PAP7501V USB2.0 PC Camera Controller

General Description

The PAP7501V High-Speed USB2.0 Camera Controller is a highly integrated and cost-effective solution for USB2.0 PC-Camera based applications. It is fully compliant with USB Video Class 1.1 and USB audio class 1.0 standard.Internal controller can be power-up loaded from external EEPROM. This allows customization of VID, PID, product string, sensor parameters…etc.

Features

.USB Features

- USB 2.0 and 1.1 compliance(high speed and full speed transceiver).
- USB video class 1.1 compliance.
- USB audio class 1.0 compliance.

.Micro Controller Features

- Built-in 8 bit micro controller with 40K-byte of mask ROM and 24K-byte SRAM.
- Firmware supports AE, AWB, and USB protocol.
- Programmable codes uploaded from serial EEPROM/Flash.

.Sensor Controller Features.

- Support up to VGA CMOS image sensors.
- Support 8 bit raw image data or YUV2 input from CMOS sensor.
- On chip color processor engine.
- Built-in MJPEG encoder.
- Support 2 wires serial interface for sensor control.

. Audio Controller Features

- Audio interface: -Built in 10 bit mono audio ADC for audio recording through microphone.
- -Sampling rate @16/48kHZ, resolution 16 bits format.
- Recording, mute and volume control.

. Miscellaneous Features

- Power consumption: < 100mA
- USB 5V power in, on-chip 3.3V regulator for IO PAD and PHY, on-chip 1.8V regulator for core logic.

Key Specification

Supply Voltage	5.0V ± 10%
Resolution	Up to 640 (H) x 480 (V)
Frame Rate	Up to 30fps
System Clock	12MHz
Power consumption	<100mA

Ordering Information

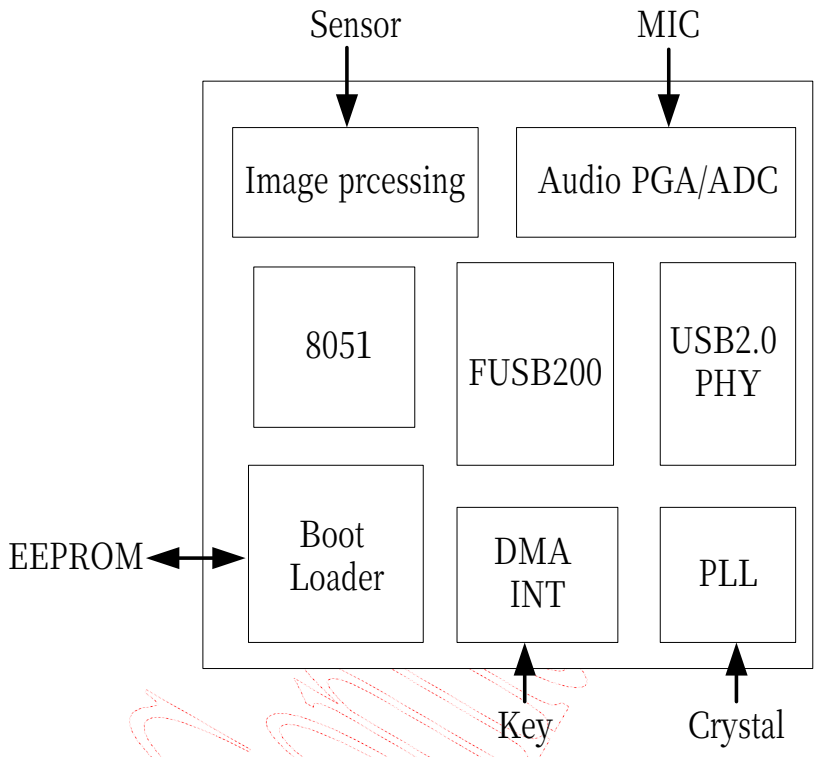
Order number	Package Type	Package Size(mm)
PAP7501V	48-pin QFN	5.53 x 5.53

PixArt Imaging Inc.
E-mail: fae_service@PixArt.com.tw

1. Pin Assignment

Pin#	Name	Type	Description
1	GND33A_PLL_I	GND	Ground for PLL
2	VDD5MA	PWR	5V Power for analog circuit
3	VDD28A_MIC	BYPASS	Analog power for Audio MIC, 2.8V
4	VCOM	BYPASS	Microphone common mode voltage reference
5	MIC_P	IN	Microphone positive input
6	MIC_N	IN	Microphone negative input
7	VDD33A_PGA	BYPASS	Analog power for Audio PGA, 3.3V
8	VSSA	GND	Microphone GND
9	VDD33A_ADC	BYPASS	Analog power for Audio ADC, 3.3V
10	VSSQ	GND	Digital ground
11	RSTN	IN	Chip power up reset (Internal pull-up 100Kohm)
12	SEN_CSB	OUT	Chip select of EEPROM
13	KEY	IN	Snapshot control signal (Active Low, internal pull-up 100Kohm)
14	GPIO4	I/O	General purpose I/O
15	VDD18K	BYPASS	Logic power for digit circuit, 1.8V
16	VDD33Q	BYPASS	Logic power for digit circuit, 3.3V
17	SEN_CLK	OUT	Clock output for sensor
18	SEN_SCL	OUT	I2C clock
19	SEN_SDA	I/O	I2C data
20	I_VSYNC	IN	Vertical synchronization signal
21	I_HSYNC	IN	Horizontal synchronization signal
22	EPR_CSB	IN	Chip Select of EEPROM
23	EPR_SO	IN	Data out of EEPROM
24	EPR_SI	OUT	Data input of EEPROM
25	EPR_SCK	OUT	Serial clock of EEPROM
26	I_PXD7	IN	Sensor digital data input
27	I_PXD6	IN	Sensor digital data input
28	I_PXD5	IN	Sensor digital data input
29	I_PXD4	IN	Sensor digital data input
30	I_PXD3	IN	Sensor digital data input
31	I_PXD2	IN	Sensor digital data input
32	I_PXD1	IN	Sensor digital data input
33	I_PXD0	IN	Sensor digital data input
34	I_PXCLK	IN	Sensor pixel clock input
35	VDD5MD	PWR	5V power for digit circuit
36	VDDAYS	BYPASS	Logic power for digit circuit, 2.5V
37	VDD5MV	PWR	5V power for PHY circuit
38	VSSQ	GND	Digital ground
39	VDD33A_HSRT_O	BYPASS	Analog power for TX/RX
40	VDD18K	BYPASS	Logic power for digit circuit, 1.8V
41	OSC_IN	IN	Crystal input
42	OSC_OUT	OUT	Crystal output
43	VDD33A_HSRT_I	BYPASS	Analog power for TX/RX
44	GND33A_HSRT_I	GND	Ground for USB TX/RX
45	RRET	IN	Reference supply current for PHY
46	DM	I/O	DM for USB PHY
47	DP	I/O	DP for USB PHY
48	VDD33A_PLL_I	BYPASS	Analog power for PLL

2.Block Diagram



The PAP7501V High-Speed USB2.0 Camera Controller is a highly integrated and cost-effective solution for USB2.0 PC-Camera based applications. It is fully compliant with USB Video Class 1.1 and USB audio class 1.0 standard. It integrates micro-controller, color processor engine, MJPEG encoder, and 24K-byte programmable SRAM.

3. Specifications

Absolute Maximum Ratings

Exceeding the Absolute Maximum Ratings shown below invalidates all AC and DC electrical specifications and may result in permanent device damage.

Symbol	Parameter	Min	Max	Unit	Notes
T_{STG}	Ambient storage temperature	-25	125	°C	
V_{DD}	DC supply voltage	-0.5	5.5	V	
V_{IN}	DC input voltage	0.5	3.8	V	
V_{OUT}	DC output voltage	-0.5	3.8	V	
ESD	ESD Rating, Human Body model		2	kV	

Recommend Operating Condition

Symbol	Parameter		Min	Typ.	Max	Unit	Notes
T_A	Temperature Range	Operation	-10	-	70	°C	
		Stable Image	0	-	50	°C	
V_{DD}	Power supply voltage		4.5	5.0	5.5	V	
F_{CLK}	System clock frequency		-	12.0	-	MHz	

DC Electrical Characteristics (Typical values at 25°C, V_{DD} =5.0V, F_{CLK}=12.0MHz)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Notes
Type: PWR						
I_{DD}	Operating Current	-	70	-	mA	@30 frame/sec
I_{PWDN}	Power Down current			500u		
Type: IN & I/O, Reset						
V_{IH}	Input voltage HIGH	1.9	-		V	
V_{IL}	Input voltage LOW		-	1.3	V	
Type: OUT & I/O						
V_{OH}	Output voltage HIGH	0.9 x V_{DD33Q}	-	-	V	
V_{OL}	Output voltage LOW	-	-	0.1 x V_{DD33Q}	V	

4. Packing Information

4.1 Product Ordering Information

Product Number : PAP7501 V

V: QFN 6*6 48L with lead-free process

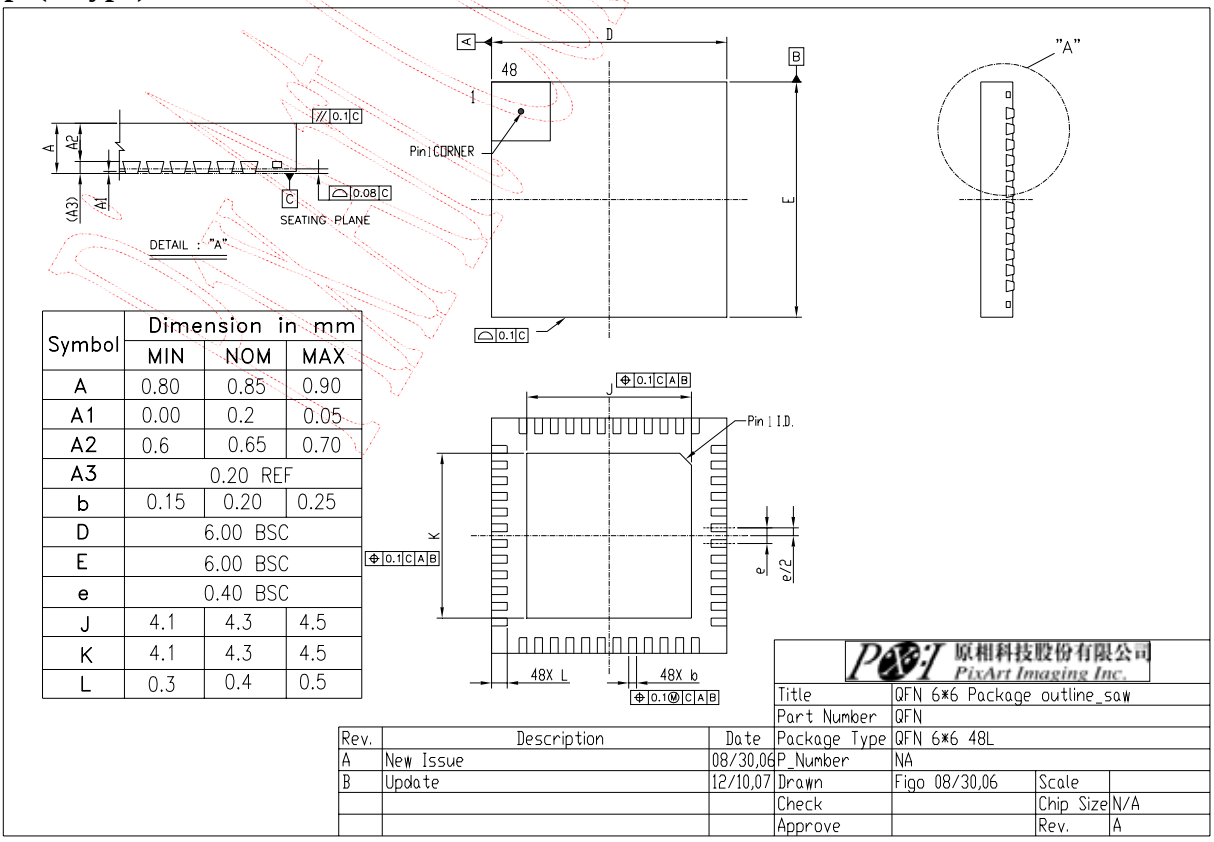
PAP7501: Part Number

4.2 Material List

Items	Process	Material
1	Leadframe Material	Copper
2	Die Attach	Conductive Epoxy
3	Wire Bonding	4N Φ1.0 mil Gold Wire
4	Cover	Epoxy Molding Compound
5	Marking	Laser or Ink
6	Lead Finish	Pd/Ni/Au plating

4.3 Package Outline Dimension

Saw Type(A type):



Symbol	Dimension in mm		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.2	0.05
A2	0.6	0.65	0.70
A3		0.20 REF	
b	0.15	0.20	0.25
D		6.00 BSC	
E		6.00 BSC	
e		0.40 BSC	
J	4.1	4.3	4.5
K	4.1	4.3	4.5
L	0.3	0.4	0.5

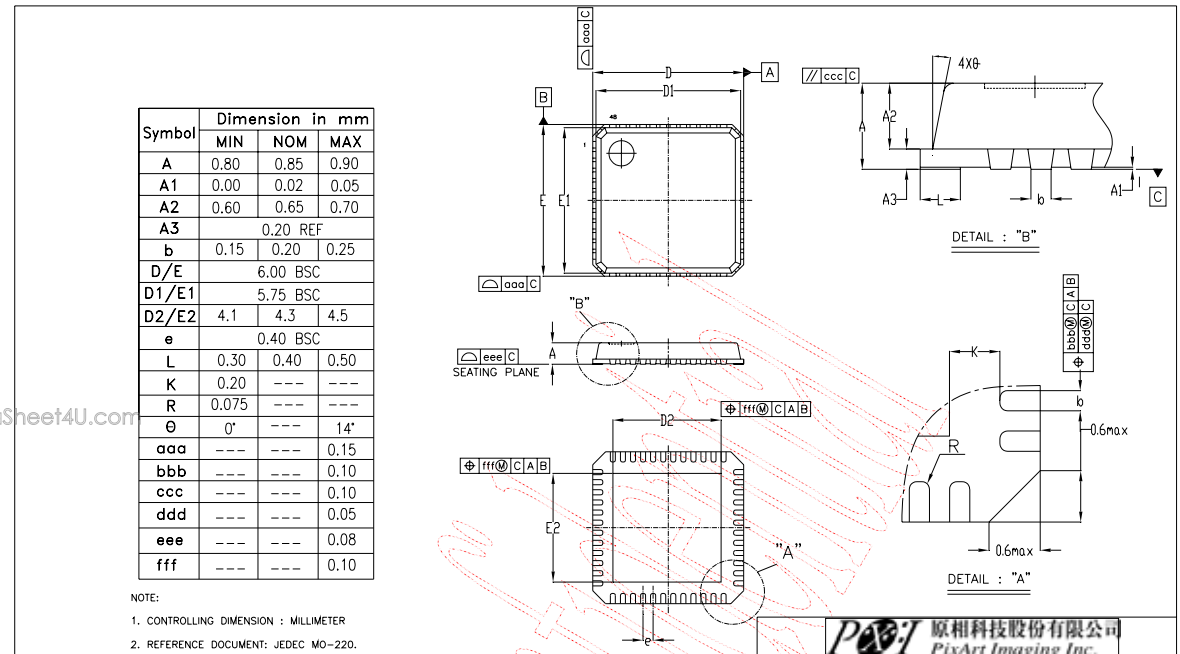
Rev.	Description	Date
A	New Issue	08/30,06
B	Update	12/10,07

原相科技股份有限公司 PixArt Imaging Inc.			
Title	QFN 6*6 Package outline_saw		
Part Number	QFN		
Package Type	QFN 6*6 48L		
P_Number	NA		
Drawn	Figo 08/30,06	Scale	
Check		Chip Size	N/A
Approve		Rev.	A

Punch Type(U type):

Symbol	Dimension in mm		
	MIN	NOM	MAX
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A2	0.60	0.65	0.70
A3		0.20 REF	
b	0.15	0.20	0.25
D/E		6.00 BSC	
D1/E1		5.75 BSC	
D2/E2	4.1	4.3	4.5
e		0.40 BSC	
L	0.30	0.40	0.50
K	0.20	---	---
R	0.075	---	---
Θ	0°	---	14°
aaa	---	---	0.15
bbb	---	---	0.10
ccc	---	---	0.10
ddd	---	---	0.05
eee	---	---	0.08
fff	---	---	0.10

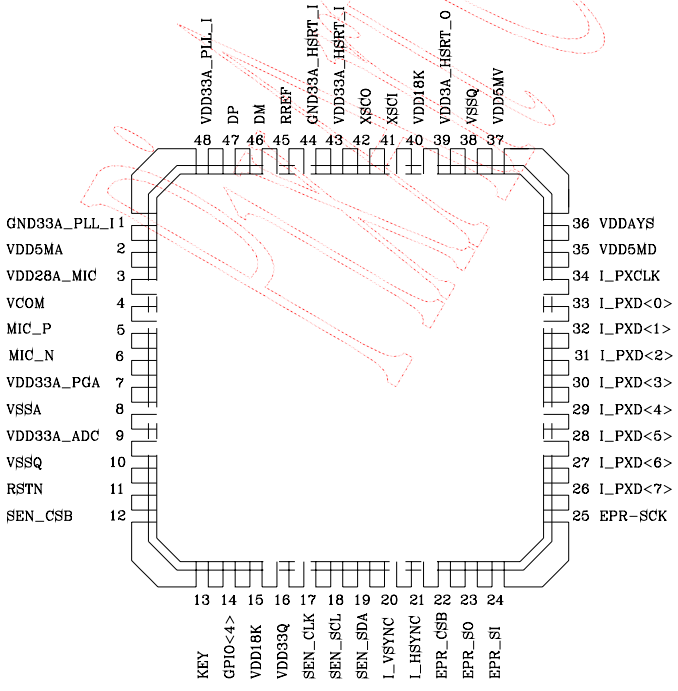
NOTE:
1. CONTROLLING DIMENSION : MILLIMETER
2. REFERENCE DOCUMENT: JEDEC MO-220.



Rev.	Description	Date
A	New Issue	02/20,06
B	Update	10/30,07

Title	QFN 6*6 Package outline		
Part Number	NA		
Package Type	QFN 6*6 48L		
P_Number	NA		
Drawn	Figo 02/20,06	Scale	
Check		Chip Size	N/A
Approve		Rev.	A

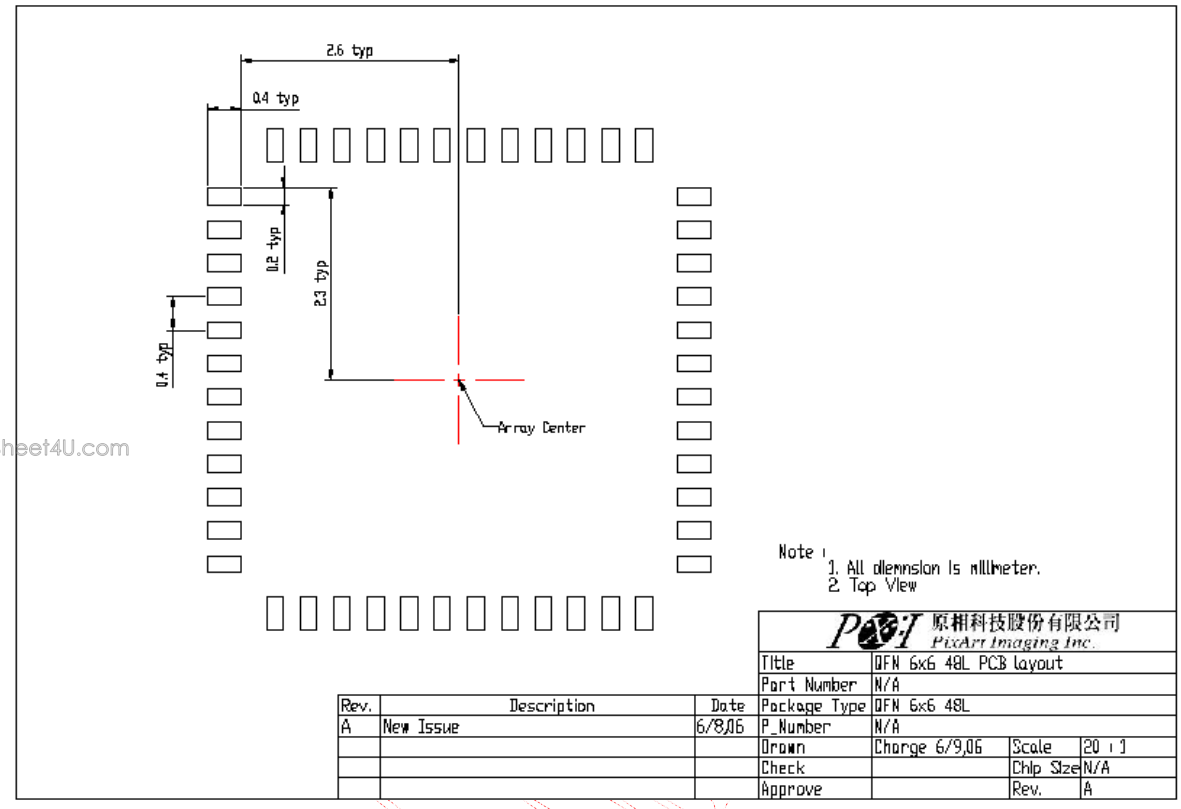
4.4 Pin Assignment



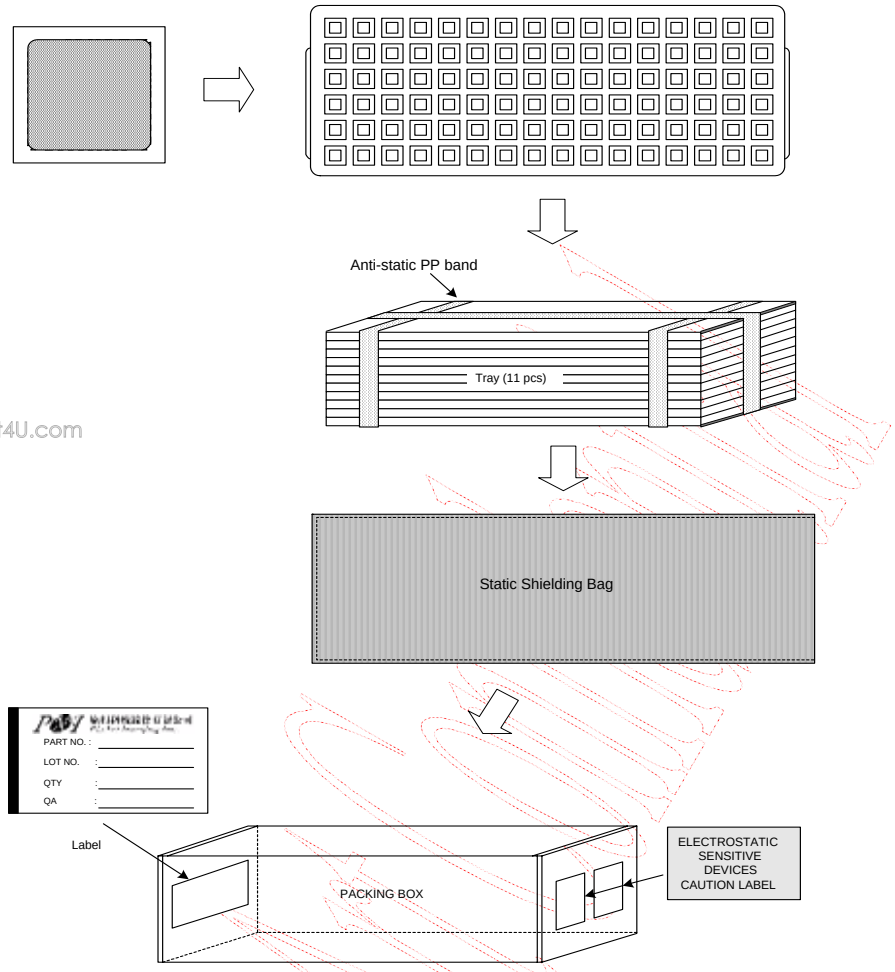
Rev.	Description	Date
A	New Issue	06/20,07
B	Modify W/B for audio	09/03,07

Title	PAP7501V Pin Assignment		
Part Number	PAP7501V		
Package Type	QFN 6*6 48L		
P_Number	PHP092C		
Drawn	Figo 09/03,07	Scale	
Check		Chip Size	NA
Approve		Rev.	A

4.5 Recommended Layout PCB



4.6 Packing Information



One packing box capacity

One packing box	**4900 units**
Remark	(490 units x 10 Trays)

Tray durable temperature = **150℃**

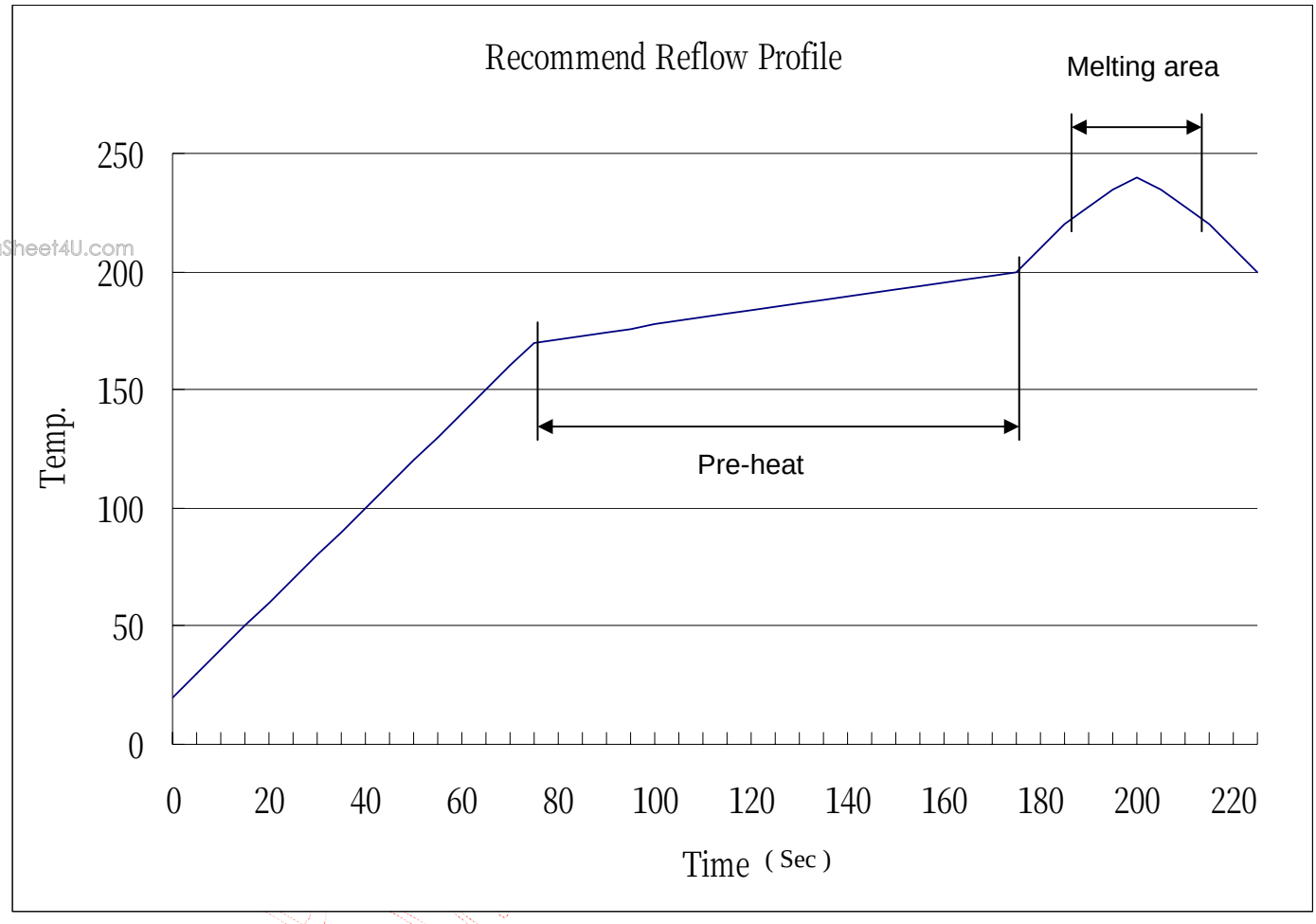
Note: 1. When the units is out of dry packing, should be operation at :

Temperature = ↓30℃ , Humidity = ↓60% RH

2. If units is out of dry packing over 168 hrs, before go through infrared reflow process must be bake with 125℃ ±5℃ @24hrs, to remove the moisture.

4.7 Recommended Condition For Infrared Reflow

Carefully observe the mounting conditions, recommended temperature profile when Mounting infrared reflows is show in the figure below.



Recommend Pb-free solder paste vender & type : 1. Almit LFM-48W TM-HP
2. Senju M705-GRN360-K

Programming rate 1.5~2.5 °C/sec	Pre-heat 170~200°C 90 +/- 30 sec	Melting area >220°C 30~50sec with peak temperature 230~245°C

4.8 Handling precaution for the prevention of ESD

Explained below are procedures that must be taken in fabrication to prevent the electrostatic destruction of semiconductor devices.
The following basic rules must be obeyed.

1. Equalize potentials of terminals when transporting or storing.
2. Equalize the potentials of the electric device, work table, and operator's body that may come in contact with the IC's.
3. Prepare an environment that does not generate static electricity.
   One method is keeping relative humidity in the work room to about 50%.

Operator

1. The operator should wear wrist straps.
   (Must maintain electric contact with bare skin)
2. Wear cotton or antistatic-treated materials clothes and gloves.
3. When a conductive mat will be used, must be ware conductive shoes.
4. Do not touch the IC's leads. Touch the body of IC's when holding.

Equipment and tools

1. Any electrical equipments and tools located on the work table surface must be isolated from The work table surface, and ground the equipments and tools that are to be used.
2. Work table surface must be use conductive material or conductive mat.
   (Should be ground through a 1MΩ resistor)

Transporting, storing and packing

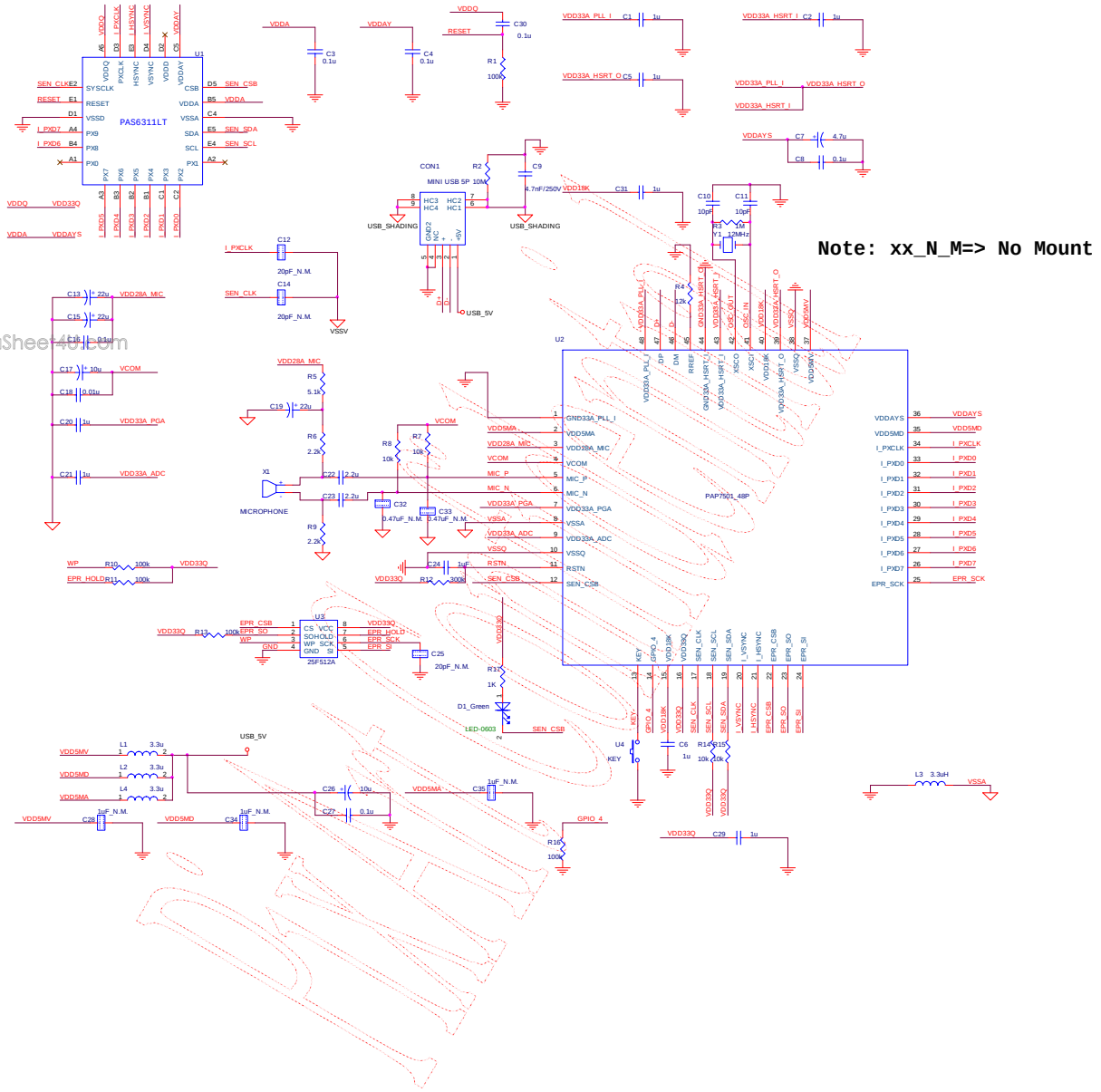
1. Use conductive IC's tray, and conductive or shielding bag to store IC's.

Soldering operation

1. Use a soldering iron with a grounding wire.
2. When perform manual soldering operation, the operator should wear wrist straps.
3. Do not use the desoldering pump when removing the IC's from the PCB board. Use a solder-wick or equivalent.

5. Reference Application Circuit

5.1 PAP7501 with PAS6311



6. Update History

Version	Update	Date
V1.0	Creation, Preliminary 1st version	01/17/2008
V1.1	Update circuit and Package information, Add C30~C35, R17, D1, Change R5 to 5.1k ohm, R6 and R9 Change to 2.2k ohm	05/06/2008