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VCO337TLNC

USB2.0 PC Camera Processor

Datasheet

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1. GENERAL DESCRIPTION

VC0337TLNC is Vimicro's latest addition to the high quality, cost effective USB2.0 PC Camera Processor family. With small footprint design and compact form factor, VC0337TLNC is targeted for high quality attachable PC camera market and high quality notebook embedded PC camera market.

VC0337TLNC comes with programmable sensor master clock output and is integrated with the parallel sensor interface. VC0337TLNC has also integrated a JPEG encode engine providing high quality video streams. With a matched sensor, VC0337TLNC can stream video at 30fps under 1.3 Mega pixels resolution (SXGA or 1280x1024), or capture still images at up to 5 Mega pixels resolution. With these features, VC0337TLNC can also offer 30fps video streaming at HD 720P (1280x720).

VC0337TLNC is fully compliant with USB Video Class (UVC) 1.0 standards and USB HID Class 1.11. VC0337TLNC is fully compliant with USB 2.0 High-Speed (HS) and backward compatible with USB 1.1 protocol.

VC0337TLNC is a UVC device that will work with any Operating System that support UVC standards, such as Windows XP (with Service Pack 2) and Vista, without the need to install the Vimicro driver. To provide for additional powerful functions such as better video quality and other special effects, the Vimicro UVC driver needs to be installed to operate these functions.

The following tables show the main video operation modes that VC0337TLNC supports:

USB2.0 Full Speed (Isochronous)

Maximum Frame Rate	SXGA	VGA	CIF	QVGA	QCIF	QQVGA
YUY422	-	-	-	-	-	15fps
JPEG (YUV422)	5fps	30fps	30fps	30fps	30fps	30fps
JPEG (YUV420)	-	30fps	30fps	30fps	30fps	30fps

Note:
1) With MS-UVC driver, under USB FS mode, only MJPEG and YUY2 are supported.
2) With Vimicro UVC driver, under USB FS mode, Bayer Raw Data formats can also be supported.

USB2.0 High Speed (Isochronous)

Maximum Frame Rate	QXGA	UXGA	SXGA	VGA	CIF	QVGA	QCIF	QQVGA
YUY422	-	5fps	7.5fps	30fps	30fps	60fps	60fps	60fps
JPEG (YUV422)	-	15fps	30fps	60fps	60fps	60fps	60fps	60fps

JPEG (YUV420)	-	-	-	60fps	60fps	60fps	60fps	60fps

Notes:

1)   With MS-UVC driver, under USB HS mode, only MJPEG and uncompressed YUV422 are supported.

2)   With Vimicro UVC driver, under USB HS mode, Bayer Raw Data formats can also be supported.

3)   EEPROM can be used to disable MJPEG output at USB2.0 HS mode.

VC0337TLNC's package information is shown below:

PRODUCT No.	PACKAGE	DESCRIPTION
VC0337TLNC	48-Pin Tiny QFN at 5mm x 7mm	With Parallel SIF, without audio

2. FULL FEATURE LIST

- Support for off-shelf VGA/SXGA/UXGA CMOS sensor
- USB2.0 PHY compatible with USB2.0 HS/FS and USB 1.1
- USB Video Class 1.0 standard compliant
- Support HID (configurable by EEPROM)
- Support UC (configurable by EEPROM)
- Microsoft WHQL compliance
- Support Win 2000 using a Vimicro driver (only for certain FW versions)
- Vista Premium Logo compliance
- Support various OS including 32-bit and 64-bit Windows
- Build-in OTP (One Time Programmable device, max. size 64K) ROM
- Support 3M motion JPEG sensors data bypass mode
- Support Watch-Dog function
- Support programmable sensor clock output (12MHz, 24MHz, 25MHz, 27MHz, 36MHz, 48MHz, 50MHz, 54MHz, 64MHz, etc.) and enables targeted sensor to output max frame rate
- Support Parallel sensor interface
- Imaging Applications
    - Video streaming up to 60fps@VGA resolution, 30fps@SXGA, and 15fps@UXGA under USB Isochronous mode
    - Still image capture and preview at up to 3M pixel resolution
- JPEG compression for video streaming
    - Be able to insert resync markers for every row of macroblocks
    - When ISP is used, JPEG engine can support up to 1.3M resolution
    - When ISP is not used, ISP Memory buffer can be used when outputting 2M JPEG at 15fps (for this case, sensor is expected to have ISP and output YUV data)
- Hardware motion detection with four zones
- Hardware digital sizer on YUV
    - 1x ~ 2x scale up (support VGA scale up to 1.3M)
    - Flexible scale down
- Hardware accelerated special effects
    - Monochrome
    - Sepia
    - Special color
    - Negative
    - Sketch
    - Mono color
- Output Video Format
    - YUY2
    - MJPEG

- ✧ Bayer (raw 8 or 10 bits/pixel), need Vimicro driver support
- One dedicated PWM output
- Support I2C for Auto-Focus Control
- Support PWM for Auto-Focus Control
- Separate 2-wire serial bus for sensor and EEPROM
- GPIOs for Typical Camera Control Support
  - ✧ Snapshot button
  - ✧ PRIVACY shutter switch for muting video and audio
  - ✧ LED indicator
  - ✧ Flip
- Support additional sensors through EEPROM
- Support remote wake up from suspend status by GPIO triggers
- Power Management
  - ✧ Optimized design for low power consumption
  - ✧ Normal mode
  - ✧ Suspend mode
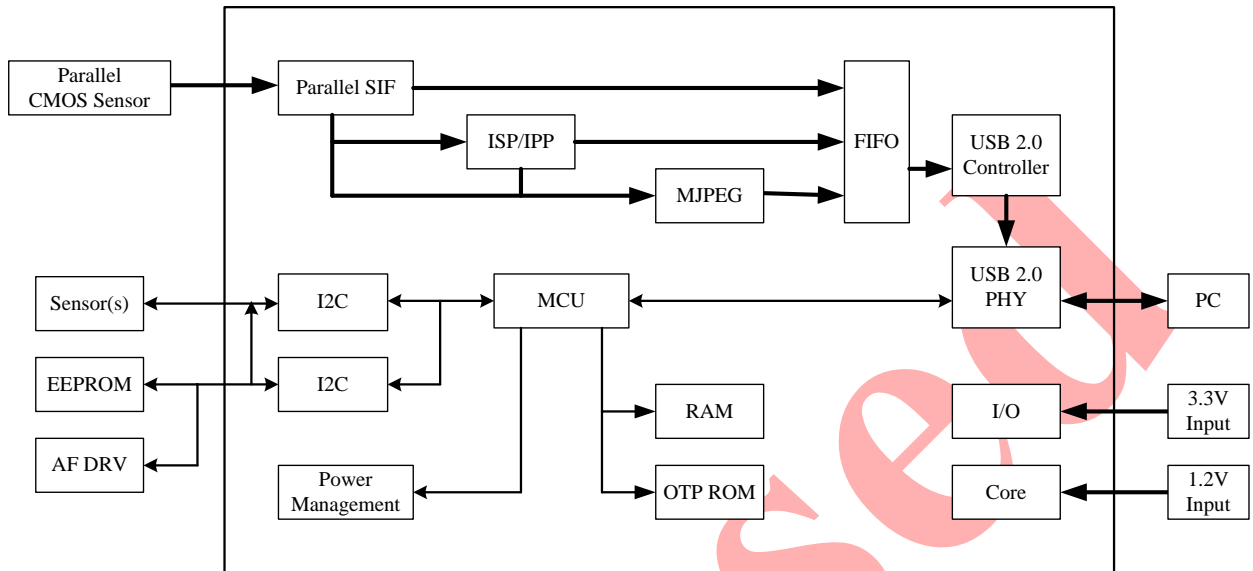 - ✧ Unconfig mode

3. CHIP BLOCK DIAGRAM

Figure 1: VC0337TLNC Chip Block Diagram

4. KEY BLOCK DESCRIPTIONS

4.1 Chip Control and Power Management

The design of VC0337TLNC is optimized for low power consumption. The whole system with sensor, EEPROM, internal I2C interfaces, OTP ROM and the inclusion of all other external components, the power consumption still complies with the USB specification:

- ✧ Work with 30fps@SXGA, operation current < 500mA
- ✧ Unconfiguration current < 100mA
- ✧ Suspend current < 500uA

The unconfiguration current can be managed in VC0337TLNC. In unconfigure mode, the firmware must configure a register to inform CPM entering the unconfigure mode. When this device is plugged into USB hub, and is bus powered, it will act as a USB standard device. According to the USB specification, it will go into suspend mode if bus keeps idle for more than 3ms. In suspend mode, the clock oscillator will be shut down and peripheral power is shut down to make the suspend current less than 500uA. The USB reset, resume signals can make the device exit from this state.

4.2 MCU (8051 Compatible)

The MCU module is an 8051 compatible central control unit. Firmware will be run and stored on internal OTP Memory. A 6k 8-bit on-chip RAM is configured as the data memory. Another 4k 8-bit SRAM is used for firmware patches. The MCU is responsible for configuring chip registers in all modules and accept external interrupts. MCU also acts as a SIC (serial bus) module controller. The chip communicates with serial bus EEPROM through 2 pins (ESDA and ESCK) with speed up to 400kHz (with 100kHz as default). Support either 8-bit or 16-bit EEPROM.

A PWM function is also embedded in the MCU module. The frequency and duty cycle of PWM signals are controlled by setting appropriate registers.

4.3 Sensor Interface (SIF)

The sensor interface (SIF) act as the bridge between the external sensor and the image processing block (ISP and JPEG) inside VC0337TLNC. The SIF receives data/clock and data/strobe signals in accordance with CCP2 specification, it then generates synchronous signal and image data to the image processing block.

◇ Provide programmable master clock for the sensor
◇ Support 10-bit Bayer pattern and YUV422 data format from sensor
◇ Support serial bus and the working frequency of the bus is programmable
◇ Support batch writing sensor registers
◇ Image window size adjustable
◇ Support Parallel sensor interface

4.4 MJPEG Unit

The MJPEG unit (JM2) contains an encoder core for JPEG frame. The encoder is tuned to provide high performance for real-time video and still image compression.

The features of the JM2 module are listed below:
◇ JPEG baseline algorithm
◇ Encoder
◇ Variable image size and different image mode
  ■ YUV422@SXGA
  ■ YUV420@VGA
◇ 128 quantization tables for both Y and C when in compression
◇ JPEG file header
◇ JPEG restart interval
◇ Real-time video compression
◇ Fully programmable Minimum Coded Unit (MCU)
◇ Auto bit rate control

4.5 Line Buffer

Two sets of line buffer memory configured by the ping-pong architecture are built within VC0337TLNC. The role of line buffer unit (LBUF, for short) is to convert data coming from SIF/ISP/IPP module from line sequence to block sequence for JM2 compression or UDC output. LBUF unit also controls all read/write access of line buffer memory.

4.6 Universal Serial Bus Controller (UDC)

◇ Compliant to USB Spec Rev. 2.0
◇ USB Video Class Rev. 1.0
◇ UTMI Rev 1.05
◇ Support control transfer, isochronous transfer and interrupt transfer
◇ Support standard request and also supports vendor/class request

4.7 OTP ROM

OTP ROM stands for "One Time Programmable" ROM. When operating in normal mode (Read Only operations) the minimal access time is 70ns; when operating in programming mode the power supply must be at least 6.5V and the programming time is 100us/BYTE.

5. PIN ASSIGNMENTS

5.1 VC0337TLNC (48-Pin Tiny QFN) Pin Assignments

PIN No.	NAME	TYPE	DESCRIPTION
1	PRIVACY	I/O, Schmitt	Dedicated GPIO for Privacy shutter
2	PWUP_RSTN	I, Schmitt	Active low power-on reset
3	CLKXOUT	O	Crystal output
4	CLKXIN	I	Crystal input
5	GPIO11	I/O	GPIO
6	PWR_SWITCH	P	Switch On / Off DVDD
7	GPIO9	I/O	GPIO
8	TEST	I, PD	Manufacturing test mod
9	ESCK	O	EEPROM clock, also act as a strap pin. When there is an EEPROM, it is EEPROM size selector: 0:8bit address, 1:16 bit address.
10	ESDA	I/O, Schmitt	EEPRPOM data
11	DVSS1	P	Core ground
12	DVDD1_off	P	Core power off
13	DVDD1_on	P	Core power on
14	SNAPB	I/O, Schmitt	Dedicated GPIO for Snapshot button
15	USB_VSDL0	P	USB PHY digital ground
16	USB_VDDL0	P	USB PHY digital power, 1.8V
17	USB_PADP	A	USB data pin data+
18	USB_PADM	A	USB data pin data-
19	USB_VSSA0	P	USB PHY analog ground
20	USB_VDDA0	P	USB PHY analog power, 3.3V
21	USB_VRES	A	Connected to an external 6.195K Ohm resistor
22	VPROG_OTP	P	OTP Program power supply (6.5V when programming)
23	OVDD1	P	I/O power
24	OVSS1	P	I/O ground
25	GPIO3	I/O	GPIO
26	CS_D0	I, PD	Sensor data
27	CS_D1	I, PD	Sensor data

PIN No.	NAME	TYPE	DESCRIPTION
28	CS_D2	I, PD	Sensor data
29	CS_D3	I, PD	Sensor data
30	CS_D4	I, PD	Sensor data
31	CS_D5	I, PD	Sensor data
32	CS_D6	I, PD	Sensor data
33	CS_D7	I, PD	Sensor data
34	CS_D8	I, PD	Sensor data
35	CS_D9	I, PD	Sensor data
36	CS_HSYNC	I/O, PD	Horizontal sync
37	CS_VSYNC	I/O, PD	Vertical sync
38	CS_CLK	O	Sensor clock
39	DVSS4	P	Core ground
40	DVDD4_off	P	Core power off
41	DVDD4_on	P	Core power on
42	CS_RSTB	O	Sensor reset
43	CS_PWDB	O	Power-down pin controlling sensor DC/DC regulator
44	OVSS2	P	I/O ground
45	OVDD2	P	I/O power
46	CS_SCK	O	Serial interface clock
47	CS_SDA	I/O, Schmitt	Serial interface data
48	CS_PCLK	I	Sensor pixel clock

Note: I/O – Input/Output

I – Input

O – Output

P – Power

A – Analog

PD – Pull-down
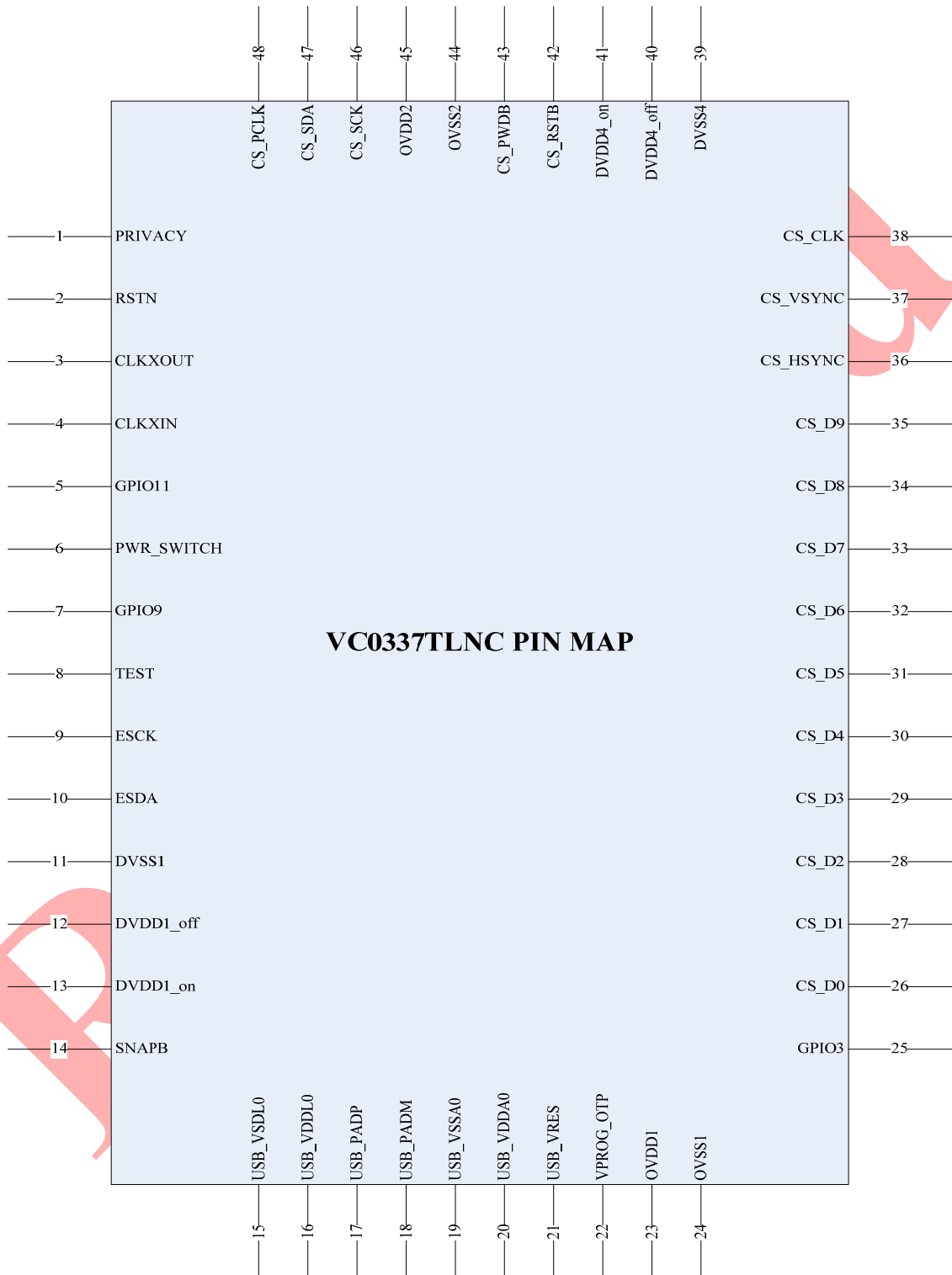
PU – Pull-up

5.2 VC0337TLNC Pin Layout Diagram

Figure 2: VC0337TLNC Pin Layout Diagram

6. ELECTRICAL CHARACTERISTICS

6.1 Recommended Operating Conditions

The recommended operating conditions are the recommended values to assure normal logic operation. As long as the device is used within the recommended operating conditions, the electrical characteristics (DC and AC characteristics) described below are assured.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage:					
Core*	DVDD, USB_VDDL	1.08	1.2	1.32	V
I/O*	OVDD, USB_VDDA	3.0	3.3	3.6	
Maximum input voltage	V_{Imax}	--	--	3.6	V
Operating Temperature	T_{OPR}	-20	--	+85	°C
Storage Temperature	T_{STOR}	-40	--	+150	°C
Digital Operating Current	I_{OP}	--	--	300	mA
Digital Suspend Current (tested under 30fps@VGA mode)	I_{SUSP}	--	--	500	uA

7. PACKAGE INFORMATION

7.1 Chip Marking Information

| CHIP MARKING INFORMATION	LEAD-FREE PACKAGE
	Vimicro VC0337TLNC Tracking No.

Note:

VC0337TLNC will use internal OTP memory to store firmware. So an extra letter (the 5th letter) is added to the package marking. For example:

1) VC0337TLNC will be a un-programmed chip with empty firmware in its OTP;
2) If the 1st version of the 337TLNA firmware code is authorized into production, we will mark the chip to be VC0337TLNCA;
3) If the 2nd version of the 337TLNA firmware code is authorized into production, we will mark the chip to be VC0337TLNCB.
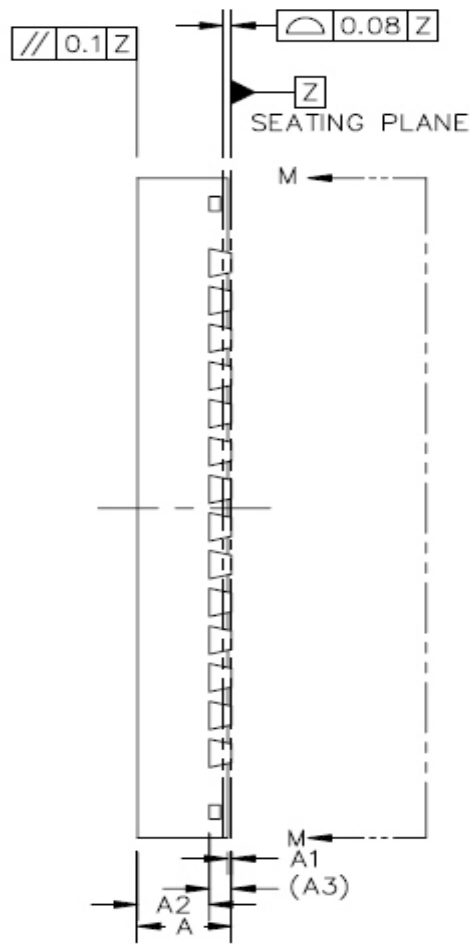
7.2   VC0337TLNC Package Specifications

TOP VIEW
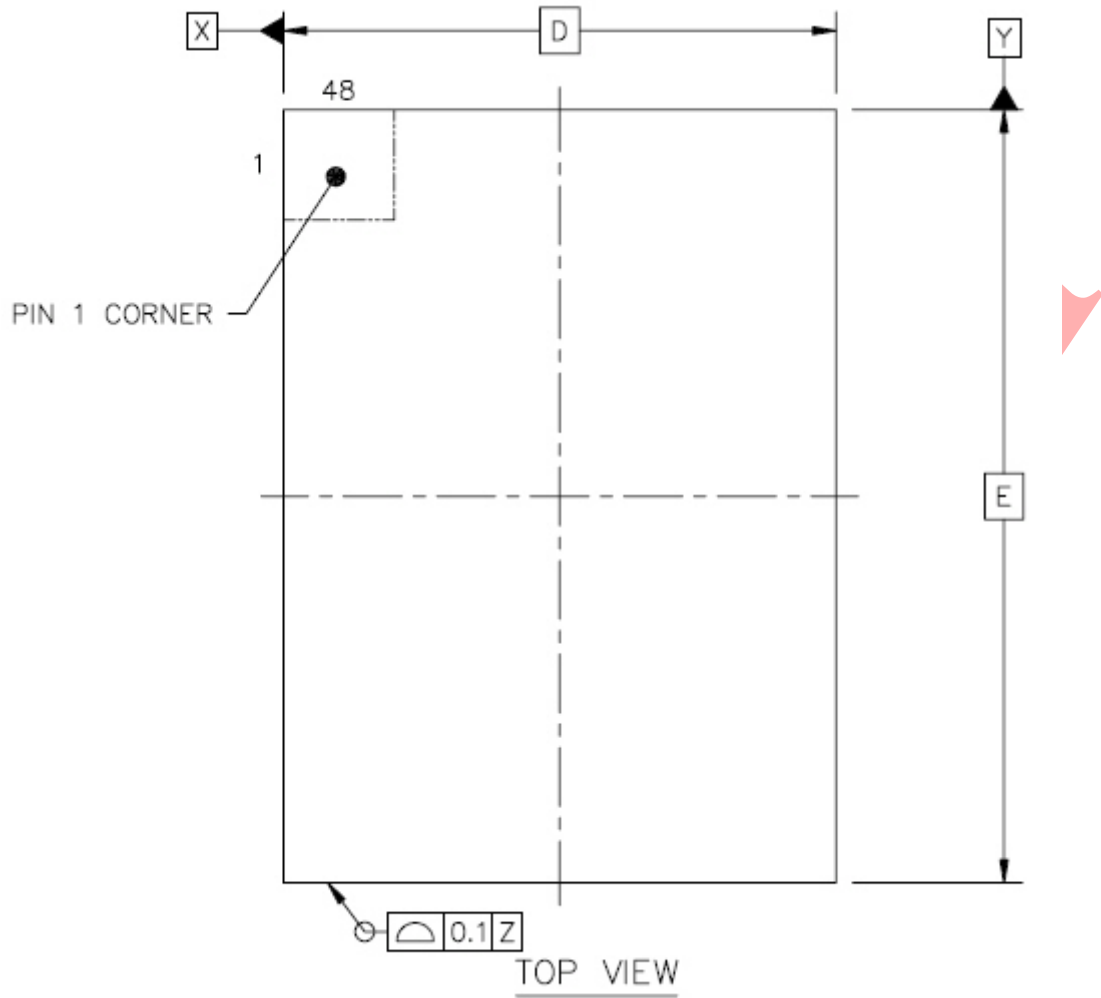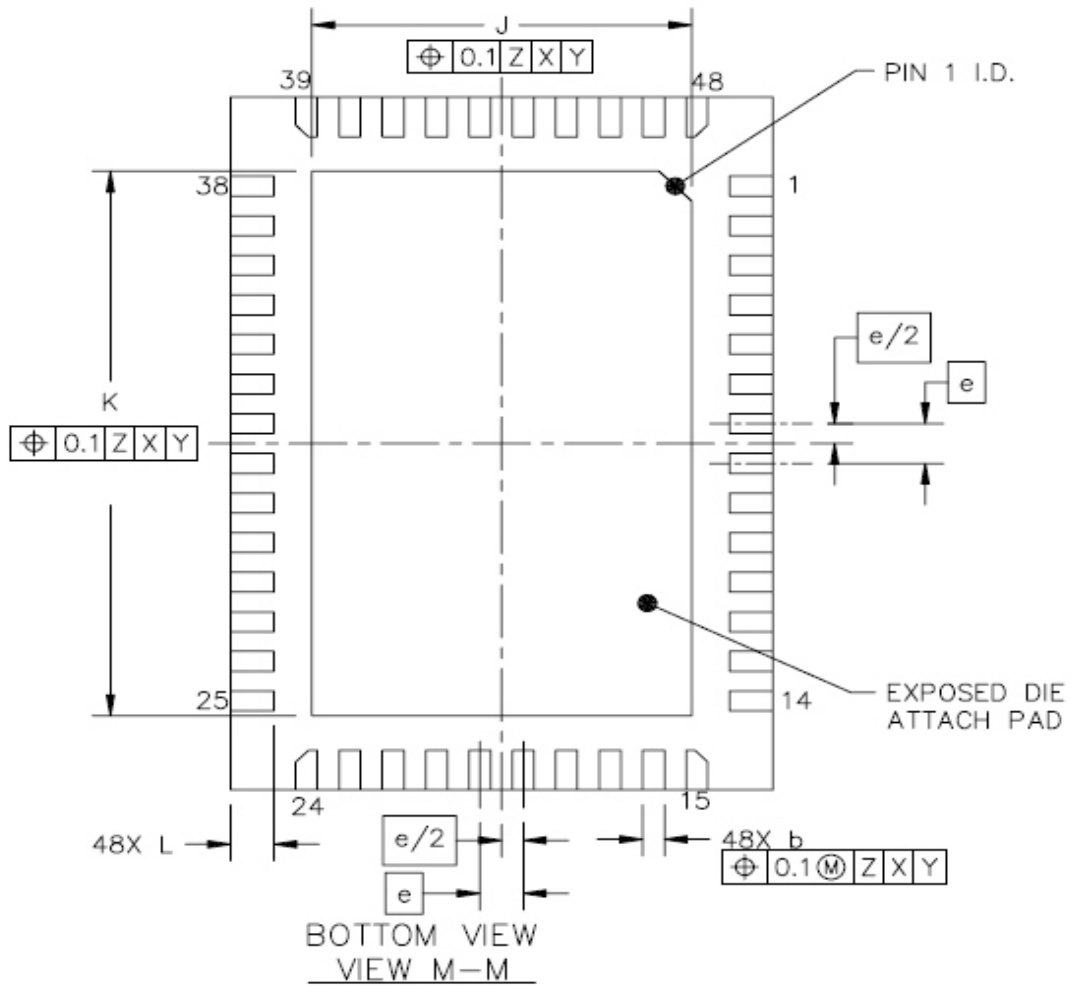
VC0337TLNC Package Dimension (unit: mm)

		SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS		A	0.8	0.85	0.9
STAND OFF		A1	0	0.035	0.05
MOLD THICKNESS		A2	---	0.65	0.67
L/F THICKNESS		A3	0.203 REF		
LEAD WIDTH		b	0.15	0.20	0.25
BODY SIZE	X	D	5 BSC		
	Y	E	7 BSC		
LEAD PITCH		e	0.4 BSC		
EP SIZE	X	J	3.4	3.5	3.6
	Y	K	5.4	5.5	5.6
LEAD LENGTH		L	0.35	0.4	0.45

NOTES:
1.0 COPLANARITY APPLIES TO LEADS, CORNER LEADS AND DIE ATTACH PAD.

8. CONTACT INFORMATION

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9. REVISION HISTORY

Version No.	Remarks	Release Date
1.0	Formal version released after engineering review.	2010-07-06