USB 2.0 Camera Controller

GH3550MDQG

Brief Spec

Document Version：1.3

Revision	Date	Description
0.1	2024.02.08	GH3550N first version
1.0	2024.09.06	formal version
1.1	2024.10.09	Update the package size
1.2	2024.12.11	Add GPIO interrupt description
1.3	2025.02.28	Add temperature description
1.3.1	2025.03.05	The layout has been fine-tuned
1.3.2	2025.03.21	Add pin power consumption description

Directory

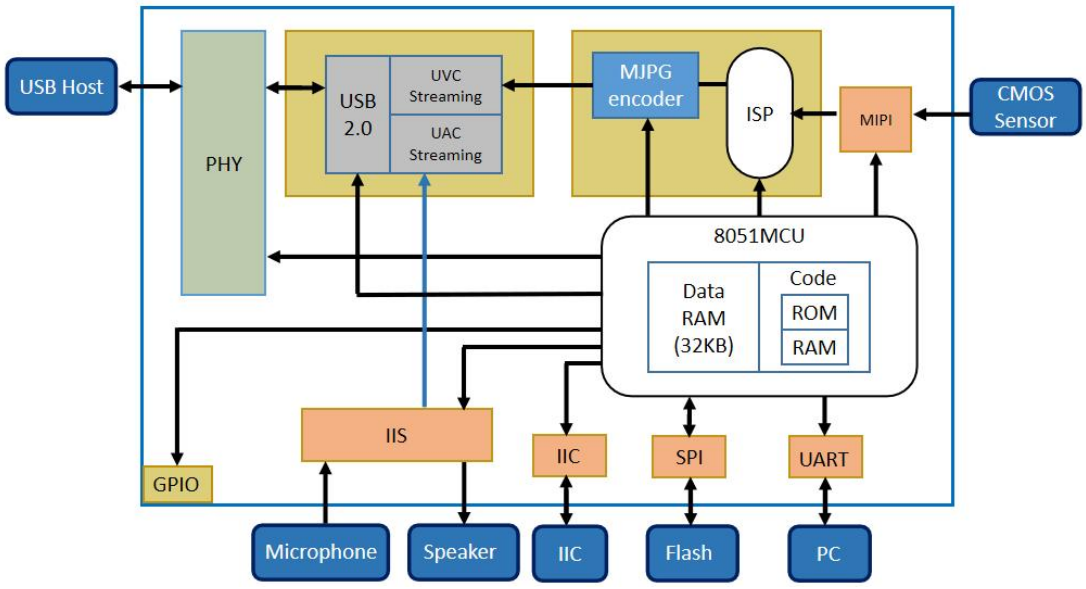
1. General Description

GH3550MDQGis an image signal processing chip that supports USB 2.0 interface. Its efficient image signal processing engine (ISP) can bring excellent visual video experience and support CMOS image sensors up to 8M@20fps to meet the requirements of high quality video.

GH3550MDQG features an independently developed GHISP-II image processing engine, an enhanced 8-bit CPU (75MHz), and an I2S channel for microphone data. It is designed with an integrated audio-video system, which helps to further reduce the need for peripheral components and PCB space. This makes the GH3550MDQG a superior choice for performance and cost-effectiveness. Additionally, it comes with development and debugging tools, as well as programming tools, enabling third parties to easily customize functions.

T GH3550MDQGprimarily functions to control the CMOS sensor, receive image data, process and convert it into a video stream, and then transmit the data to the host via USB. It features 3A (Automatic Exposure, Automatic White Balance, Automatic Focus), noise reduction, 2D noise reduction, bad point compensation, motion detection, OSD, and privacy shielding, all designed to enhance the visual experience. The device supports USB 2.0 High Speed (HS) and USB Video Class (UVC) and Audio Class (UAC 2.0) protocols, making it ideal for applications requiring high-quality video, such as high-resolution cameras, surveillance, video conferencing, and machine vision (AI).

1.1. System Block Diagram



2. Features

2.1. Introduction

- 3.3V (VDD), 1.8V (IO) and 1.15V (Core) external power supply
- Enhanced 8-bit processor (CPU 75MHz)
- Ultra low power consumption
- Use external Flash storage to store custom code and data
- No external RAM
- The input crystal frequency is 12MHz
- 46-pin QFN 4.5mm×6.5mm package

2.2. USB Controller

- Supports USB2.0 High Speed and Full Speed
- Supports video UVC 1.1
- Supports audio UAC 2.0
- USB2.0 HS/FS automatic detection and switching

2.3. Sensor Interface

2.3.1 MIPI CSI-2 RX Interface

- Supports MIPI-CSI2: 1 Clock Lane and 2 Data Lane
- Supports up to 800 million pixel MIPI CSI-2 CMOS sensor
- Supported image data type: RAW10 (Bayer pattern)
- The MIPI data rate is up to 1.5Gbps/Lane

2.3.2 Supported resolution and frame rate, frame rate limited by USB2.0 bandwidth (output resolution size can be customized within the range)

Mode	3264*2448	2560*1440	1920*1080	1280*720	640*480
YUV2	1	2	5	12	30
MJPEG	20	30	60	120	120

2.4. Color processing

- AE/AWB/AF processing
- Reduce color noise processing
- High performance 2d noise reduction
- ISP amplify
- The bad point compensation function is poor. The built-in self-developed AI bad point compensation function module can

compensate 512 isolated points or 256 regional bad points, and the number of each regional bad points is unlimited

- Mobile detection
- Distortion correction processing
- OSD
- privacy protection
- The digital color gain of the R/Gr/Gb/B channels with edge enhancement is controlled respectively
- The digital color gain of Y/Cb/Cr channels is controlled respectively
- Pixel offset compensation for R/Gr/Gb/B channels
- Adjustable gamma for RGB channels
- A programmable color transformation matrix for R/G/B input
- Prevent edge color distortion
- Edge enhancement can be configured
- The adjustable gamma of channel Y
- After image processing, the window function can be configured
- Adjust color and saturation

2.5. Audio

- UAC MIC IN supports I2S communication
- Multi-frequency support,frequencyrange/16/22.05/48 KHz
- Accuracy supports 16 bits
- Supports dual-channel
- UAC2.0 protocol

2.6. JPEG Encoder

- Built-in JPEG encoder
- Supports USB, video MJPEG load programmable compression

2.7. GPIO

- The 5 GPIOs can be customized to define the following functions, including SENSOR RESET, SENSOR-EN, Flash write protection, 1.1V EN, and LED

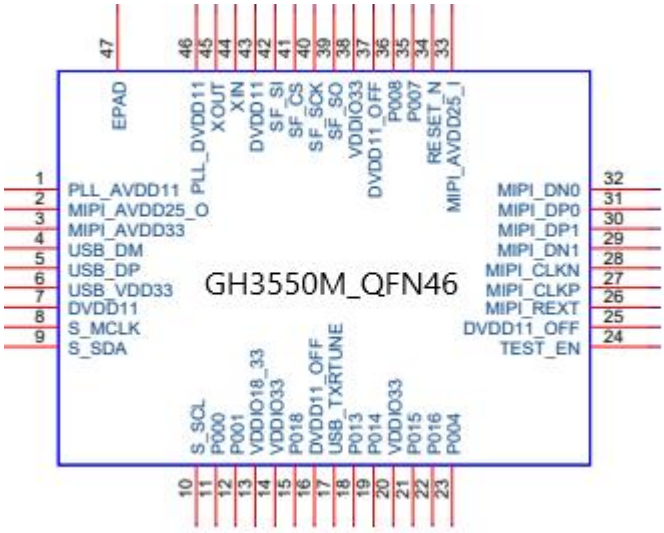
2.8. Pre-Defined USB Video Class

- Brightness control (UVC definition)
- Contrast control (UVC definition)
- Color tone control (UVC definition)
- Saturation control (UVC definition)
- Clarity control (UVC definition)
- Gamma control (defines UVC)
- White balance (UVC definition)

- Backlight compensation (UVC definition)
- Gain (UVC definition)
- Power frequency (defined by UVC definition)
- Auto exposure (UVC definition)
- UVC expansion unit support

3. Pin definition

3.1. QFN46



4. Pin Description

Number	Pin Name	Describe
EPAD	GND	GND
1	PLL_AVDD11	1.1v PLL digital power input
2	MIPI_VDD25_O	XTAL output
3	MIPI_AVDD33	XTAL import
4	USB_DM	1.1v constant on digital power input
5	USB_DP	Flash SI
6	USB_VDD33	Flash CS
7	DVDD11	Flash SCK
8	S_MCLK	Flash SO
9	S_SDA	IO 3.3v power supply
10	S_SCL	1.1v digital power input
11	P000	GPIO_08(with interrupt)/I2C2_SDA/UART_RX, 15mA output
12	P001	GPIO_07/I2C2_SCL/UART_TX, 15mA output drive
13	VDDIO18_33	Chip reset pin, low is valid
14	VDDIO33	2.5v MIPI analog power input
15	P018	MIPI DN0
16	DVDD11_OFF	MIPI DP0

17	USB_TXRTUNE	MIPI DP1
18	P013	MIPI DN1
19	P014	MIPI CLKN
20	VDDIO33	MIPI CLKP
21	P015	MIPI external resistance
22	P016	1.1v digital power input
23	P004	Connect to power ground
24	TEST_EN	GPIO_04,15mA output drive
25	DVDD11_OFF	GPIO_16/I2S_RX_WS
26	MIPI_REXT	GPIO_15/I2S_RX_MCK
27	MIPI_CLKP	IO 3.3v power input
28	MIPI_CLKN	GPIO_14 (interrupt enabled)/I2S_RX_SCK/UART_RX
29	MIPI_DN1	GPIO_13 (interrupt enabled)/I2S_RX_SD/UART_TX
30	MIPI_DP1	USB non-essential resistance
31	MIPI_DP0	1.1v digital power input
32	MIPI_DN0	GPIO_18,15mA output drive
33	MIPI_AVDD25_I	IO 3.3v power input
34	RESET_N	IO variable power supply 1.8V~3.3V
35	P007	GPIO_01(with interrupt)/UART_RX, 15mA output drive,
36	P008	GPIO_00(with mid-end)/UART_TX, 15mA output drive,
37	DVDD11_OFF	Sensor I2C SCL
38	VDDIO33	Sensor I2C SDA
39	SF_SO	Give the Sensor a clock
40	SF_SCK	1.1v constant digital power input
41	SF_CS	USB 3.3V analog power input
42	SF_SI	USB DP
43	DVDD11	USB DM
44	XIN	3.3v analog power input
45	XOUT	MIPI2.5VLDO output
46	PLL_DVDD11	1.1v PLL analog power input

5. Electrical characteristics

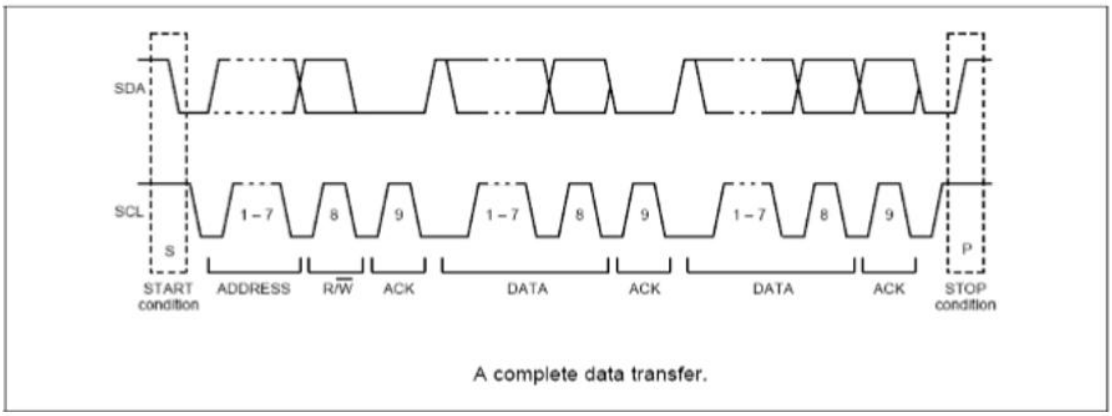
5.1. DC characteristics

Parameter	Symbol	MIN	Typ	MAX	UNIT
Power	AVDD33	3.0	3.3	3.6	V
	VDDIO33_18	3.0/1.62	3.3/1.8	3.6/1.98	V
	VDDIO33	3.0	3.3	3.6	V
	USB_VDD33	3.0	3.3	3.6	V
	PLL_AVDD11	1.0	1.1	1.2	V
	PLL_DVDD11	1.0	1.1	1.2	V
	DVDD11	1.0	1.1	1.2	V
	DVDD11_OFF	1.0	1.1	1.2	V

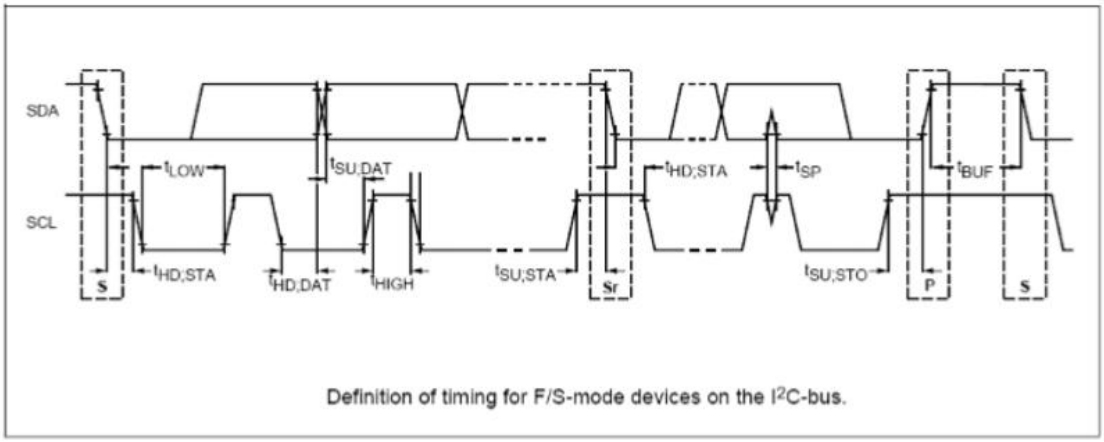
	MIPI_AVDD25	2.3	2.5	2.7	V
Power consumption	AVDD33		13.3		mA
	VDDIO33_18		1.53		mA
	VDDIO33		13.2		mA
	USB_VDD33		2.26		mA
	PLL_AVDD11		6.2		mA
	PLL_DVDD11		9.45		mA
	DVDD11		21.4		mA
	DVDD11_OFF		337		mA
Output voltage	MIPI_VDD25_O	2.3	2.5	2.7	V
Digital signal input voltage	Vin		3.3/1.8	3.6/1.98	V
Digital signal output voltage	Vout		3.3/1.8	3.6/1.98	V
Working temperature	TA	-40		85	℃

5.2. AC operating conditions

5.2.1. IIC interface



A complete data transfer.



Definition of timing for F/S-mode devices on the I²C-bus.

Parameter	Symbol	standard mode			Fast mode			UNIT
		MIN	Typ	MAX	MIN	Typ	MAX	
SCL clock frequency	f_{SCL}	-	400	-	-	1000	-	KHz
Maintain the time start condition	$t_{HD;STA}$	-	1250	-	-	500	-	ns
The low level cycle of the SCL clock	t_{LOW}	-	1250	-	-	500	-	ns
The high level cycle of the SCL clock	$t_{HD;STA}$	-	1250	-	-	500	-	ns
Repeat the setting time of the initial condition	$t_{SU;STA}$	-	1250	-	-	500	-	ns
Data retention time: write	$t_{HD:DAT}$ $t_{HD:DAT}$	- 10	625 -	- -	- 10	250 -	- -	ns ns
Data retention time: Read	$t_{SU:DAT}$ $t_{SU:DAT}$	- 10	625	-	- 10	250 -	- -	ns ns
Data set time: write, data set time: read	$t_{SU:STO}$	-	1249	-	-	499	-	ns
The total bus free time between the start condition and the stop condition	t_{BUF}	4.8			1.4			ns

5.2.2. MIPI Sensor interface

- Electrical characteristics of low power mode

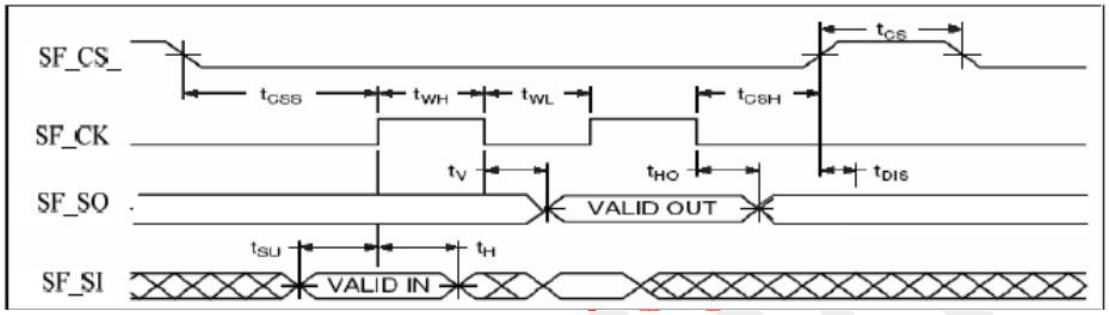
Parameter	Symbol	MIN	Typ	MAX	UNIT
VIH	Logic 1 input voltage	880			mV
HIL	Logic 0 input voltage, not in ULP state			550	mV
VHYST	Input hysteresis	25			mV

- Electrical characteristics of high speed mode

Parameter	Symbol	MIN	Typ	MAX	UNIT

VCMRX(DC)	Common mode voltage		200		mV
VID	Differential input voltage		200		mV
ZID	Differential input impedance	80		125	Ω

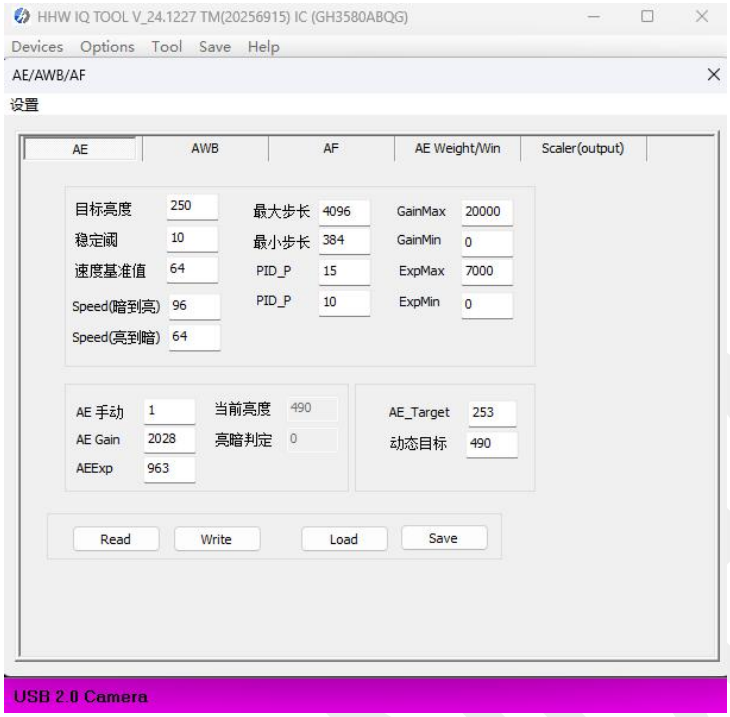
5.2.3. Flash interface



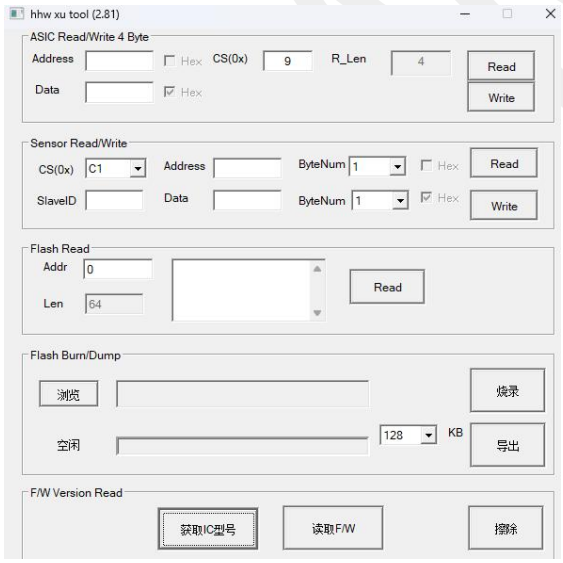
Parameter	Symbol	MIN	Typ	MAX	UNIT
SCK clock frequency	f_{SCK}	-	60	-	MHz
Chip low level to SF_CK edge	t_{CSS}	136		-	ns
SF_CK edge to high level on the chip	t_{CSH}	32		-	ns
Chip high level cycle	t_{CS}	120		-	ns
Clock high period	t_{WH}	8	-	-	ns
Clock low phase cycle	t_{WL}	8	-	-	ns
Set the input data time	t_{SU}	6	-	-	ns
Input data retention time	t_H	6	-	-	ns
Output data is valid for @ CL=20pF	t_V	-	-	5	ns
Output data retention time @ CL=20pF	t_{HO}	0	-	-	ns

6. tools

6.1. IQ debugging tool

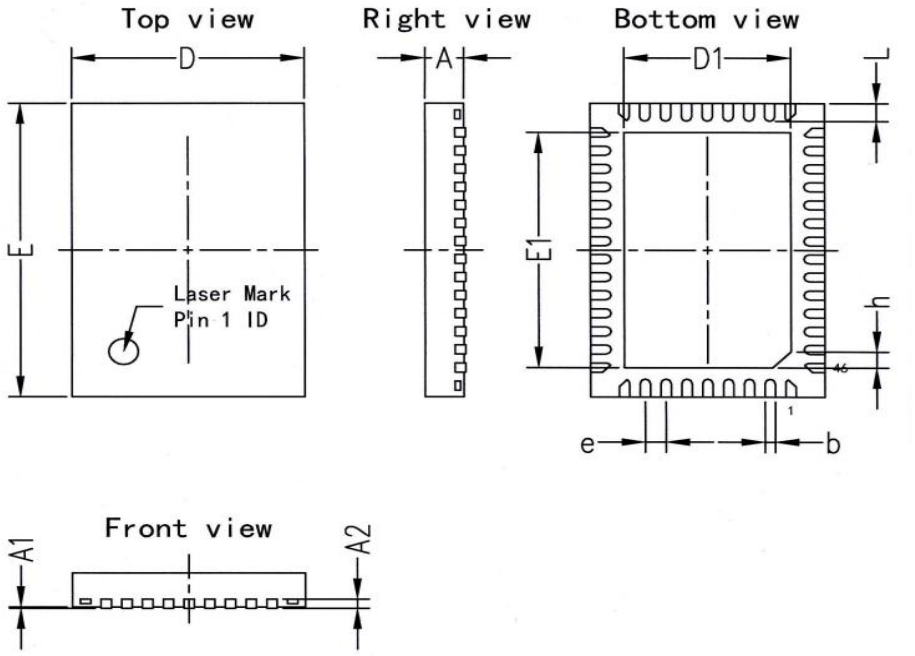


6.2. XU Burn tool/Register reading tool



7. Package

- QFN46

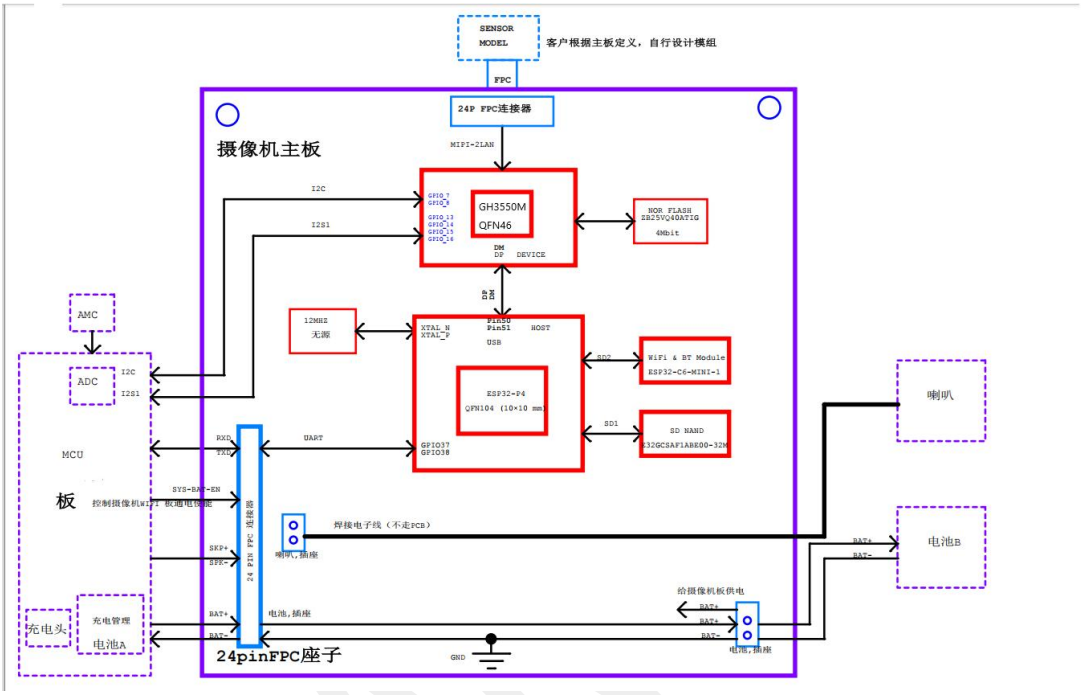


	SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS	A	0.70	0.75	0.80
STAND OFF	A1	0.00	0.02	0.05
L/F THICKNESS	A2		0.203REF	
BODY SIZE X	D	4.40	4.50	4.60
BODY SIZE Y	E	6.40	6.50	6.60
EP SIZE X	D1	3.10	3.20	3.30
EP SIZE Y	E1	5.10	5.20	5.30
LEAD WIDTH	b	0.15	0.20	0.25
LEAD PITCH	e		0.40BSC	
LEAD LENGTH	L	0.35	0.40	0.45
CHAMFER	h	0.30	0.35	0.40
LF PAD SIZE	x	3.40	Y	5.40

8. Refer to the schematic diagram

8.1. USB camera diagram

- GH3550MDQGoutputs video and audio data through USB2.0
- The peripheral is powered by a PMU chip
- Dual-channel microphone input



9. Contact information

- Shenzhen GRANDHAN (SZ) Microel ectronics Co.,Ltd
- Tel:+86 0755-28681854
- Email：hr@grandhanhk.com
- Add:Room 2110, Building A, Bairuida Building, Xintianxia Industrial City, Bantian Street, Longgang District, Shenzhen