MS2109

Single Chip for HD Video Acquisition by USB

Datasheet

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General Description

MS2109 is a HD Video Acquisition Chip, which is internally integrated with USB2.0 controller and data transceiver module, HDMI RX module, Audio and Video Processing module. MS2109 can transmit the Audio and Video signals by HDMI interface to PC, Smart Phone or Tablet Computer through USB interface to preview or collect audio and video information. USB video complies with UVC specification and Audio complies with UAC specification. It supports Windows, Android and MacOS systems.

Features

HDMI RX
- HDMI 1.4b compatible
- Support DVI 1.0
- Support HDCP 1.4
- Support RGB444, YCBCR422, YCBCR444, YCBCR420 color space
- Support deep color 24/30/36 bit mode
- Support CEA-861/CEA-861-F video format
- Maximum input resolution: 4K(3840×2160@30Hz)

USB video output
- Support YUV&MJPEG modes
- Maximum output resolution: 1920×1080@30Hz
- Support user customized resolution
- Compatible with USB1.1 mode
- Compatible with UVC1.0 protocol

Audio output
- Support SPDIF output
- USB Audio conforms to UAC1.0 specification

- USB Audio default 96KHz mono output
- USB Audio supports customized resolution output

Digital audio input
- Support digital audio interface I2S input

USB2.0
- On-chip high speed USB Device
- Support descriptor customization

OS Support
- Windows XP,7,8,10
- Android 5.0 or Higher
- MacOS

Clock
- Only one 24MHz crystal needed
- On-chip PLL

Power & Reset
- On-chip power on reset

Package
- QFN-48 plastic(7mm×7mm)
- PB-free and RoHS compliant

Applications

- High Definition Video Acquisition
- Security Monitoring
- Medical Image

Table of Content
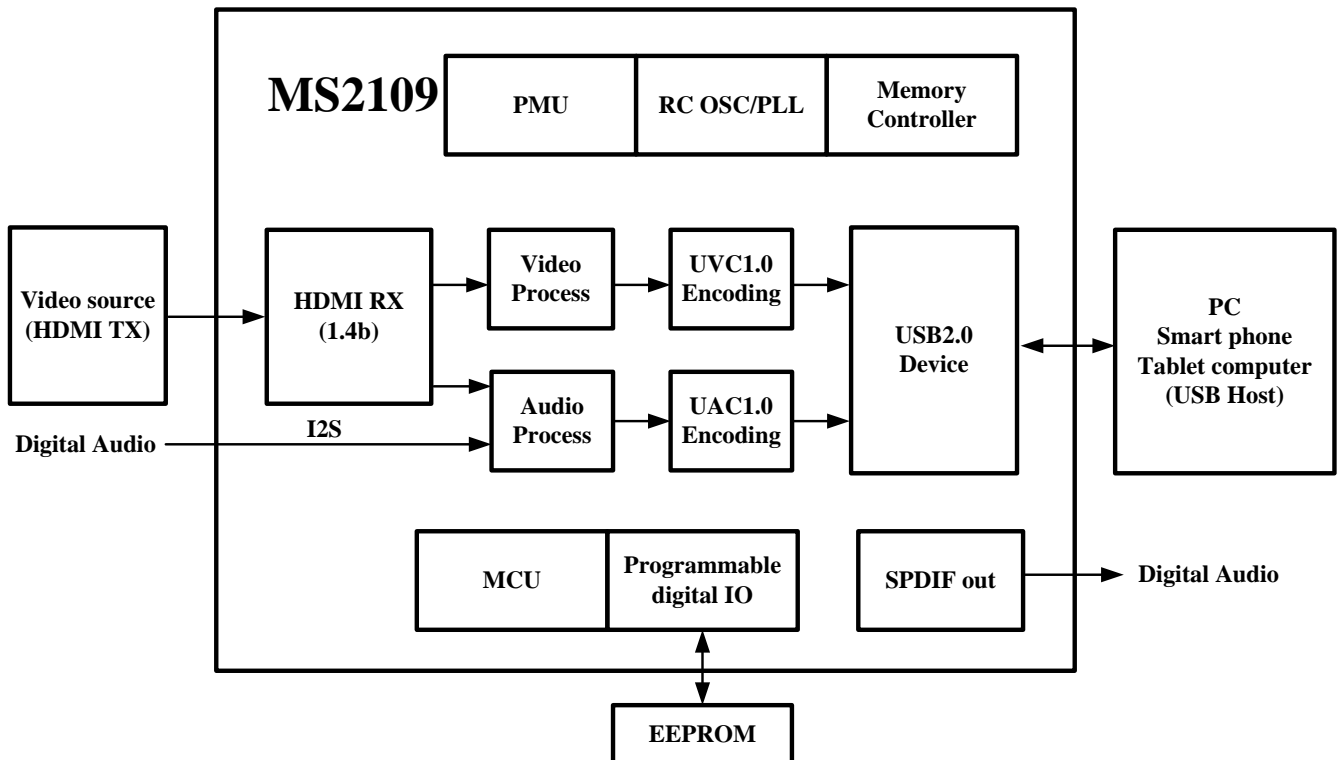
Function Block Diagram

Figure 1 Function Block Diagram

Function Description

GPIO

The MS2109 has five programmable GPIOs. Default functions are as follows:

Table 1. GPIO function description

Item	Function
GPIO0	Default function: output 0 when the player is on, otherwise output 1. Connect a LED to indicate the working status.
GPIO1	Default: input pull-up state. When grounded, HDCP function can be tested. Users need to purchase HDCP key for business applications.
GPIO2(SCL)	Default: connect external EEPROM SCL
GPIO3(SDA)	Default: connect external EEPROM SDA
GPIO5	Default: connect external EEPROM WP

All GPIOs supports user programming redefinition.

EDID

Table 2. The default EDID definition

Item	Description
Display Product Name	HDMI TO USB
Best resolution 1	1080P@60, 148.5MHz
Best resolution 2	720P@60, 74.25MHz
Video support resolution list	640×480@60 800×600@60 1024×768@60 1152×864@60 1280×720@60 1280×800@60 1280×960@60 1280×1024@60 1440×900@60 1600×900@60 1680×1050@60 1920×1080@60
Color space support	RGB, YUV444, YUV422
Deep color	30bits, 36bits
Audio format support	Format: L-PCM Sampling rate: 32kHz, 44.1KHz, 48Khz Number of channels: maximum two channels Bit width: 16bit, 20bit, 24bit

MS2109 supports users to customize EDID through external EEPROM.

HDCP

MS2109 HDMI RX supports HDCP 1.4. The user needs to transcode the HDCP key through the MS2109 tool and burn it into the external EEPROM.

MS2109 has built-in HDCP test mode, which can test HDCP function by grounding GPIO1.

Digital Audio Input

MS2109 supports digital audio I2S input. The signal source of USB audio input can be configured through external EEPROM. MS2109 can generate 12.288MHz clock output for audio ADC.

USB Video

MS2109 USB video conforms to UVC1.0 protocol and supports two video formats: YUV and MJPEG. Maximum output resolution: $1920 \times 1080@30Hz$. MS2109 compatible with USB1.1 mode.

Table 3. Default output resolution

USB2.0 Mode:	
YUV422:	MJPEG:
$1920 \times 1080@5Hz$	$1920 \times 1080@30Hz/25Hz/20Hz/10Hz/5Hz$
$1600 \times 1200@5Hz$	$1600 \times 1200@30Hz/25Hz/20Hz/10Hz/5Hz$
$1360 \times 768@8Hz$	$1360 \times 768@30Hz/25Hz/20Hz/10Hz/5Hz$
$1280 \times 1024@8Hz$	$1280 \times 1024@30Hz/25Hz/20Hz/10Hz/5Hz$
$1280 \times 960@8Hz$	$1280 \times 960@/50Hz/30Hz/20Hz/10Hz/5Hz$
$1280 \times 720@10Hz$	$1280 \times 720@60Hz/50Hz/30Hz/20Hz/10Hz$
$1024 \times 768@10Hz$	$1024 \times 768@60Hz/50Hz/30Hz/20Hz/10Hz$
$800 \times 600@20Hz/10Hz/5Hz$	$800 \times 600@60Hz/50Hz/30Hz/20Hz/10Hz$
$720 \times 576@25Hz/20Hz/10Hz/5Hz$	$720 \times 576@60Hz/50Hz/30Hz/20Hz/10Hz$
$720 \times 480@30Hz/20Hz/10Hz/5Hz$	$720 \times 480@60Hz/50Hz/30Hz/20Hz/10Hz$
$640 \times 480@30Hz/20Hz/10Hz/5Hz$	$640 \times 480@60Hz/50Hz/30Hz/20Hz/10Hz$
USB1.1 Mode:	
MJPEG:	
$640 \times 480@20Hz/15Hz/10Hz/5Hz$	

MS2109 USB output resolution can be configured through external EEPROM and customized by users.

Audio Output

MS2109 supports SPDIF audio output & USB audio output. USB Audio conforms to UAC1.0 protocol. The default output of USB audio is 96KHz mono. It can be configured through external EEPROM to realize user-defined, stereo and 192KHz output.
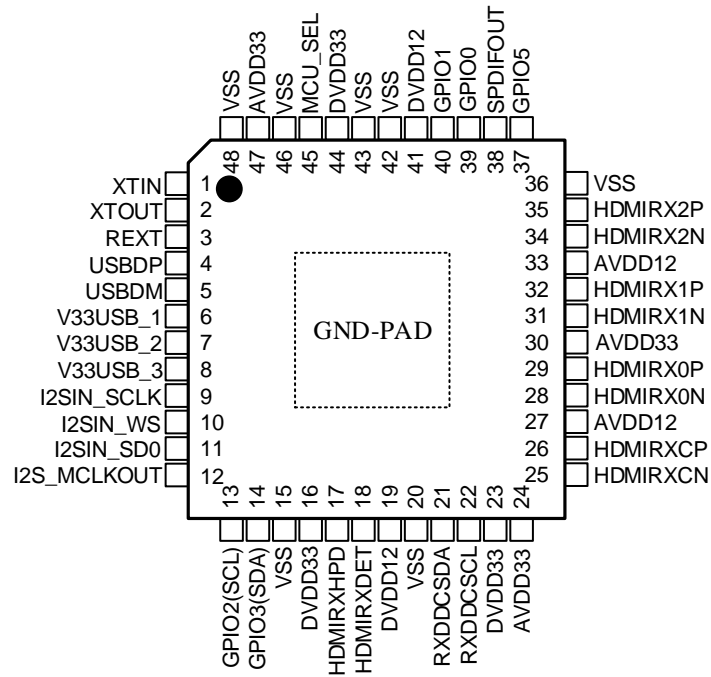
Pin Map

Figure 2 Package Top View

PIN Description

Table 4. Pin Description

Pin Name	Pin #	Type	Description
GPIO			
GPIO0	39	DIO	General Purpose IO Default function: drive an led to indicate whether video playback is on
GPIO1	40	DIO	General Purpose IO Function can be defined by user
GPIO2(SCL)	13	DIO	General Purpose IO Default function: Connect external EEPROM SCL
GPIO3(SDA)	14	DIO	General Purpose IO Default function: Connect external EEPROM SDA
GPIO5	37	DIO	General Purpose IO Default function: Connect external EEPROM WP
Option PIN			
MCU_SEL	45	DI	Debug reserved
USB			
XTIN	1	AI	24MHz crystal input
XTOUT	2	AO	24MHz crystal output
REXT	3	AO	Connect a 4.7k resister to ground
USBDP	4	DIO	USB differential signal D+
USBDM	5	DIO	USB differential signal D-
HDMIRX			
HDMIRXCN	25	DI	HDMI RX Differential Clock Input Negative
HDMIRXCP	26	DI	HDMI RX Differential Clock Input Positive
HDMIRX0N	28	DI	HDMI RX Differential Data0 Input Negative
HDMIRX0P	29	DI	HDMI RX Differential Data0 Input Positive
HDMIRX1N	31	DI	HDMI RX Differential Data1 Input Negative
HDMIRX1P	32	DI	HDMI RX Differential Data1 Input Positive
HDMIRX2N	34	DI	HDMI RX Differential Data2 Input Negative
HDMIRX2P	35	DI	HDMI RX Differential Data2 Input Positive
HDMIRXHPD	17	DO	HDMI RX HPD signal output
HDMIRXDET	18	DI	HDMI RX 5V detection signal input
RXDDCSDA	21	DIO	HDMI RX DDC SDA
RXDDCSCL	22	DI	HDMI RX DDC SCL
Audio output			
SPDIF	38	DO	SPDIF audio output
Audio input			

Pin Name	Pin #	Type	Description
I2SIN_SCLK	9	DI	I2S input SCLK signal
I2SIN_WS	10	DI	I2S input WS signal
I2SIN_SD0	11	DI	I2S input sd0 signal
I2S_MCLKOUT	12	DO	12.288MHz clock output
System Power & Ground			
V33USB_1	6	P	3.3V Power input
V33USB_2	7	P	3.3V Power input
V33USB_3	8	P	3.3V power input
DVDD33	16,23,44	P	Digital 3.3V
AVDD33	24,30,47	P	Analog 3.3V
AVDD12	27,33	P	Analog 1.2V
DVDD12	19,41	P	Digital 1.2V
VSS	15,20,36,42, 43,46,48	G	Ground
GND-PAD		G	Ground

Table 5. Abbreviation of Pin Description

Abbreviation	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
DIO	Digital Bi-direction
P	Power
G	Ground
NC	No Connect

Electrical Characteristics

Absolute Maximum Ratings

Table 6. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Maximum Operating Voltage	V_{DD33}	3.6	V
Maximum Operating Voltage	V_{DD12}	1.32	V
Voltage On Any Pin With Respect to Ground	V_I	-0.5 to DVDD33+0.5	V
Ambient Operating Temperature	TA	0 to 70	℃
Storage Temperature	Tsto	-65 to +150	℃
Allowable Junction Temperature	Tjmax	125	℃
Allowable Shell Temperature	Tcmax	124	℃

Note1: Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and does not imply functional operation of the device. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability.

Table 7. ESD Ratings

Parameter	Symbol	Value	Unit
Human Body Model	V_{ESD}(HBM)	±2000	V
Machine Model	V_{ESD}(MM)	±200	V
Charged Device Model	V_{ESD}(CDM)	±500	V

ESD CAUTION: Electrostatic charges accumulate on the human body and test equipment and can discharge without detection. Although this product features have dedicated ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

Table 8. Thermal Resistance

Parameter	Symbol	Value	Unit
Junction-to-ambient Thermal Resistance (JEDEC 4-layer test board)	$R_{\theta JA}$	33	℃/W
Junction-to-board Thermal Resistance	$R_{\theta JB}$	5	℃/W
Junction-to-case Thermal Resistance	$R_{\theta JC}$	14	℃/W

DC Characteristics

Table 9. DC Characteristics

Parameter	MIN	TYP	MAX	Unit	Condition
DVDD33	3.15	3.3	3.55	V	GND = 0V, TA = +25 ℃ unless otherwise noted
AVDD33	3.15	3.3	3.55	V	
DVDD12	1.14	1.2	1.26	V	
AVDD12	1.14	1.2	1.26	V	

Parameter	MIN	TYP	MAX	Unit	Condition
Input Low Voltage	GND		0.2×DVDD33	V	
Input High Voltage	0.7×DVDD33		DVDD33	V	
GPIO Pull High resister		50k		Ω	
GPIO Pull Down resister		50k		Ω	

Supply Currents In Different Mode

Table 10. Typical Value of Current in Different Input Modes (unit: mA)

UVC Output fixed at 1920×1080@30Hz, MJPEG mode, typical value of current in different input modes (unit: mA)

Parameter	3840×2160@30Hz	1920×1080@60Hz	1280×720@60Hz
DVDD12	167	120	75
AVDD12	80	74	63
AVDD33	121	63	60
DVDD33	42	42	38

Table 11. Typical Current Value of USB Host Under Different Working Conditions (unit: mA)

Parameter	UVC ON, Input 1080P, Output 1080P	UVC OFF, HDMI no source	USB Suspend
DVDD12	120	22	1
AVDD12	74	54	2
AVDD33	63	14	1
DVDD33	42	8	4

Typical Application Circuit
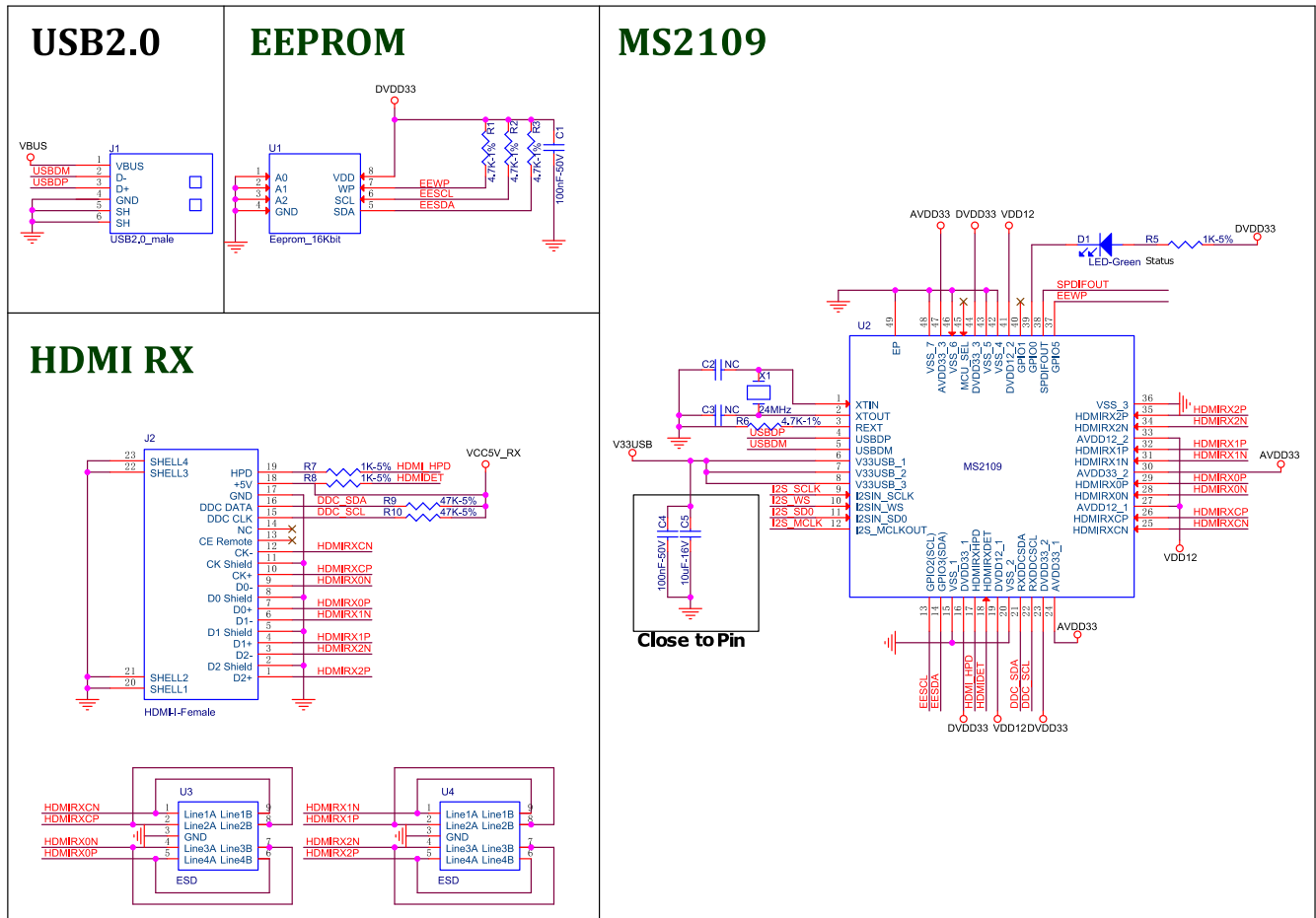
Figure 3 Typical Application Circuit
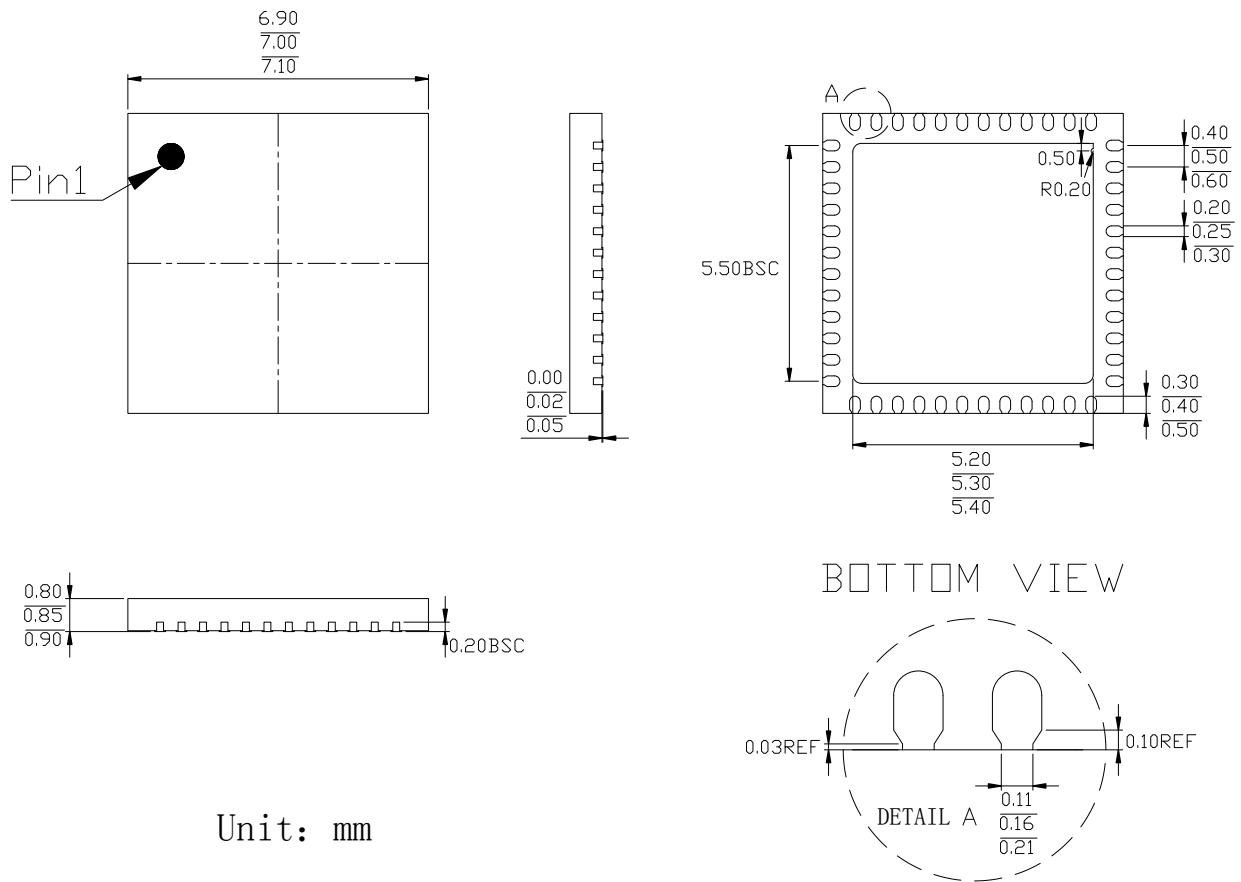
Package Outline
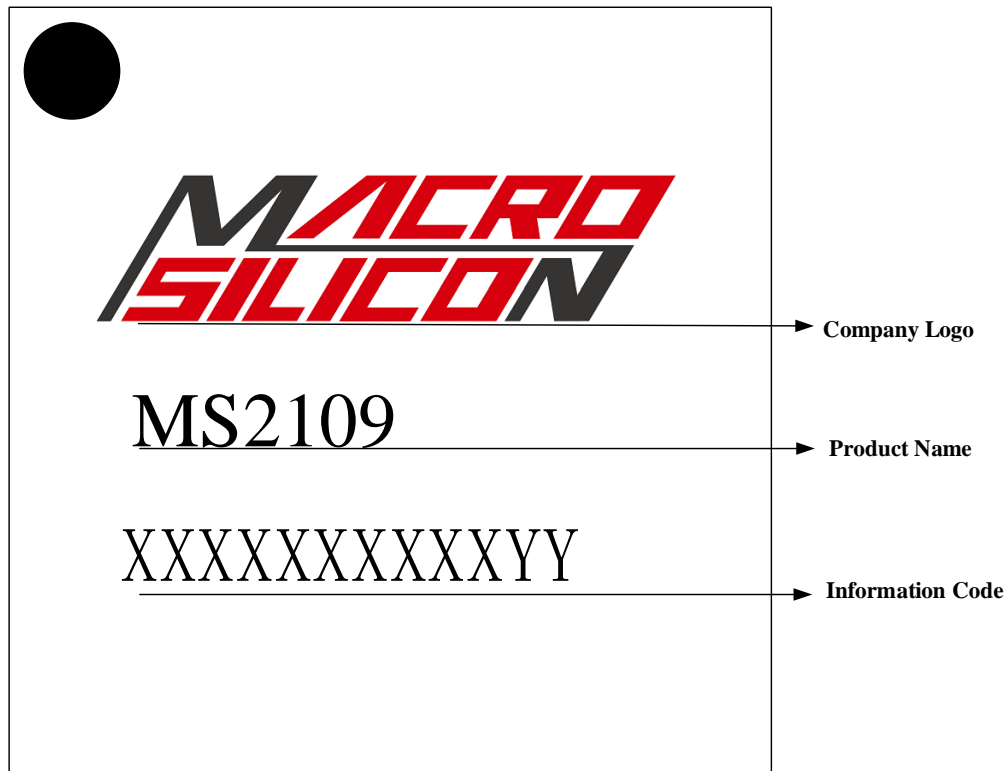

Figure 4 QFN48 Package Diagram

Top Mark

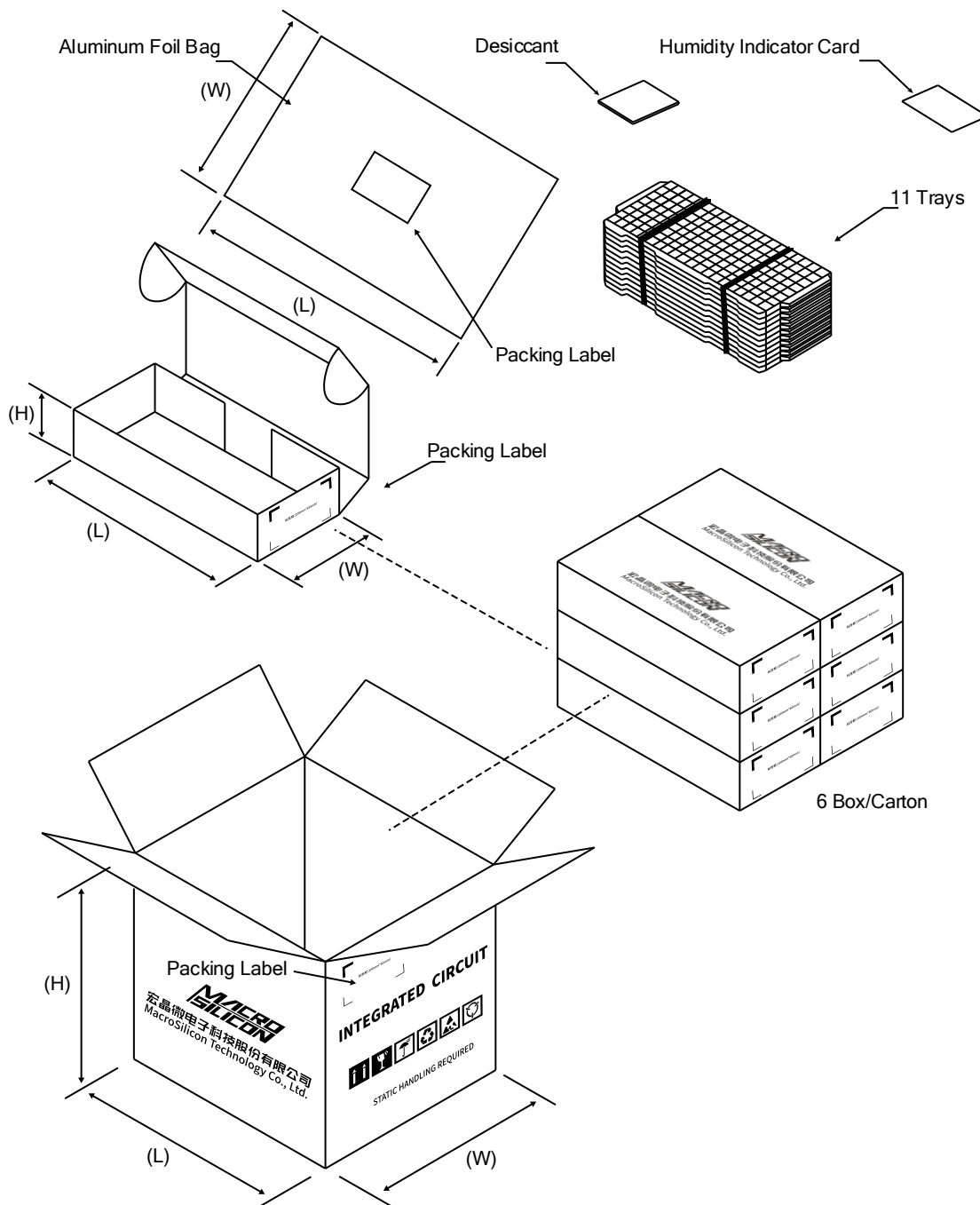Figure 5 Top Mark Diagram

Packing Information

Packing Information

Figure 6 Packing Information Diagram

Table 12. Packing Carton Dimension

Packing Carton Dimension (Unit: mm)	
Inner Carton	370(L)*155(W)*85(H)
Outer Carton	390(L)*330(W)*280(H)

Table 13. Packing Standards

Package Outline	Quantity Per TRAY (Unit：PCS)	Quantity Per Inner carton (Unit：PCS)	Quantity Per Outer Carton (Unit：PCS)	Inner Carton: Outer Carton
QFN48（7X7）	260	2600	15600	6:1

Carrier Tray Dimension

SECTION B-B(1:1)

SECTION C-C(1:1)

BACK VIEW

SECTION D-D(1:1)

DETAIL E(1:1)

NOTE: SCALLOP IS CENTERED ON SIDE OF TRAY.

DETAIL CELL (FRONT)

DETAIL CELL (BACK)

Figure 7 Tray Dimension Diagram

Reflow Specifications

Table 14. Reflow Temperature Curve Description

Reflow Profile	Pb-Free Assembly
Preheating time (T_{smin} to T_{smax})	60~120 seconds (150~200 ℃)
Liquidous Temperature (T_L)	217 ℃
Peak Temperature (T_P)	260 ℃ (+5/-0 ℃)
Ramp-up Rate (T_L to T_P)	≤ 3.0 ℃/seconds
Time Maintained above T_L	60~150 seconds
Time Within 5 ℃ of Peak Temperature (above 255 ℃)	30~40 seconds
Ramp-up Rate (T_P to T_L)	≤ 6.0 ℃/seconds
Time 25 ℃ to Peak Temperature	≤ 8 minutes
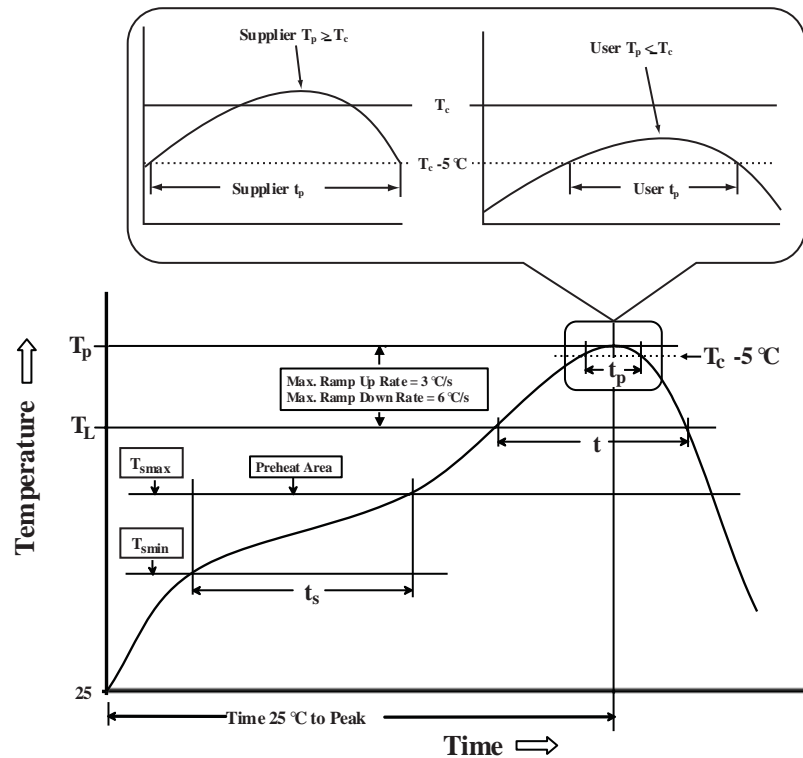
Figure 8 Reflow Temperature Diagram

Revision History

Date	Version	Author	Comments
2019-12	V1.0	ZF Wang	Initial Version
2020-7	V2.0	MJ Du	Modified Power Description
2021-4	V2.1	MJ Du	Revise Top Mark Diagram
2021-6	V2.2	MJ Du	Modified Part Description
2021-11	V2.3	Y Zhao	Update document template
2022-1	V2.4	MJ Du	Add limit temperature parameter
2022-3	V2.5	MJ Du	Add Packing Information
2022-8	V2.6	Y Niu	Add some subsections