上海冠显光电科技有限公司
Shanghai Top Display Optoelectronics Co., LTD

X2A1 Model
Datasheet

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Mar.26.2025

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Revision History

Revision	Date	Description
1.0	Mar.26.2025	Initial Release Version.

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1. Overview

1. High performance and low cost.
2. Short time to make an HMI product: PC software ("GIRAFFE®") to design UI and Communication.
3. Based on the RISC-V CPU architecture. Equipped with powerful 2D graphics acceleration processor, PNG/JPEG decoding engine.
4. 24/18/16 - bit RGB interface, and the LCD resolution supports up to 800x600.
5. Support WAV and MP3 format audio playback.
6. 3 UARTs with a baud rate of up to 3Mbps, support hardware - controlled 485 direction, and the 485 communication rate is also up to 3Mbps.
7. 2 I2Cs.
8. Support up to 2 CAN ports.
9. 1 QSPI port.
10. Support up to 2 independent 16 - bit PWMs or 1 complementary PWM.
11. Support resistive touchscreens and capacitive touchscreens.
12. Built - in 4MB of ROM for users to save the user interface. Larger ROMs can be selected or expanded via an SD card.

Model	Maximum Resolution	ROM
X2A1	800*600	4MB

2. Description

2.1 CPU Architecture

The X2 Model is based on RISC-V CPU architecture.

2.2 Memory Subsystem

This section consists of internal memory and external memory:

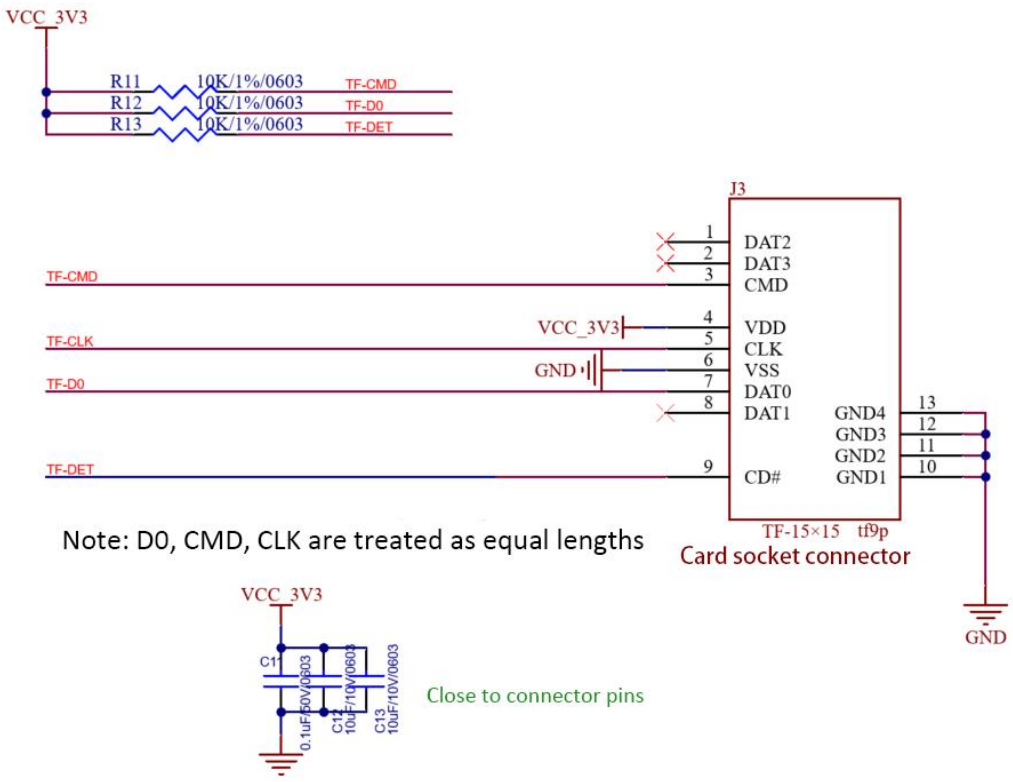
- ROM
- SD Interface

ROM

- Internal 8M Bytes memory, 4M Bytes left for users.
- Support Firmware download via a Micro SD card.

SD Interface

- Support external memory
- SD reference design



2.3 Reliability Assurance System

- Support watchdog reset inside
- Built - in temperature sensor, support high - and - low - temperature interrupt alarms and over - temperature reset.

2.4 Display System

This section includes:

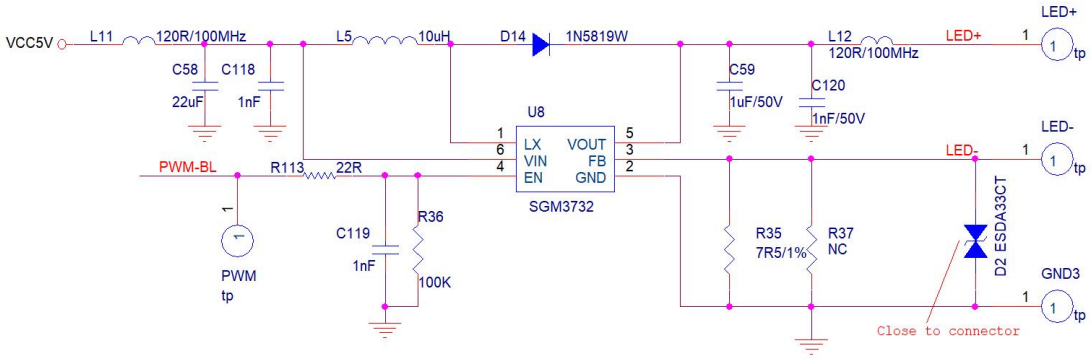
- **Display Output**
- **Backlight Control**

Display Output

- RGB interface, up to 800×600@60Hz.
- Support RGB565/RGB666/RGB888 interfaces.

Backlight Control

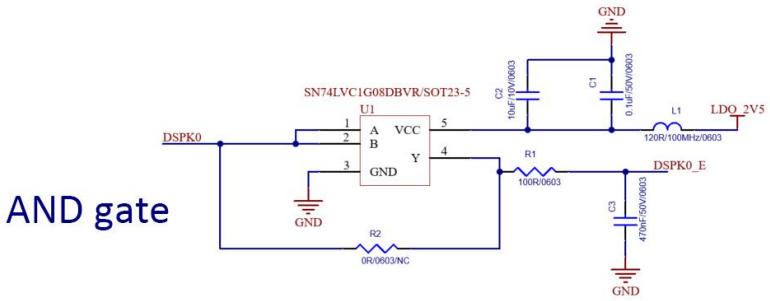
- To adjust backlight brightness & power on/off backlight
- Reference design for backlight control



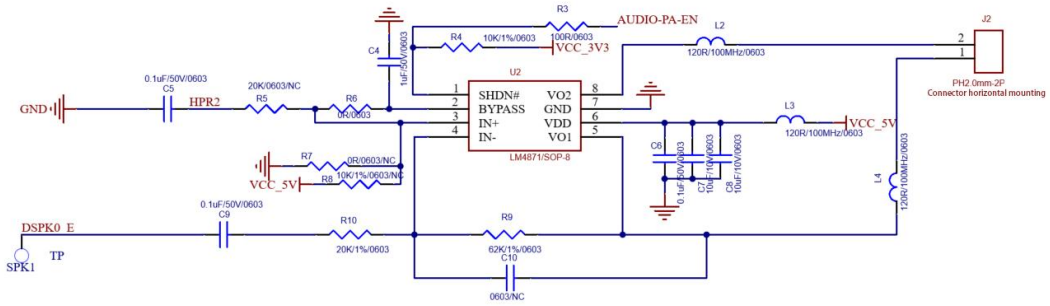
2.5 Audio Subsystem

Audio Decoder

- Digital PWMS output (DSPK).
- Reference Design



Speaker



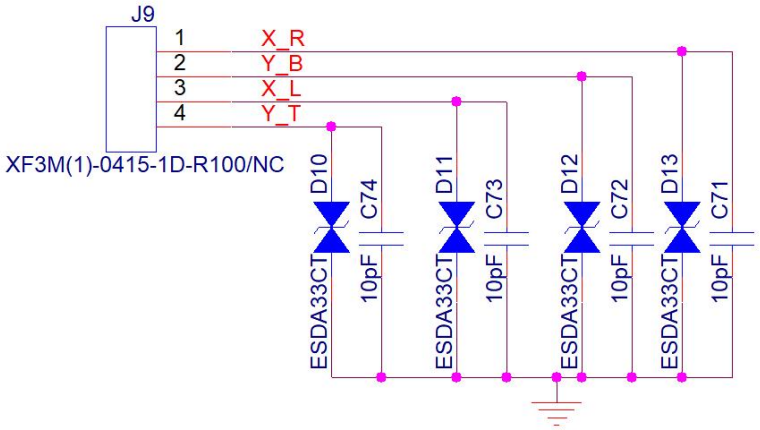
2.6 System Peripherals

This section includes:

- **TP**
- **UART**
- **IIC**

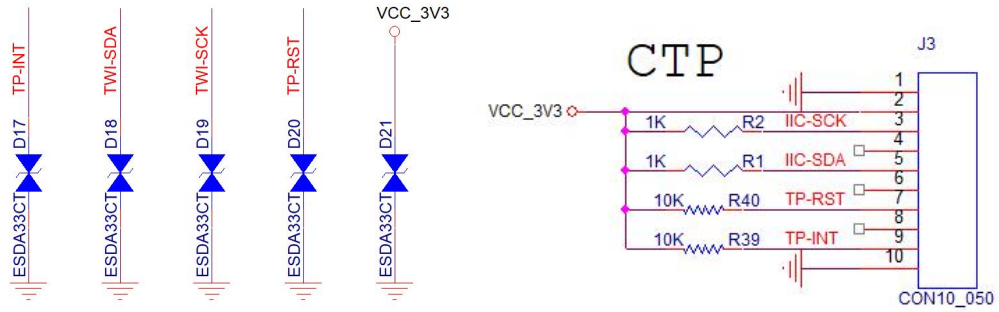
Resistive Touch Screen (RTP)

- 12-bit SAR type analog-to-digitalconverter
- 4-wire I/F
- Sampling frequency: 2MHz
- Median and averaging filter to reduce noise
- Reference Design



Capacitive Touch Screen (CTP)

- Reference Design

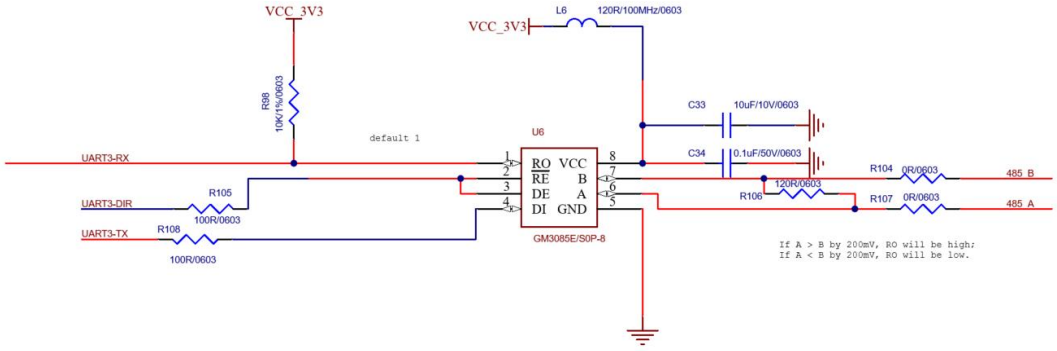


UART

- 2 UART for user
- Compatible with industry-standard 16550 UART
- Baud rate: up to 3Mbps.
- Data bits: 8, parity bit: none, stop bits:1
- 4096-Bytes receive data cache

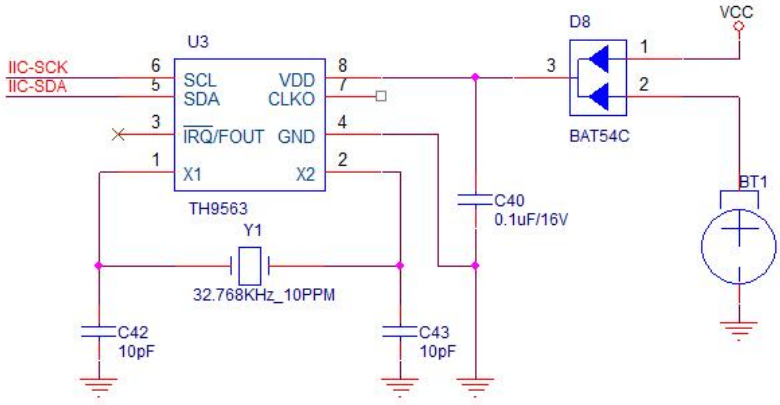
485

- 485 speed can reach 3Mbps.
- Reference Design



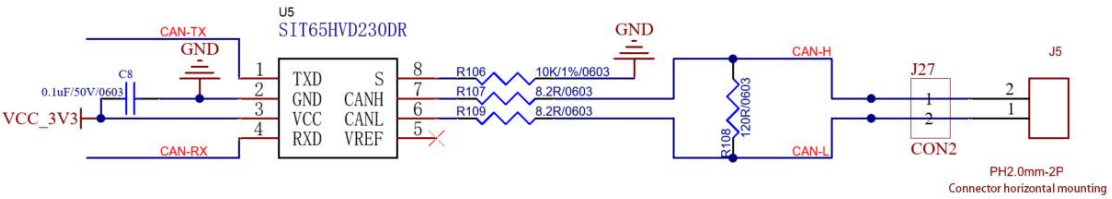
I2C

- 2 user I2Cs.
- Can mount multiple devices simultaneously.
- RTC - supported ICs: PCF8563, TH9563, TCS9563, HYM8563.
- Reference Design



CAN

- Reference Design



2.7 Firmware update

- **Via TF card**

Update firmware via TF card

- Download the firmware to a TF card, and then plug in and restart.

3. PIN Description

3.1 Pin Table

Following table describes the X2A1 pin characteristics from seven aspects: *Pin Num, Pin Name, Default Function, Type, Reset* State, Default Pull Up/Down and so on.

(1) ***Default function:*** defines the default function of each pin, especially for pins with multiplexing functions; pins marked with port numbers in Function 2 can be used as GPIOs when other multiplexing functions are not in use.
(2)***Pin types:*** O for output, I for input, I/O for input/output, A for analog, AI for analog input, AO for analog output, AI/O for analog input/output, OD for Open-Drain, P for power and G for ground;
(3)***Reset state:*** defines the terminal state during reset. Z represents high impedance.
(4)***Default pull - up/pull - down:*** defines whether there is an internal pull - up or pull - down resistor. Unless otherwise specified, the pin is floating by default and can be configured as pull - up or pull - down.

Pin Num(1)	Default Function	Function 2	Function 3	Pin Type(2)	Reset State(3)	Default Pull Up/ Down(4)	Description
SD Card							
4	SDC-DET			I/O	Z	-	Used for TF card.
67	SDC-D0			I/O	Z	-	
68	SDC-CLK			I/O	Z	-	
1	SDC-CMD			I/O	Z	-	
Debug and Reset							
56	Debug_TX				Z		Debug interface, which can check the system operating status. UART 3.3V, baud rate 115200. Keeping Debug_TX grounded during startup can force the device into update mode.
57	Debug_RX				Z		

50	RESET#				-	-	Enabled by low level.
GPIO/Peripherals							
2	PWM0_A	PC4	I2C1_SCL	I/O	Z	-	16 - bit PWM, with a maximum frequency of 24MHz. When PWM0_A and PWM0_B work simultaneously, their frequencies must be the same.
3	PWM0_B	PC5	I2C1_SDA	I/O	Z	-	
36	BUZZER	PE12		I/O	Z	-	Connected to an active buzzer.
37	DSPK0	PE13		I/O	Z	-	Digital PWM audio output port.
44	PA-EN	PB6	UART1_TX	I/O	Z	-	Automatically enables/disables the audio power amplifier. A logic high level is used to turn it off.
45	LCD-CS	PB7	UART1_RX	I/O	Z	-	This pin is used for LCDs that require SPI initialization.
46	LCD-RST	PB8	UART1_RTS	I/O	Z	-	This pin is used for LCDs that require initialization.
47	UART3_DIR	PB9		I/O	Z	-	Connected to the direction pin of the 485 chip during 485 communication.
48	UART3_TX	PB10		I/O	Z	-	Used for UART or RS485, 3.3V TTL.
49	UART3_RX	PB11		I/O	Z	-	
58	I2C1_SCL	PA2	ADC2/CAN1_T	I/O	Z	-	A 2 - 5KΩ pull-up

			X /UART1_TX /UART2_CTS				resistor is required.
59	I2C1_SDA	PA3	ADC3/CAN1_ RX/UART1_RX /UART2_RTS	I/O	Z	-	A 2 - 5KΩ pull-up resistor is required.
60	UART2_TX	PA4	ADC4/CAN0_T X	I/O	Z	-	3.3V TTL
61	UART2_RX	PA5	ADC5/CAN0_ RX	I/O	Z	-	3.3V TTL
66	STATUS-LED	PC0		I/O	Z	-	Indicates the working status of the system. For example, when no screen is connected, it can indicate the download completion status, etc.
LCD							
5	LCD-PWM			I/O	Z		Enable/disable or adjust the LCD backlight brightness.
6	LCD-DE			I/O	Z		
7	LCD-VSYNC			I/O	Z		
8	LCD-HSYNC			I/O	Z	-	The RGB order of the LCD is determined by the pull-up/down states of Config-RB/Config 16-23/Config8-1 5/Config0-7 during power-on. The pull-up/down resistors cannot be omitted. Config-RB: Swap RB; Config16-23: Mirror the color order of PD16 -
10	LCD-CLK			I/O	Z	-	
12	LCD-R7	PD23		I/O	Z	-	
13	LCD-R6	PD22		I/O	Z	-	
14	LCD-R5	PD21		I/O	Z	-	
15	LCD-R4	PD20	Config-RB	I/O	Z	-	
16	LCD-R3	PD19	Config16-23	I/O	Z	-	
17	LCD-R2	PD18		I/O	Z	-	
18	LCD-R1	PD17		I/O	Z	-	
19	LCD-R0	PD16		I/O	Z	-	
20	LCD-G7	PD15		I/O	Z	-	
21	LCD-G6	PD14		I/O	Z	-	
22	LCD-G5	PD13		I/O	Z	-	
23	LCD-G4	PD12	Config8-15	I/O	Z	-	
24	LCD-G3	PD11	Config0-7	I/O	Z		
25	LCD-G2	PD10		I/O	Z		
26	LCD-G1	PD9		I/O	Z		

27	LCD-G0	PD8		I/O	Z		PD23; Config8-15: Mirror the color order of PD8 - PD15; Config0-7: Mirror the color order of PD0 - PD7.
28	LCD-B7	PD7		I/O	Z		
29	LCD-B6	PD6		I/O	Z		
30	LCD-B5	PD5		I/O	Z		
31	LCD-B4	PD4	LCDInit-CLK	I/O	Z		
32	LCD-B3	PD3	LCDInit-SDA	I/O	Z		
33	LCD-B2	PD2		I/O	Z		
34	LCD-B1	PD1		I/O	Z		
35	LCD-B0	PD0		I/O	Z		
Touch Screen							
62	CTP_SCL	PA8	RTP-XR	A	-	-	Used for capacitive/resistive touch screens.
63	CTP_SDA	PA9	RTP-YB	A	-	-	
64	CTP-RST	PA10	RTP-XL	A	-	-	
65	CTP-INT	PA11	RTP-YT	A	-	-	
QSPI/GPIO							
38	SPI0_WP	PB0		I/O	Z		QSPI/GPIO interface.
39	SPI0_MISO	PB1		I/O	Z		
40	SPI0_CS0	PB2		I/O	Z		
41	SPI0_HOLD	PB3		I/O	Z		
42	SPI0_CLK	PB4		I/O	Z		
43	SPI0_MOSI	PB5		I/O	Z		
Power							
53, 54	VCC			P	-	-	3.3±0.3V input
55	LDO_2V5			P	-	-	2.5V output, used to provide a reference power supply for audio output.
9, 11, 51, 52	GND			P	-	-	-

3.2 Detailed Pin Description

Pin Name	Description	Type
Touch panel		
RTP_YT	Resistive touch screen Y-axis top input	AI
RTP_YB	Resistive touch screen Y-axis bottom input	AI
RTP_XR	Resistive touch screen X-axis right input	AI

RTP_XL	Resistive touch screen X-axis left input	AI
Other Signals		
RESET#	Chip reset signal, active low	I
PWM	Pulse width modulation signal output	O
UART		
UART_TX	UART data transmission	O
UART_RX	UART data reception	I
SDC		
SDC_D0	SD/MMC/SDIO data bit	I/O
SDC_CLK	SD/MMC/SDIO clock	O
SDC_CMD	SD/MMC/SDIO command	I/O
IIC(Open-Drain)		
IIC_SCL	IIC clock	I/O
IIC_SDA	IIC data	I/O

4. Electrical Characteristics

4.1 Maximum Ratings

Symbol	Parameter	Min	Max	Unit
Tstg	Storage Temperature	-20	125	℃
II/O	Input/output Current for Input and Output	-55	60	mA
VCC	Power Supply for VCC and I/O	-0.3	3.6	V

4.2 Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
Tj	Junction Temperature	-20	-	105	℃
Ta	Ambient Operating Temperature [Commercial grade]	-20	-	85	℃
VCC	Power Supply	3.0	3.3	3.6	V
P	Module Power Consumption			0.5	W

4.3 DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-Level Input Voltage	0.7 * 3.3	-	3.3 + 0.3	V
V_{IL}	Low-Level Input Voltage	-0.3	-	0.3 * 3.3	V
R_{PU}	Input pull-up resistance		33		KΩ
R_{PD}	Input pull-down resistance		33		KΩ
I_{IH}	High-Level Input Current	-	-	10	uA
I_{IL}	Low-Level Input Current	-	-	10	uA
V_{OH}	High-Level Output Voltage	3.3-0.3	-	3.3	V
V_{OL}	Low-Level Output Voltage	0	-	0.3	V
IoH	High - level driving capability	8	-	60	mA
IoL	Low - level driving capability	8	-	55	mA
I_{OZ}	Tri-State Output Leakage Current	-10	-	10	uA
C_{IN}	Input Capacitance	-	-	5	pF
C_{OUT}	Output Capacitance	-	-	5	pF

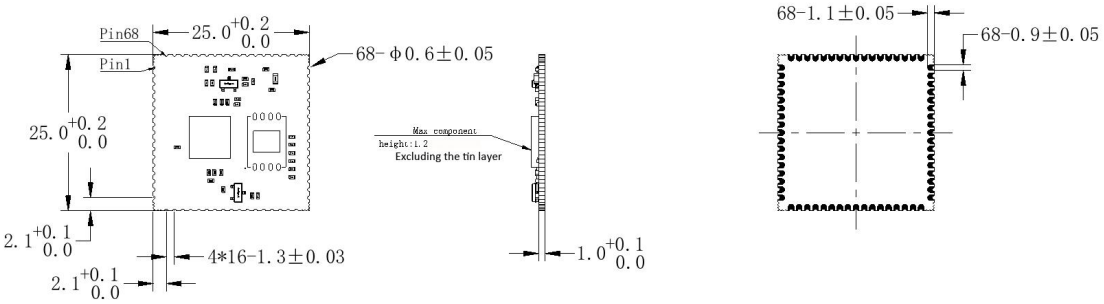
4.4 Power Up/ Down Sequence

No special restrictions for power up/ down sequence.

5. Package Dimension

5.1 Structure

The following figure shows the top, bottom, and side views of the X2A1 package dimensions.

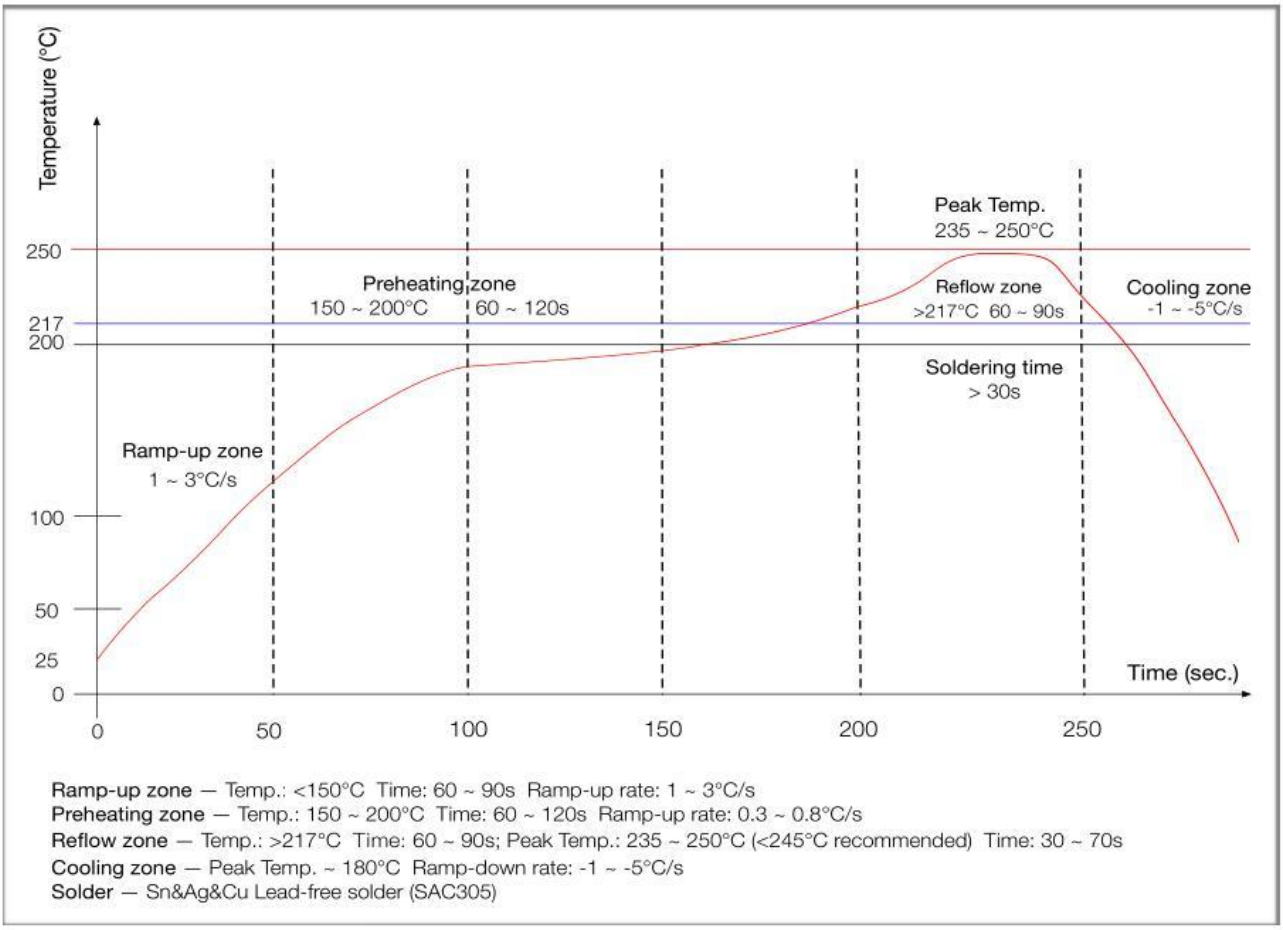


Number	Number of Pins	Lead - free (RoHS) **(1)**	REACH	Moisture Sensitivity Level **(2)**	Plating Information
X2A1	68	YES	YES	Level-3-260C-168 HR	ENIG

(1) Lead - free (RoHS): TDO's term "lead - free" means that semiconductor products meet the current RoHS requirements for all 6 substances, including that the weight percentage of lead in homogeneous materials shall not exceed 0.1%. If designed for high - temperature soldering, TDO's lead - free products are applicable to the specified lead - free process.

(2) Moisture Sensitivity Level: Humidity sensitivity level and peak soldering temperature classified according to JEDEC industry standards.

6. Reflow Profile



Ramp-up zone — Temp.: <150°C Time: 60 ~ 90s Ramp-up rate: 1 ~ 3°C/s
Preheating zone — Temp.: 150 ~ 200°C Time: 60 ~ 120s Ramp-up rate: 0.3 ~ 0.8°C/s
Reflow zone — Temp.: >217°C Time: 60 ~ 90s; Peak Temp.: 235 ~ 250°C (<245°C recommended) Time: 30 ~ 70s
Cooling zone — Peak Temp. ~ 180°C Ramp-down rate: -1 ~ -5°C/s
Solder — Sn&Ag&Cu Lead-free solder (SAC305)