iCE40 UltraPlus Always-On Display

User Guide

FPGA-UG-02026-1.0

June 2017

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1. Introduction

This document describes how to perform the Always-On Display demo on the iCE40 UltraPlus™ Mobile Development Platform (MDP) Board. The step-by-step procedure for setting up the demo platform is provided in detail.

The Ambiq Micro Apollo EVK base board is used in this demo as well as the Think Silicon NEMA|dc display controller and composition engine. The demo showcases the ability of iCE40 UltraPlus to drive a small wearable display and buffer one full image frame.

The Always-On Display demo includes four sub-demo modes listed below.

- Bouncing logo
- Globe rotation and bouncing
- Heart rate
- Fitness running

1.1. Sub-Demo Modes

Table 1.1 describes the four sub-demo modes which can be performed in the Always-On Display demo.

Table 1.1. Sub-Demo Modes

Index	Description	Layer Resolution	Number of Frames	Screenshot
Demo 1	Bouncing logo	100 x 100	1	
Demo 2	Globe rotation and bouncing	40 x 40	12	
Demo 3	Heart rate	130 x 70	3	

Table 1.1. Sub-Demo Modes *(continued)*

Demo 4	Fitness running	120 x 40	4	

Screen Resolution: 240 x 240

NEMA|dc Color Mode: RGB8888

2. Functional Description

The Ambiq Micro EVK board provides image data to the iCE40 UltraPlus device. It also provides features for starting the demo and switching between the different modes. After receiving image data, the iCE40 UltraPlus device manipulates the display on the LCD panel.

Figure 2.1 shows the functional diagram of the Always-On-Display demo.

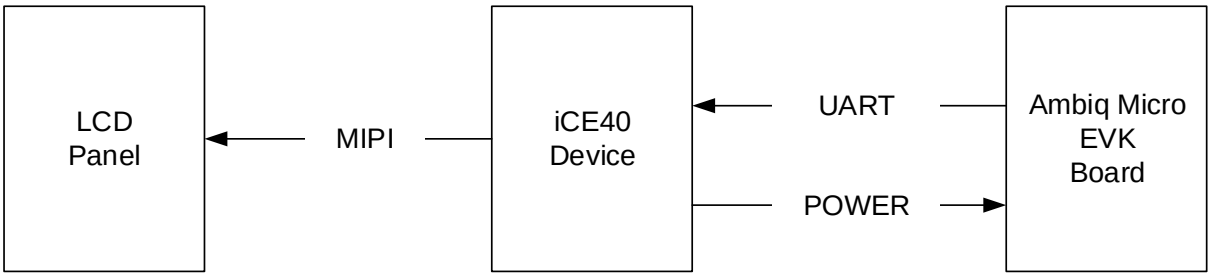

Figure 2.1. Always-On-Display Demo Functional Diagram

3. Demo Platform Setup

3.1. Configuring the Apollo EVK Base Board

3.1.1. Upgrading the Ambiq MCU Firmware on the Ambiq Apollo EVK Board

The Ambiq Apollo EVK board provides two power supply sources:

- USB connector (J1); and
- External 3.3 V DC input (JP9).

When upgrading the Ambiq MCU firmware, choose the USB connector power supply source.

The jumper and switch settings for performing firmware upgrade on the Apollo EVK base board are described below and shown in Figure 3.1.

To set jumpers and switch:

1. Connect JP9 slot pin 4 and pin 6 (horizontal).
2. Connect J9 slot pin 1 and pin 2.
3. Set SW2 to ON position.

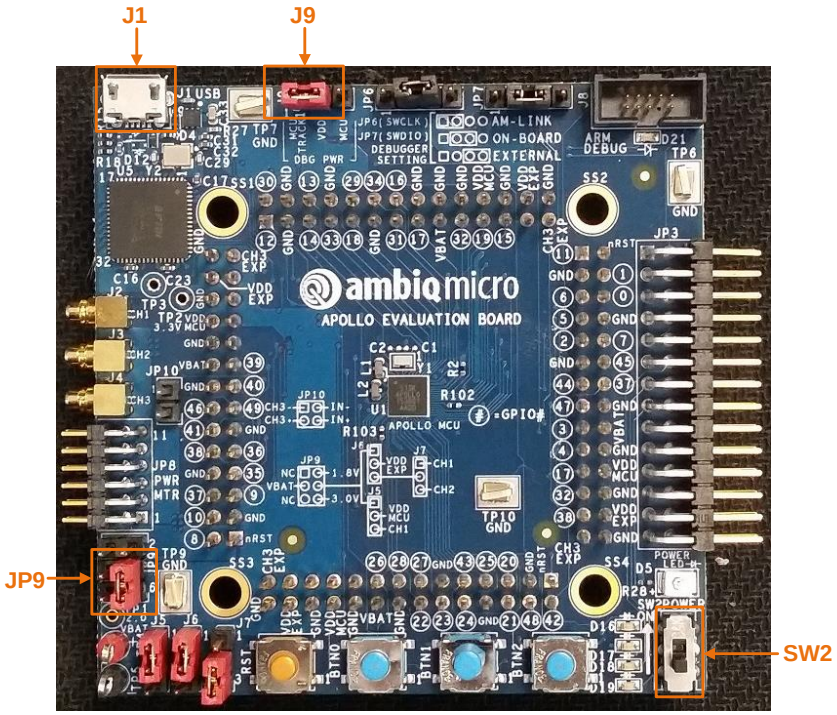

Figure 3.1. Jumper Settings on Apollo EVK Base Board for Firmware Upgrade

3.1.2. Programming the Firmware

To program the Ambiq MCU firmware:

1. Download and install the Ambiq flash program tool available in Ambiq Control Center.
2. Open the Ambiq Control Center application and select **Utilities > AM Flash**.

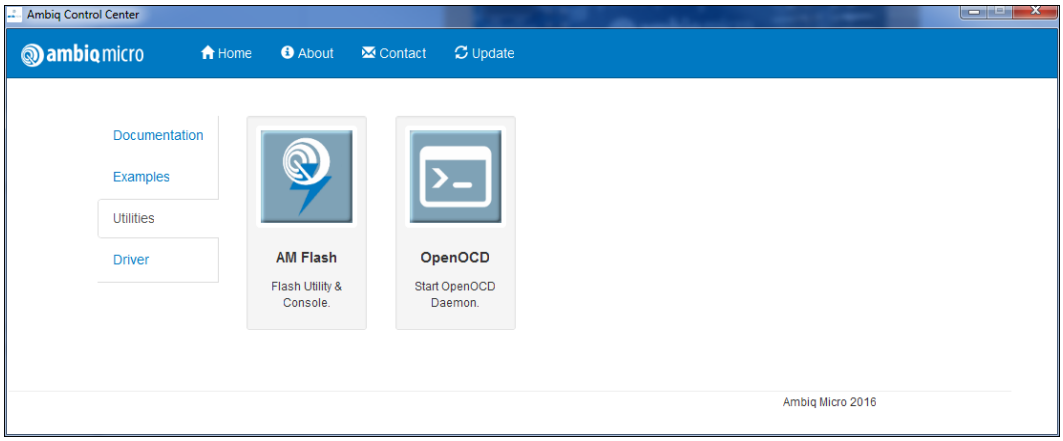

Figure 3.2. Ambiq Control Center Main Window

3. In the AM Flash window, click **Browse** and select the binary file ambiq_nemadc.bin provided by Lattice.

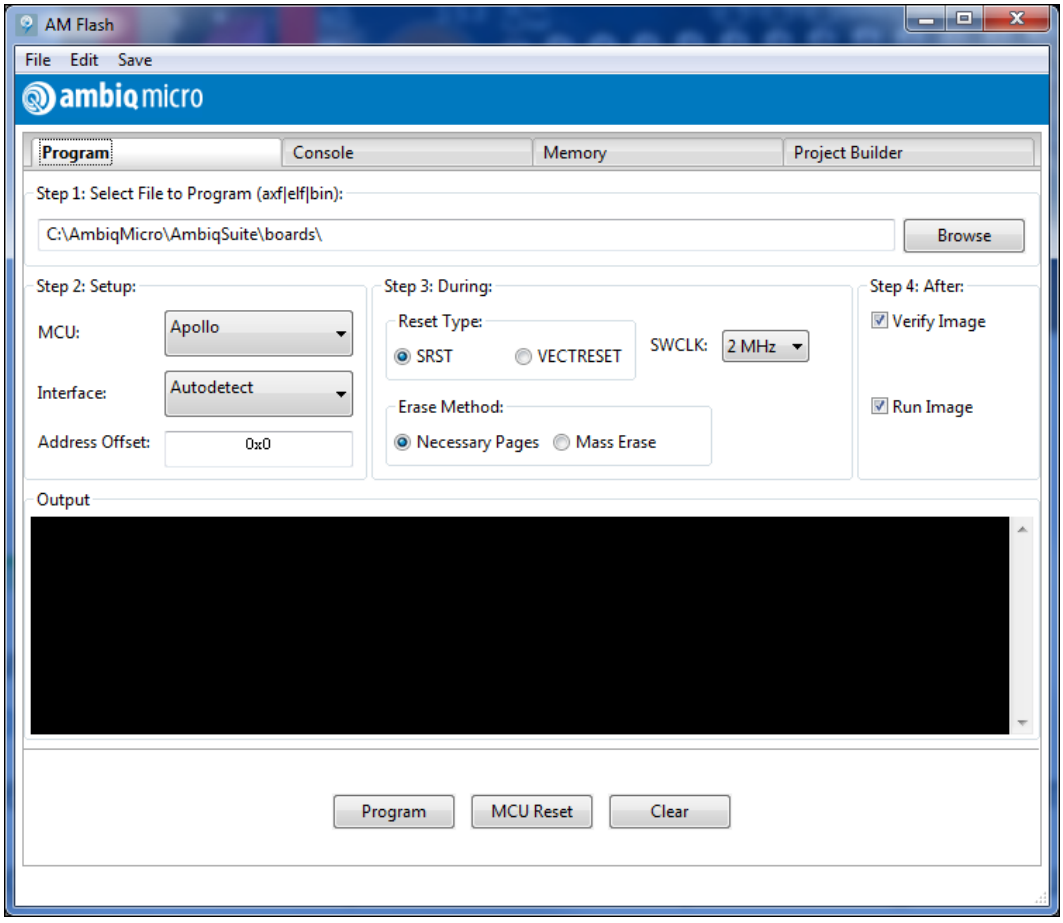

Figure 3.3. AM Flash Window

4. Connect the Apollo board to the PC using the USB cable.
5. Click the **Program** button to start the firmware upgrade.

3.2. Configuring the MDP Board

3.2.1. Setting Jumpers and Switches

Before running the demo, the MDP board must be configured by setting the switches and jumpers as shown in Figure 3.4.

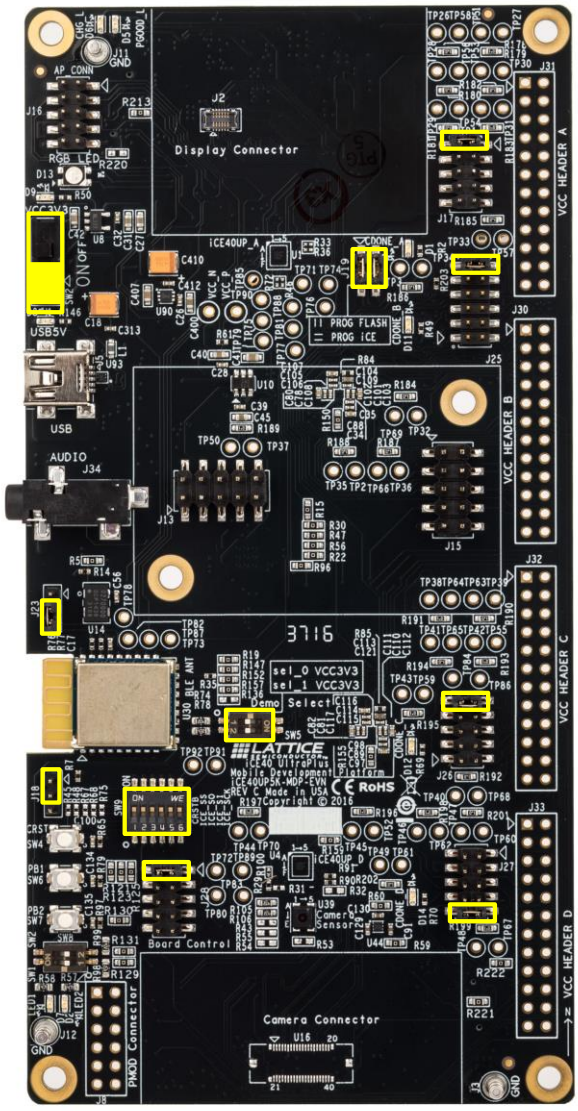

Figure 3.4. MDP Board Configuration

Table 3.1 provides detailed information on the MDP switch and jumper configuration.

Table 3.1. MDP Board Configuration Details

ITEMS	CONFIGURATION	DESCRIPTION
J25,J26,J27	Shunt pin 9-10	Disables the ICE40UP5K_B/C/D devices
J17	Shunt pin 1-2	Enables the ICE40UP5K_A device
J28	Shunt pin 1-2	Board control for programming SPI Flash.
J19	Shunt pin 1-3,2-4(vertical)	Enables programming of SPI Flash

J23	Shunt pin 2-3	Uses Xtal U14 as clock source
SW2	Set to ON	Power switch; slide down for power-ON.
SW5	All set to OFF	Selects the ICE40UP5K_A as the target device

3.2.2. Programming SPI Flash on the MDP Board

To program SPI flash in Diamond Programmer (version 3.8 or higher):

1. Connect the MDP board to the PC using a USB cable and power ON the MDP board.
2. Start Diamond Programmer.
3. In the Diamond Programmer Getting Started dialog box, select **Create a new project from a JTAG scan** and click **OK**.
4. After scanning, set **Programming Speed Settings** to **Use customer Clock Divider** and select the value **5**.
5. Set Device Family to "iCE40 UltraPlus" and Device to "iCE40UP5K".
6. Open the Device Properties dialog. Apply the settings as shown in Figure 3.5.

   Access mode: set to "SPI Flash Programming".

   Operation: set to "SPI Flash Erase, Program, Verify" mode.

   Programming File: load bit stream file for demo.

   SPI Flash Options: select correct Flash chip.

   Load from File button should be used to refresh fields such as "Data file size" and "End address(Hex)".
7. Click **OK** to exit Device Properties dialog.
8. Click the **Program** button in Diamond Programmer to download the bitstream file.

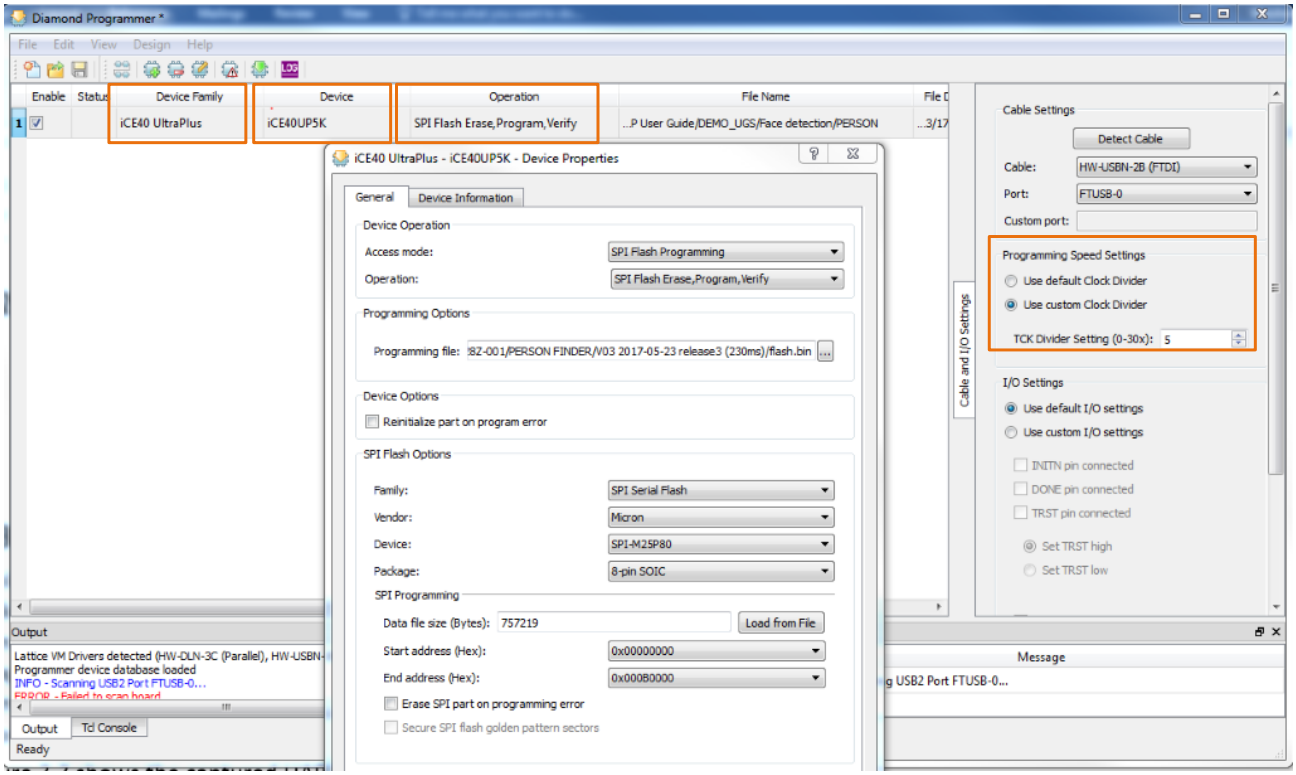

Figure 3.5. Programming Settings in Diamond Standalone Programmer

3.3. Connecting the Lattice MDP Board to the Apollo EVK Base Board.

Before running the demo, remove the USB cable from J1 on the Apollo EVK board and shunt Pin3-4 of JP9 to get the power supply from the Lattice MDP board. There are three lines that need to be connected between these two boards. Table 3.2 provides detailed information on these connections.

Table 3.2. Board Connection Descriptions

Lattice J31 Slot	Ambiq Board.	Description
Pin 1	Pin 35	UART Rx for iCE40UP5K_A(U1) on MDP board
Pin 2	Pin VBAT	External power supply from Lattice to Ambiq board.
Pin23	GND	GND line

Figure 3.6 shows detailed information on the board connection.

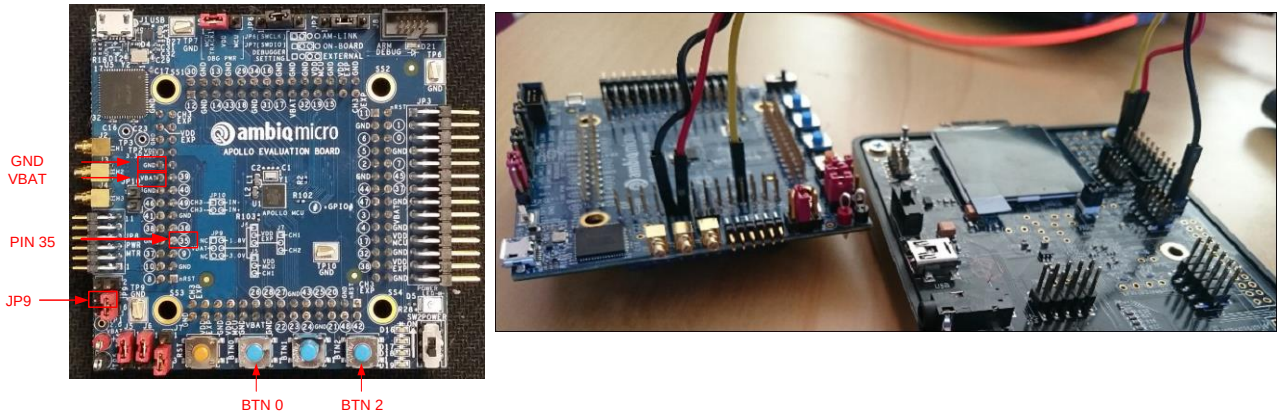

Figure 3.6. Board Connection between MDP Board and Apollo EVK Base Board

3.4. Starting the Demonstration.

1) Press button 2 on the Apollo EVK base board to start the demo.
2) Press button 0 on the Apollo EVK base board to switch among the sub demo modes.

Technical Support Assistance

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

Revision History

Date	Version	Change Summary
June 2017	1.0	Initial release.

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