



LI-5M01 HD Camera Board User Guide V1.23

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1. Overview

Leopard Imaging provides the Time-to-Market camera development kit with seamless interface to Aptina DEMO2, TI DM6446 DVEVM, TI DM355 DVEVM through DM355 Adapter Board (LI-355A) and Analog Device Digital Video Surveillance Kit by Avnet. The LI-5M01 is a high-resolution digital camera board. It incorporates an Aptina Imager MT9P031, which is a 1/2.5-inch CMOS active-pixel digital image sensor with an active imaging pixel array of 2592H x 1944V. The LI-5M01 Camera Board produces extraordinarily clear, sharp digital pictures, and it is capable of capturing both continuous video and single frames, which makes it the perfect choice for consumer electronics and industrial applications including digital still cameras, digital video cameras, and surveillance cameras.

Features:

- 1/2.5-Inch 5-Megapixel CMOS High Definition Digital Imager
- Active imaging pixels: 2592H x 1944V
- Pixel Size: 2.2 μ m x 2.2 μ m
- 12-bit Digital Output with Line and Frame Synchronization
- Max Data rate: 96 Megapixel Per Second
- Support for 2592 x 1944 (full resolution), QXGA, UXGA, SXGA, XGA, VGA and custom format
- Dynamic Range: 70.1dB
- Simple two-wire serial interface
- Snapshot Triggering Input
- Superior low-light performance
- High frame rate
- Low noise CMOS imaging technology that achieves CCD image quality
- Direct interface to Aptina Development board
- Direct interface to TI DM6446 Evaluation Module
- Direct interface to Analog Device Digital Video Surveillance Kit by Avnet.
- Interface to TI DM355 Evaluation Module through the DM355 Adapter Board (LI-355A)
- Flexible I/O voltage: 1.8V to 3.3V
- High resolution lens
- Free Linux driver and example code for DM6446 and DM355

Applications:

- Digital Still Camera Development
- Digital Video Camera Development
- Digital PC Camera Development
- High Definition Surveillance System Development



2. Connectors, Jumpers and Switches

J1: Sensor Control pins.

/OE has a 3.3K pull down resistor to ensure the sensor is in operation mode.

1	/OE
2	NC
3	STROBE
4	GND

J2: 50-pin signal connector for Davinci EVM.

This connector is pin-to-pin compatible with the DC4 connector on the DM6446 DVEVM, such that the LI-5M01 camera board can be plugged in the DM6446 DVEVM DC4 directly.

1	RESET	14	D1	27	GND	40	IC2_DATA
2	CAPTURE_EN	15	D2	28	GND	41	V_IO
3	GND	16	D3	29	D8	42	V_IO
4	GND	17	D4	30	D9	43	GND
5	GIO1	18	D5	31	D10	44	GND
6	GIO4	19	D6	32	D11	45	V_3.3V
7	GND	20	D7	33	D12	46	V_3.3V
8	GND	21	GND	34	D13	47	GND
9	PWM1	22	GND	35	D14	48	GND
10	PWM2	23	GND	36	D15	49	V_5V
11	GND	24	HD	37	GND	50	V_5V
12	GND	25	PCLK	38	GND		
13	D0	26	VD	39	I2C_CLK		

J3: JTAG connector for the CPLD.

1	3.3V
2	GND
3	TDO
4	TDI
5	TCK
6	TMS

J4: Extended connector for Aptina Demo2.

1	D0
2	D1
11	TRIGGER
13	GND
Other pins	NC



J5: Primary connector for Aptina Demo2.

This connector is pin-to-pin compatible with Aptina Demo2. It can be used directly on a Aptina Demo2, and be able to run with the demo software from Aptina. The Analog Device Digital Video Surveillance Kit by Avnet is also supported through this connector.

1	D4	2	D5
3	D6	4	D7
5	D8	6	D9
7	D10	8	D11
9	D2	10	D3
11	GND	12	GND
13	LINE_VALID	14	NC
15	NC	16	/RESET
17	FRAME_VALID	18	I2C_SDATA
19	I2C_SCLK	20	NC
21	GND	22	V_IN
23	PIXCLK	24	GND
25	GND	26	NC

SW1: Output bit order switch.

This switch sets the output bit order on J2. There are two modes available.

10-bit mode: sensor data bus d[11:2] are connected to J2 d[9:0]. And J2 d[11:10] are grounded, J2 d[15:12] are floating.

12-bit mode: sensor data bus d[11:0] are connected to J2d[11:0]. J2 d[15:12] are floating.

(Pin1, Pin2)	Bit order
(on, on)	10-bit
(on, off)	10-bit
(off, on)	10-bit
(off, off)	12-bit



3. Use LI-5M01 with DM6446 DVEVM

The LI-5M01 has seamless interface to the TI's Davinci DM6446 DVEVM board. It can sit on top of a DVEVM board. Through the DC4 connector, the DVEVM board is able to configure the Aptina's sensor on the LI-5M01, and receive real-time digital video frames.

In this document, it assumes that the DVEVM has been up and running with the on-board video decoder. The user should be able to run the encoder/decoder demo software provided by Texas Instruments. And the DVEVM software version should be 1.30.00, which can be downloaded from TI's web site.

3.1 Hardware setup

Configure the LI-5M01 output to 12-bit mode by selecting the SW1 to 00 (both 1 and 2 should be on).

Turn off the DVEVM power.

Connect the LI-5M01 to connector DC4. Make sure pin 1 of J2 aligned with pin 1 of DC4 as shown in Figure 1.

Turn on the power. The power indicator LED D1 on the LI-5M01 should light up.

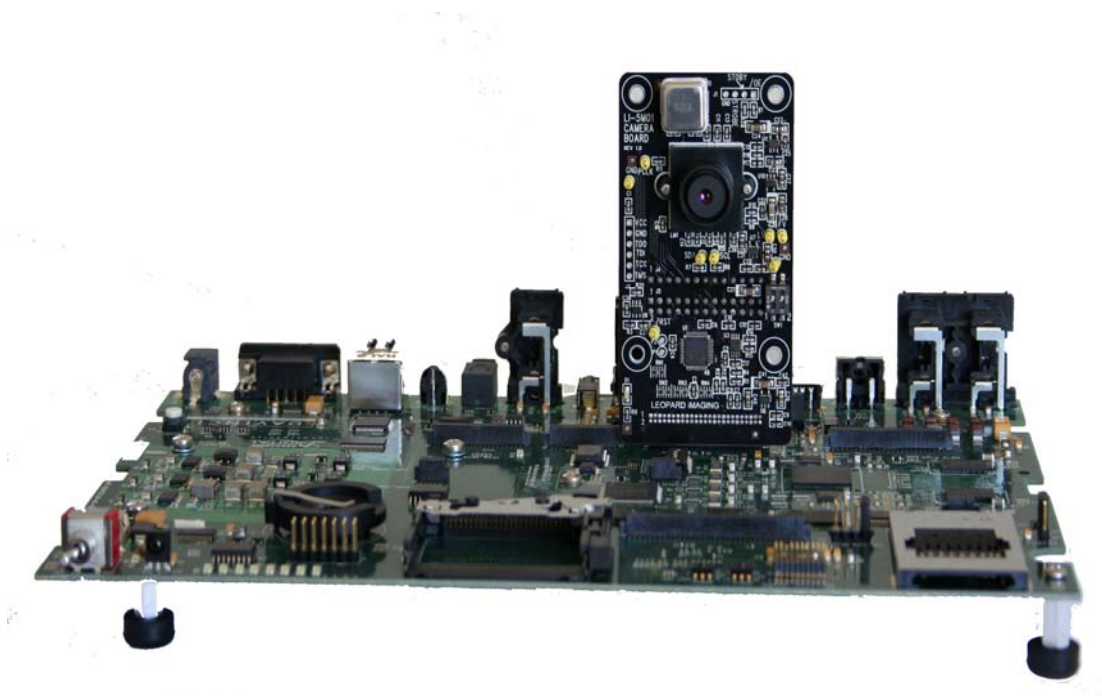


Figure 1. LI-5M01 board with DM6446 DVEVM board



3.2 Software setup

First of all, follow the TI's "DVEVM Getting Started Guide" to install the software on a Linux machine. Set up a TFTP server to allow the DVEVM to load kernel through network. It is recommended to use NFS as the target file system, so as to build and run other applications easily.

TI provides an application note on understanding the Davinci previewer engine, as well as its Linux driver source code. This demo is based on this note and the previewer engine driver.

3.2.1 Software setup with DVSDK 1.30.00

Step 1.

Download patches from Leopard Imaging website. Copy it to your linux kernel source code directory. Run the patch:

```
patch -p1 < leopard_lsp1.30_p1.patch  
patch -p1 < leopard_lsp1.30_p2.patch  
patch -p1 < leopard_lsp1.30_p3.patch  
patch -p1 < leopard_lsp1.30_p4.patch
```

Step 2.

Run **make ARCH=arm CROSS_COMPILE=arm_v5t_le-davinci_dm644x_defconfig** to load default settings.

Step 3.

Run **make ARCH=arm menuconfig** and go to device driver -> multimedia devices -> Video For Linux, change Davinci Video Capture to <M> (module), save and exit.

Step 4.

Compile the kernel and modules, using:

```
make ARCH=arm CROSS_COMPILE=arm_v5t_le- ulmage  
make ARCH=arm CROSS_COMPILE=arm_v5t_le- modules
```

Step 5.

Install modules:

```
make INSTALL_MOD_PATH=your path to target file system  
modules_install
```

Step 6.

After booting up the DM355 with the new kernel, load the module using modprobe:

```
modprobe davinci_capture
```

Step 7.



Leopard Imaging provides previewer sample code for DVEVM1.30.00 at: https://www.leopardimaging.com/5M_HD_Camera_Board.html. With this software, user is able to individually adjust analog gain, digital gain, as well as red, green and blue gain to achieve better image quality.

4. Use LI-5M01 with DM355 DVEVM

The DM355 DVEVM digital video port consists of a 26-pin dual-row connector and a 13-pin single-row connector. Leopard Imaging provides an adapter board (part # LI-355A) to server as the bridge between the LI-5M01 and the DM355 DVEVM.

The current software for the DM355 DVEVM is DVSDK v1.30. To demonstrate the LI-5M01 board with the DM355 DVEVM, go to our web site and download the free application with source code at https://www.leopardimaging.com/5M_HD_Camera_Board.html

4.1 Hardware setup

Configure the LI-5M01 output to 12-bit mode by selecting the SW1 to 00 (both 1 and 2 should be on).

Turn off the DM355 DVEVM power.

Connect the adapter board to DVEVM, then plug the LI-5M01 to the adapter board. Make sure pin 1 of J2 aligned with pin 1 silkscreen on the adapter board as shown in Figure 2.

Turn on the power. The power indicator LED D1 on the LI-5M01 should light up.

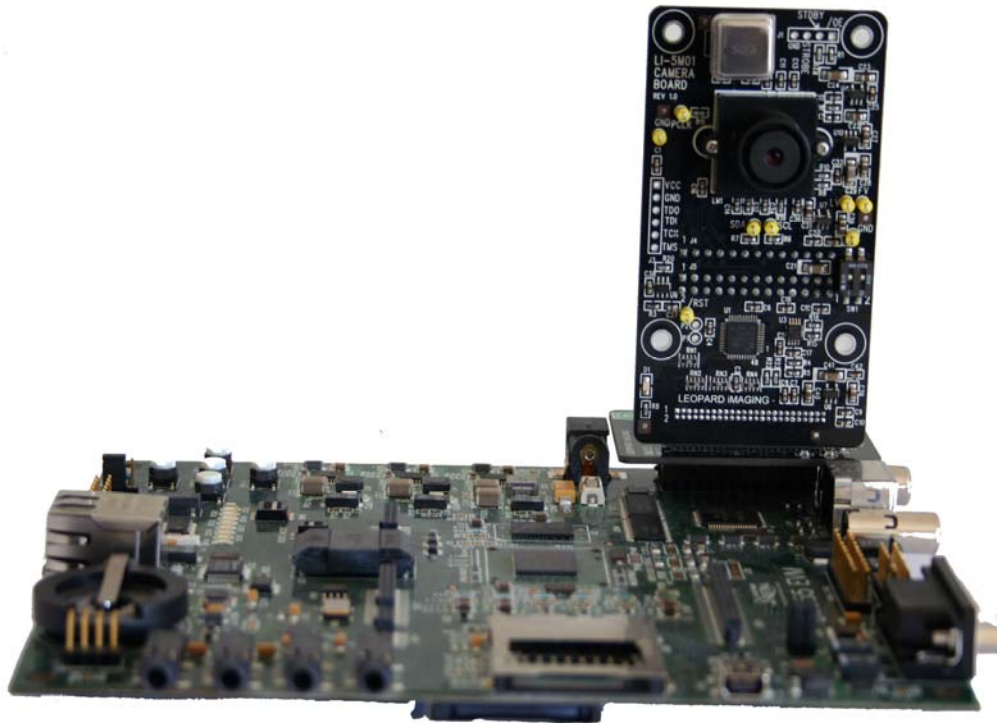


Figure 2. LI-5M01 board with DM355 DVEVM board

4.2 Software setup

Follow TI's "DVEVM Getting Started Guide" to install the software on a Linux machine. Set up a TFTP server to allow the DVEVM to load kernel through network. It is recommended to use NFS as the target file system, so as to build and run other applications easily.

4.2.1 Software setup with DVSDK 1.30

In DVEVM version 1.30.00, the driver does not work if it is compiled into the kernel. A workaround is to make it a module and load it in run time.

Step 1.

Download patches from Leopard Imaging website. Copy it to your linux kernel source code directory. Run the patch:

```
patch -p1 < leopard_lsp1.30_p1.patch  
patch -p1 < leopard_lsp1.30_p2.patch  
patch -p1 < leopard_lsp1.30_p3.patch  
patch -p1 < leopard_lsp1.30_p4.patch  
patch -p1 < leopard_lsp1.30_p5.patch
```




Step 2.

Run ***make ARCH=arm CROSS_COMPILE=arm_v5t_le-davinci_dm355_evm_defconfig*** to load default settings.

Step 3.

Run ***make ARCH=arm menuconfig*** and go to device driver -> multimedia devices -> Video For Linux, change Davinci Video Capture to <M> (module), save and exit.

Step 4.

Compile the kernel and modules, using:

make ARCH=arm CROSS_COMPILE=arm_v5t_le- ulmage
make ARCH=arm CROSS_COMPILE=arm_v5t_le- modules

Step 5.

Install modules:

Make INSTALL_MOD_PATH=your path to target file system
modules_install

Step 6.

After booting up the DM355 with the new kernel, load the module using modprobe:

modprobe davinci_capture
modprobe dm355_ipipe_driver

Step 7.

Get the latest ipipe example source code and binary file from Leopard Imaging, compile and load it to the target system and run it.

5. Use LI-5M01 with Aptina's Demo2

The LI-5M01 is fully compatible with Aptina's Demo2. It can be plugged in the Aptina's Demo2 board directly and powered from USB cable. Aptina's demo software can detect the sensor on the board and display video frames on the screen without any changes.



Revision History

Revision Number	Note	Date
1.0	Initial document	06/17/2008
1.1	Added p2 patch for DVSDK 1.30	07/20/2008
1.2	Added p3 patch for DVSDK 1.30	08/04/2008
1.21	Fixed an error on SW1, Added patch 4	09/07/2008
1.22	Added patch 5	12/21/2008
1.23	Fixed an error	01/21/2009



NOTICE

This HD Camera Board is intended for engineering development, demonstration or evaluation use only. Persons handling this product must have electronics training and follow good engineering practice.

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Leopard Imaging Inc.
47061 Warm Springs Blvd
Fremont, CA 94539
Fax: (510) 489-8352
Email: sales@leopardimaging.com
Technical Support: support@leopardimaging.com
Web site: www.leopardimaging.com