Sound Card

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Introduction
History and Growing Trend
Basic structure
Types
DSP process
AC'97 and HD Audio
• A sound card (also known as an audio card) is an internal computer expansion card that facilitates the input and output of audio signals to and from a computer under control of computer programs. 

• Typical uses of sound cards include providing the audio component for multimedia applications such as music composition, editing video or audio, presentation, education and entertainment (games) and video projection.
Sound Blaster (1988)
  - The creator of Sound Blaster is the Singapore-based firm Creative Technology.
  - Argues

Soundblaster 16
  16-bits complex tones

Soundblaster 64 Gold
  64-bits complex tones, 3D
  120db dynamic range, 96db Signal to Noise Ratio

Soundblaster Live! 5.1
Growing Trend

- ISA (Industrial Standard Architecture)
  ↓
- PCI (Peripheral Component Interconnect)
  - More lifelike playback effect
  - 3D sound of higher quality
  - USB audio equipment
Basic Structure

Composed of many sorts of electronic components and linkers.

1. Voice control chip
2. Digital signal processor (DSP)
3. FM synthesis
4. Wave table synthesis
5. Jumper
   5.1 I/O address
   5.2 IRQ (Interrupt Request) number
   5.3 DMA channel
   5.4 Joysticks port
Main ports

- Control chip
- Sound output interface
- Sound input output interface
- Bus interface
- Fiber interface
- Power amplifier chip
- Internal input output interface
<table>
<thead>
<tr>
<th>Colour</th>
<th>Function</th>
<th>Connector</th>
<th>symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pink</td>
<td>Analog microphone audio input.</td>
<td>3.5 mm TRS</td>
<td>A microphone</td>
</tr>
<tr>
<td>Light blue</td>
<td>Analog line level audio input.</td>
<td>3.5 mm TRS</td>
<td>An arrow going into a circle</td>
</tr>
<tr>
<td>Lime green</td>
<td>Analog line level audio output for the main stereo signal (front speakers or headphones).</td>
<td>3.5 mm TRS</td>
<td>Arrow going out one side of a circle into a wave</td>
</tr>
<tr>
<td>Brown/Dark</td>
<td>Analog line level audio output for a special panning,'Right-to-left speaker'.</td>
<td>3.5 mm TRS</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>Analog line level audio output for surround speakers, typically rear stereo.</td>
<td>3.5 mm TRS</td>
<td></td>
</tr>
<tr>
<td>Orange</td>
<td>Analog line level audio output for center channel speaker and subwoofer</td>
<td>3.5 mm TRS</td>
<td></td>
</tr>
<tr>
<td>Gold/Grey</td>
<td>Game port / MIDI</td>
<td>15 pin D</td>
<td>Arrow going out both sides into waves</td>
</tr>
</tbody>
</table>
types

Integrated sound card
On-board sound card
Independent sound card
digital signal processor (DSP)

Definition: A digital signal processor (DSP) is a specialized microprocessor with an architecture optimized for the fast operational needs of digital signal processing.
TMS320

- TMS32010, TMS32011, TMS320C10/C14/C15/C16/C17
- TMS32020, TMS320C25/C26/C28
- TMS320C30/C31/C32
- TMS320C40/C44
- TMS320C5x/C54x
Digital signal processing algorithms typically require a large number of mathematical operations to be performed quickly and repetitively on a set of data. Signals are constantly converted from analog to digital, manipulated digitally, and then converted again to analog form. Many DSP applications have constraints on latency; that is, for the system to work, the DSP operation must be completed within some fixed time.
Most general-purpose microprocessors and operating systems can execute DSP algorithms successfully, but are not suitable for use in portable devices because of power supply and space constraints. A specialized digital signal processor, however, will tend to provide a lower-cost solution, with better performance, lower latency, and no requirements for specialized cooling or large batteries.
Harvard architecture

The Harvard architecture is a computer architecture with physically separate storage and signal pathways for instructions and data.
Harvard architecture      Von Neumann architecture
Instruction pipeline

The fundamental idea is to split the processing of a computer instruction into a series of independent steps, with storage at the end of each step.
Basic five-stage pipeline in a [RISC] machine (IF = Instruction Fetch, ID = Instruction Decode, EX = Execute, MEM = Memory access, WB = Register write back). In the fourth clock cycle (the green column), the earliest instruction is in MEM stage, and the latest instruction has not yet entered the pipeline.
Integrated sound card

• AC’97
  Audio CODEC'97

• HD Audio
  High Definition Audio
AC’97

• short for Audio Codec '97

• Intel Corporation's Audio Codec standard

• used mainly in motherboards, modems, and sound cards
- an AC'97 digital controller
  ---- built into the I/O Controller Hub (ICH) of the chipset
- an AC'97 audio and modem codecs
  ---- the analog component of the architecture
- defines a high-quality, 16- or 20-bit audio architecture

- surround sound support for the PC

- supports a 96 kHz sampling rate at 20-bit stereo resolution

- a 48 kHz sampling rate at 20-bit stereo resolution

- multichannel recording and playback

- defines a maximum of 6 channels of analog audio output
Realtek alc655
### 图9 AC97前置音频连接针脚定义

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AUD_MIC_IN (麦克输入)</td>
</tr>
<tr>
<td>2</td>
<td>AUD_GND (音频电路地线)</td>
</tr>
<tr>
<td>3</td>
<td>AUD_MIC_BIAS (麦克偏置)</td>
</tr>
<tr>
<td>4</td>
<td>AUD_VCC (为模拟功放提供+5V)</td>
</tr>
<tr>
<td>5</td>
<td>AUD_FPOUT_R (前置右声道输出)</td>
</tr>
<tr>
<td>6</td>
<td>AUD_RET_R (前置右声道返回)</td>
</tr>
<tr>
<td>7</td>
<td>HP_ON (保留)</td>
</tr>
<tr>
<td>8</td>
<td>KEY (无针脚)</td>
</tr>
<tr>
<td>9</td>
<td>AUD_FPOUT_L (前置左声道输出)</td>
</tr>
<tr>
<td>10</td>
<td>AUD_RET_L (前置左声道返回)</td>
</tr>
</tbody>
</table>

- 5/6 由导线短接
- 9/10 由导线短接
• a 16-bit, full-duplex

• AC'97 Rev. 2.3 compatible

• six-channel

• CODEC provides three pairs of stereo outputs with 5-bit volume control, a mono output, and multiple stereo and mono inputs

• flexible mixing, gain, and mute functions

• The ALC655 CODEC supports host/soft audio
HD Audio

- the specification released by Intel in 2004
- capable of playing back more channels at higher quality
- had the codename Azalia
- capable of delivering 192-kHz 32-bit quality for two channels
- 96-kHz 32-bit for up to eight channels
Realtek alc655
• 7.1+2 Channel

• High-performance DACs with 95dB SNR (A-Weighting), ADCs with 85dB SNR (A-Weighting)

• 16/20/24-bit S/PDIF-IN supports 44.1k/48k/96kHz sample rate

• 16/20/24-bit S/PDIF-OUT supports 44.1k/48k/96k/192kHz sample rate

• Wide range (–80dB ~ +42dB) volume control with 1.5dB resolution of analog to analog mixer gain

• Pin compatible with the ALC880 and ALC882
THANK YOU!