TI Designs：TIDEP-0087
用于 EV 充电基础设施的人机界面 (HMI) 参考设计

说明

这种基于处理器的参考设计有助于更快地推向市场，并帮助客户设计具有成本效益的电动车辆(EV)充电基础设施或电动汽车供应设备(EVSE)的人机界面(HMI)解决方案。此参考设计展示了对于 EVSE HMI 而言常见的二维 (2D) Qt 图形用户界面 (GUI)，以及用于软件渲染图形的 TI 处理器功能。AM335x 处理器可提供了具备各种处理速度和兼容软件以满足低端至高端 应用的需求，以及与 EVSE HMI所需的关键外围设备的足够的连接（如通用异步接收器/发送器 (UART) 和 CAN）。

资源

TIDEP-0087	设计文件夹
AM335x	产品文件夹
AM335x 入门套件	EVM 产品文件夹
AM335x SDK	软件产品文件夹

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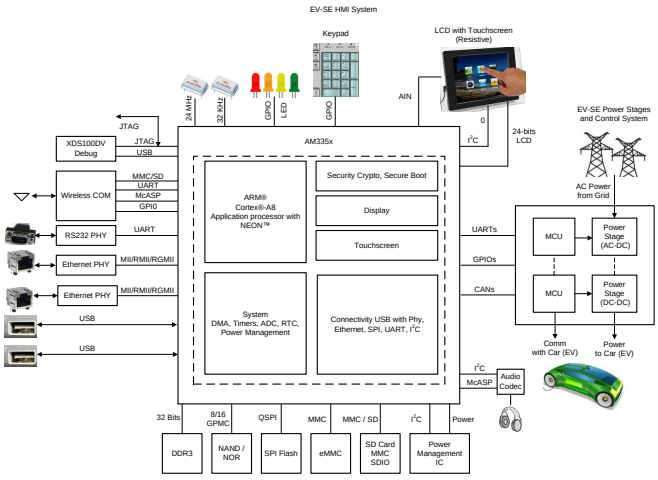
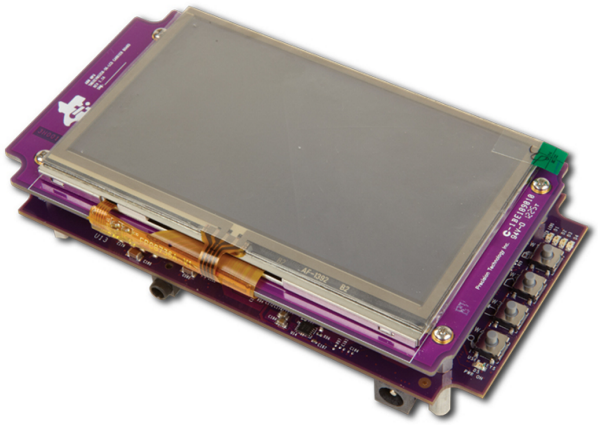
特性

- 充电站选项（使用软件加速图形和 Qt）的四个示例屏幕
- 支持电阻式触摸屏
- 在提供的 4.3 英寸 LCD 上支持 480×272 分辨率；在其他显示器上可扩展到 2048×2048
- 在 TI 的处理器 SDK-Linux 上构建以便于扩展到其他平台 Sitara™处理器

应用

- EV 供电设备 (EVSE)





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1 System Description

With increasing battery capacity and decreasing battery cost, electric vehicles are becoming more mainstream each day. The EVSE is an infrastructure element that supplies electric energy for the recharging of electric vehicles, such as plug-in electric vehicles, including electric cars, neighborhood electric vehicles, and plug-in hybrids.

The EVSE system consists of a power stage, some sort of central processing unit (CPU) such as a microcontroller (MCU) or microprocessor (MPU), communication subsystems for both internal data exchange and external communications, and an HMI.

The Sitara™ AM335x processor, which is one of the most popular processors for industrial HMI applications, not only has the resources targeted for processing the user interface of a charging station, but the AM335x processor's easy-to-use programming tools and portfolio of on-chip capabilities give designers a head start on EVSE development projects.

Based on the AM335x Starter Kit Evaluation Module (EVM), the TIDEP-0087 reference design is a quick starting point for customers who want to design an EVSE HMI module or system for an EV charging infrastructure.

The TI AM335x high-performance processors are based on the ARM® Cortex®-A8 core (see 图 1). These enhanced processors have rich peripherals and an advanced display capability, including 2-D and 3-D acceleration to help customers design cost-effective EVSE HMIs. The devices support high-level operating systems (HLOS) such as Linux, which is available free of charge from TI. The devices offer an upgrade to systems based on lower-performance ARM cores, provide updated peripherals, and support the typical interfaces to connect to EV charging power stages, such as UART and CAN.

图 **1. Sitara™ AM335x Chip**

The AM335x supports 24-bit, liquid-crystal display (LCD) controllers with a resolution up to 2048 × 2048, which allows system designers to select various screen sizes and resolutions based on use cases and provides scalability from low to mid-end.

The Qt framework is used to develop the GUI for EVSE HMI application software. Qt is a cross-platform application framework written in C++. Learn more about Qt at https://www.qt.io.

2 System Overview

2.1 Block Diagram

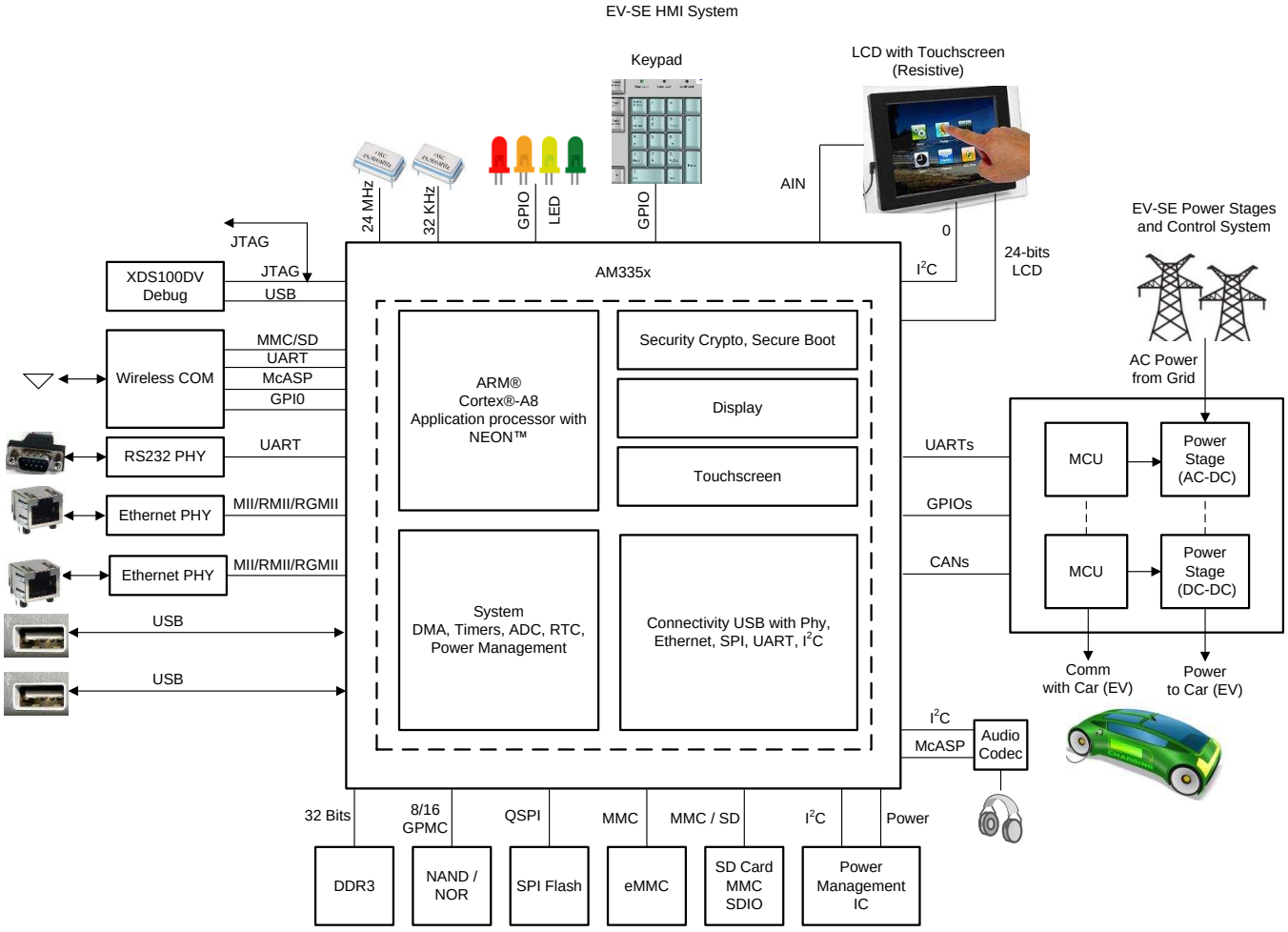


图 2. EVSE HMI Block Diagram

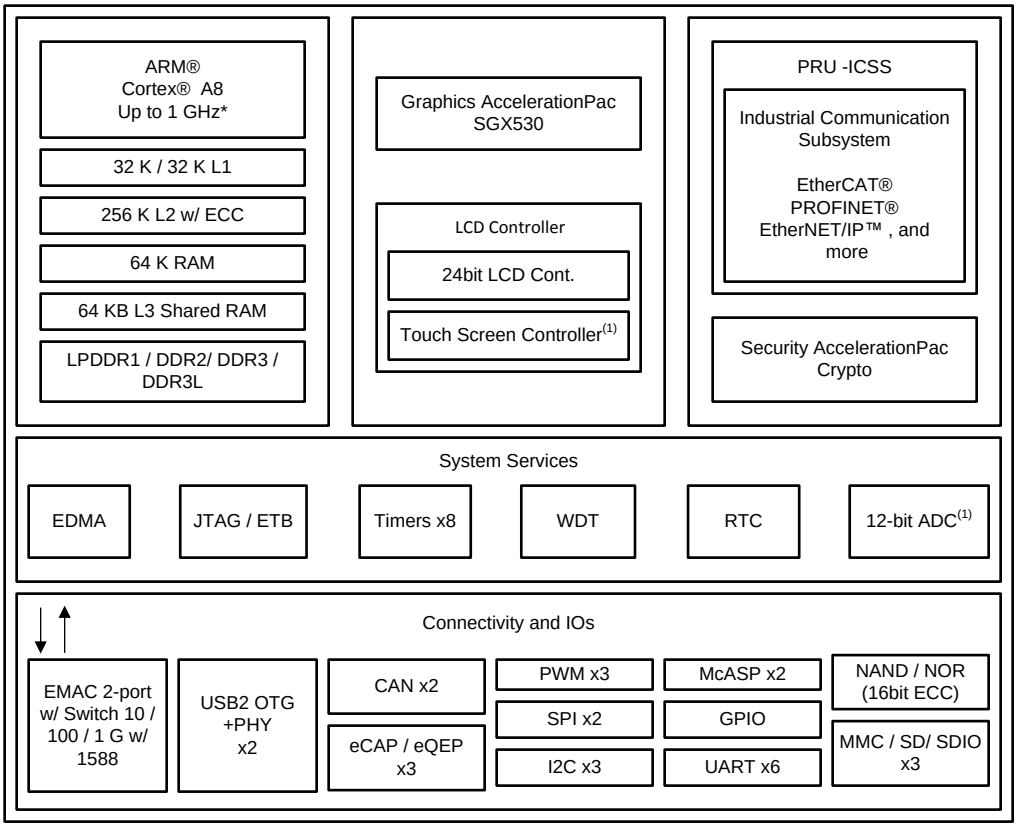
2.2 Highlighted Products

2.2.1 AM335x

The AM335x processors, based on the ARM Cortex-A8 core, are enhanced with image, graphics processing, peripherals, and industrial interface options, such as EtherCAT® and PROFIBUS®.

These devices support HLOS, such as Linux. The AM335x processors contain the subsystems in 图 3: the microprocessor unit (MPU) subsystem, which is based on the ARM Cortex-A8 core, and the PowerVR SGX™, which is a graphics accelerator subsystem that provides 3-D graphics acceleration to support display and gaming effects.

The Programmable Real-Time Unit Subsystem and Industrial Communication SubSystem (PRU-ICSS) is separate from the ARM core and allows independent operation and clocking for greater efficiency and flexibility. The PRU-ICSS enables additional peripheral interfaces and real-time protocols, such as EtherCAT, PROFINET®, EtherNet/IP™, PROFIBUS, Ethernet Powerlink™, Sercos™, and others.



00 MHz / 1 GHz only available on 15 x 15 package. 13 x 13 support up to 600 MHz. Use of TSC will limit available ADC channels.

图 3. AM335x Block Diagram

Additionally, the programmable nature of the PRU-ICSS, along with its access to pins, events, and all system-on-chip (SoC) resources, provides flexibility in implementing fast, real-time responses, specialized data handling operations, custom peripheral interfaces, and in offloading tasks from the other processor cores of an SoC.

3 Hardware, Software, Testing Requirements, and Test Results

3.1 Required Hardware and Software

3.1.1 Hardware

The AM335x Starter Kit EVM is required to run the EVSE HMI demonstration application. The AM335x Starter EVM is a stand-alone test, development, and evaluation module system that enables developers to write software and develop hardware around an AM335x processor subsystem.

See the *AM335x Starter Kit Hardware User's Guide* for instructions on getting started and details on the hardware architecture of the AM335x Starter Kit EVM.

3.1.2 Software

The AM335x Processor SDK for Linux (Processor-SDK-Linux) provides a fundamental software platform for development, deployment, and execution of Linux-based applications. The EVSE HMI demonstration application source code is integrated in the Processor-SDK-Linux. The example application can be played through Matrix GUI application launcher. More information on Qt application development using Processor-SDK-Linux can be found in and .

The Processor-SDK-Linux package contains a software user's guide and additional documentation for setting up and running the demonstration applications. Download the package from www.ti.com/tool/PROCESSOR-SDK-AM335X.

For the purposes of this design guide, use a Linux host machine for the following instructions. With the required hardware, program the SD card with the Linux processor SDK image using the following steps:

1. Download the SDK installer ti-processor-sdk-am335x-evm-xx.xx.xx.xx-Linux-x86-Install.bin from TI.com (where *xx.xx.xx.xx* is the version number of the latest Linux processor SDK).
2. Create the SD card with default images using the *SDK Create SD Card Script* or see the user's guide.
3. Boot the Linux kernel and file system using the created SD card.

3.2 Testing and Results

3.2.1 Test Setup

This subsection provides details of the test setup with the required hardware and software to run the TI EVSE HMI software application.

1. Insert the micro SD card created in 节 3.1.2 in the location shown in 图 4.
2. Insert the 5-V power supply and press the power button shown in 图 4.

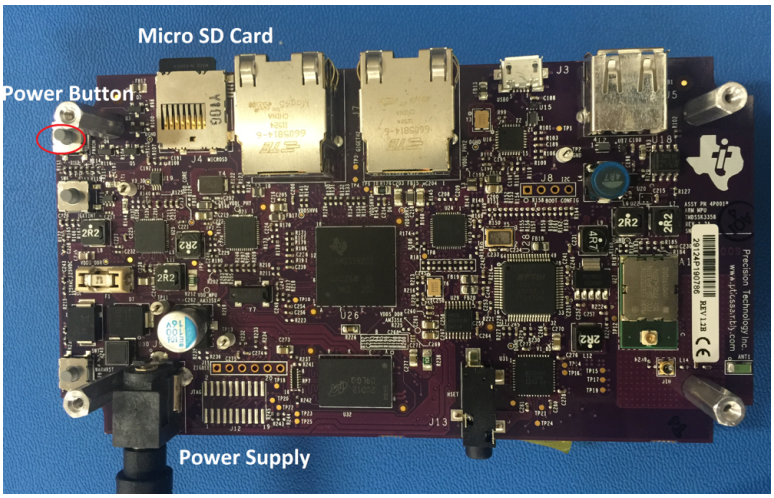


图 **4. AM335x Starter Kit Setup (LCD Face Down)**

3. The board boots up, the Matrix GUI application launches, and the interface shows on the LCD screen (see 图 5).

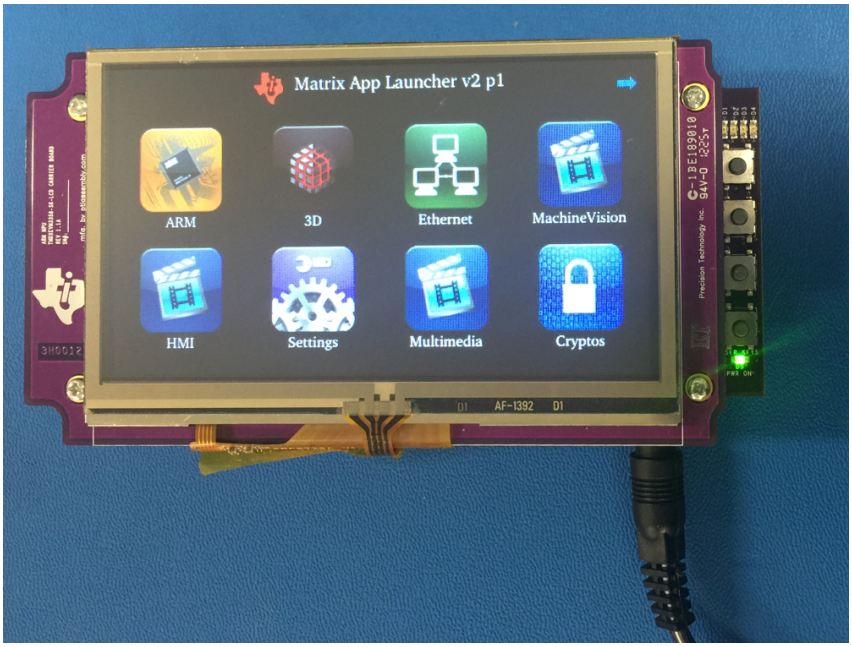


图 **5. AM335x Starter Kit Setup (LCD Face Up)**

3.2.2 Test Results

The test results are as follows:

1. 图 6 shows the default Matrix GUI. Click on the *HMI* icon to navigate to the EVSE HMI demonstration.

图 **6. AM335x Default Matrix GUI**

2. 图 7 shows the HMI Submenu, which is the next screen that appears. Click on the *EVSE* icon.

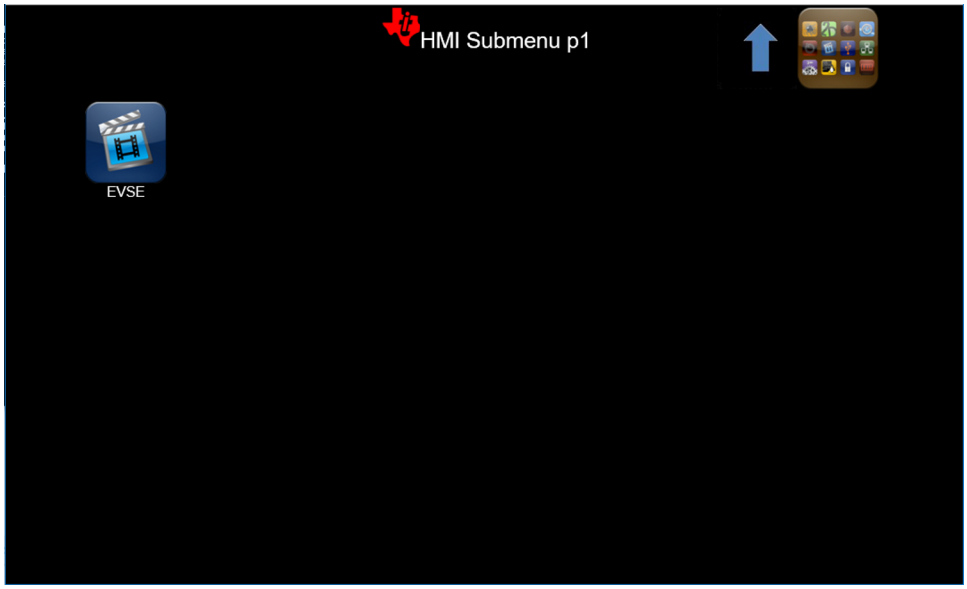


图 **7. HMI Submenu**

3. 图 8 then shows on the screen. Click the *Run* button to launch the EVSE HMI demonstration GUI.

图 **8. EVSE HMI Description and Run Screen**

4. The EVSE HMI demonstration GUI launches and the *Welcome* screen shows (see 图 9).
   - The green *Click to Continue* button on the left navigates to the next page of the demonstration.
   - The orange *Exit* button on the right exits out of the demonstration and returns to the Matrix GUI in the previous 图 6.

> 注: The *Exit* button on this screen is the only way to exit out of the demonstration GUI and return to the Matrix GUI.

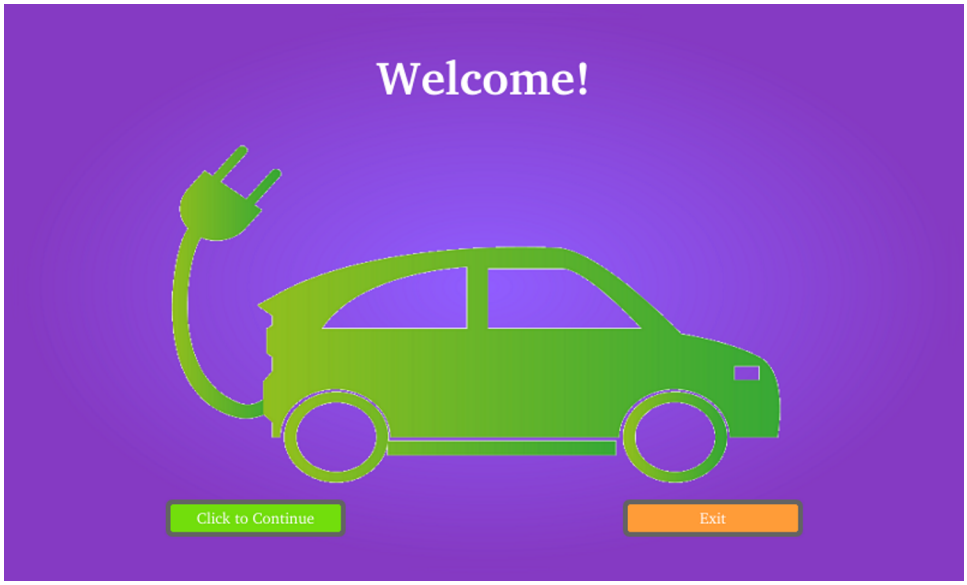


图 **9. EVSE HMI Demonstration GUI—Welcome Screen (Page One)**

5. The *Click to Continue* button in 图 9 leads to the charging mode screen shown in 图 10.
   - All four of the option buttons (*Option 1* through *Option 4*) direct the user to the third page of the GUI.
   - The home icon in the bottom-right corner directs the user back to the *Welcome* screen in 图 9.

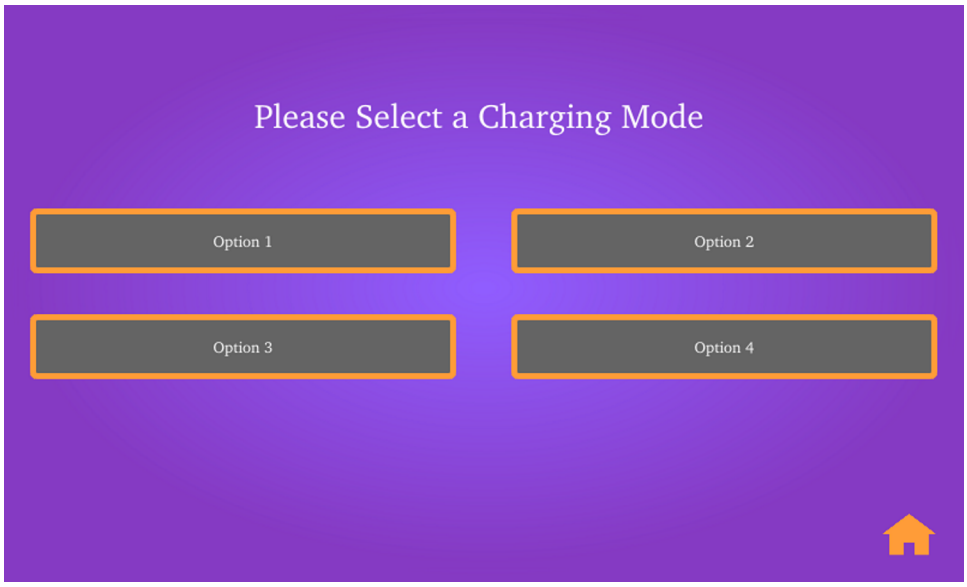


图 **10. EVSE HMI Demonstration GUI—Charging Mode Screen (Page Two)**

6. 图 11 shows page three of the GUI.
   - The *Ok* button directs the user to the last page of the GUI.
   - The home icon in the bottom-right corner leads to the *Welcome* screen in 图 9.

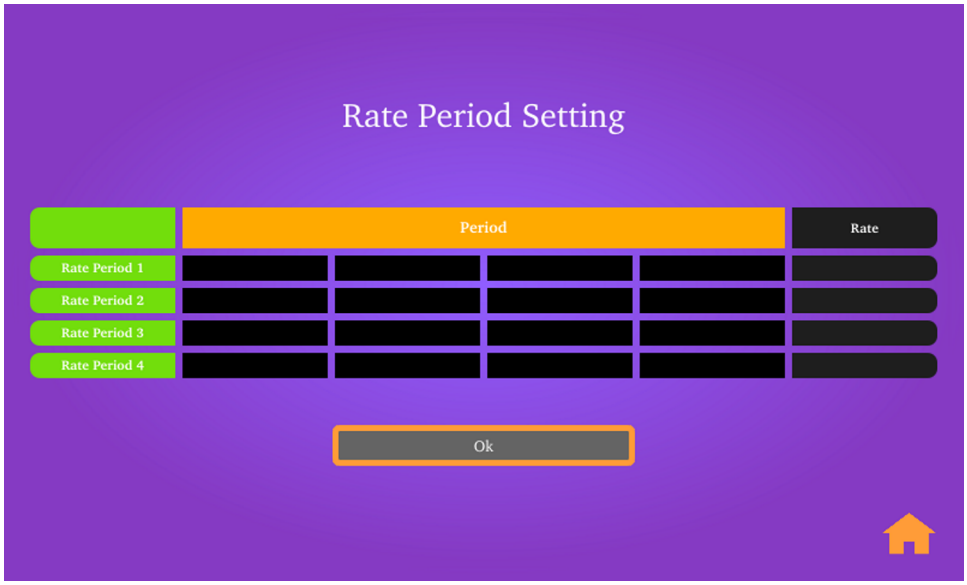


图 **11. EVSE HMI Demonstration GUI—Rate Period Setting Screen (Page Three)**

7. 图 12 shows the last page in the demonstration.
   - After pressing the *Begin Charge* button, the progress bar, *Remaining Time* field, and *Elapsed Time* field begin updating.
   - The *End Charge* button directs the user back to the *Welcome* screen in 图 9.

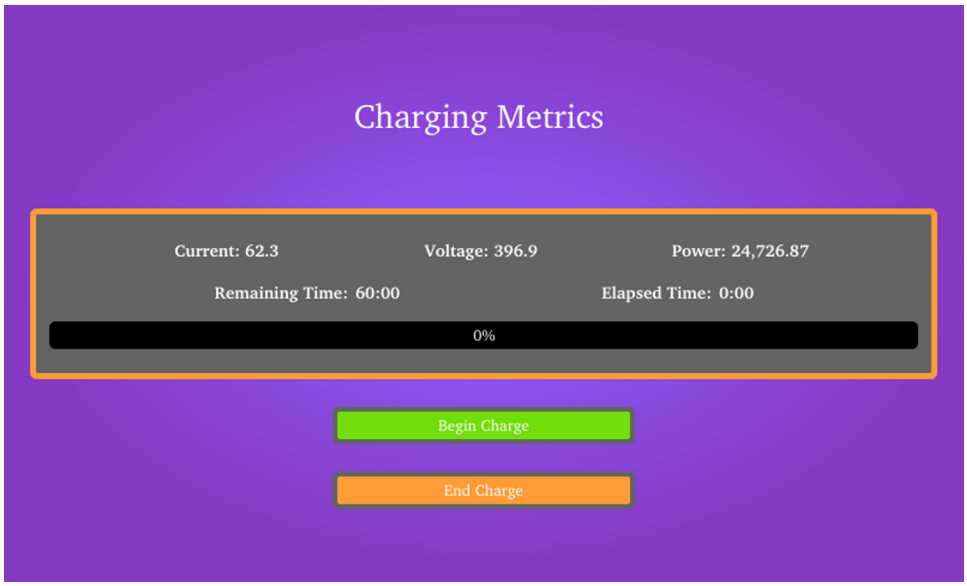


图 **12. EVSE HMI Demonstration GUI—Rate-Charging Metrics Screen (Page Four)**

4 Design Files

To download the hardware design files for the AM335x Starter Kit, see the design files at TIDEP-0087.

5 Software Files

Download the Processor SDK Linux for AM335x from the AM335x software product page.

6 Related Documentation

1. Texas Instruments, *AM335x Starter Kit Hardware User's Guide*, AM335x Wiki Page
2. Texas Instruments, *Qt Training: Multipage Resizable Graphical User Interfaces containing Media*, Application Report (SPRACB2)
3. Texas Instruments, *Sitara Linux Training: Hands on with QT*, Wiki Page
4. Texas Instruments, *Processor SDK Linux Software Developer's Guide*, Wiki Page
5. Texas Instruments, *Processor Linux SDK Graphics and Display*, Wiki Page

6.1 商标

7 Terminology

EV— Electric vehicle

EVM— Evaluation module

EVSE— Electric vehicle supply equipment

GUI— Graphical user interface

HLOS— High-level operating systems

HMI— Human machine interface

PRU-ICSS— Programmable Real-Time Unit Subsystem and Industrial Communication SubSystem

SDK— Software development kit

SoC— System-on-chip

UART— Universal asynchronous transmitter/receiver

8 About the Author

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