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1. Product Description

1.1. Overview

HLK-V20 is a high-performance pure offline voice recognition module newly launched by Hi-link Electronics according to a large number of pure offline control scenarios and products. It can be widely and quickly applied to smart homes, various smart small appliances, 86 boxes, toys, lamps, Industrial, medical, Internet of Things, automotive, security and lighting products that require voice control.

The module uses a 32bit RSIC architecture core, and adds a DSP instruction set specifically for signal processing and speech recognition, an FPU operation unit that supports floating point operations, and an FFT accelerator. The audio signal is trained and learned through the neural network to improve the voice signal Recognition ability.

The solution supports offline recognition of 150 local commands, free configuration of wake-up words, command words, and broadcast reply words through the background, supports lightweight RTOS systems, rich peripheral interfaces, and simple and friendly customized tools.

The physical diagram of the module is shown below:

![Module physical diagram](image.png)

Figure 1. Module physical diagram
1.2. Product features

**Processing kernel:**
- 32bit RISC core, running frequency 240M
- Support DSP instruction set and FPU floating point operation unit
- FFT accelerator: supports up to 1024 points of complex FFT/IFFT operations or 2048 points of real FFT/IFFT operations
- Customized voice algorithm operator

**Storage:**
- Built-in high-speed SRAM
- Built-in 2MB FLASH

**Audio input and output:**
- Support 1 analog Mic input, SNR≥94db
- Support 4 digital Mic input
- Support dual channel DAC output
- Support I2S input/output

**Power supply and clock:**
- Built-in 5V to 3.3V, 3.3V to 1.2V LDO to power the chip
- RC 12MHz clock source and PLL phase-locked loop clock source
- Set POR (Power on Reset), low voltage detection and watchdog

**Peripheral interface:**
- Support up to 10 GPIO
- All GPIOs can be configured as external interrupt input and wake-up sources
- 1 standard SPI Master interface, the highest rate is 30MHz
- 1 SPI Slave interface with a maximum rate of 30MHz
- 1 full-duplex UART with a maximum rate of 3Mbps
- 1 I2C master/slave controller with a maximum rate of 400kHz
- 2 PWM outputs
- 1 12-bit SAR-ADC with a maximum sampling rate of 450Khz

**Custom voice:**
- Customize the startup announcement
- Custom voice wake-up words
- Customize voice command words
- Custom TTS voice broadcast
- Support no wake-up words (no need to wake up, direct recognition of command words)
The module has rich system peripherals, including UART/I2C/SPI/PWM/I2S/DAC/GPIO/DMic/AMic. The following figure shows the functional block diagram of the module system.

![System Functional Diagram](image)

**Figure 2**  System Functional diagram

### 1.3. Pin description

![Module Pinout Diagram](image)

**Figure 3**  Module pinout diagram
The module has 16 pins, including power amplifier output, differential input and serial port. Specific definitions as below table.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Items</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>B8</td>
<td>I</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>2</td>
<td>B7</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>3</td>
<td>B6</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>4</td>
<td>A27</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>5</td>
<td>A26</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>6</td>
<td>SPK+</td>
<td>O</td>
<td>Power amplifier differential output P terminal</td>
</tr>
<tr>
<td>7</td>
<td>SPK-</td>
<td>O</td>
<td>Power amplifier differential output N terminal</td>
</tr>
<tr>
<td>8</td>
<td>VCC</td>
<td>PWR</td>
<td>Power supply</td>
</tr>
<tr>
<td>9</td>
<td>GND</td>
<td>GND</td>
<td>GND</td>
</tr>
<tr>
<td>10</td>
<td>B2</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>11</td>
<td>B3</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>12</td>
<td>A25</td>
<td>I/O</td>
<td>General purpose input/output</td>
</tr>
<tr>
<td>13</td>
<td>MIC-</td>
<td>I</td>
<td>MIC1 differential input N terminal</td>
</tr>
<tr>
<td>14</td>
<td>MIC+</td>
<td>I</td>
<td>MIC1 differential input P terminal</td>
</tr>
<tr>
<td>15</td>
<td>RX</td>
<td>I/O</td>
<td>Uart rx</td>
</tr>
<tr>
<td>16</td>
<td>TX</td>
<td>I/O</td>
<td>Uart tx</td>
</tr>
</tbody>
</table>

Table 1  Pin definition description
1.4. Mechanical dimensions

![Module size diagram](image)

Unit: mm

Figure 4  Module size diagram

2. Function description

The HLK-V20 test board is convenient for customers to intuitively experience voice control LED lights and serial port output protocol data after voice recognition.

The demo firmware supports voice wake-up words: Xiaoke Xiaoke, Xiaoling Xiaoling, Hello Lamp, Hello Rubik's Cube, Xiaohai Xiaohai.

For details of voice command words and corresponding broadcast words, please refer to **HLK-V20 Demo firmware command words and broadcast words V1.1.xlsx**.

For English voice command words and wake-up words, please refer to **HLK-V20 Demo firmware command words and broadcast words (English version) V1.0.xlsx**.
2.1. Test board description

![Test Board Description Diagram]

Figure 5   Test Board description diagram

2.2. Local voice commands to control LED lights

1. Use the USB data cable to power on the test board, and connect external speakers and microphones.

2. After the module wakes up, use the command word "turn on the air conditioner", the LED on the bottom panel will light up; use the command word "turn off the air conditioner", and the LED light will go out.

3. Use the command word "turn on the light" to turn on the LED on the bottom panel, and use the command word "turn off the light" to turn off the LED.

4. Use the command word "Turn on the switch", the bottom panel LED will light up, use the command word "Turn off the switch", the LED light will go out.

2.3. Serial port output protocol data after local voice recognition

1. Use the USB data cable to power on the test board, and connect external speakers and microphones.

2. Open the serial port tool on the PC side, and the serial port configuration is 115200-8-N-1.

3. Use the wake-up word to wake up. After the module recognizes the wake-up word and command word, the serial port outputs protocol data. For details of the serial port protocol data, please refer to **HLK-V20 UART communication protocol description V1.0.pdf**.
3. Application examples

The module can be used with the serial port of the MCU. After the voice module recognizes the voice command, it outputs protocol data through the serial port, and the MCU serial port receives the voice module serial port data for processing.

The module can be used as the main control, used in voice control LED lights, voice control relays and other scenarios.

The module can be used in the following scenarios: voice-activated chandeliers, voice-activated wall lamps, voice-activated bath heaters, voice-activated switches, voice-activated spotlights, voice-activated ceiling lamps, voice-activated desk lamps, wall switches, hotel control panels, LED desk lamps, panels, clothes dryers, electric curtains, fans, Smart door locks, sweepers, smart desk lamps, smart air conditioners, smart teapots, story machines, smart curtains, smart fans, sound-controlled speakers, and car sound-controlled.

The module is highly integrated, simplifies the peripheral circuit, and provides a reference for the schematic diagram of the test board. The figure below is the schematic diagram of the test board.
4. Electrical characteristics

4.1. Electrical parameters

<table>
<thead>
<tr>
<th>Electrical parameters</th>
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<tbody>
<tr>
<td>Power input voltage</td>
</tr>
<tr>
<td>Working temperature</td>
</tr>
</tbody>
</table>

Table 2  Electrical parameters

4.2. Current waveform

Module test environment: test module with backplane

4.2.1. Standby power consumption

5V power supply, average standby power consumption of 63mA. The detailed current waveform is shown below.
4.2.2. Wake-up recognition power consumption

5V power supply, with speaker (8Ω1W) wake-up recognition, average power consumption 77mA. The detailed current waveform is shown below.
5. Recommended reflow soldering temperature

Please strictly follow this temperature curve when the module is heated for the second time.

Too much deviation of the reflow soldering temperature will damage the module!

<table>
<thead>
<tr>
<th>Temperature zone</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper zone</td>
<td>125</td>
<td>135</td>
<td>155</td>
<td>185</td>
<td>195</td>
<td>225</td>
<td>240</td>
<td>230</td>
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<tr>
<td>Lower zone</td>
<td>125</td>
<td>135</td>
<td>155</td>
<td>185</td>
<td>195</td>
<td>225</td>
<td>240</td>
<td>230</td>
</tr>
</tbody>
</table>

Conveyor speed: 70.0 cm/min
### 6. Appendix A Document Revision History

<table>
<thead>
<tr>
<th>Version number</th>
<th>Version number Range of revision</th>
<th>Date</th>
<th>Revised by</th>
</tr>
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<tr>
<td>V1.0</td>
<td>Initial version</td>
<td>2020/7/17</td>
<td>Mr. Jiang</td>
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<tr>
<td>V1.1</td>
<td>Add voice custom description</td>
<td>2020/7/24</td>
<td>Mr. Jiang</td>
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