EVDK Based Package Detection Demonstration

User Guide

FPGA-UG-02074 Version 1.0

September 2018

Contents

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Acronyms in This Document

A list of acronyms used in this document.

Acronym	Definition
CNN	Convolutional Neural Network
EVDK	Embedded Vision Development Kit
FPGA	Field-Programmable Gate Array
LED	Light-emitting diode
MLE	Machine Learning Engine
SDHC	Secure Digital High Capacity
SDXC	Secure Digital eXtended Capacity
SPI	Serial Peripheral Interface
VIP	Video Interface Platform
USB	Universal Serial Bus
NN	Neural Network

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1. Introduction

This document provides technical information and instructions for setting up and running the EVDK Based Package Detection Demo. This demo is designed to utilize the Lattice Machine Learning Engine (MLE) IP and implemented onto the Lattice Embedded Vision Development Kit (EVDK). The EVDK Based Package Detection demo takes image data from one of the cameras on the EVDK and feeds it through a CNN and outputs the input image with a bounding box overlay through the HDMI Output.

Refer to the following documents for detailed information on Lattice development boards and kit:

- Lattice Embedded Vision Development Kit User Guide (FPGA-UG-02015)
- CrossLink VIP Input Bridge Board Evaluation Board User Guide (FPGA-EB-02002)
- ECP5 VIP Processor Board Evaluation Board User Guide (FPGA-EB-02001)
- HDMI VIP Output Bridge Board Evaluation Board User Guide (FPGA-EB-02003)

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2. Functional Description

The EVDK Based Package Detection Demo is designed to utilize the Lattice Embedded Vision Development Kit with MicroSD Card Adapter Board, as shown in Figure 2.1.

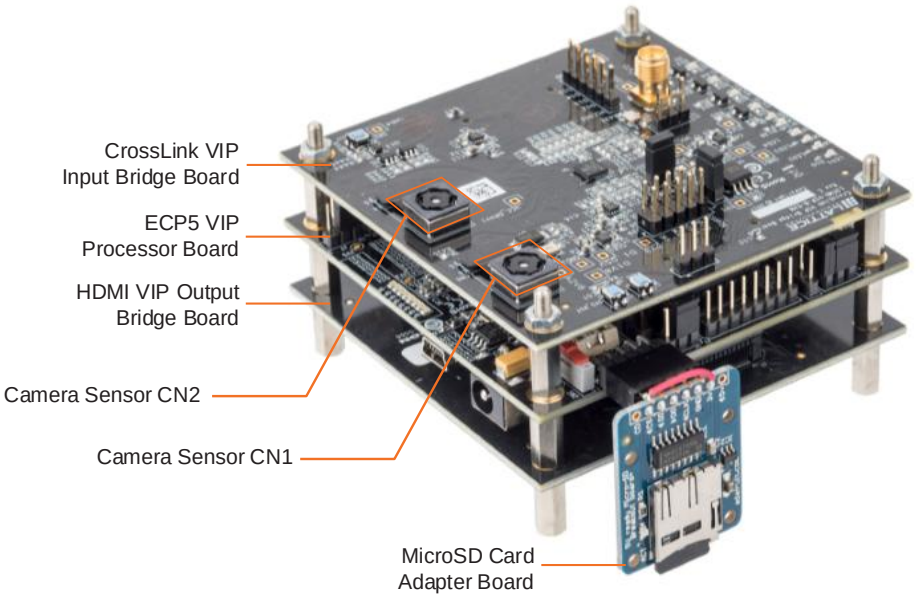

Figure 2.1. Lattice EVDK with MicroSD Card Adapter Board

The Lattice Embedded Vision Development Kit features a stackable modular architecture consisting of three boards:

- CrossLink Video Interface Platform (VIP) Input Bridge Board
- ECP5 VIP Processor Board
- HDMI VIP Output Bridge Board

Figure 2.1 shows Revision C of the Embedded Vision Development Kit. For earlier revisions, refer to the user guide of the specific evaluation board. For more information on the Embedded Vision Development Kit, visit the Lattice website Embedded Vision Development Kit page.

The firmware, which holds the CNN training results (from Caffe tool) is stored inside the SD card. The MLE breaks the image into a 7 x 7 grid, and determines cells with a high probability of the presence of a package. A green boundary overlay is created for these high probability cells.

As shown in Figure 2.2, the video data taken by the camera sensor (CN2) on the CrossLink VIP Input Bridge Board are fed into the ECP5 VIP Processor Board where the MLE processes the image data. This data, with weights and biases from the firmware, is used to create bounding boxes.

The implementation of this demo in ECP5-85 consists of 8 Neural Network engines (NN) engines.

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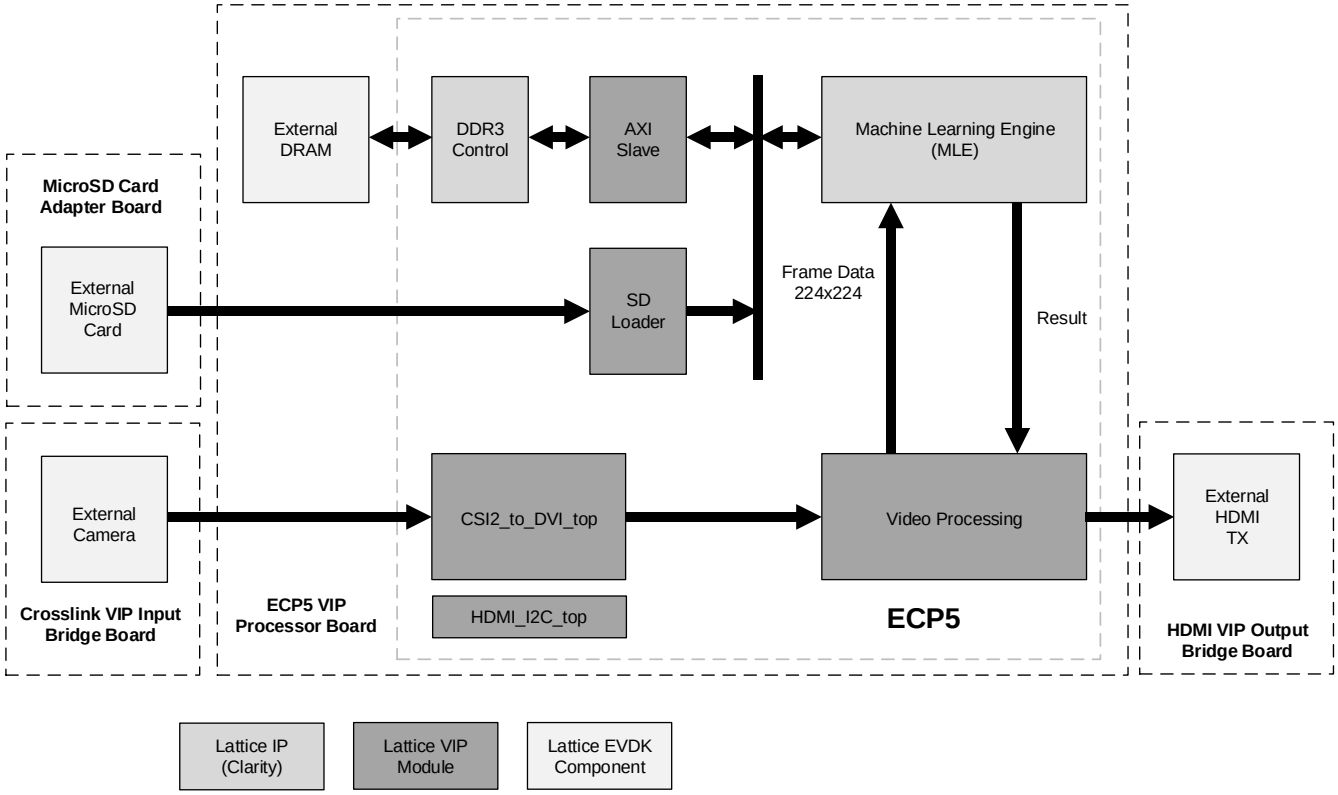

Figure 2.2. Package Detection Demo Diagram

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3. Demo Setup

This section describes the demo setup.

3.1. Hardware Requirements

- Lattice Embedded Vision Development Kit (LF-EVDK1-EVN)
  - Mini-USB Cable (Included in the kit)
  - 12 V Power Supply (Included in the kit)
- HDMI Cable
- HDMI Monitor (1080p60)
- MicroSD Card Adapter (MICROSD-ADP-EVN)
- MicroSD Card (Standard only - less than 2 GB, not SDHC/SDXC and others)

3.2. Software and Firmware Requirements

- Diamond Programmer (Refer to www.latticesemi.com/programmer)
- Programming files for Embedded Vision Development Kit
  - Dual_Camera_to_Parallel_Crosslink.bit (targets CrossLink)
  - package_detection_ecp5.bit (targets ECP5)
- MicroSD card Image writer software (Win32diskimager)
  - URL link: https://sourceforge.net/projects/win32diskimager/
- MicroSD card image
  - package_detection.bin

3.3. Board Settings

Before programming the boards, perform the following steps:

1. On the ECP5 VIP Input Bridge Board, make sure the jumper settings are as shown in Figure 3.1.
2. On the CrossLink VIP Processor Board (see Figure 3.2), ensure that SW2 is ON to power the board (LEDs should be ON).
3. Connect the 12 V power supply to the barrel plug J4.
4. Connect the mini-USB cable from the PC to the mini-USB connector J2.

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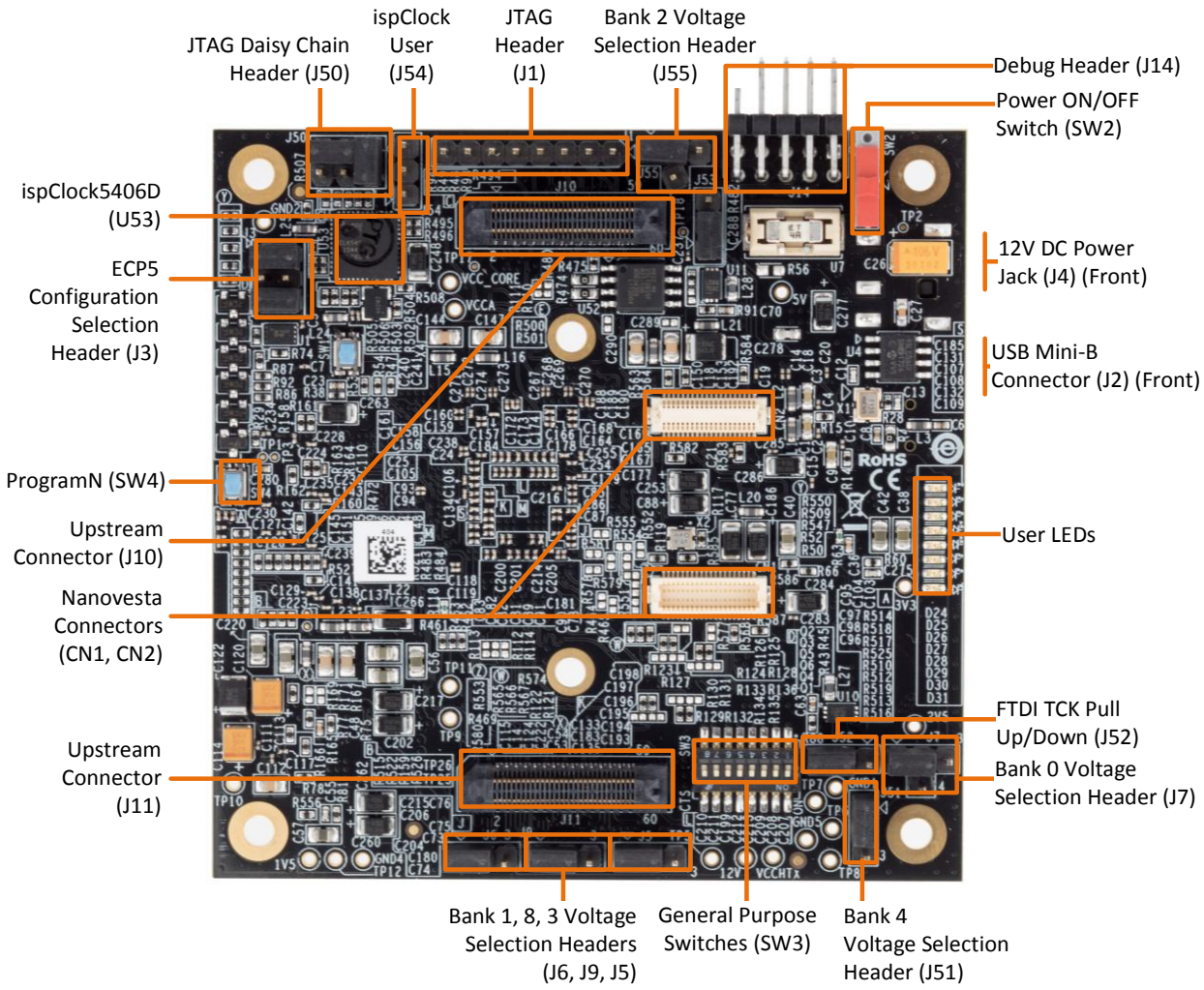

Figure 3.1. Back View of ECP5 VIP Input Bridge Board

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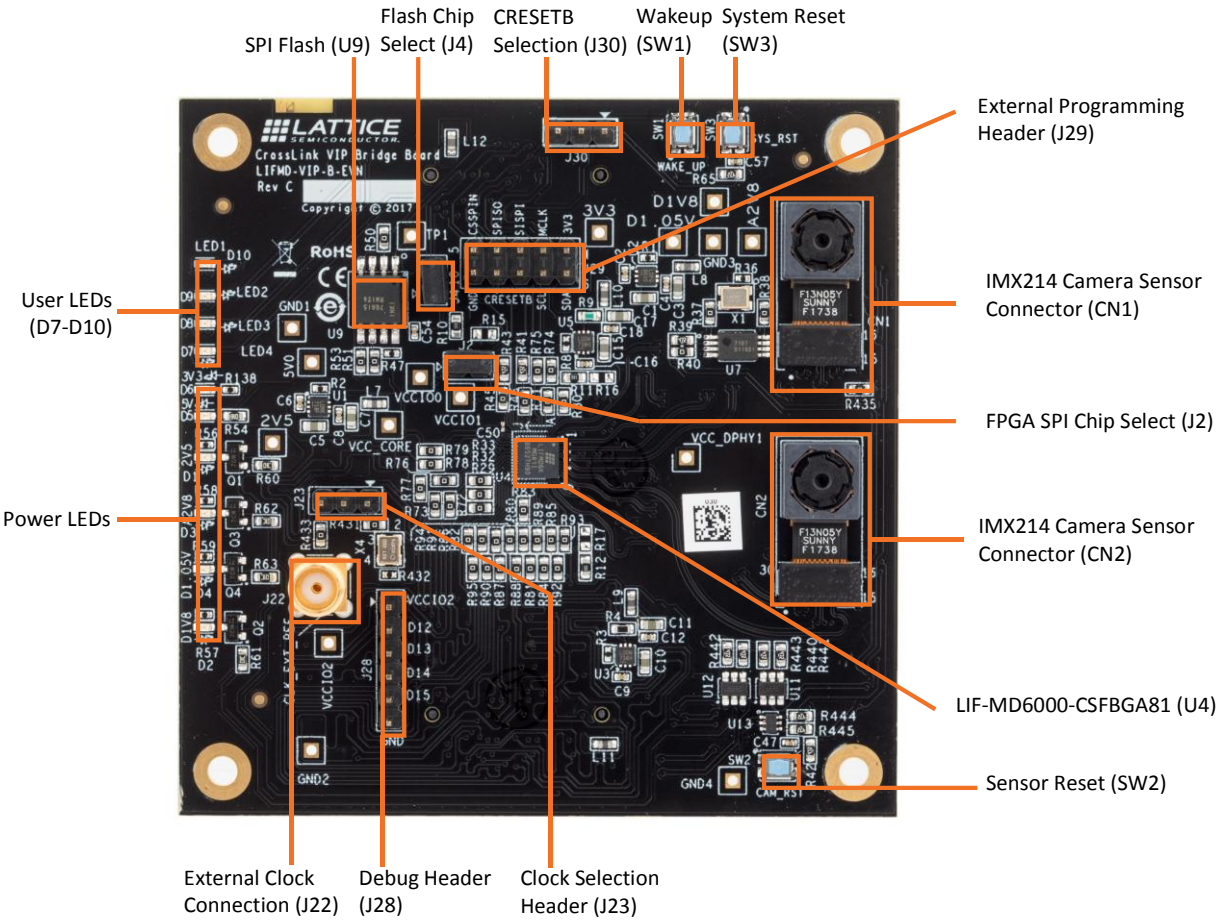

Figure 3.2. Top View of CrossLink VIP Input Bridge Board

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4. Programming the Demo

Both the CrossLink VIP Input Bridge Board and the ECP5 VIP Processor Board must be configured and programmed. Also, the demo design firmware must be programmed onto the MicroSD card which is plugged into the MicroSD Card Adaptor Board.

For instructions on programming the ECP5 and Crosslink devices, refer to the Lattice Embedded Vision Development Kit User Guide (FPGA-UG-02015).

4.1. Programming the MicroSD Card Firmware

To write the image to the MicroSD Card:

1. Download and install the Win32diskimager Image Writer software from the following link: https://sourceforge.net/projects/win32diskimager/.
2. Use Win32diskimager to write the appropriate Flash image file to the SD memory card. Depending on your PC, you may need a separate adapter (not described in this document) to physically connect to the card. See the Programming the Demo section to determine the file for the specific demo.
3. Connect the MicroSD Card as shown in Figure 4.1.

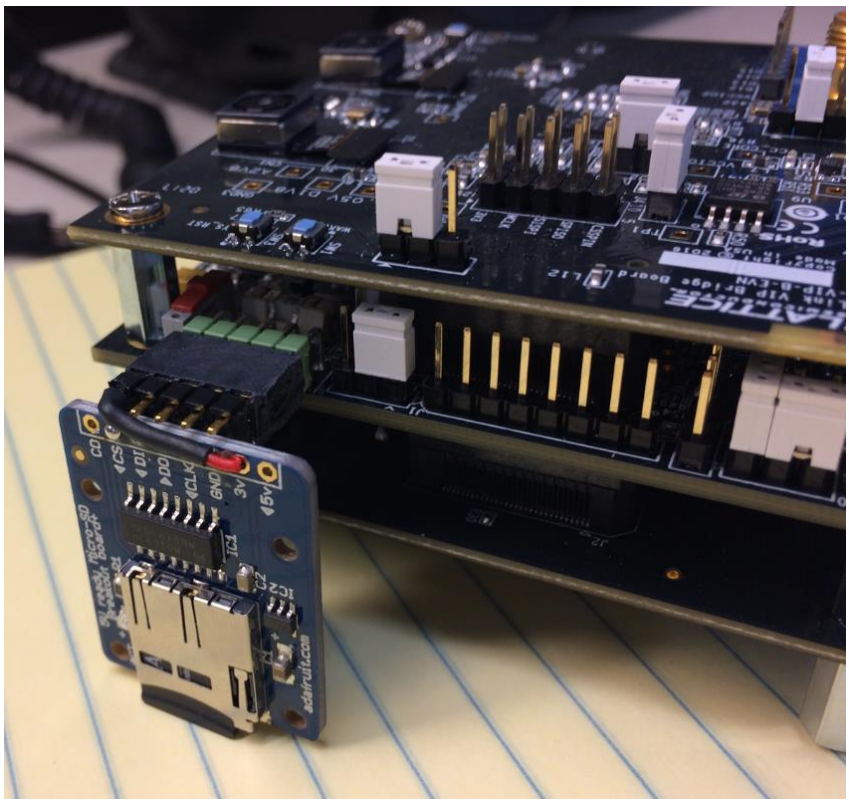

Figure 4.1. Connecting the MicroSD Card

4. In Win32 Disk Imager, select the image file **~/Demonstration/package_detection_demo.bin** as shown in Figure 4.2.
5. Select the card reader in **Device**.
6. Click **Write**.

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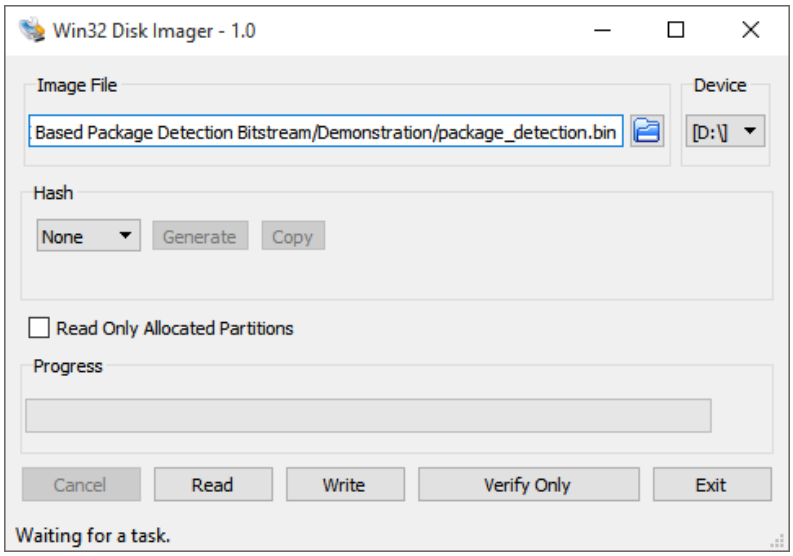

Figure 4.2. Win32 Disk Imager

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5. Running the Demo

To run the demo:

1. Insert the configured MicroSD Card into the MicroSD Card Adapter, and connect it to the Embedded Vision Development Kit.
2. Cycle the power on the Embedded Vision Development Kit to allow ECP5 and CrossLink to be reconfigured from Flash.
3. Connect the Embedded Vision Development Kit to the HDMI monitor. The camera image should be displayed on monitor.
4. Place test image in front of the camera. Bounding boxes should be displayed around locations with a high probability that a package is present.

   Note: The current demo has been trained to work best with white packages. By retraining the network, it would be possible to support a variety of other package styles. Figure 5.1 shows an example output with a package present.

Since demo firmware/information is written to non-volatile Flash memory, it runs at power-up.

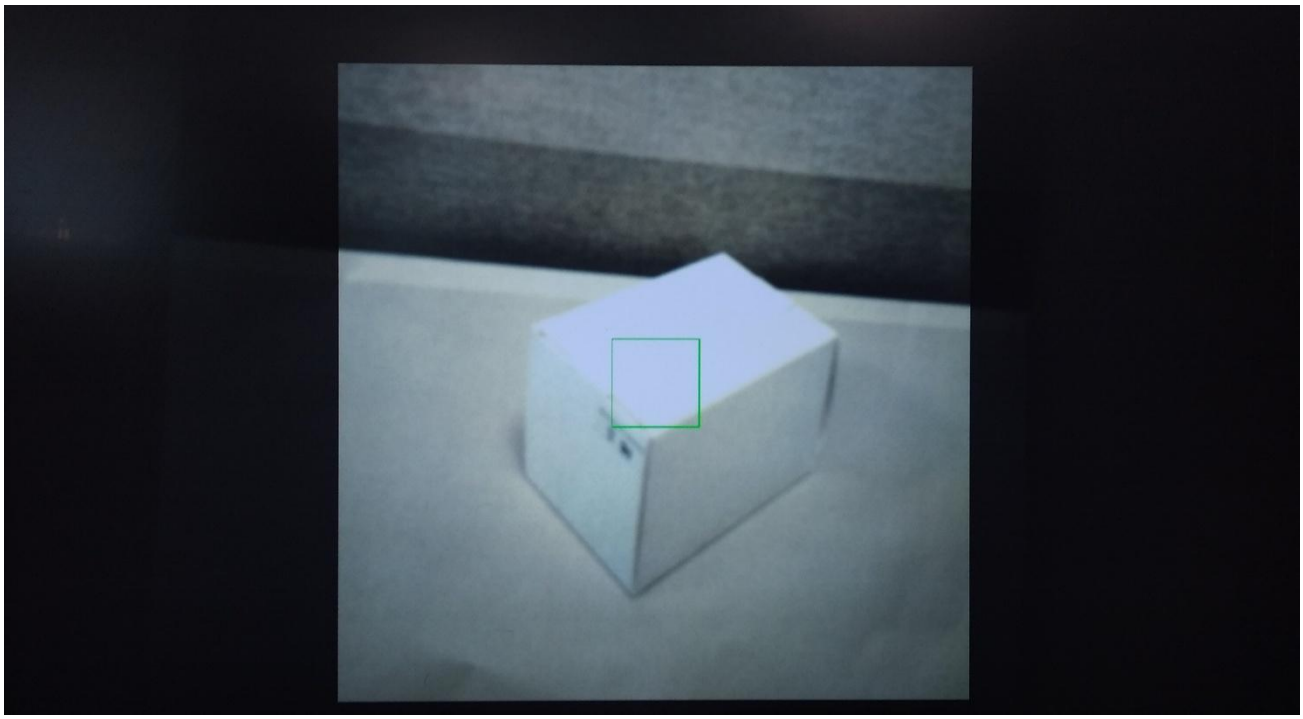

Figure 5.1. Output Image with Package Present

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Technical Support

For assistance, submit a technical support case at www.latticesemi.com/techsupport.

Revision History

Revision 1.0, September 2018

Section	Change Summary
All	Initial release.

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