, AES17 filter | | 110 | | dB |
| | $V_{DD}$ = 12V, $R_{LOAD}$ = 10kΩ, $V_O$ = 4Vrms, A-weighted, AES17 filter | | 116 | | dB |

## ELECTRICAL CHARACTERISTICS (continued)

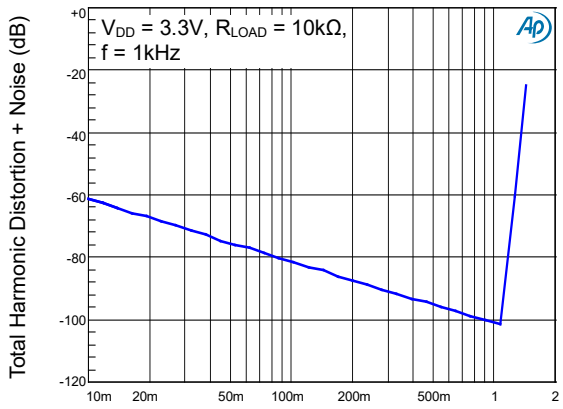
(At $T_A$ = +25℃ and $V_{DD}$ = 2.8V to 12V, unless otherwise noted.)

| PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Signal-to-Noise Ratio (SNR) | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 1Vrms, BW = 22Hz to 22kHz, A-weighted, AES17 filter | | 104 | | dB |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 2Vrms, BW = 22Hz to 22kHz, A-weighted, AES17 filter | | 110 | | dB |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 4Vrms, BW = 22Hz to 22kHz, A-weighted, AES17 filter | | 116 | | dB |
| Noise Voltage ($V_N$) | $V_{DD}$ = 3.3V to 12V, A-weighted, AES17 filter | | 6 | | $\mu V_{RMS}$ |
| Output Impedance when Muted ($Z_O$) | $V_{DD}$ = 3.3V to 12V | | 150 | | Ω |
| Input-to-Output Attenuation when Muted | $\overline{MUTE}$ = GND | | 45 | | dB |
| Slew Rate | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = $2V_{PP}$ | | 15 | | V/μs |
| | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 32Ω, $V_O$ = $1V_{PP}$ | | 5 | | V/μs |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = $4V_{PP}$ | | 18 | | V/μs |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 32Ω, $V_O$ = $2V_{PP}$ | | 9 | | V/μs |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = $4V_{PP}$ | | 20 | | V/μs |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 32Ω, $V_O$ = $2V_{PP}$ | | 9 | | V/μs |
| Unity-Gain Bandwidth (GBP) | $V_{DD}$ = 3.3V to 12V | | 60 | | MHz |
| Crosstalk-Line L-R and R-L | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 1Vrms, BW = 22Hz to 22kHz | | -120 | | dB |
| | $V_{DD}$ = 3.3V, f = 1kHz, $R_{LOAD}$ = 32Ω, $P_O$ = 10mW, BW = 22Hz to 22kHz | | -89 | | dB |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 2Vrms, BW = 22Hz to 22kHz | | -126 | | dB |
| | $V_{DD}$ = 5V, f = 1kHz, $R_{LOAD}$ = 32Ω, $P_O$ = 20mW, BW = 22Hz to 22kHz | | -89 | | dB |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 10kΩ, $V_O$ = 4Vrms, BW = 22Hz to 22kHz | | -132 | | dB |
| | $V_{DD}$ = 12V, f = 1kHz, $R_{LOAD}$ = 32Ω, $P_O$ = 20mW, BW = 22Hz to 22kHz | | -89 | | dB |
| Current Limit ($I_{LIM}$) | $V_{DD}$ = 3.3V to 12V | | 65 | | mA |

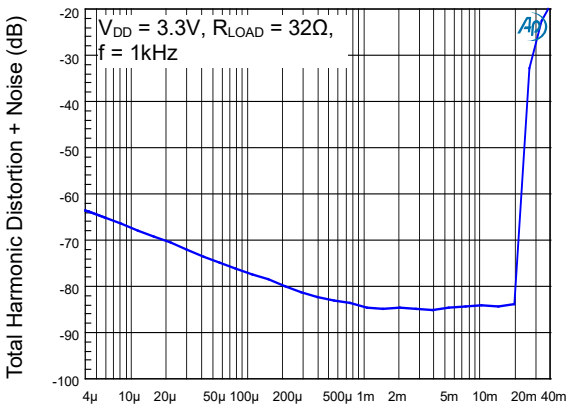
## TYPICAL PERFORMANCE CHARACTERISTICS

At $T_A$ = +25℃, Gain = -1, $R_{IN}$ = 10kΩ, $R_F$ = 10kΩ, $C_{FLY}$ = 1μF and BW = 22Hz to 22kHz, unless otherwise noted.

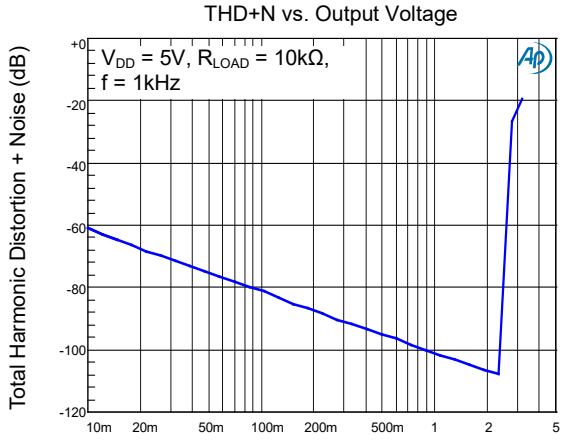
THD+N vs. Output Voltage



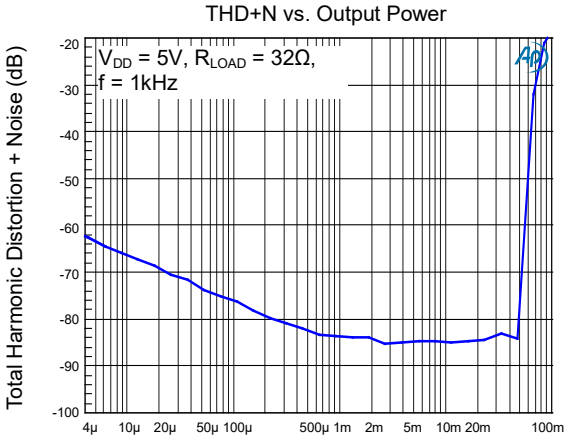

THD+N vs. Output Power



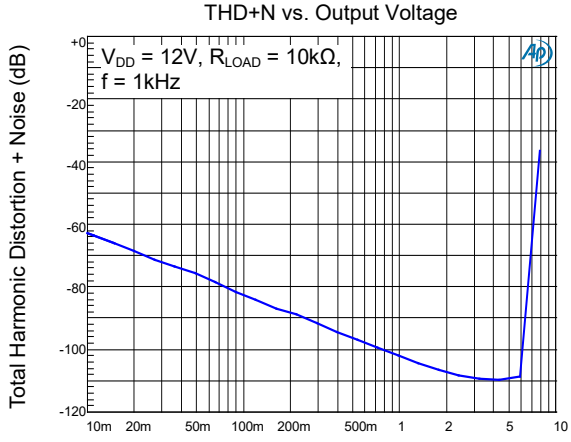

THD+N vs. Output Voltage



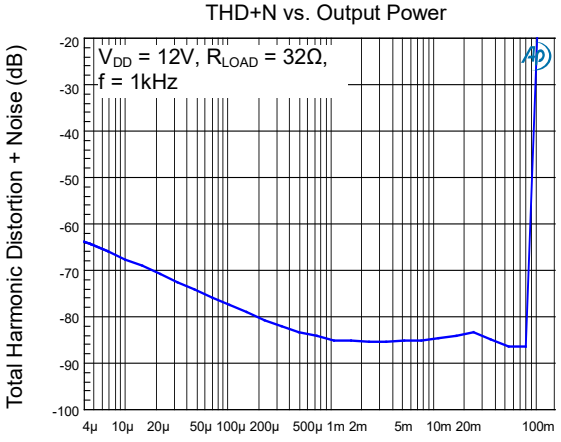

THD+N vs. Output Power




THD+N vs. Output Voltage



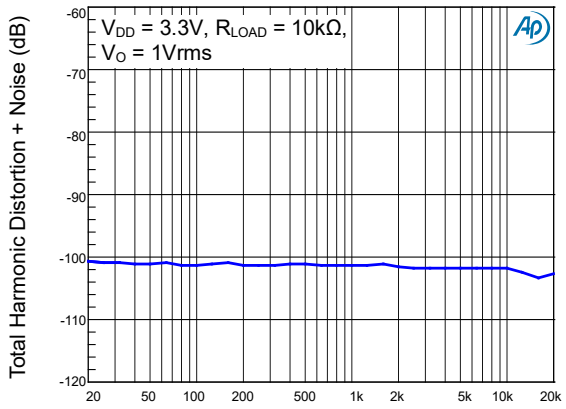

THD+N vs. Output Power



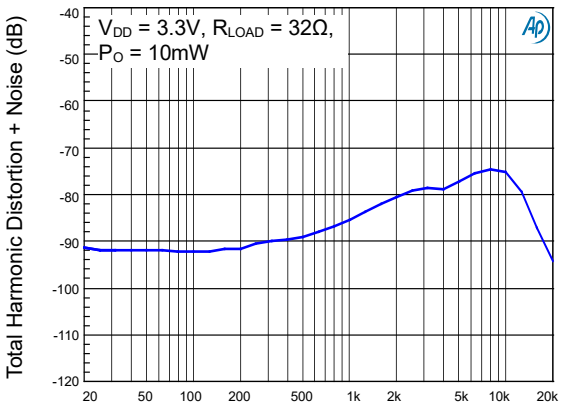
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A$ = +25℃, Gain = -1, $R_{IN}$ = 10kΩ, $R_F$ = 10kΩ, $C_{FLY}$ = 1μF and BW = 22Hz to 22kHz, unless otherwise noted.

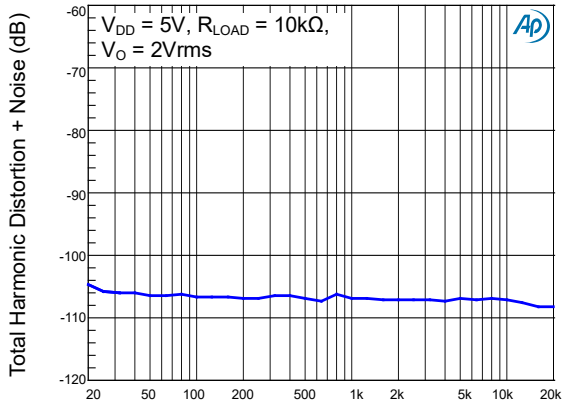
THD+N vs. Frequency



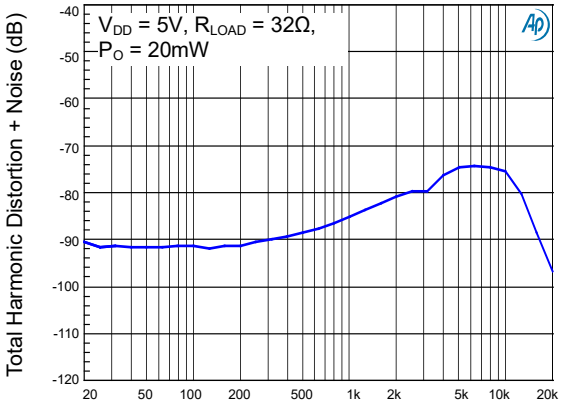

THD+N vs. Frequency



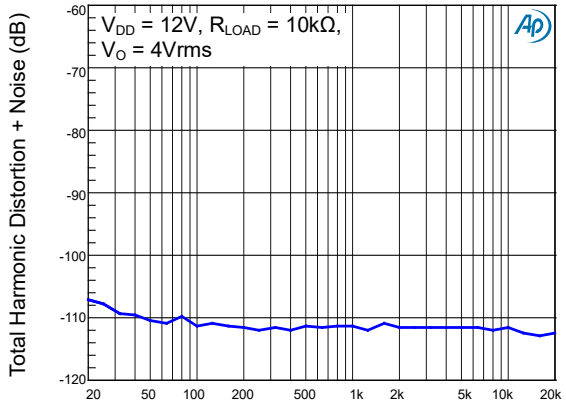

THD+N vs. Frequency



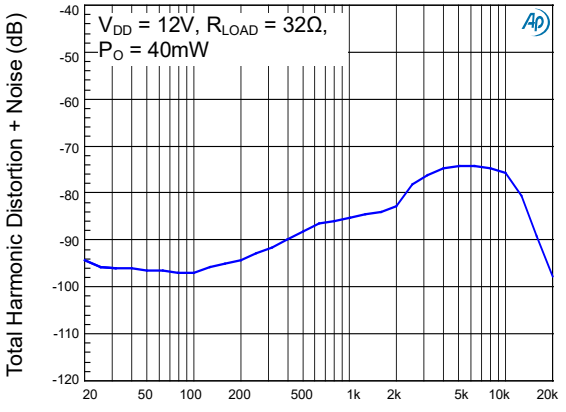

THD+N vs. Frequency




THD+N vs. Frequency



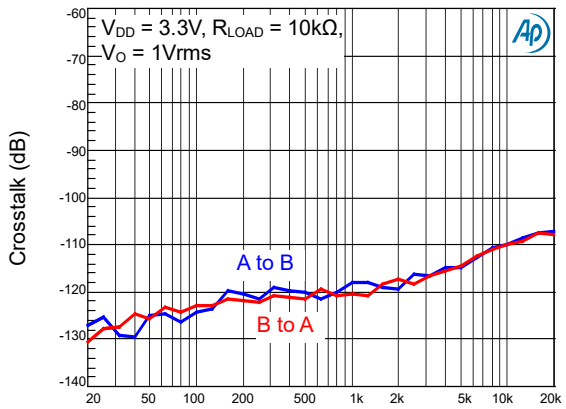

THD+N vs. Frequency



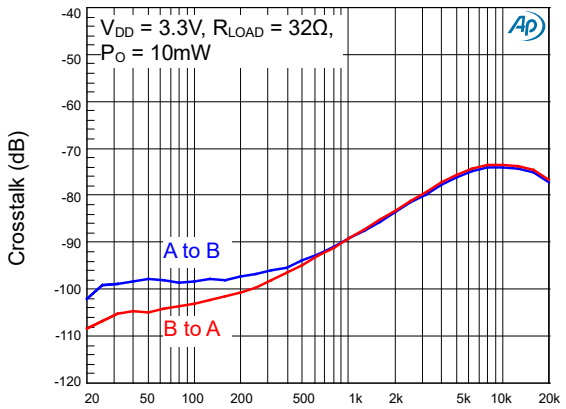
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At $T_A$ = +25℃, Gain = -1, $R_{IN}$ = 10kΩ, $R_F$ = 10kΩ, $C_{FLY}$ = 1μF and BW = 22Hz to 22kHz, unless otherwise noted.

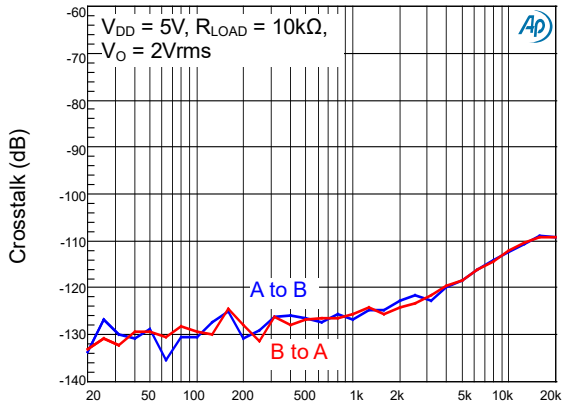
Crosstalk vs. Frequency



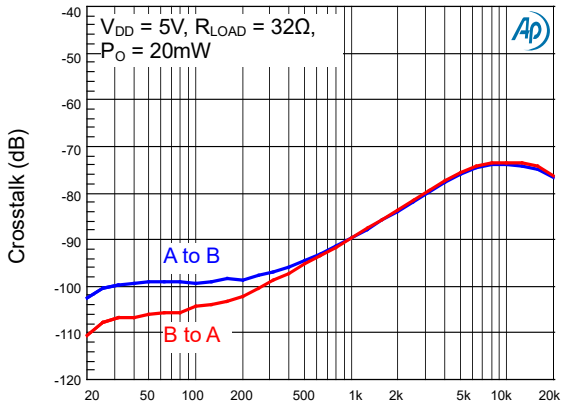

Crosstalk vs. Frequency



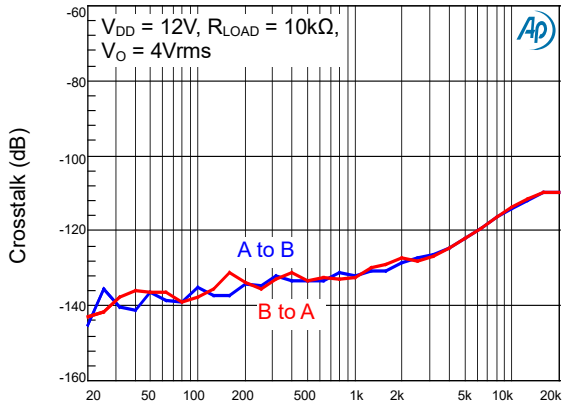

Crosstalk vs. Frequency



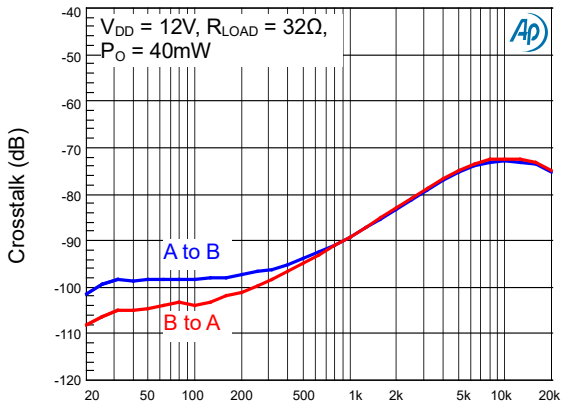

Crosstalk vs. Frequency




Crosstalk vs. Frequency




Crosstalk vs. Frequency



## TYPICAL APPLICATION

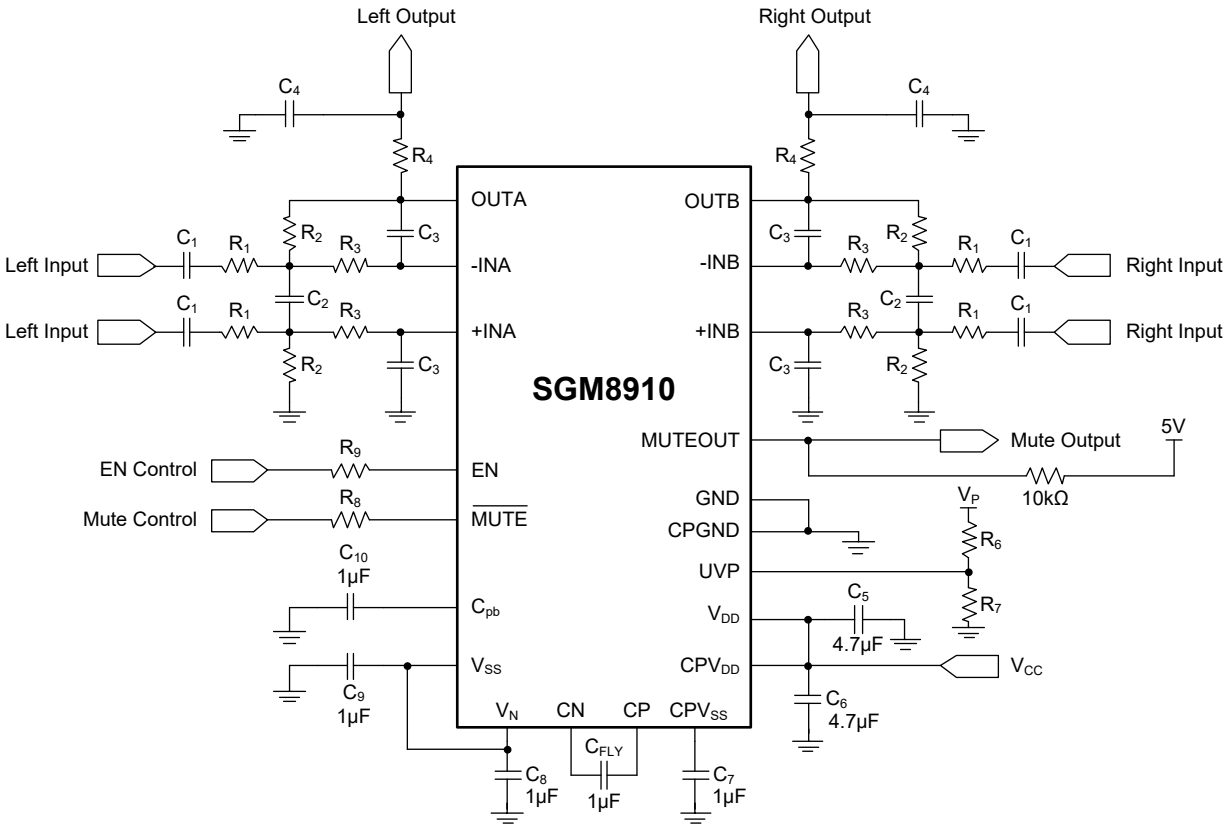



**Figure 1. Typical Application Circuit**

## FUNCTIONAL BLOCK DIAGRAM

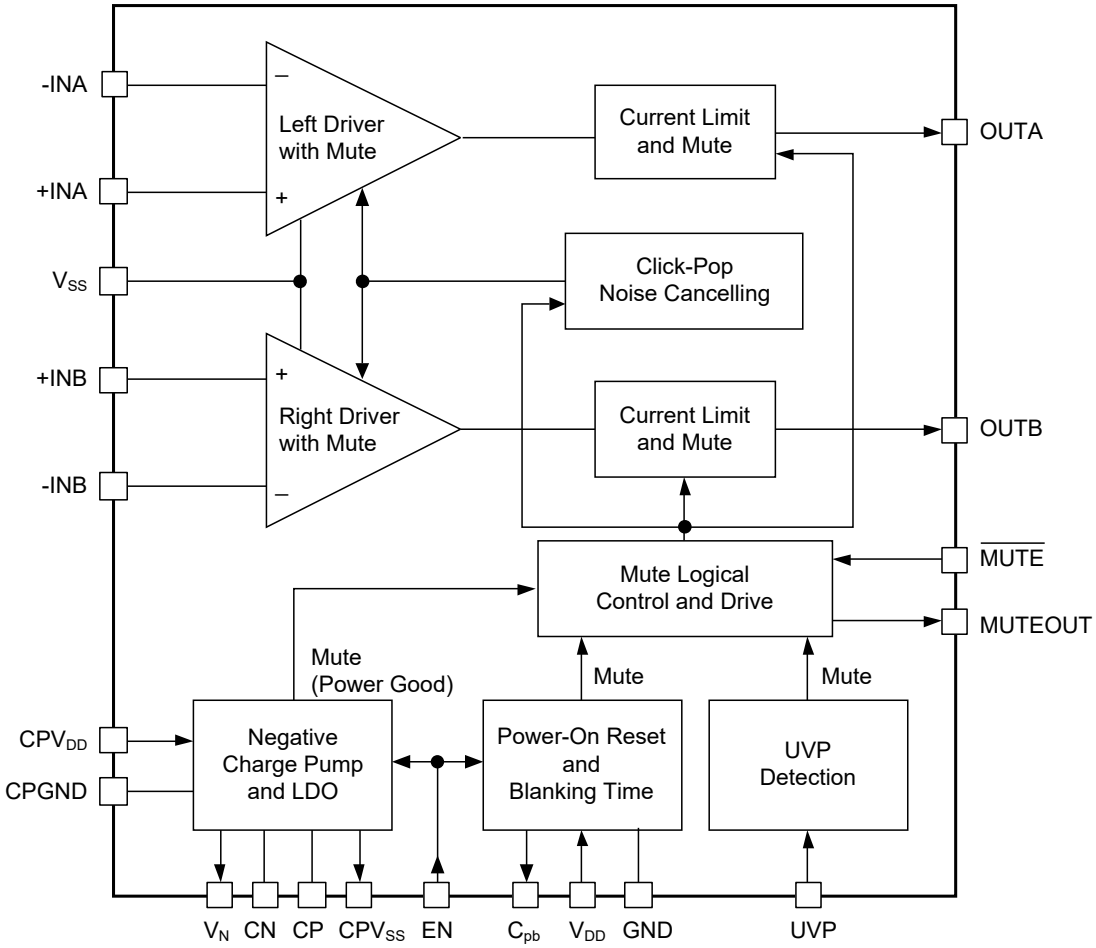



**Figure 2. Block Diagram**

# REVISION HISTORY

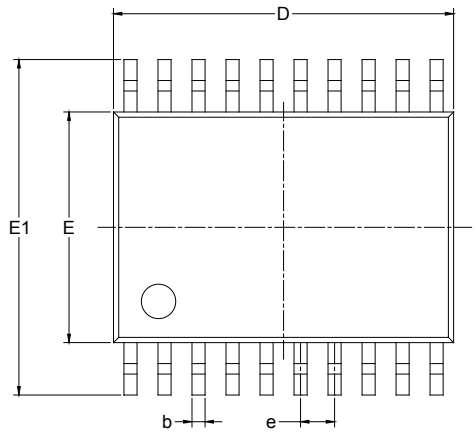
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

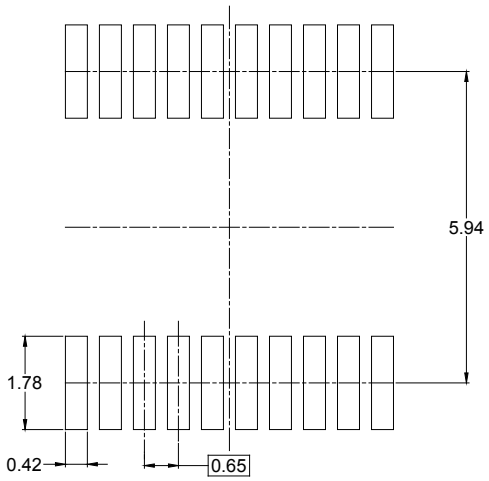
**Changes from Original (FEBRUARY 2018) to REV.A**

| | |
|---|---|
| Changed from product preview to production data | All |

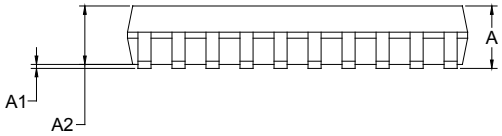
# PACKAGE OUTLINE DIMENSIONS

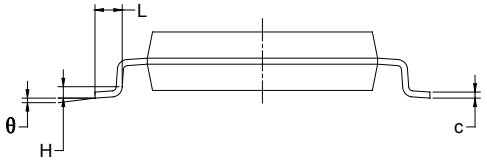
## TSSOP-20




**RECOMMENDED LAND PATTERN** (Unit: mm)

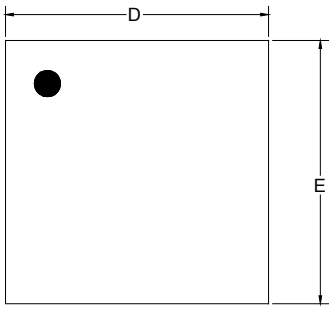


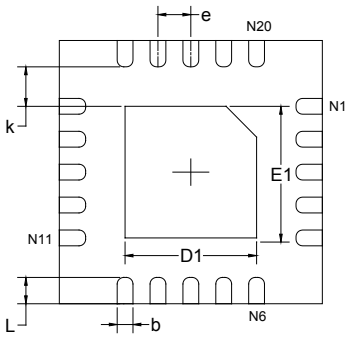

| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | | 1.100 | | 0.043 |
| A1 | 0.050 | 0.150 | 0.002 | 0.006 |
| A2 | 0.800 | 1.000 | 0.031 | 0.039 |
| b | 0.190 | 0.300 | 0.007 | 0.012 |
| c | 0.090 | 0.200 | 0.004 | 0.008 |
| D | 6.400 | 6.600 | 0.252 | 0.259 |
| E | 4.300 | 4.500 | 0.169 | 0.177 |
| E1 | 6.250 | 6.550 | 0.246 | 0.258 |
| e | 0.650 BSC | | 0.026 BSC | |
| L | 0.500 | 0.700 | 0.02 | 0.028 |
| H | 0.25 TYP | | 0.01 TYP | |
| θ | 1° | 7° | 1° | 7° |

# PACKAGE OUTLINE DIMENSIONS

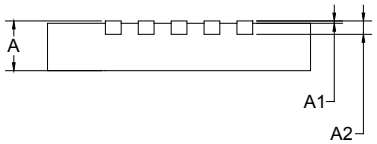
## TQFN-4×4-20L



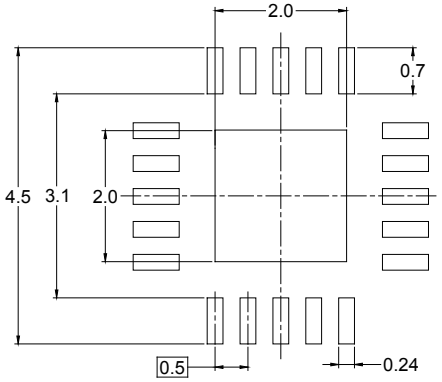

TOP VIEW




BOTTOM VIEW




SIDE VIEW

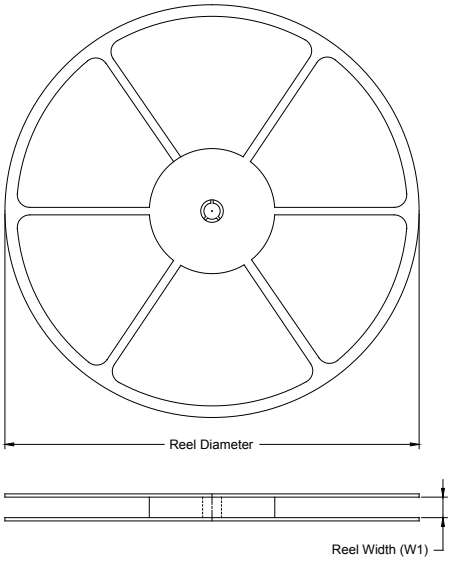



**RECOMMENDED LAND PATTERN** (Unit: mm)

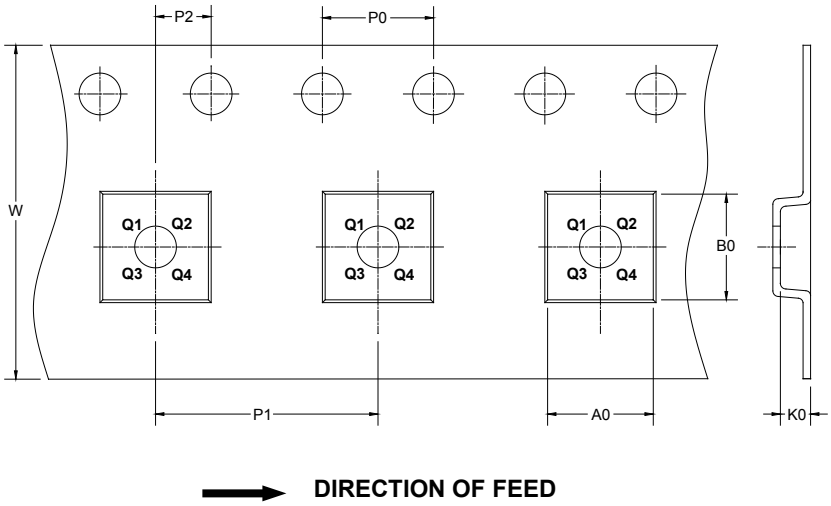
| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.700 | 0.800 | 0.028 | 0.031 |
| A1 | 0.000 | 0.050 | 0.000 | 0.002 |
| A2 | 0.203 REF | | 0.008 REF | |
| D | 3.900 | 4.100 | 0.154 | 0.161 |
| D1 | 1.900 | 2.100 | 0.075 | 0.083 |
| E | 3.900 | 4.100 | 0.154 | 0.161 |
| E1 | 1.900 | 2.100 | 0.075 | 0.083 |
| k | 0.200 MIN | | 0.008 MIN | |
| b | 0.180 | 0.300 | 0.007 | 0.012 |
| e | 0.500 TYP | | 0.020 TYP | |
| L | 0.300 | 0.500 | 0.012 | 0.020 |

# TAPE AND REEL INFORMATION

### REEL DIMENSIONS




### TAPE DIMENSIONS




DIRECTION OF FEED

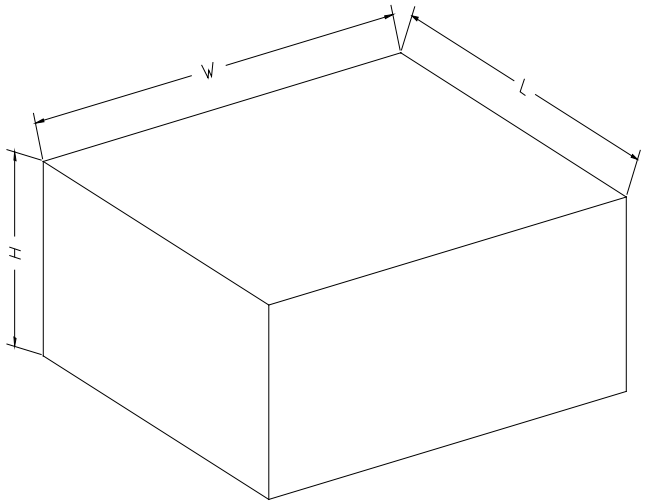
NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF TAPE AND REEL

| Package Type | Reel Diameter | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P0 (mm) | P1 (mm) | P2 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|
| TSSOP-20 | 13″ | 12.4 | 6.80 | 6.85 | 1.70 | 4.0 | 8.0 | 2.0 | 12.0 | Q1 |
| TQFN-4×4-20L | 13″ | 12.4 | 4.30 | 4.30 | 1.10 | 4.0 | 8.0 | 2.0 | 12.0 | Q2 |

DD0001

## CARTON BOX DIMENSIONS




NOTE: The picture is only for reference. Please make the object as the standard.

## KEY PARAMETER LIST OF CARTON BOX

| Reel Type | Length (mm) | Width (mm) | Height (mm) | Pizza/Carton |
|---|---|---|---|---|
| 13″ | 386 | 280 | 370 | 5 |

DD0002