SiliconMotion

LUMINA FAMILY

SM3732

USB2.0 PC Camera Controller

Preliminary Datasheet

Revision 0.2	Mar 2011

Revision History

Revision	Date	Description
0.1	Dec 30, 2010	Preliminary release
0.2	Mar 9, 2011	• Updated the pin names of Pin 8~10, 15, 16, and 23 in Chapter 2. • Updated the pin descriptions of Pin 1~4, 7~10, 23, 25, 33, 34, and 39 in Chapter 2. • Updated Reference Circuit in Chapter 3.

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1. Overview

1.1 Product Description

The SM3732 is a highly integrated single chip image controller for USB 2.0 PC camera solution. It supports CMOS image sensor with up to 5.0 mega-pixels. With the embedded clock oscillation circuit, Finite Time Programming memory, and LDO, the SM3732 can reduce the BOM cost and IC real estate for camera module design, resulting in smaller form factor and more competitive camera products to the market. The SM3732 supports UVC (USB Video Class) in Windows XP (Service Pack 2/3), Windows Vista and Windows 7 environments, making the PC camera a convenient plug-and-play USB PC camera just like a USB disk.

1.2 Key Features

- USB Specification Revision 2.0 and 1.1 compliant
- USB Endpoints: Control pipe, Isochronous IN, Interrupt IN
  - Supports isochronous video pipe up to 24 MB/s
- Embedded Clock Oscillation Circuit for Lower BOM Cost
- Embedded Finite Time Programmable (FTP) memory can replace external EEPROM for storage of:
  - VID/PID customized information
  - Tuning parameters of sensor image quality
  - Firmware upgrade
- Sensor Interface
  - Supports 1.3 megapixels CMOS sensor: RGB (Bayer-pattern), YUV, and MJPEG data input
  - Supports 5.0 megapixels CMOS sensor: YUV data input
  - 8-bit/10-bit parallel bus
  - Pixel clock up to 96 MHz (YUV data input) and 80 MHz (Raw data input)
  - Supports CMOS sensor clock and power down mode
- Image Processing Functions
  - Auto exposure statistics supports 25 windows
  - Histogram statistics
  - Auto white balance statistics
  - Auto focus statistics
  - Automatic bad pixel compensation
  - Adaptive denoise function
  - Separate lens shade compensation for R, G, B
  - Separate R, G, B raw data gamma
  - Black offset compensation
  - Adaptive color interpolation

  - Adaptive Gb/Gr balance
  - Edge enhancement
  - Color correction
  - Gamma correction
  - Brightness/Contrast/Hue/Saturation
  - Bi-linear scale up/scale down
  - Programmable digital zoom (64 segments max.)

- Motion JPEG (MJPEG) Compression
  - Supports 1280 x 1024 (1.3 megapixels)
  - Programmable quantization table for dynamic compression ration
  - High frame rate performance
    - 60 fps @ VGA and under VGA
    - 30 fps @ 1.3M/ HD 720P (including scale up from VGA)

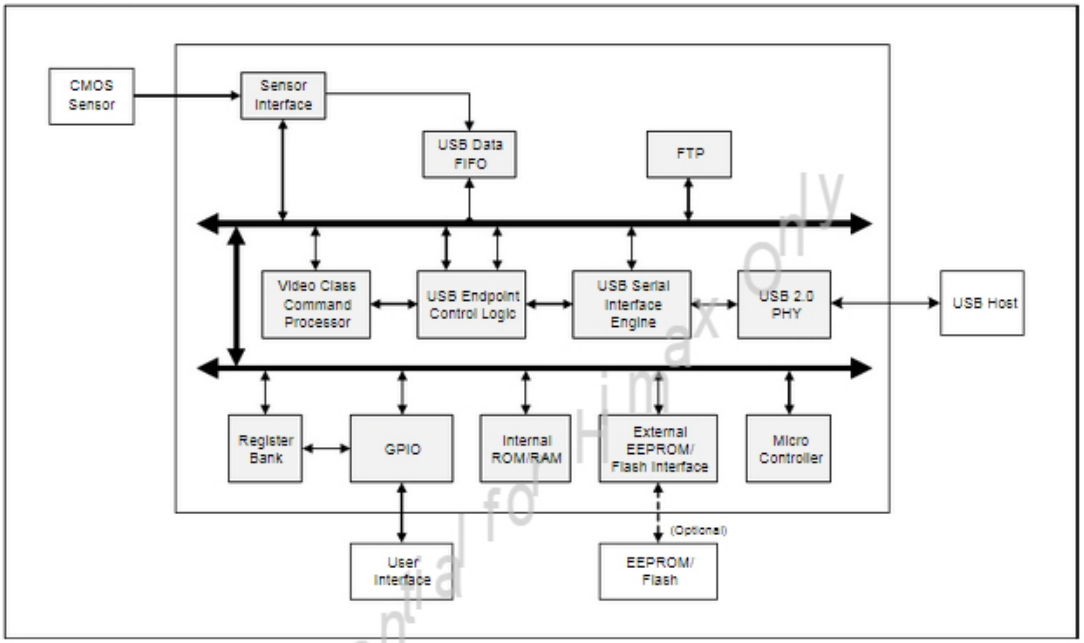
- Output Format Support
  - YUY2
  - 8-bit/10-bit RGB raw data
  - MJPEG 4:2:2

- Compliant to USB Video Class V1.1 and the Property Page
  - Brightness control
  - Contrast control
  - Hue control
  - Saturation control
  - Sharpness control
  - Gamma control
  - Privacy control
  - Digital zoom/pan/tilt

- Serial IIC Interface Supports External EEPROM (optional)
- Supports 4 GPIO pins and 1 GPO pin
- Embedded LDO 3.3 V/2.8V/1.8V/1.5V for power supply requirements of a variety of sensors
- Supports operation systems: Windows 7, Windows Vista, Windows XP, Mac OSX 10.4 or later, and Linux Kernel V2.6 and above

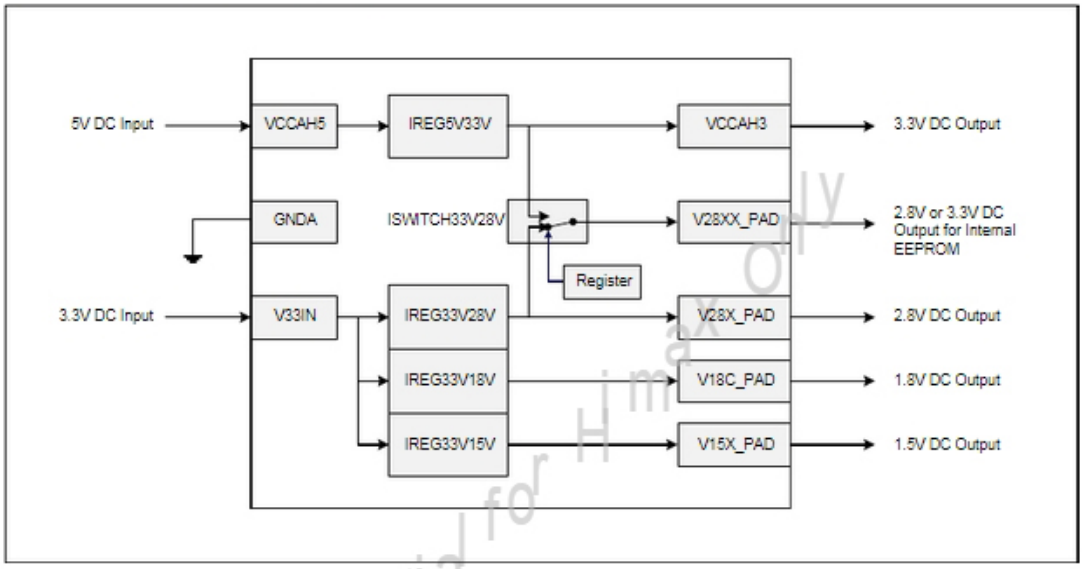
1.3 Block Diagram

Figure 1: SM3732 Block Diagram



1.4 Regulator Topology

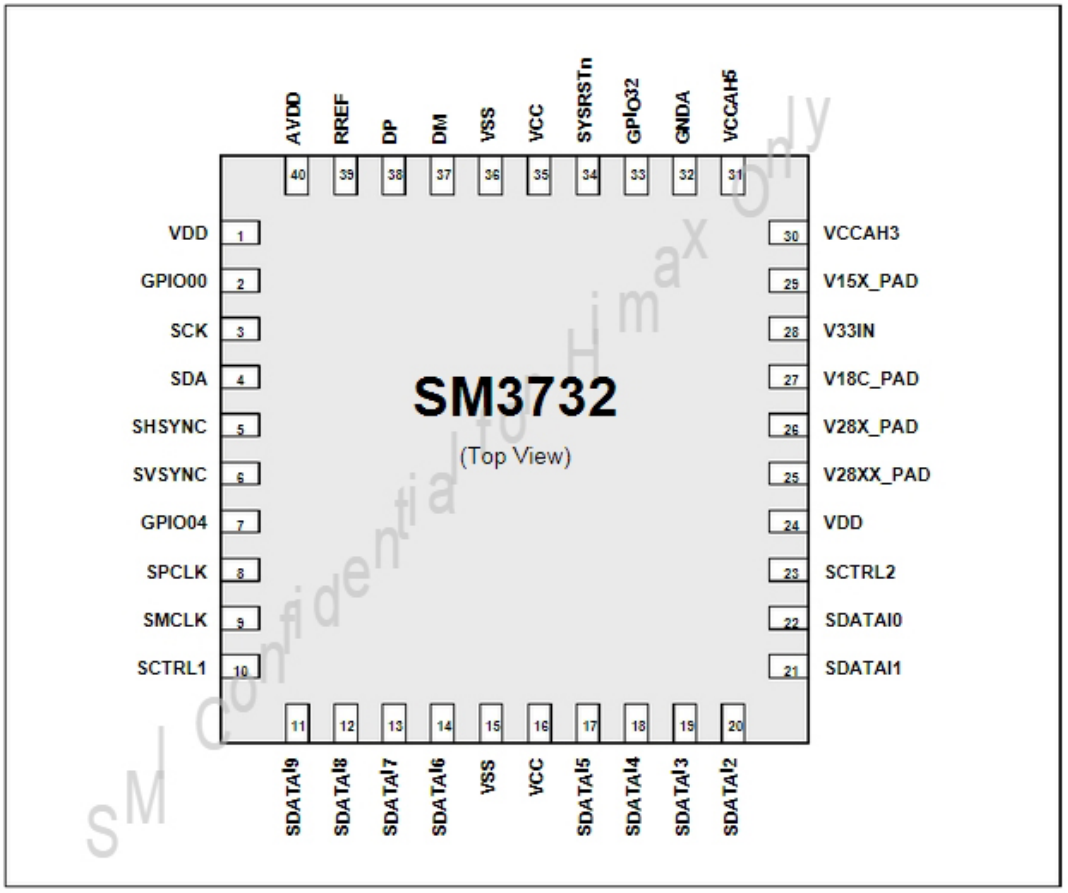
Figure 2: SM3732 Regulator Topology



2. Pin Assignments and Signal Descriptions

2.1 Pin Assignments

Figure 3: SM3732 Pin Assignments



2.2 Signal Description Table

Table 1: Signal Descriptions

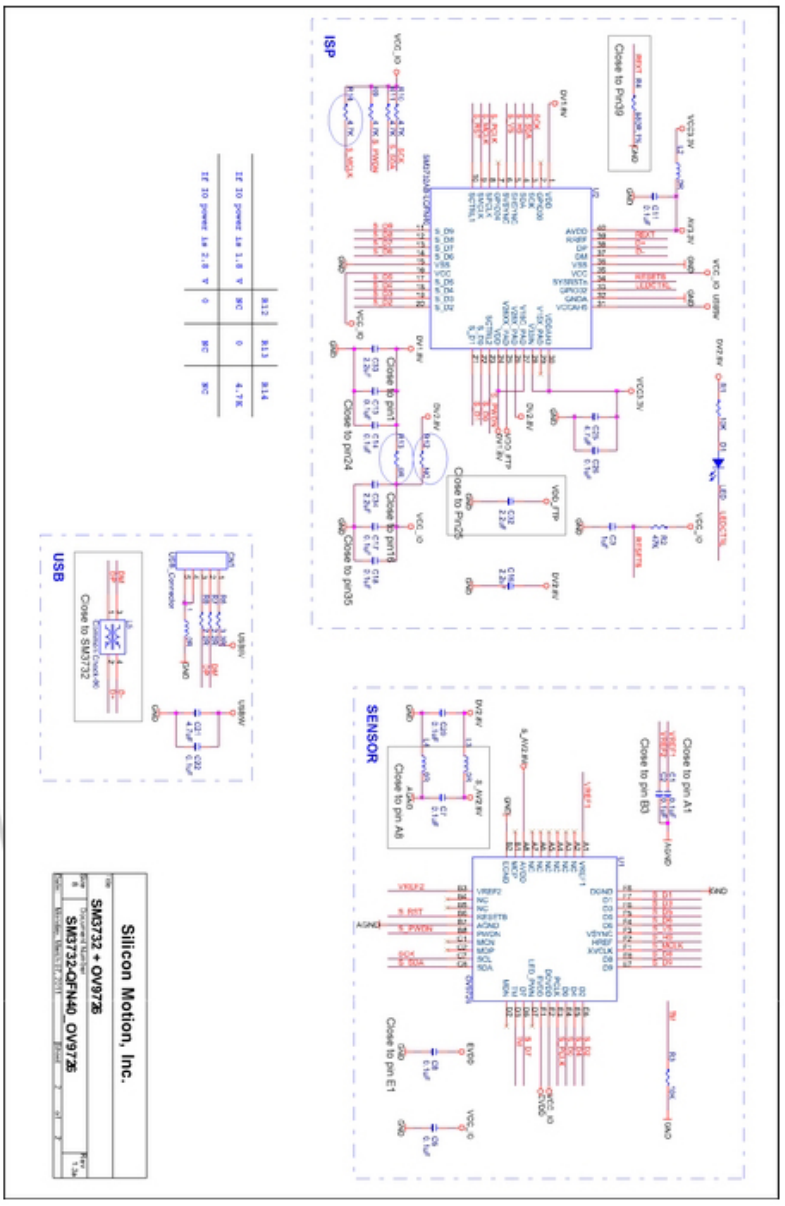
Pin No.	Signal	Type	Description
1	VDD	P	Core power 1.8V input.
2	GPIO00	I/O	Embedded CPU GPIO0[0].
3	SCK	O	Serial bus clock. Connect to VCC with an external 4.7 kΩ pull-up resistor.
4	SDA	I/O	Serial bus data. Connect to VCC with an external 4.7 kΩ pull-up resistor.
5	SHSYNC	I	Sensor HSYNC input.
6	SVSYNC	I	Sensor VSYNC input.
7	GPIO04	I/O	Embedded CPU GPIO0[4].
8	SPCLK	I	Sensor feedback clock.
9	SMCLK	I/O	Sensor input master clock. Embedded CPU GPIO0[6].
10	SCTRL1	I/O	Sensor control pin 1. Embedded CPU GPIO0[7].
11	SDATAI9	I	Sensor data input bit 9.
12	SDATAI8	I	Sensor data input bit 8.
13	SDATAI7	I	Sensor data input bit 7.
14	SDATAI6	I	Sensor data input bit 6.
15	VSS P		Ground.
16	VCC P		I/O power.
17	SDATAI5	I	Sensor data input bit 5.
18	SDATAI4	I	Sensor data input bit 4.
19	SDATAI3	I	Sensor data input bit 3.
20	SDATAI2	I	Sensor data input bit 2.
21	SDATAI1	I	Sensor data input bit 1.
22	SDATAI0	I	Sensor data input bit 0.
23	SCTRL2	O	Sensor control pin 2.
24	VDD	P	Core power 1.8V input.
25	V28XX_PAD	P	Power supply for internal FTP. Connect to VSS with an external 2.2uF bypass capacitor.
26	V28X_PAD	P	Regulator 2.8V output.
27	V18C_PAD	P	Regulator 1.8V output.
28	V33IN	P	3.3V input for LDO 2.8V/1.8V/1.5V.
29	V15X_PAD	P	Regulator 1.5V output.
30	VCCAH3	P	Regulator 3.3V output.
31	VCCAH5 P		Regulator 5V input.

Pin No.	Signal	Type	Description
32	GNDA P		Regulator Ground.
33	GPIO32	I/O	Embedded CPU GPIO3[2].
34	SYSRSTn	I	Chip reset, low active. An external RC (47 kΩ/1uF) reset circuit must be connected between VCC and VSS.
35	VCC P		I/O power.
36	VSS P		Ground.
37	DM	I/O	USB D- pin.
38	DP	I/O	USB D+ pin.
39	RREF	I	Connection for external reference resistor. Connect to ground with a 680Ω (±1%) resistor.
40	AVDD	P	USB analog power 3.3V.

3. Application Circuit

Figure 4 shows an example of application circuit used for reference purpose only.

Figure 4: Reference Circuit



4. Electrical Characteristics

This chapter contains preliminary data and may be updated in a later version.

4.1 DC Characteristics

Table 2: Absolute Maximum Ratings

Parameter	Min	Max	Unit
Regulator 3.3V Input with Respect to Ground		3.6	V
Regulator 5V Input with Respect to Ground		5.5	V
Digital Input Pins with Respect to Ground	-0.5	+3.6	V
USB Power Analog Input with Respect to Ground	-0.5	+3.6	V
Junction Temperature	-40	+125	°C
Storage Temperature	-55	+120	°C

Table 3: Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Core Supply Voltage	VDD 1.62	1.8	1.98		V
I/O Supply Voltage	VCC 3.0	3.3	3.6		V
	VCC 2.8				V
	VCC 1.8				V
Regulator 5V Input	VCCAH5	4.0	5.0	5.25	V
Regulator 3.3V Input	V33IN	3.0	3.3	3.6	V
Ambient Operating Temperature	T_A 0		25	70	°C

Note: The output voltage V_{025V} meets the specification listed in Table 5 only when V33IN is larger than 3.14V.

Table 4: DC Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Input Low Voltage	V_{IL} -0.3			0.8	V
Input High Voltage	V_{IH} 2.0			3.6	V
Input Leakage Current	I_{LI} -10		+10		uA
Pull-up Resistance	R_{PU} 39	65		116	kΩ
Pull-down Resistance	R_{PD} 40	56		108	kΩ
Output Low Voltage	V_{OL}			0.4	V
Output High Voltage	V_{OH} 2.4				V

Table 5: Embedded Regulator Characteristics

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit	Remark
Regulator Power Input	V_{In5V}	T_J = 25°C	4.0	5.0	5.5	V	VCCAH5
	V_{In33V}	T_J = 25°C	3.14	3.3	3.6	V	V33IN
Regulator Output	V_{O33V}	3.6V< V_{In5V} <5.5V; I_{O33} = 200mA; T_J = 25°C	3.24	3.3	3.36 V		VCCAH3
	V_{O28V}	3.0V< V_{In33V} <3.6V; I_{O28} = 80mA; T_J = 25°C	2.74	2.8	2.86 V		V28X_PAD
	V_{O18V}	3.0V< V_{In33V} <3.6V; I_{O18} = 150mA; T_J = 25°C	1.71	1.8	1.89 V		V18C_PAD
	V_{O15V}	3.0V< V_{In33V} <3.6V; I_{O15} = 80mA; T_J = 25°C	1.4	1.5	1.6 V		V15X_PAD
Output Current	I_{O33}	V_{In5V} = 5V; T_J = 25°C		200	300	mA	
	I_{O28}	V_{In33V} = 3.3V; T_J = 25°C		80	120	mA	
	I_{O18}	V_{In33V} = 3.3V; T_J = 25°C		150	250	mA	
	I_{O15}	V_{In33V} = 3.3V; T_J = 25°C		80	120	mA	
Output Noise	V_{rms33V}	V_{In5V} = 5V; I_{O33} = 200mA; T_J = 25°C	TBD				(RMS)
	V_{rms28V}	V_{In33V} = 3.3V; I_{O28} = 80mA; T_J = 25°C	TBD				(RMS)
	V_{rms18V}	V_{In33V} = 3.3V; I_{O18} = 150mA; T_J = 25°C	TBD				(RMS)
	V_{rms15V}	V_{In33V} = 3.3V; I_{O15} = 80mA; T_J = 25°C	TBD				(RMS)

4.2 AC Characteristics

Table 6: AC Operating Conditions

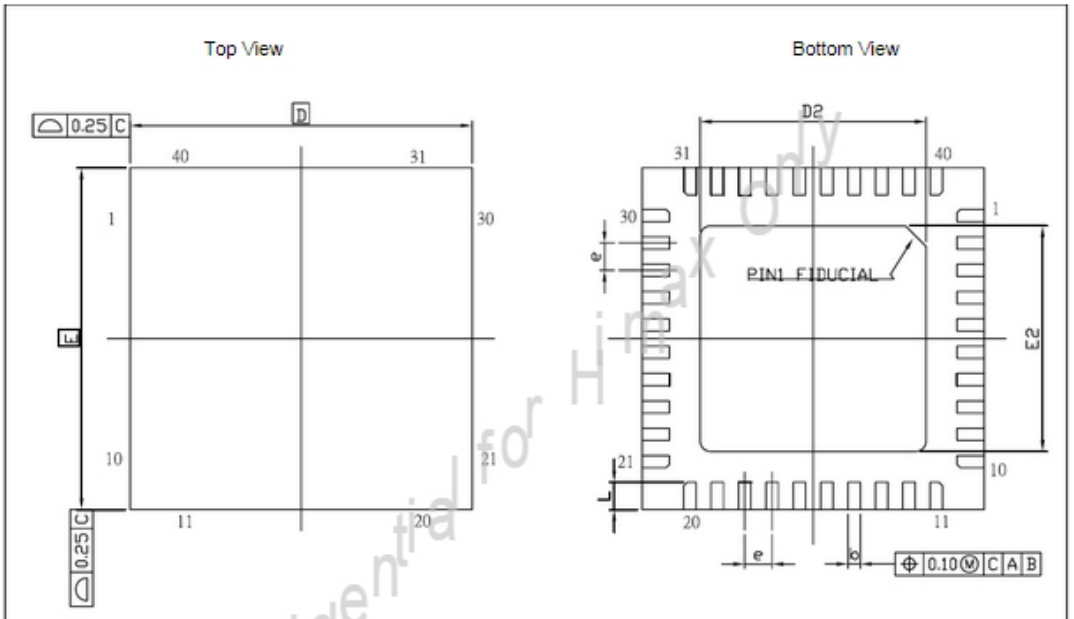
Parameter	Min	Max	Unit
Sensor Clock Frequency		30 MHz	
Two-wire Serial Clock Frequency		400	KHz

Table 7: AC Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Output Sensor Clock			24		MHz
Operation Supply Current	I_{OP}		TBD		
Suspend Current	I_{SUSP}		TBD		
Package Surface Temperature (Working on VGA @ 30 fps)	TWK		TBD		

5. Mechanical Dimensions

5.1 QFN-40 Package Outline

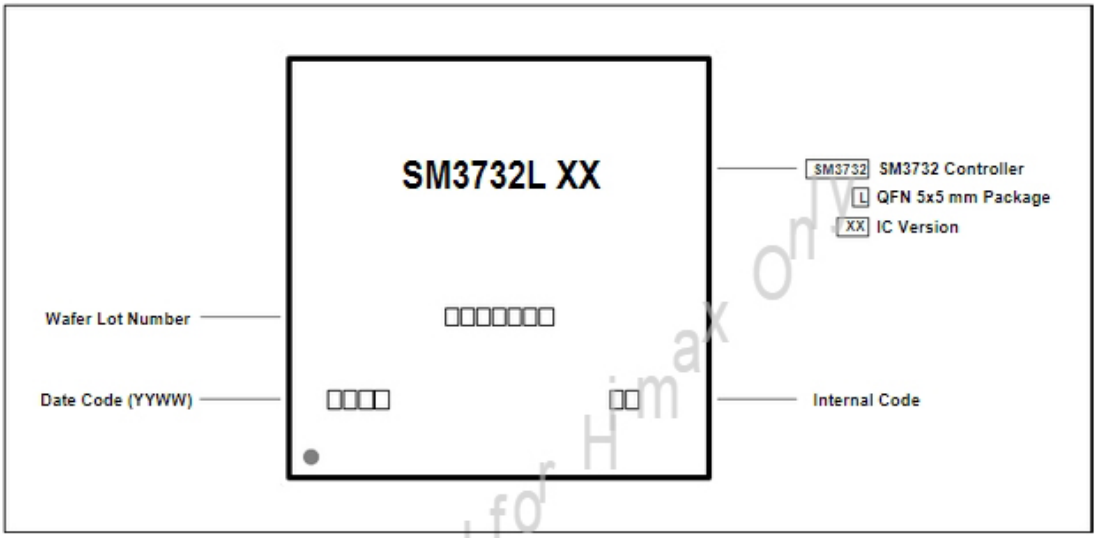


Symbol	MIN	NOM	MAX	Symbol	MIN	NOM	MAX
A	0.70	0.75	0.80	E		5.00 BSC	
A1	0	0.02	0.05	E2	3.20	3.30	3.40
A3		0.203 REF		e		0.40BSC	
b	0.15	0.20	0.25	L	0.35	0.40	0.45
D		5.00 BSC		y			0.08
D2	3.20	3.30	3.40				

Note:
1. Controlling Dimension: Millimeter.
2. Dimensioning and tolerancing conform to ASME Y14.5M-1994.
3. Lead frame material is olin194 and thickness is 0.203mm (8 mil).

5.2 Marking Information

Figure 5: Top Marking



6. Product Ordering Information

6.1 Ordering Information

Table 8: Ordering Information

Ordering Number	Operating Temperature	Package Type	Descriptions
SM373LX020000-XX	0°C ~ 70°C	QFN 40-pin	5 x 5 x 0.8 (mm)

Note: The suffix "XX" denotes the IC version.