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Chapter 1. Introduction

1.1 Overview

This document describes the functions, interfaces, technical specifications, appearance, and structure of the CEM630 module. It can help the R&D engineers using this module to provide design references.

1.2 Abbreviations

ADC	Analog-Digital Converter	模数转换
AFC	Automatic Frequency Control	自动频率控制
AGC	Automatic Gain Control	自动增益控制
ARFCN	Absolute Radio Frequency Channel Number	绝对射频信道号
B2B	Board to Board Connector	板对板连接器
BER	Bit Error Rate	比特误码率
CDMA	Code Division Multiple Access	码分多址
DAI	Digital Audio interface	数字音频接口
DAC	Digital-to-Analog Converter	数模转换
DSP	Digital Signal Processor	数字信号处理
DTR	Data Terminal Ready	数据终端准备好
EFR	Enhanced Full Rate	增强型全速率
EMC	Electromagnetic Compatibility	电磁兼容
EMI	Electro Magnetic Interference	电磁干扰
ESD	Electronic Static Discharge	静电放电
EVDO	Evolution Data Only	演进数据优化或者进化的数据
FR	Full Rate	全速率
GPRS	General Packet Radio Service	通用分组无线业务
HR	Half Rate	半速率
IMEI	International Mobile Equipment Identity	国际移动设备标识
ISO	International Standards Organization	国际标准化组织
PLL	Phase Locked Loop	锁相环
PPP	Point-to-point protocol	点到点协议
RAM	Random Access Memory	随机访问存储器
ROM	Read-only Memory	只读存储器
RTC	Real Time Clock	实时时钟
SMS	Short Message Service	短消息服务
UART	Universal asynchronous receiver-transmitter	通用异步接收/发送器
UIM	User Identifier Management	用户身份管理
USB	Universal Serial Bus	通用串行总线
VSWR	Voltage Standing Wave Ratio	电压驻波比

Chapter 2. Module review

2.1 Product Introduction

CEM630 is a stamp hole chip package CDMA2000 1X EVD0 Rev.A module uses Qualcomm's latest EVD0 single-chip platform QSC6085, supports WinCE/Linux and other operating systems, with language, SMS and high data services. CEM630 can be used in the following situations:

- ✧ Netbook, notebook
- ✧ PDA、MID
- ✧ Wireless POS machine
- ✧ Wireless advertising, media
- ✧ Wireless routing, switch
- ✧ Remote monitoring
- ✧ Smart meter reading
- ✧ lottery machine
- ✧ Other wireless terminals, etc.

2.2 Module function block diagram

The functional block diagram of the CEM630 module is shown in Figure 2-1 below:

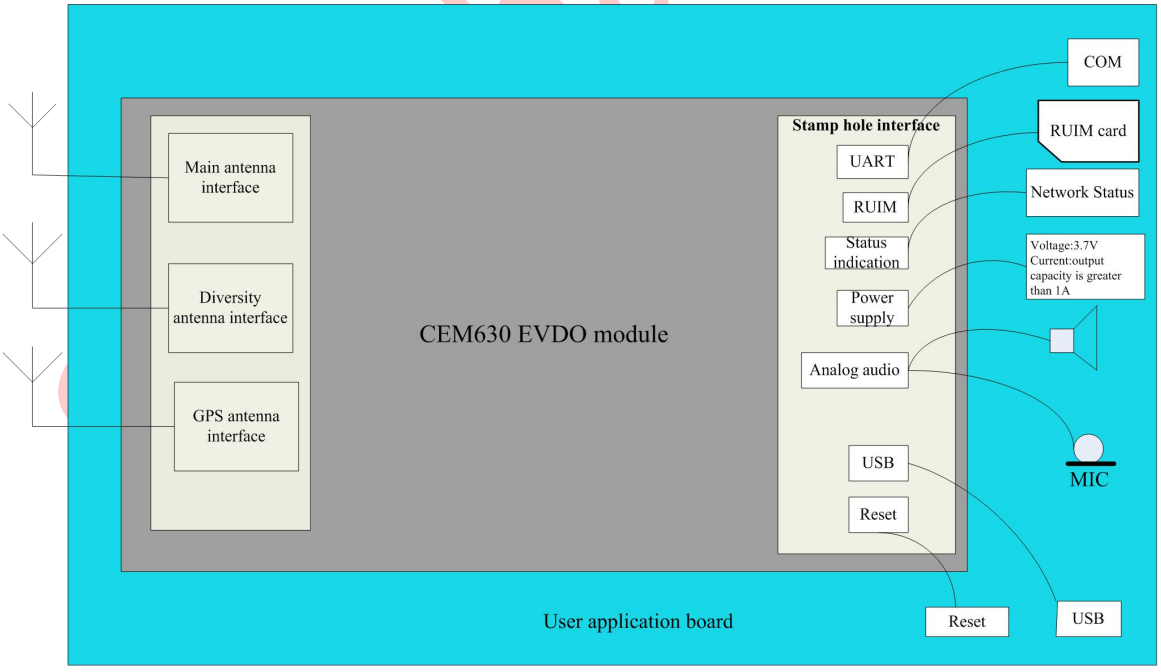

Figure 2-1 Functional Block Diagram of the CEM630 Module

2.3 Main function of the module

The main functions of the CEM630 module are as follows:

- ✧ Support CDMA800/1900 frequency band
- ✧ Support GPS function
- ✧ Support for primary/diversity antenna reception
- ✧ Support 1 USB 2.0 Full speed interface
- ✧ Support 1 channel RUIM card interface (3.0V/1.8V)
- ✧ Support 1 channel 8-wire UART interface
- ✧ Support 2 PCM/I2S interface (transmits digital voice)
- ✧ Support 2 channels of GPIO
- ✧ Support 1 LED lights control
- ✧ Extended AT instruction set supporting standard AT instruction set and domain

Chapter 3. Technical specifications

3.1 Overall technical indicators

The overall technical specifications of the CEM630 module are shown in the following table:

Table 3-1 Overall technical indicators

Characteristic		Description
CDMA standard		IS95A/B
		CDMA2000 1x Rev.0
		CDMA2000 1xEV-DO Rev. 0
		CDMA2000 1xEV-DO Rev. A
Data rate		Upstream:1.8 Mbit/s Max
		Downstream:3.1 Mbit/s Max
Working frequency	CDMA 800MHz	Send:824–849 MHz
		Receive:869–894 MHz
	CDMA 1900MHz	Send:1850–1910 MHz
		Receive:1930–1990 MHz
Operating Voltage		3.3~4.2V Recommended value 3.7V
Working current		Off：<10uA
		Standby：<2mA
		Peak：700mA
Size		31mm×39.5mm×2.6mm
Weight		16g
Temperature	Operating temperature	-30℃～+70℃（Full parameter）
		-40℃～+85℃（Feature）
	Storage temperature	-55℃～+125℃
Humidity		5%～95%

3.2 RF receiving indicators

The RF receiving indicators of the CEM630 module are shown in the following table:

Table 3-2 Radio Frequency Receive

Technical indicators	Description
Frequency Range	869–894 MHz
Receiving sensitivity	<-108 dBm
Receive signal range	-25 dBm~ -104dBm
Monophonic immunity	-101dBm(FER≤1%,-30dBm@±900KHz)
Intermodulation spurious response attenuation	-101dBm(FER≤1%,-43dBm@±900 KHz /±1700KHz) -90dBm(FER≤1%,-32dBm @±900 KHz /±1700KHz) -79dBm(FER≤1%,-21dBm @±900 KHz /±1700KHz)
Conductive spurious emissionemission	<-76dBm/1MHz（Receiving band）
	<-61dBm/1MHz（Transmission band）

	<-47dBm/30KHz（Other frequencies）
Demodulation of forward traffic channel under additive Gaussian white noise conditions	FER≤3.0％（Test 1: Rate Set 1（9600bps）
	FER≤1.0％（Test 2: Rate Set 1（9600bps）
	FER≤0.5％（Test 3: Rate Set 1（9600bps）
	FER≤1.0％（Test 4: Rate Set 1（4800bps）
	FER≤1.0％（Test 5: Rate Set 1（2400bps）
	FER≤1.0％（Test 6: Rate Set 1（1200bps）
	FER≤3.0％（Test 7: Rate Set 2（14400bps）
	FER≤1.0％（Test 8: Rate Set 2（14400bps）
	FER≤0.5％（Test 9: Rate Set 2（14400bps）
	FER≤1.0％（Test 10: Rate Set 2（7200bps）
	FER≤1.0％（Test 11: Rate Set 2（3600bps）
	FER≤1.0％（Test 12: Rate Set 2（1800bps）

3.3 RF emission indicators

The RF emission indicators of the CEM630 module are shown in the following table:

Table 3-3 RF emissions

Technical indicators	Description
Frequency Range	824 ~ 849 MHz
Maximum frequency deviation	±300Hz
Maximum output power	> 23dBm
Minimum output power	< -50dBm
Open loop power control	（Test 1:－25dBm/1.23MHz）－48±9.5dBm
	（Test 2:－60dBm/1.23MHz）－8±9.5dBm
	（Test 3:－93.3dBm/1.23MHz）20±9.5dBm
Closed loop power control	±24dB(9600bps Data rate)
	±24dB(4800bps Data rate)
	±24dB(2400bps Data rate)
	±24dB(1200bps Data rate)
Conductive spurious emission	-42dBc/30KHz or -54dBm/1.23MHz（|Δf|: 885KHz~1.98MHz）
	-54dBc/30KHz or -54dBm/1.23MHz（|Δf|: 1.98MHz~4.00MHz）
	<-36dBm/1kHz（|Δf| > 4MHz, 9KHz < f < 150KHz,）
	<-36dBm/10kHz（|Δf| > 4MHz, 150kHz<f<30MHz,）
	<-36dBm/100kHz（|Δf| > 4MHz, 30MHz<f<1GHz）
	<-30dBm/1MHz（|Δf| > 4MHz, 1GHz<f<12.75GHz）

3.4 Power Supply DC Characteristics

The DC characteristics of the CEM630 module power supply are shown in the following table:

Table 3-4 DC characteristics of the power supply

Parameter	Description	Min	Typical	Max	Unit
VCC	Module input power	3.3	3.7	4.2	V
VIH	Input high level	0.65*VDDIO		VDDIO+0.3	V
VIL	Input low level	-0.3		0.35*VDDIO	V
VOH	Output high level	VDDIO-0.45		VDDIO	V
VOL	Output low level	0		0.45	V
CIN	Input capacitance	-		7	pF

Here VDDIO = 2.6V/1.8V.

Chapter 4 Interface definition

The CEM630 module interface definition is shown in the following table:

Table 4-1 Interface definition

Features	Pin	Signal name	Input /Output	Description	Remarks
RUIM card interface	1	RUIM_VCC	Output	2.85V/1.8VµçÔ´	
	2	RUIM_RST	Output	RUIM card reset signal	
	3	RUIM_CLK	Output	RUIM card clock line	
	4	RUIM_DATA	Two way	RUIM card data cable	
Audio	6	EAR2_P	Output	Single-ended audio output channel 2	
	7	SPKR_OUT_P/ EAR1_OUT_P	Output	Differential audio output channel 1 positive	
	8	SPKR_OUT_N/ EAR1_OUT_N	Output	Differential audio output channel 1 negative	
	9	MIC2_P	Input	Single-ended audio input channel 2	
	10	MIC1_P	Input	Differential audio input channel 1 positive	
	11	MIC1_N	Input	Differential audio input channel 1 negative	
Reset	13	/PON_RESET	Input	Reset signal	Active low
Power supply	14	VBUS	Input	USB power	
	15	VCHG	Input	Charger Recommended to hang	If not required, charge the battery through the module, it is recommended to hang
	16	V_MAIN	Input	Module main power supply 3.2V-4.2V	
	17	VREG_MSMP	Output	Digital power supply IO port voltage, 2.6V/1.8V	
	18	V_MAIN	Input	Module main power supply 3.2V-4.2V	
	29	ON/OFF	Input	Switching machine control active low	
	21	/CTS	Input	Allows reception of 2.6V/1.8V, active low	

UART	22	RXD	Input	Module receives data from the user	2.6V/1.8V
	23	TXD	Output	Module sends data to the user	2.6V/1.8V
	24	RI	Output	Ring tone	2.6V/1.8V
	25	/RTS	Output	Send request	2.6V/1.8V Active low
	26	/DTR	Input	Data terminal is ready	
PCM	27	PCM_DOUT（DCD）	Output	PCM data output	2.6V/1.8V Reuse with DCD
	28	PCM_SYNC（/DSR）	Output	PCM frame sync clock	2.6V/1.8V，Reuse with DCD
	32	PCM_CLK	Output	PCM data clock	2.6V/1.8V
	33	PCM_DIN	Input	PCM data input	2.6V/1.8V
USB	30	USB_DP	Two way	USB data +	
	31	USB_DM	Two way	USB data -	
LED	34	STATUS_LED	Output	Module working status indicator	
Antenna	19	RF_ANT	Two way	Antenna interface	
	37	GPS_ANT	Input	GPS	
	39	AUX_ANT	Input	Diversity antenna	
GND	5，12 20，35，36，38，40	GND			

Chapter 5. Main function interface description

5.1 UART interface (optional function)

Table 5-1 UART Interface Definition

Pin	Signal name	I/O properties	High value	Description
22	UART1_RXD	Input	2.6V/1.8V	UART1 data reception
23	UART1_TXD	Output	2.6V/1.8V	UART1 data transmission
21	UART1_CTS_N	Input	2.6V/1.8V	UART1 ready to send
25	UART1_RTS_N	Output	2.6V/1.8V	UART1 request to send
24	UART1_RI_N	Output	2.6V/1.8V	UART1 ringing indication
26	UART1_DTR_N	Input	2.6V/1.8V	UART1 DTE is ready
27	UART1_DCD_N	Output	2.6V/1.8V	UART1 carrier detection
28	UART1_DSR_N	Output	2.6V/1.8V	UART1 DCE is ready
	GND			Ground

The UART interface supports 3-wire or 8-wire serial protocols.
The UART interface supports the following features:

- ✧ Software download upgrade
- ✧ Data communication
- ✧ AT Command
- ✧ Bluetooth

When the UART interface is directly connected to the microprocessor, the reference design is as follows. If the 3-wire connection is used, the RTS and CTS should be shorted. It should be noted that if the levels on both sides do not match, a level shifting device can be connected in series on the signal line or a bidirectional Schottky diode can be added.

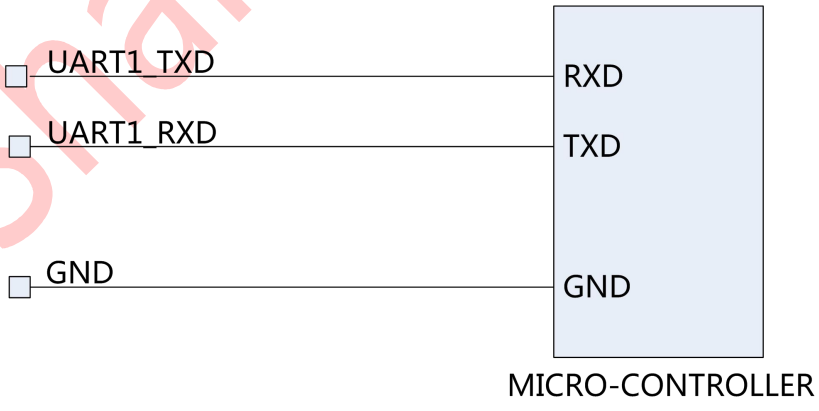

Figure 5-1 UART interface and microprocessor connection reference design

The UART interface can also be connected to the standard RS232-C interface via an RS232 level shifting chip. The reference design diagram is as follows:

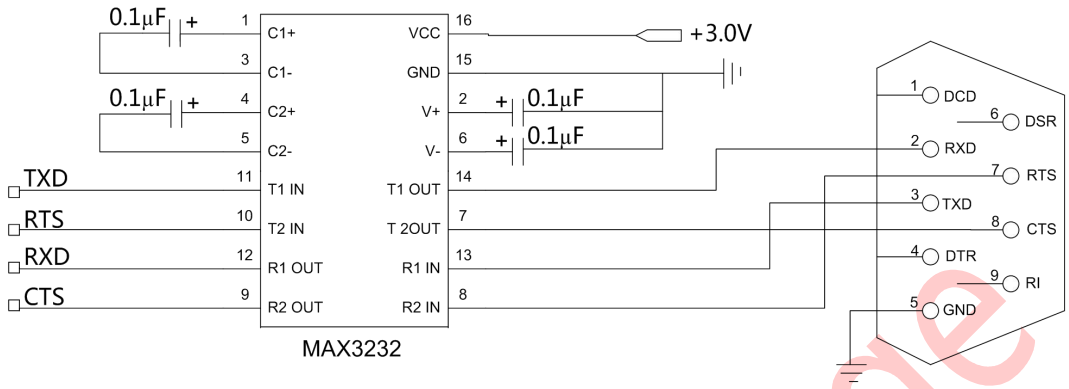

Figure 5-2 Serial connection reference design

Note: Figure 5-2 is just a connection diagram, and the level matching relationship is not considered.

5.2 USB interface

Table 5-2 USB Interface Definition

Pin	Signal name	I/O properties	High value	Description
31	USB_D-	Two way	3.3V	USB data cable -
30	USB_D+	Two way	3.3V	USB data cable +
	GND			Ground

The USB interface supports USB 2.0 Fullspeed and Lowspeed. Note that CEM630 can only be a slave device.

The USB interface supports the following features:

- ✧ Software download upgrade
- ✧ Data communication
- ✧ AT Command

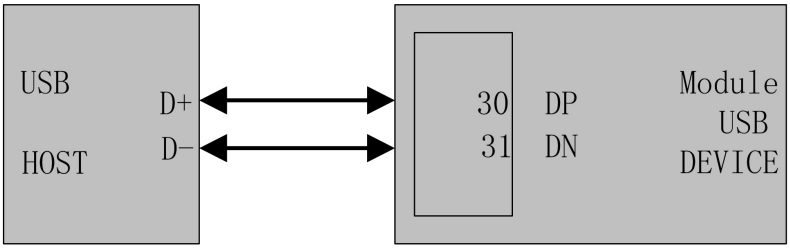

Figure 5-3 USB interface signal

The USB interface reference design is shown below. Note that the ESD protection device should be added to the data line.

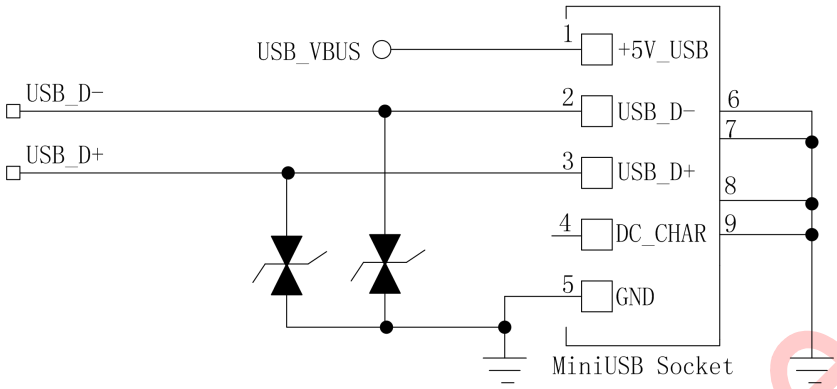

Figure 5-4 USB interface reference design

Note:

1. As shown in the USB interface reference design drawing, it should be noted that the ESD protection device should be added to the data line. The USB trace design of the DTE interface board needs to strictly follow the USB2.0 protocol requirements, and the differential trace has a control impedance of 90Ω.

2. The USB bus supply voltage is provided internally by the module and does not need to be provided externally. At the same time, since the USB interface of the module does not provide USB bus power, the module can only be used as a slave device of the USB bus.

5.3 PCM interface (optional feature)

Table 5-3 PCM Interface Definition

Pin	Signal name	I/O properties	High value	Description
32	PCM_CLK	B	2.6V/1.8V	PCM clock
27	PCM_DOUT	O	2.6V/1.8V	PCM data output
33	PCM_DIN	I	2.6V/1.8V	PCM data input
28	PCM_SYNC	B	2.6V/1.8V	PCM synchronization
	GND			Ground

This interface is a PCM/I2S interface and can support the following functions:

- ✧ Bluetooth
- ✧ Codec interface
- ✧ DAC/ADC interface

The following figure shows an application of the PCM interface for digital voice transmission. It is converted to analog voice by an external Codec chip, and then connected to the MIC and RECEIVER.

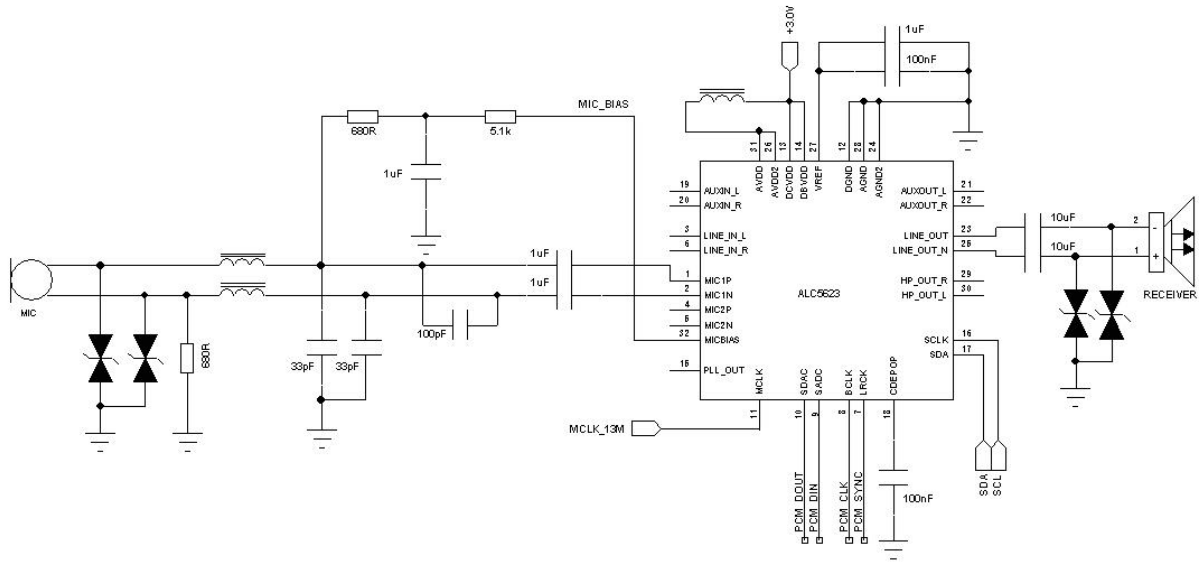

Figure 5-5 PCM digital voice application reference design

5.4 AUDIO interface

Table 5-4 AUDIO Interface Definition

Pin	Signal name	I/O properties	High value	Description
10	MIC1_P	Analog input		Audio input positive end
11	MIC1_N	Analog input		Audio input negative
9	MIC2_P	Analog input		Audio input positive end
6	EAR2_OUT_P	Headphone output		Audio input positive end
7	SPKR_OUT_P/ EAR1_OUT_P	Handsfree/handle output		Audio input positive end
8	SPKR_OUT_N/ EAR1_OUT_N	Handsfree/handle output		Audio input negative
	GND			Ground

The AUDIO interface provides two audio input and output interfaces, one for single-ended mode and the other for differential mode. The MIC bias voltage and DC blocking capacitors are already provided inside the module, so the external design is no longer required.

The differential line of the differential audio interface should pay attention to the parallel equidistance in the PCB design. The length of the trace should be as short as possible. The filter circuits on both sides should be as symmetrical as possible. The positive and negative differential signals should be as close as possible, and the outside should be handled in the package. The audio input and audio output need to be separated to prevent crosstalk, while away from power, RF, antenna and other circuits. In addition, ESD protection devices are recommended at the MIC, RECEIVER/SPEAKER interfaces.

The reference design of the differential audio input and output interface is as follows:

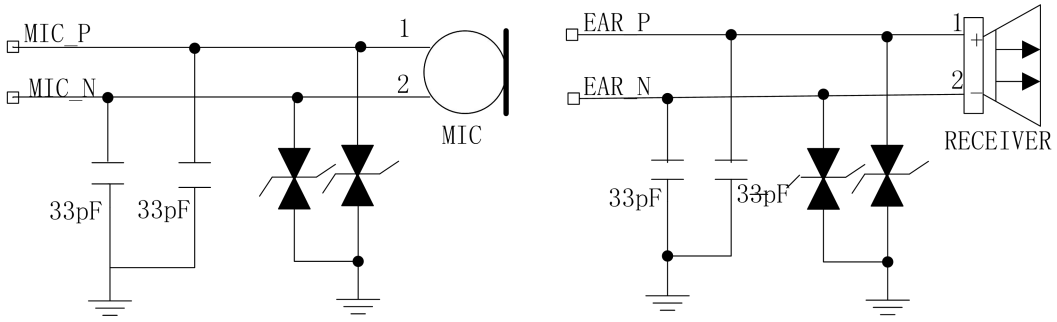

Figure 5-6 Differential Audio Interface Reference Design

The differential audio channel can also work in single-ended mode, such as an external headphone jack. The single-ended audio interface is best handled on the outside of the PCB design trace. The audio input and audio output need to be separated to prevent crosstalk, and away from power, RF, antenna and other circuits. In addition, an ESD protection device is recommended at the interface.

The reference design diagram for the single-ended audio interface is as follows:

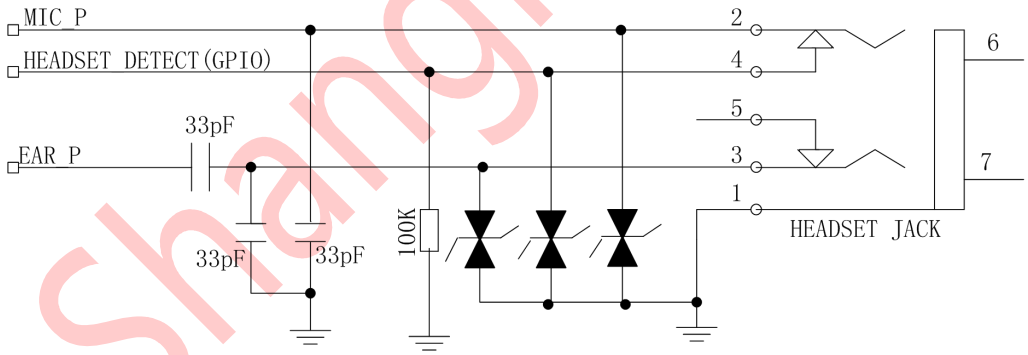

Figure 5-7 Single-ended audio interface reference design

5.5 RUIM card interface

Table 5-5 RUIM card interface definition

Pin	Signal name	I/O properties	High value	Description
1	RUIM_VCC	Output	1.8V/2.85V	RUIM card power supply
4	RUIM_DATA	Two way	1.8V/2.85V	RUIM card data
3	RUIM_CLK	Output	1.8V/2.85V	RUIM card clock
2	RUIM_RESET	Output	1.8V/2.85V	RUIM card reset
	GND			Ground

The CEM630 module can be connected to a 3.0V/1.8V RUIM card and can be automatically detected.It is recommended to connect 33 μ capacitors between RUIM_CLK, RUIM_DATA, RUIM_RESET and GND to filter out the interference of RF signals, and connect 33ohm resistors in series on UIM_CLK, RUIM_DATA and RUIM_RESET. Also, be careful to place the ESD protection device next to the RUIM deck.

The RUIM card interface reference design diagram is as follows:

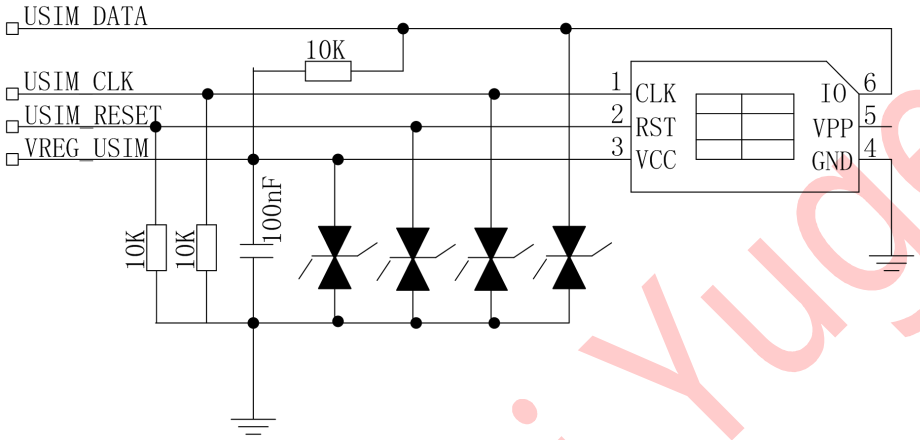

Figure 5-8 RUIM card interface reference design

5.6 Control and general purpose I/O interface (optional feature)

Table 5-6 Control and General I/O Interface Definitions

Pin	Signal name	I/O properties	High value	Description
29	PWR_ON_N	Input	～VBAT-0.3V	Low level on, off
34	LED_STATUS	Current input	3.3V	Work status light, "Low" valid defaults to "High" Current sink
13	RESET_IN	Input	1.8V	Module reset control pin, low effective
	GND			Ground

RESET_IN: This module can be reset by pulling this pin low for 50ms. This pin is sensitive to interference and should be protected when wiring.

LED_STATUS: This control is controlled by SINK type current source mode. The maximum current that can flow in is 40mA. When external LED lamp is connected, the current limiting resistor should be connected in series. The resistance value can be calculated from the rated voltage/rated current of the selected LED lamp.

The reference design of the LED light interface is as follows:

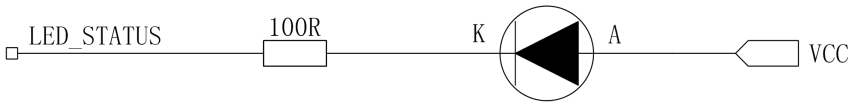

Figure 5-9 LED lamp reference design

LED_STATUS is the working status indicator of the CEM630 module, controlled by the module software. The status table is as follows:

Table 5-7 LED_STATUS Status Indicator Table

CEM630 working mode	LED display status
Search network	Single flash (cycle is 3s)
Successfully registered network, but in idle state (ie, not in call or data transfer state)	Double flash (cycle is 3s)
Call or data transfer status	Fast flashing (cycle is 0.2s)

5.7 Power interface

Table 5-8 Power Interface Definition

Pin	Signal name	I/O properties	High value	Description
16	VBAT	power input	3.2V～4V	main power supply
18	VBAT	power input	3.2V～4V	main power supply
14	USB_VBUS	power input	5V	Recommended to hang
15	VCHG	power input	5V	If you do not need to charge the battery through the module, it is recommended to hang
17	VREG_MSMP	power output	2.6V/1.8V	Power supply for external interface OC gate
1	RUIM_VCC	power output	1.8V/2.85	RUIM card power supply
	GND			Ground

The maximum average power consumption of the CEM630 module is about 700mA. It is recommended to use LD0 or switching power supply of 1.5A or more. In order to maintain the instantaneous voltage stability during operation, it is recommended to add a large storage capacitor, such as 220uF tantalum capacitor, to the power port of the motherboard.

5.8 Antenna socket interface

The module contains three RF antenna interfaces: main set, diversity and GPS. The connection to the main set antenna interface (M), diversity antenna interface (A) and GPS antenna interface (G) must be 50 ohm characteristic impedance traces and antennas.

Table 5-9 Antenna interface characteristics

Parameter	Conditions	Specifications
Sensitivity	1900 MHz	<-107 dBm（Typical）
	800 MHz	<-107 dBm (Typical)
	GPS	-155 dBm
RF output power	1900 MHz	24.5 dBm (Typical)
	800 MHz	24.5 dBm (Typical)
Gain		0 dBi (unity) gain or greater
Impedance		50Ω
VSWR		Less than 3.0:1

It is recommended to use an antenna with a gain value greater than 1 dBi.

According to the user's circuit board routing to debug the parameters of each device, you can connect 68~100nH inductor to the ground to prevent static electricity. Pay attention to the impedance matching and antistatic or lightning strike of the antenna.

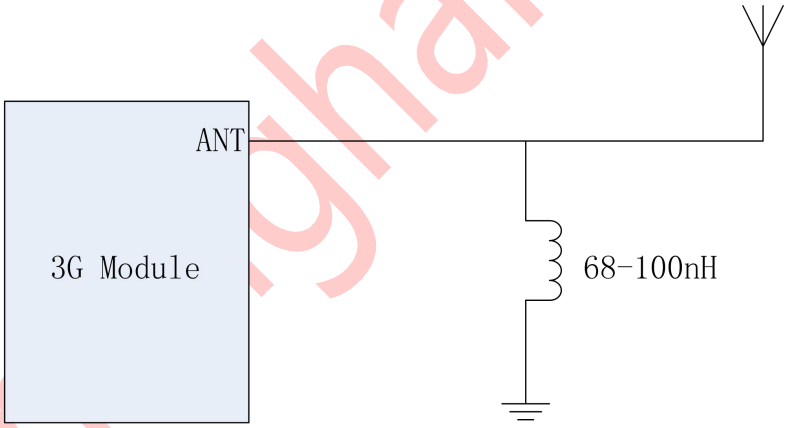

Figure 5-10 Antenna interface ESD protection recommended

Chapter 6. structure

6.1 Structural size

The outline drawing of the CEM630 module is as follows:

Figure 6-1 Outline drawing of the CEM630 module

The pinout arrangement and module dimensions of the CEM630 module are shown in Figure 6-2 (Note: This is a perspective view from the top of the module shield):

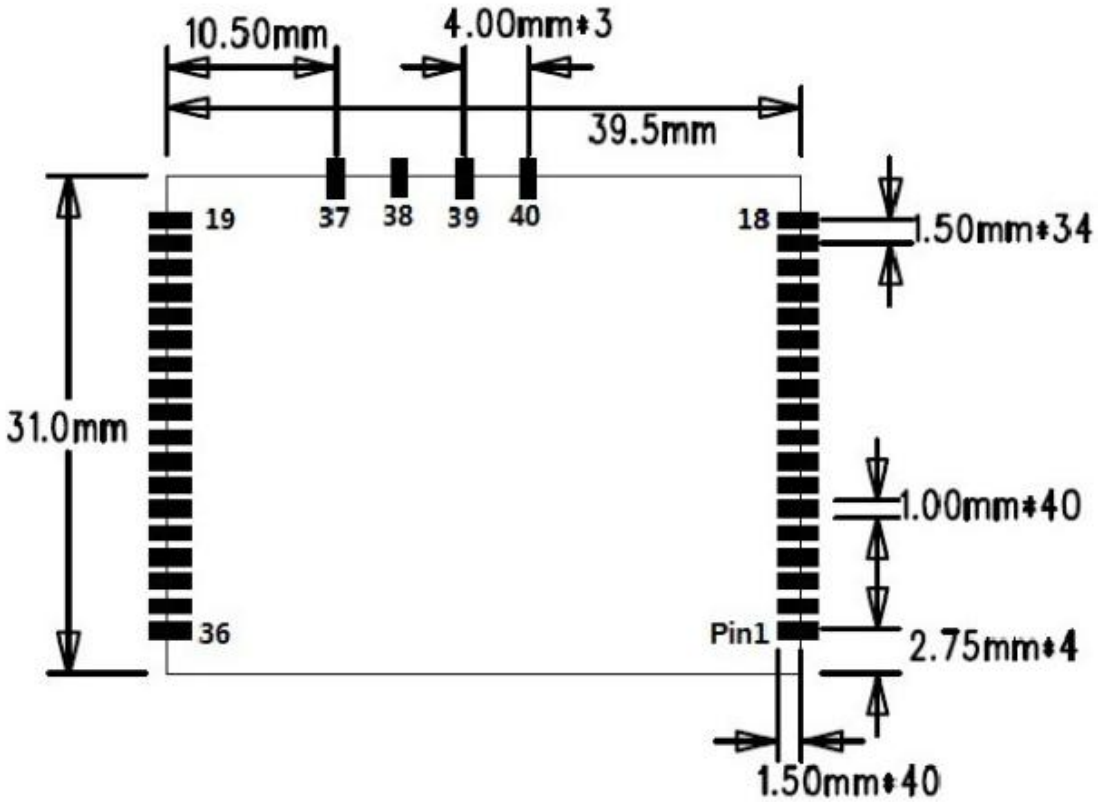

Figure 6-2 CEM630 module pin arrangement diagram (perspective view from above the module)

Chapter 7. Selection guide

Table 7-1 CEM630 module model description

Model	Frequency band	Whether with GPS	Whether to support voice	IO port voltage	Remarks
CEM630	CDMA/EVDO:800M	No	No	2.6V/ 1.8V	The IO port level defaults to 2.6V-1.8V interface level.
CEM630V	CDMA/EVDO:800M	No	Yes	2.6V/ 1.8V	
CEM630G	CDMA/EVDO:800M	Yes	Yes	2.6V/ 1.8V	
CEM630DGV	CDMA/EVDO:800M /1900M	Yes	Yes	2.6V/ 1.8V	