

# **EP70XXC Demonstration Platform User Manual**

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## 1. Hardware

### 1.1 Overview

The EP70XX Demo Platform comprises a single board that contains either the EP7010 or EP7038 device with no external components for the operation of the IVR.

The demo platform is equipped to connect a PC via a micro-USB connector and a USB-to-I2C translation circuit, allowing IVR configuration through a Graphical User Interface (GUI). There are also headers and test points to connect input power, output loads and probe I/O signals.

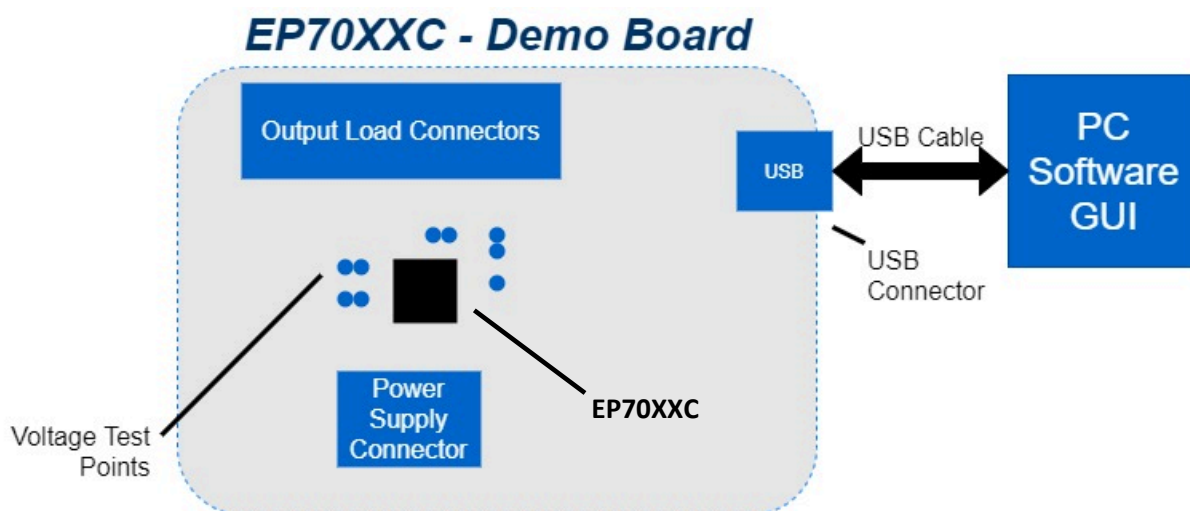


Figure 1. EP70XXC Demo Board and Supporting Features.

### 1.2 Measurement Point Summary

| Property                              | Location               |
|---------------------------------------|------------------------|
| <b>Input Voltage (PVIN)</b>           | TP8 (VIN), TP6 (GND)   |
| <b>Output Voltage VR1</b>             | TP3 (VOUT1), TP4 (GND) |
| <b>Output Voltage VR2</b><br>(Note 2) | TP1 (VOUT2), TP2 (GND) |
| <b>Output Voltage VR3</b><br>(Note 2) | TP7 (VOUT3), TP5 (GND) |
| <b>Power Good</b>                     | TP9 (PG)               |

Note 1: All test points are kelvin connected to their corresponding measurement pins.

Note 2 The EP7010C Demo Board will not feature VR2 and VR3 or the associated test points.

### 1.3 Pictures

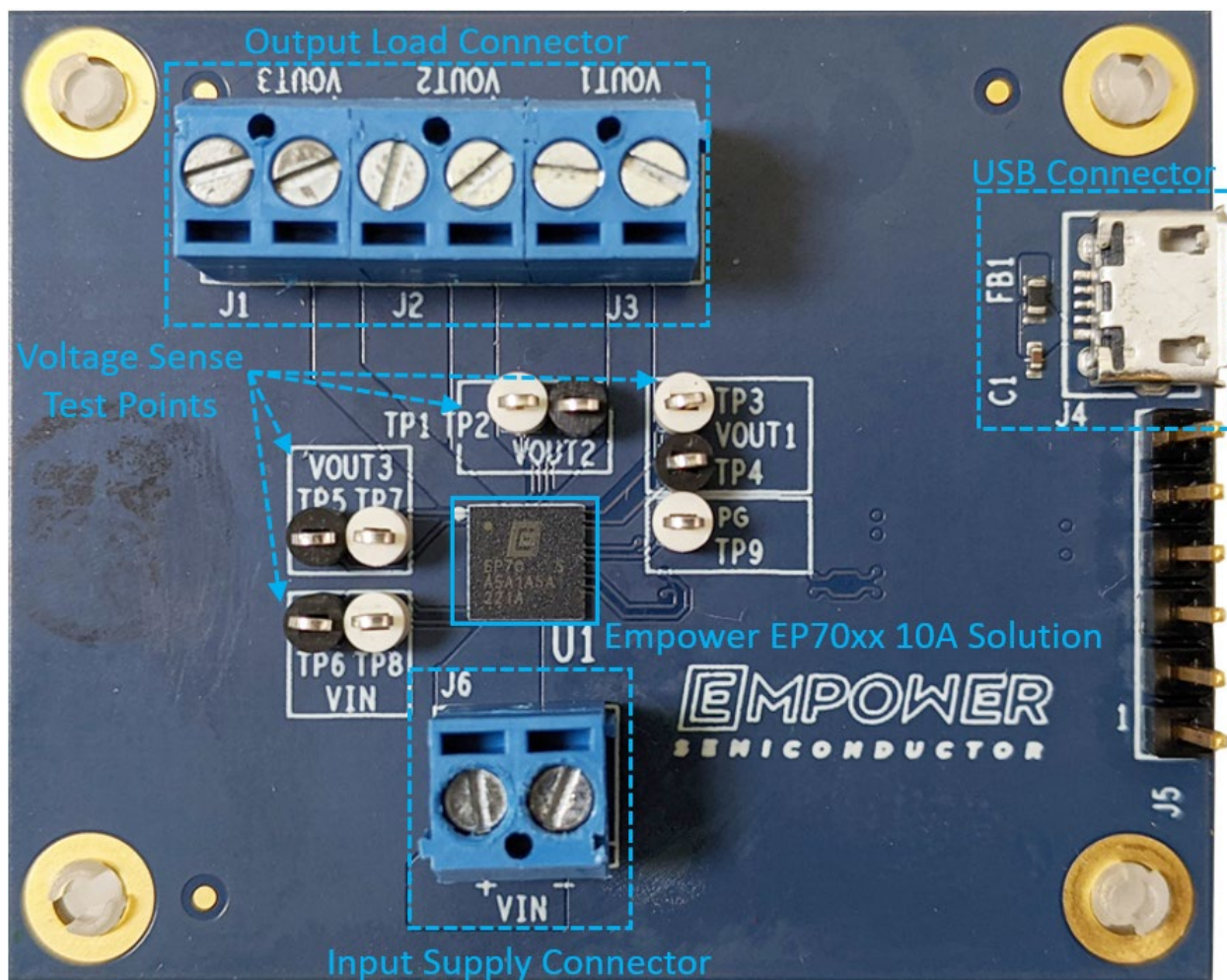


Figure 2. Top View of EP7038C Demo Board

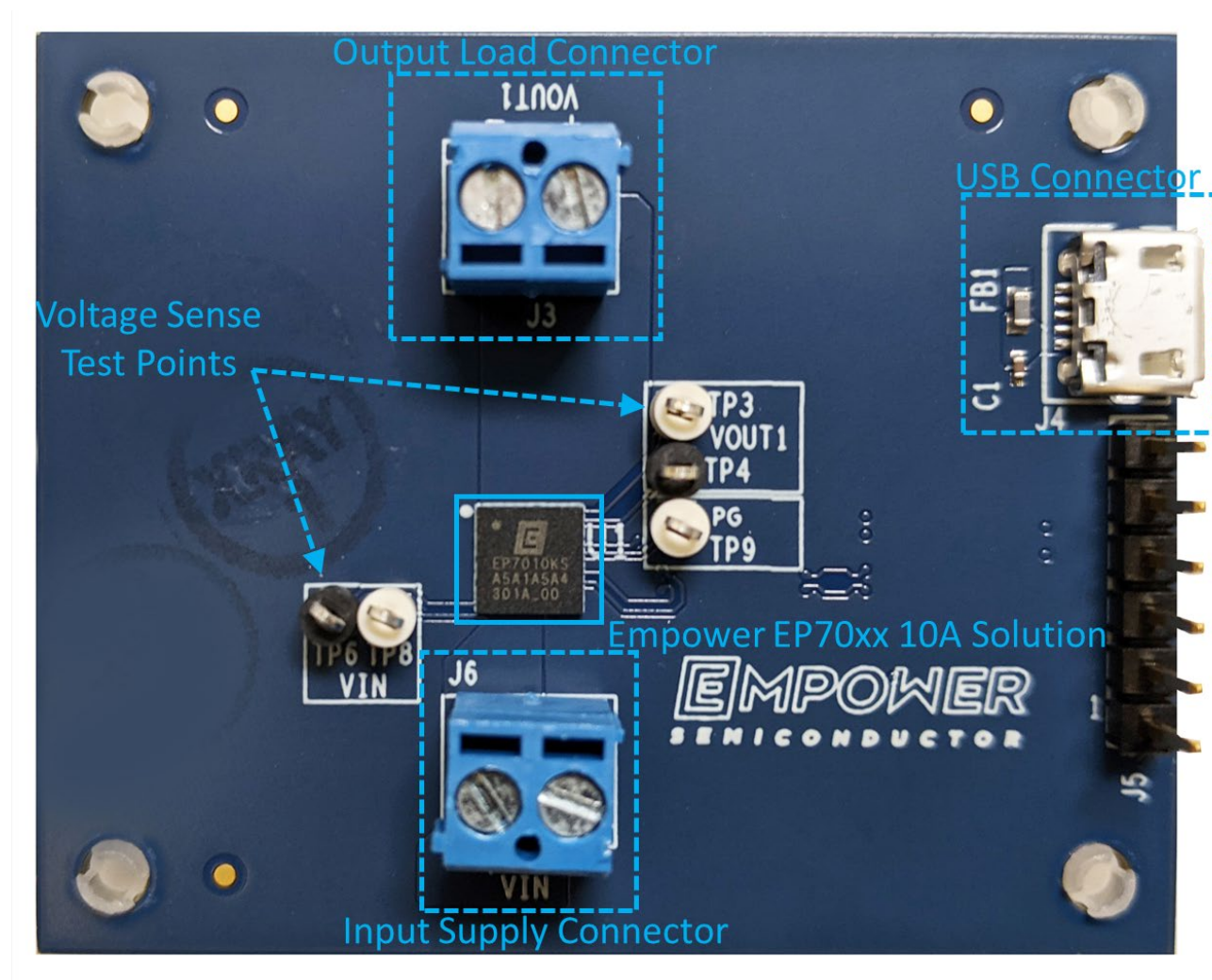


Figure 3. Top View of EP7010C Demo Board



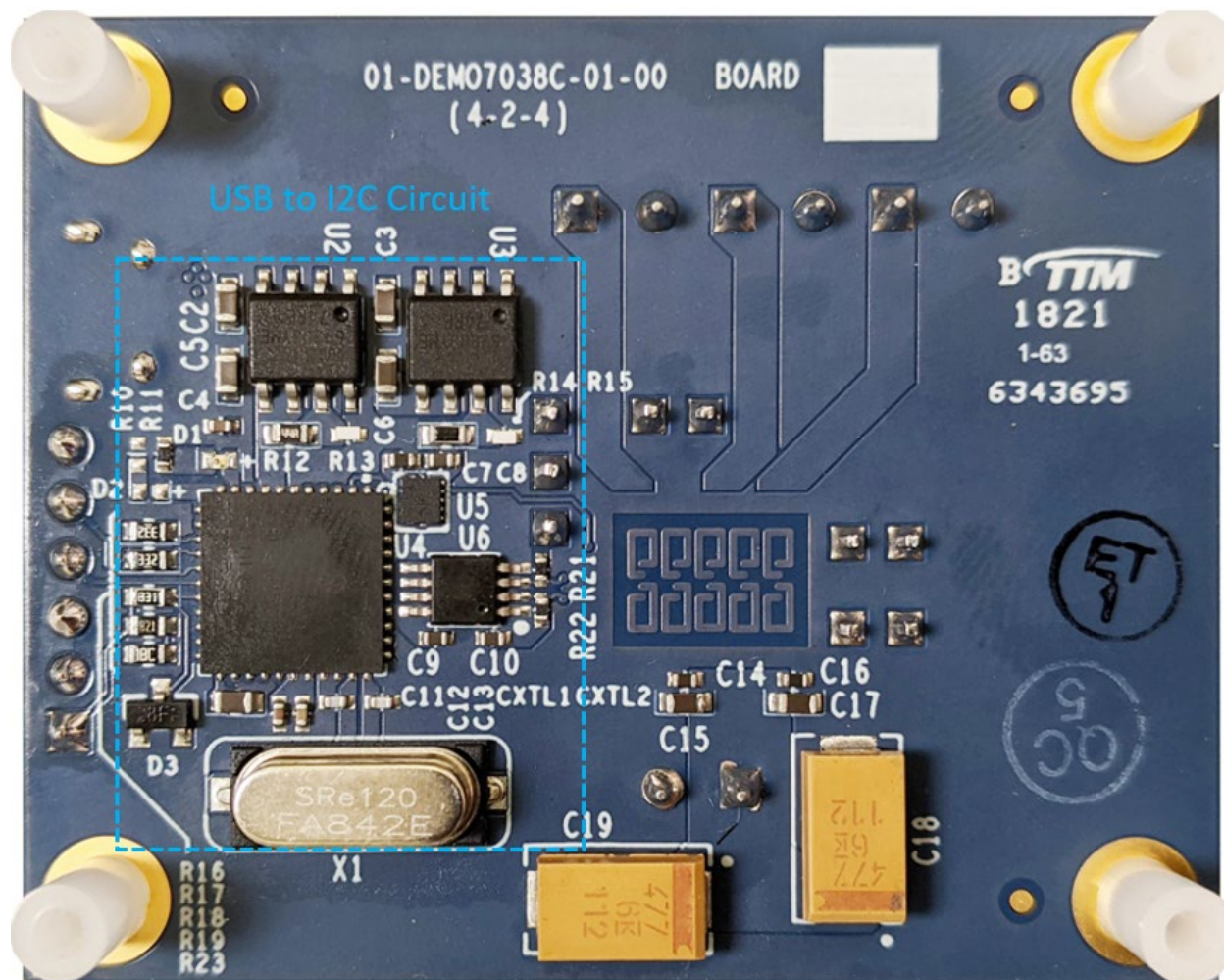


Figure 4. Bottom of EP70XXC-Demo Board

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## 2. Using the EP70XXC Demo Platform

The EP70XXC Demo Platform consists of the Demo board and the USB cable.

### 2.1 QuickStart Sequence

1. Ensure an appropriate bench power supply programmed to provide 1.8V is connected to the demo board input connector (J6). Refer Figure 2.
2. Plug in the USB cable (provided in the demo board package).
3. Start the EP70XXC demo GUI. Download the GUI installation from [www.empowersemi.com/ep70xx-demo](http://www.empowersemi.com/ep70xx-demo)
4. Click on the IVR Enable button to enable EP70XXC.
5. Click on the Enable button in the VR1 Panel.
6. Move the VR1 Output Target setting to 0.8 V.
7. Click on the Execute button (if *Execute on Change* box is unchecked).
8. The Die Telemetry panel of VR1 should be reading the Output Voltage at 0.8 V.
9. Repeat steps 5 through 8 for VR2 and VR3 if it is a EP7038C-DEMO

### 2.2 Turning on and Control of the EP70XXC

The enable (EN) signal to EP70XXC is controlled through the Demo GUI. In the Core panel of the GUI, the IVR Enable button controls the EN signal, enabling and disabling EP70XXC. Ensure that the 1.8V input is connected to J6 and enabled before enabling the EP70XXC.

### 2.3 Measuring Input and Output Voltages and Currents

The EP70XXC Demo Platform includes test points for measuring the EP70XXC input voltage and the output voltage of each VR (refer to Figure 2). Each voltage measurement is Kelvin-sensed at the EP70XXC package so that losses on connectors and PCB traces are not included in the measurements. Input current and load current measurements are required to be performed externally through meters.

### 2.4 Measuring Power-Good (PG)

The power-good (PG) signal indicates that each of the enabled voltage regulators is in regulation. PG signal can be measured with a voltmeter or an oscilloscope. To measure PG, connect a voltmeter or the oscilloscope probe to the PG (TP9) and one of the VSS test pins on the demo board.

### 3. Schematics

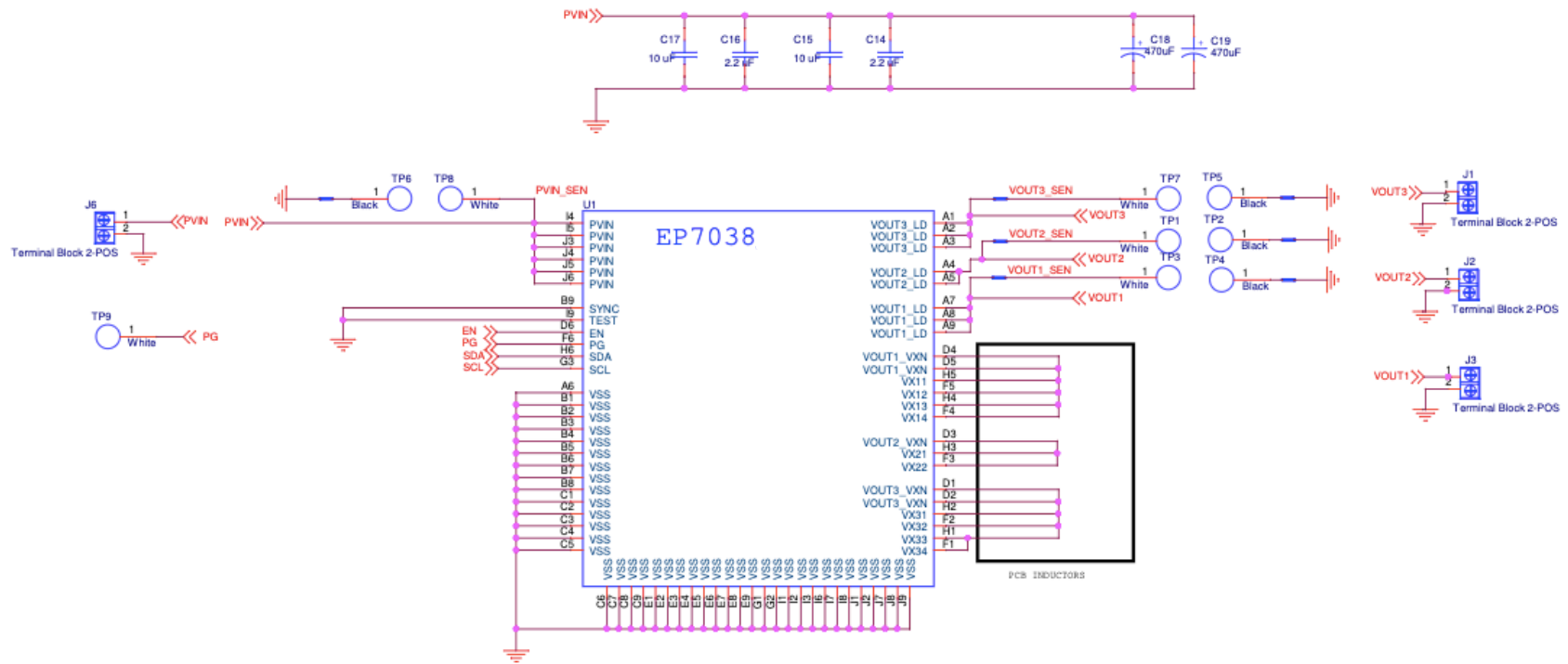
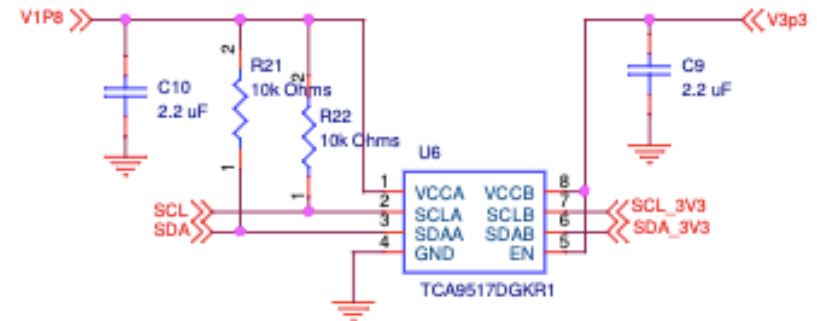
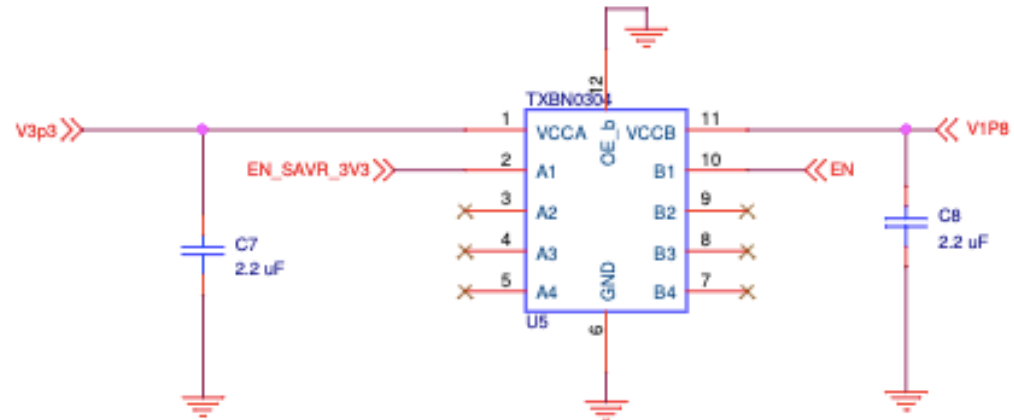
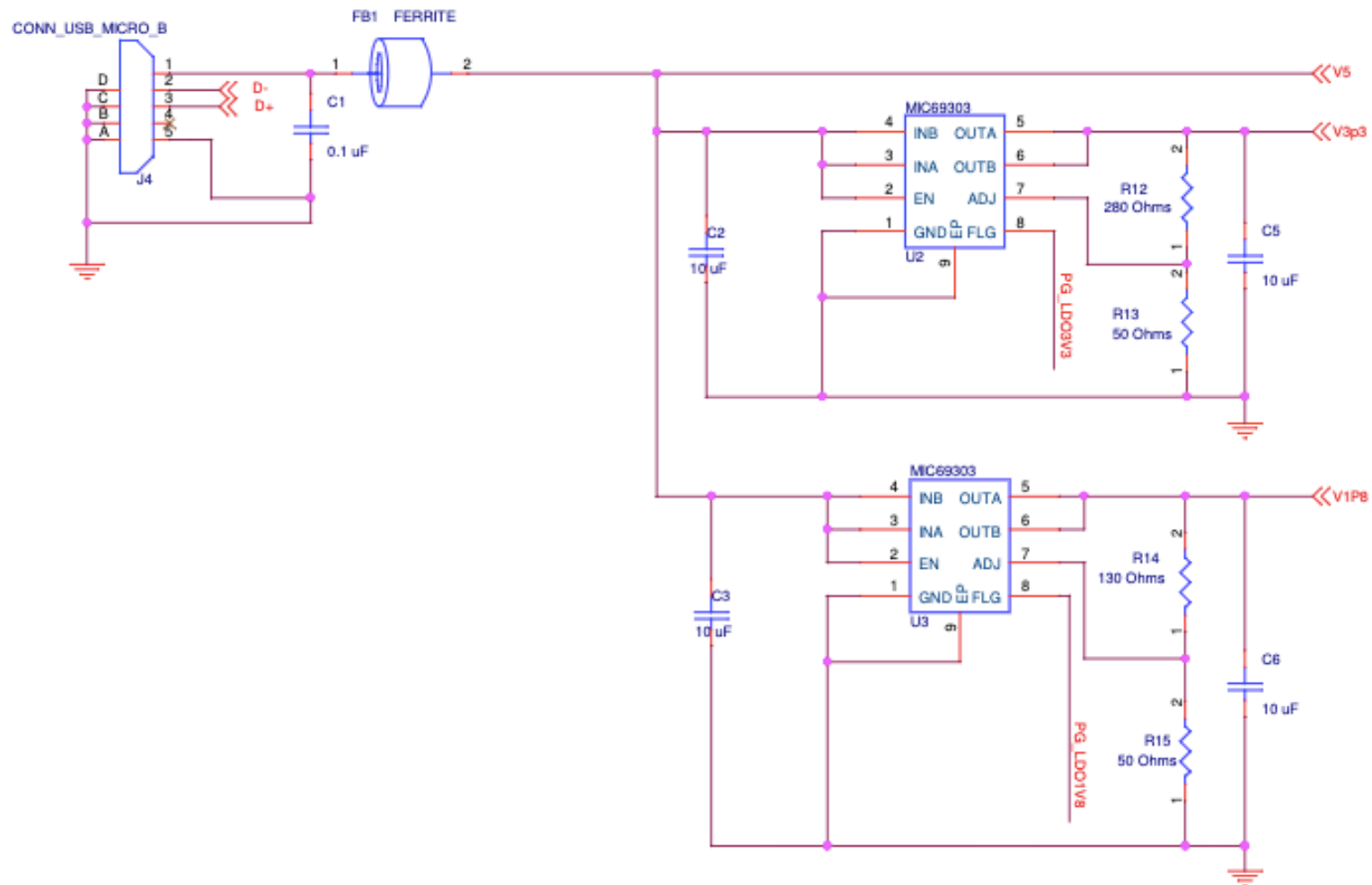


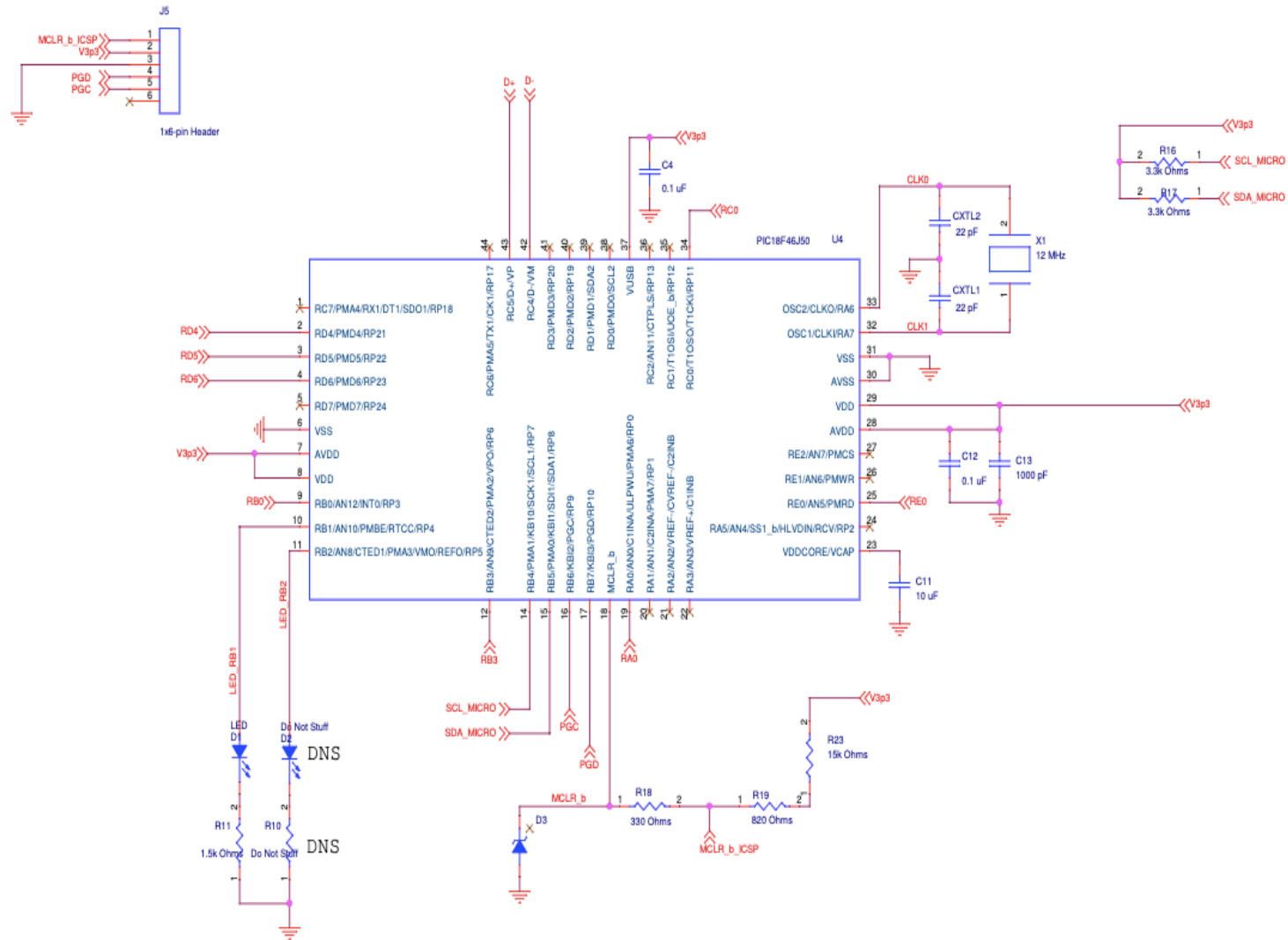
Figure 5. EP7038C Schematic



SCL\_MICRO >> << SCL\_3V3  
SDA\_MICRO >> << SDA\_3V3  
RD4 >> << EN\_SAVR\_3V3







## 4. Software

### 4.1 Installation

The DEMO GUI is delivered in a ZIP archive from the Empower Website at [www.empowersemi.com/ep70xx-demo](http://www.empowersemi.com/ep70xx-demo). Please follow the preparation steps described below.

- UNZIP the archive file.
- Find the unzipped folder EP70XXC-DEMO-GUI.
- Connect a 1.8 V bench power supply and USB cables from a PC to the demo board.
- Launch EP70XXC executable file in the unzipped folder.

### 4.2 Overview

The Demonstration Platform is delivered with software to assist the customer configure the product and monitor the output voltages. The GUI consists of a File Menu, a Core Info panel, three VR Info Panels (VR1, VR2, VR3) for the EP7038C Demo and one VR Info Panel (VR1) for the EP7010 Demo, and an Activity Log.

Please ensure the Main Supply is connected to the demonstration platform (a 1.8V bench supply is required). A USB cable is required to connect the demonstration platform to a USB port on the PC side (also provided). The GUI application will not start if those connections are not properly made (See Troubleshooting). More details are available in the Hardware section of this manual.

The voltage drop between the external power supply and the input terminal of EP70XXC should be limited to 200mV. It is highly recommended to use thick lead wires to keep the wire resistance below 20 mΩ and minimize the external parasitic inductance.

### 4.3 Execute Button

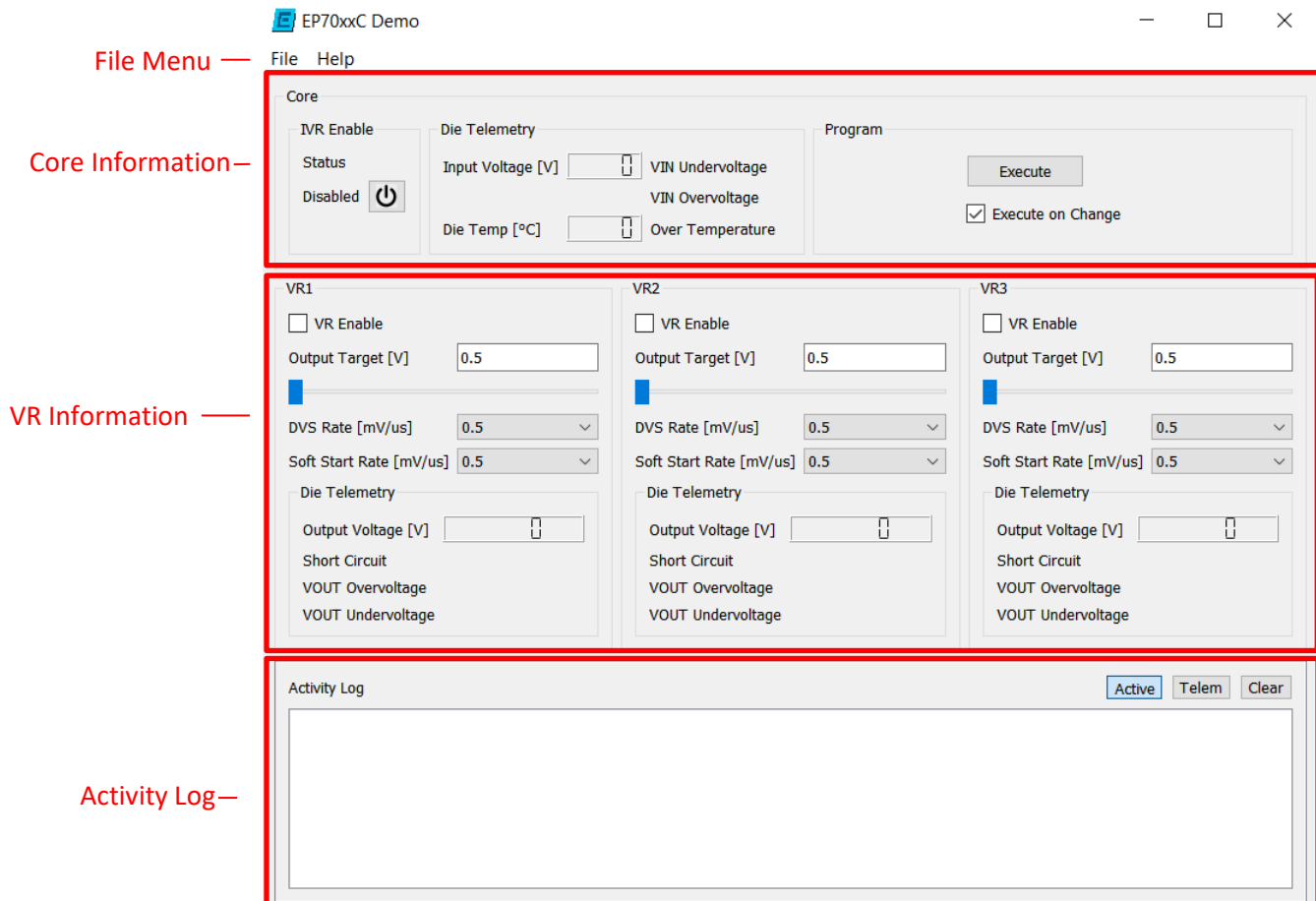
The EP70XXC digital interface is double buffered, allowing multiple writes to configuration registers, with all the writes only taking place when an Execute command is issued. The EP70XXC Demo GUI follows the same method. Setting changes in the VR Info panels will only take place after the *Execute* button is clicked unless the *Execute on Change* box is checked. However, for the purposes of the demo board, the output voltage target slider will take effect immediately irrespective of the *Execute* button or the *Execute on Change* box. For example, to start VR1 to 1.1 V, the sequence would be:

- Click on the VR1 Enable check box.
  - VR1 will *not* start up.
- Move the DAC target combo box to 1.1 V.
  - Note: the above two steps could also have been done in reverse order.
- Click on the *Execute* button.

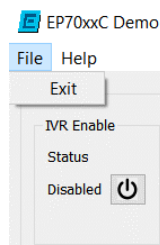
If the *Execute on Change* box is checked, the configuration registers will be updated after each change that the user makes to any of the VR parameters without waiting for the *Execute* button to be depressed.

## 4.4 GUI Overview

Below is an overview snapshot, briefly describing the GUI structure.



## 4.5 File Menu



- **Exit** – close the application, power down the First Stage and disable the IVR.



## 4.6 Core Panel

- **IVR Enable Button** – Controls the voltage on the EN pin of the EP70XXC, enabling and disabling the chip.
- **Die Telemetry** – Indicators showing the EP70XXC reporting of the current input voltage and die temperature.
- **Execute Button** – Loads all the setting changes in the VR panels (see below) into the EP70XXC and issues the Execute command to the part. This button should be clicked for the changes to take effect unless the *Execute on Change* box is checked.
- **Execute on Change checkbox** – If checked, the configuration registers will be updated after each change that the user makes to any of the VR parameters without waiting for *Execute* button to be depressed.

## 4.7 VR Panel

- **VR Enable** – Enables or disables the associated VR.
- **Output Target** – Changes the target output voltage of the associated VR.

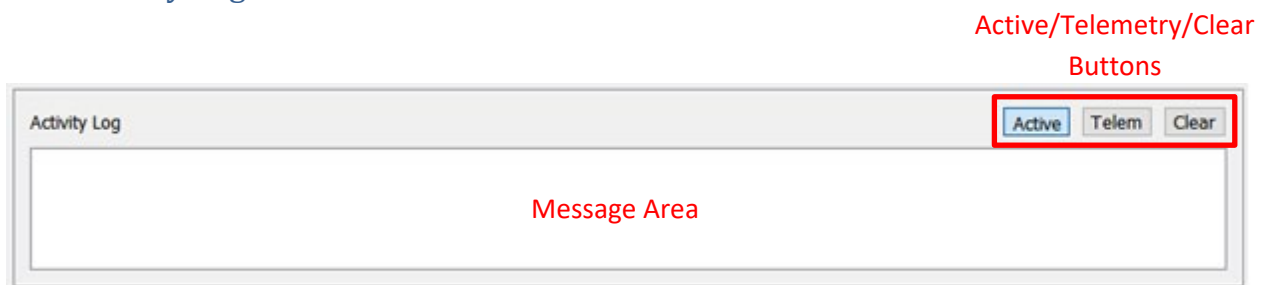
Note that the Output Target setting will take effect immediately irrespective of whether the *Execute* button is pressed or the *Execute on Change* checkbox is checked. This is a feature of the software for ease of use.

- **DVS Rate** – Changes the DVS Rate setting of the associated VR. This DVS Rate is used on all output voltage changes made while the VR is already enabled.
- **Soft Start Rate** – Changes the Soft Start Rate setting of the associated VR. This Soft Start Rate is used on the initial voltage ramp after enabling.

Note that the *Execute* button must be pressed before it takes effect unless the *Execute on Change* checkbox is checked.

- **Die Telemetry** – Indicators showing the EP70XXC reporting of the output voltage and short circuit, undervoltage, and overvoltage conditions.

## 4.8 Activity Log



- **Message area** – This area prints out all messages logged by the Demo.
- **Active** – This button defaults to on (shaded light blue). Unclicking this button (shaded to gray) will turn off all message reporting.
- **Telemetry** – Clicking this button will include all telemetry messaging in the Log. It defaults to off, as the amount of telemetry messaging is very high.
- **Clear** – Clears the Log of all messages but does not prevent new messaging.

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## 5. Suggested Tests

### 5.1 Efficiency

#### Test Procedure

- Since all VRs share one input, efficiency of each VR should be evaluated with other VRs disabled.
- Connect voltmeter to the input voltage test point and setup an appropriate current measurement externally. Ensure that the current measurement device (meter or resistor) is setup such that it does not drop any significant voltage, since that may lower the input voltage to the EP70xx device below the under-voltage warning or lockout thresholds.
- Connect voltmeter to the output voltage test points and setup appropriate current measurement points for the VR output that is being measured.
- Connect a load to the appropriate regulator output using the terminal blocks J3, J2, or J1 (for VR1, VR2 and VR3 appropriately).
- Configure EP70XXC using Demo GUI.
- Measure the input voltage and current and output voltage and current for the VR being evaluated.
- Calculate the input power by multiplying the input voltage and current.
- Calculate the output power by multiplying the output voltage and current.
- Calculate the efficiency by dividing the output power by the input power.

### 5.2 Dynamic Voltage Control

#### Test Procedure

- Configure EP70XXC using Demo GUI.
- If desired, apply load through the terminal block J3, J2 or J1 (for VR1, VR2 or VR3 appropriately).
- Set the dynamic starting voltage via Demo GUI.
- Set the DVS Rate using the Demo GUI.
- Measure the EP70XXC output voltage for the desired VR.
- Measure the output voltage using an oscilloscope for the regulator being measured. Make sure that the trigger for the oscilloscope is between the starting and ending voltages.

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## 5.3 Line Regulation

### Test Procedure

- Configure EP70XXC using Demo GUI.
- If desired, apply load through the J3, J2 or J1 (for VR1, VR2 or VR3 appropriately).
- Set the EP70XXC input voltage (from external supply) to the minimum level, 1.62 V.
- Measure the regulator output voltage.
- Increase the input voltage gradually in a few steps to the maximum level, 1.98 V.
- Measure the regulator output voltage at each step.
- Slope of the best linear fit through the measured data represents the line regulation.

## 5.4 Load Regulation

### Test Procedure

- Configure EP70XXC using Demo GUI.
- Using bench equipment, apply the minimum load through the J3, J2 or J1 (for VR1, VR2 or VR3 appropriately).
- Measure the regulator output voltage.
- Increase the load current gradually in a few steps to until the maximum load has been reached.
- Measure the regulator output voltage at each step.
- Slope of the best linear fit through the measured data represents the line regulation.

## 5.5 Regulator Startup

### Test Procedure

- Monitor the Power Good (PG) signal at TP9 test point on the EP70XXC Demo board using an oscilloscope.
- Monitor the regulator output voltage by connecting an oscilloscope to the appropriate VR output test point (Ex:TP3 and TP4 for VOUT1).
- If desired, apply load through the terminal block J3, J2 or J1 using bench equipment.
- Configure EP70XXC using Demo GUI but leave the VR disabled.
- Enable the VR using Demo GUI.
- Monitor the VR output voltage and Power Good startup waveforms.

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## 5.6 Regulator Shutdown

### Test Procedure

- Monitor the Power Good (PG) signal at TP9 test point on the EP70XXC Demo board using an oscilloscope.
- Monitor the regulator output voltage by connecting an oscilloscope to the appropriate VR output test point (Ex:TP3 and TP4 for VOUT1).
- If desired, apply load through the terminal block J3, J2 or J1 using bench equipment.
- Configure EP70XXC using Demo GUI.
- Ensure that the VR output voltage is in regulation.
- Disable the VR through Demo GUI.
- Using the oscilloscope, measure the VR output voltage and Power Good shutdown waveforms.

## 5.7 Output Short-Circuit and Recovery

### Test Procedure

- Connect a switch capable of sustaining 1.5x maximum load current for the VR being evaluated to the output load terminal block J3, J2 or J1 corresponding to the regulator VR1, VR2 or VR3 respectively. Make sure the switch is open.
- Configure EP70XXC using Demo GUI.
- If desired, apply a DC load through the same terminal blocks using bench equipment.
- Close the switch to apply a short-circuit to the VR output.
- Measure the short circuit response using an oscilloscope and/or voltmeter.



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## 6. Troubleshooting

*Nothing happens after clicking on the executable.*

It is likely that either the input power for the EP70xx device has not been provided, or the USB cable is not plugged in. If the software is not able to establish communication with the demo board, the software will give a warning message and shut down.

*The GUI looks really messed up on my high-resolution screen.*

Right-click on the executable, and under Properties -> Compatibility, click Change High DPI Settings. In the resulting dialog, select Override High DPI Scaling Behavior, and set the selection to System.

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## 7. Notice and Legal Disclaimer

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