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KIT34704AEPEVBE 8-Channel Evaluation Board

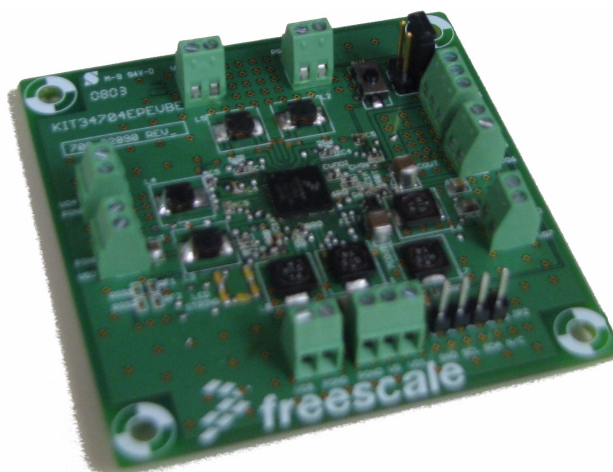


Table of Contents

1	Kit Contents / Packing List	2
2	Important Notice	3
3	Introduction	4
4	Required Equipment	6
5	EVB Setup Configuration Diagram	7
6	KIT34704AEPEVBE Schematic	8
7	KITUSBI2CEVME Schematic	9
8	KIT34704AEPEVBE - Using Hardware	11
9	KITUSBI2CEVME - Using Hardware	13
10	KIT34704EPEVBE Graphical User Interface	15
11	KIT34704AEPEVBE Board Layout	21
12	KITUSBI2CEVME Board Layout	29
13	KIT34704AEPEVBE Bill of Material	34
14	KITUSBI2CEVME Bill of Material	36
15	References	37
16	Revision History	38

1 Kit Contents / Packing List

- KIT34704AEPEVBE
- KITUSBI2CEVME - USB to I²C bridge board for controlling PMIC
- USB A-B Cable
- 4-pin female to female I²C communication cable
- CD34704A

2 Important Notice

Freescall provides the enclosed product(s) under the following conditions:

This evaluation kit is intended for use of ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY. It is provided as a sample IC pre-soldered to a printed circuit board to make it easier to access inputs, outputs, and supply terminals. This EVB may be used with any development system or other source of I/O signals by simply connecting it to the host MCU or computer board via off-the-shelf cables. This EVB is not a Reference Design and is not intended to represent a final design recommendation for any particular application. Final device in an application will be heavily dependent on proper printed circuit board layout and heat sinking design as well as attention to supply filtering, transient suppression, and I/O signal quality.

The goods provided may not be complete in terms of required design, marketing, and or manufacturing related protective considerations, including product safety measures typically found in the end product incorporating the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge. In order to minimize risks associated with the customers applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards. For any safety concerns, contact Freescale sales and technical support services.

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3 Introduction

This Evaluation Board demonstrates the capability of the MC34704A as a multi-channel power management IC (PMIC) meant to address power management needs for various multimedia application microprocessors. It provides 8 independent voltages through a terminal block connector for an easier out-of-the-box evaluation. A single terminal block connector for input power supply allows the user to supply the board with either a external DC power supply or a Li-Ion battery to fully evaluate the performance accordingly.

The KIT34704AEPEVBE has the ability to program the switching frequency of regulators 1 through 5 as well as the default soft start timing for all regulators during startup by changing few external components. All other features can be programmed via I²C communication using a standard 100mils 4-pin header to communicate with either the USB-I²C bridge included in this package or with any other I²C communication device preferred by the user.

3.1 EVB Features

- Input voltage operation range from 2.7V to 5.5V
- 8 independent output voltages, accessible through terminal blocks.
- Capable to be programmed via I²C
- On/Off push button
- Programable Switching frequency for REG1-5 by changing external components
- Programable default soft start for all regulators by changing external components
- 100mils 4-pin standard header connector for I²C communication
- Small Board Size (6.2cm x 6.2cm)

3.2 MC34704A Device Description/Features

- Input voltage operation range from 2.7 to 5.5V
- 8 -DC/DC switching regulators with +/-2% output voltage accuracy
- Capable of operating at up to 2.0 MHz switching frequency I²C programmability
- Output under voltage and over voltage detection for each regulator
- Over current limit detection and short circuit protection for each regulator
- Thermal limit detection for each regulator, except REG7
- Integrated Compensation for REG1, REG3, REG6 and REG8
- 5μA maximum shutdown current (All regulators are off, 5.5V VIN)
- True Cut-off on all of the boost and buck-boost regulators.

3.3 USB to I²C Board Features

- Provides an LED for USB Power Status and JB8 Communication Status
- “B” type USB interface connector
- 4 pin connector for the I²C Interface (SDA, SCL, 5V and GND)
- I²C Level Shifter IC to allow communication with 5V or 3.3V devices
- For more information please refer to KITUSBI2CEVME Documentation

4 Required Equipment

Minimum required equipment:

- Power supply (Select One):
 - 2.7V to 5.5V
 - 1 cell Li/Ion/Polymer (2.7 to 4.2V)
 - 5.0V USB supply or AC wall adapter
- USB enabled Computer with Windows XP or higher.
- CD contains a Graphical User Interface (GUI) allowing control of all PMIC Features through I²C communication.

5 EVB Setup Configuration Diagram

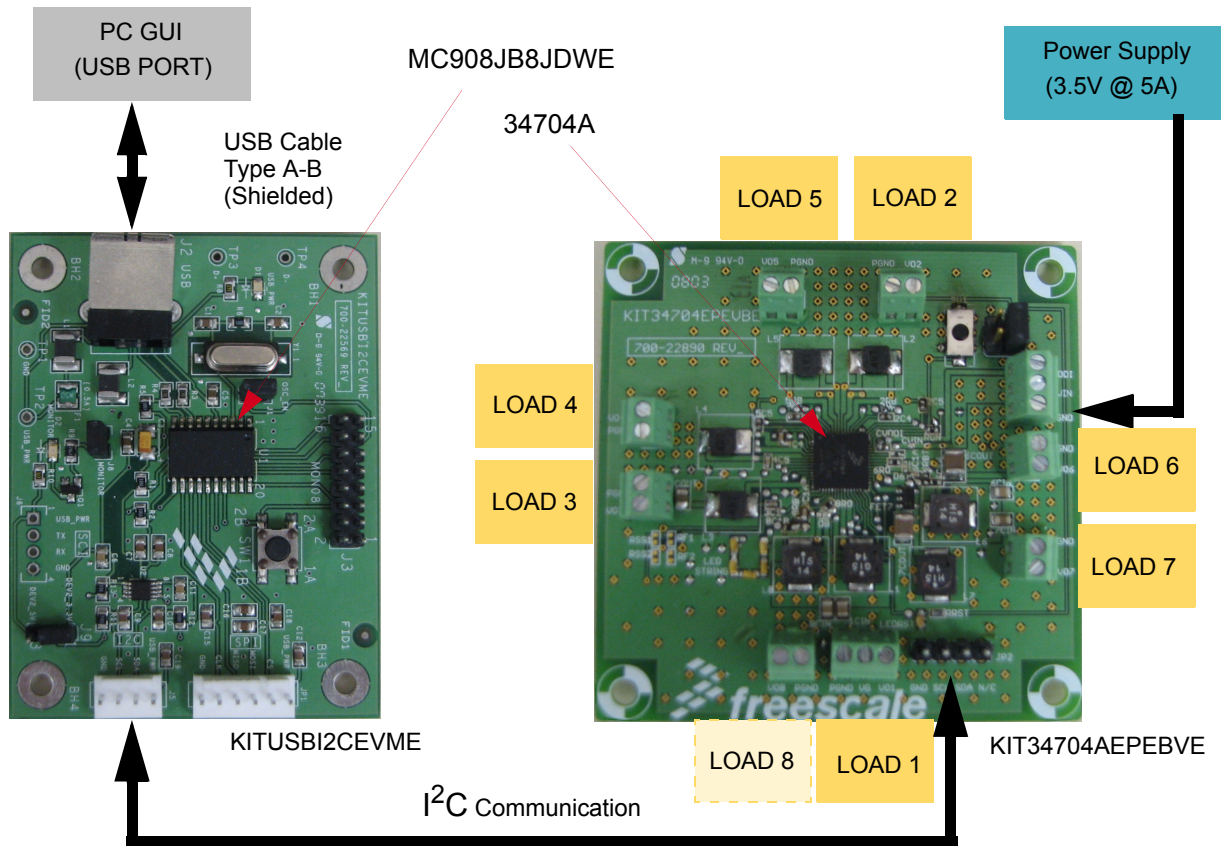


Figure 1. EVB Setup Configuration Diagram

6 KIT34704AEPEVBE Schematic

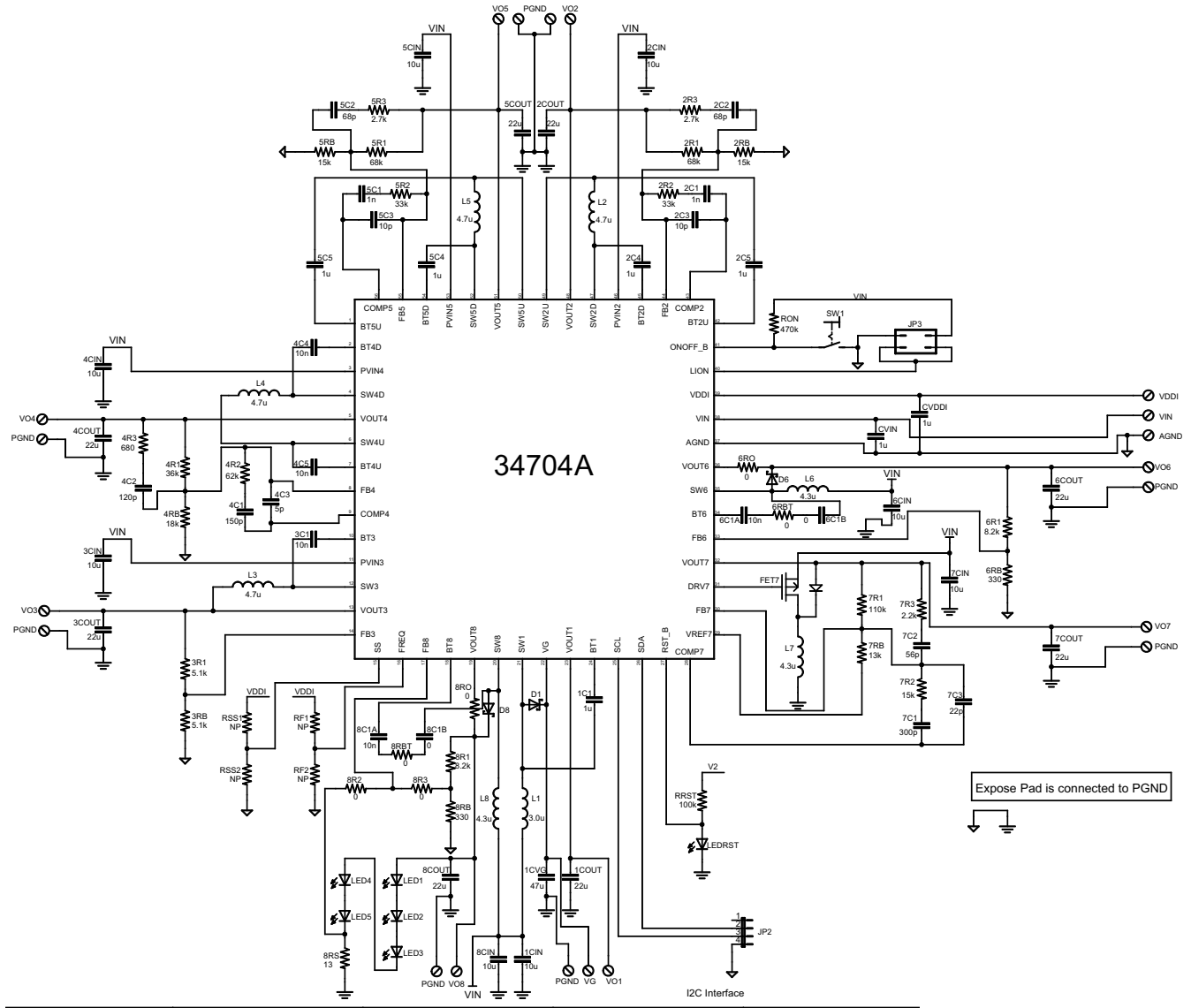


Figure 2. KIT34704AEPEVBE Schematic

7 KITUSBI2CEVME Schematic

I2C Bidirectional Communication: Device 1(3.3V) - Device 2(5V)

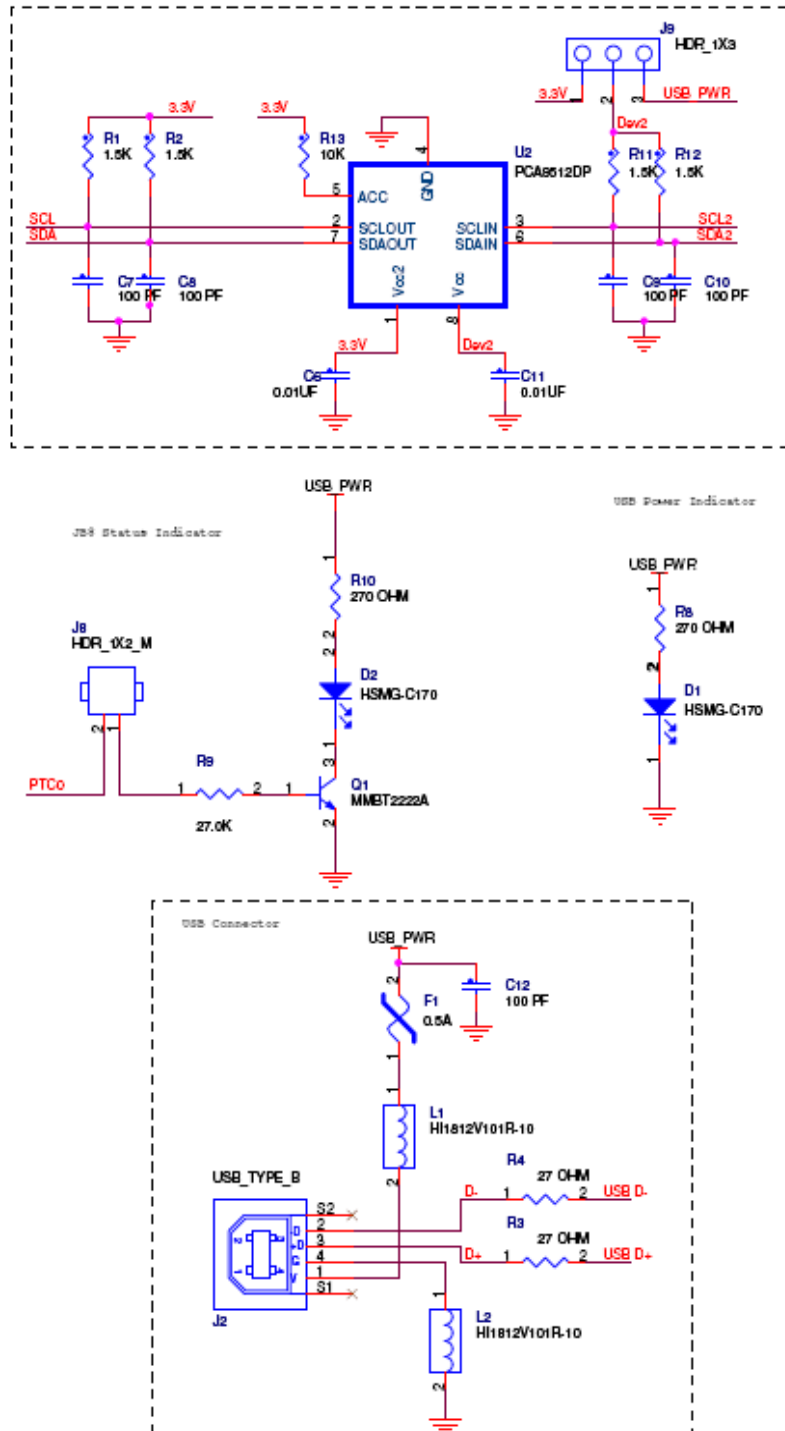


Figure 3. KITUSBI2CEVME Schematic 1



8 KIT34704AEPEVBE - Using Hardware

The KIT34704AEPEVBE operates with a single power supply from 2.7 to 5.5V and is controlled via I²C with the help of an USB-I²C bridge. Applying Input power supply will start up the VG regulator, set switching frequency and soft start and finally turn on REG2, REG3 and REG4 in stand alone mode, all other features can only be controlled via I²C.

8.1 Jumper Connections

Use a jumper on J3 to connect pins 3-4 vertically to set LION to VIN.

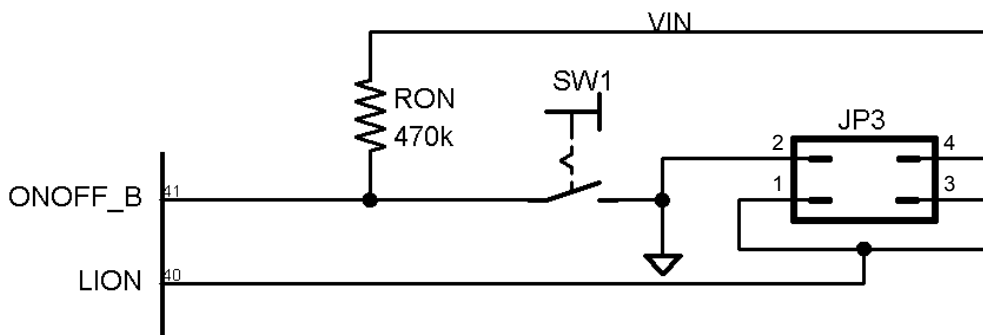


Figure 5. LION set to VIN

Pin 2,3 and 4 of JP2 corresponds to SDA,SCL, and GND signals respectively of the I²C communication, connect to the USB-I²C bridge for programming.

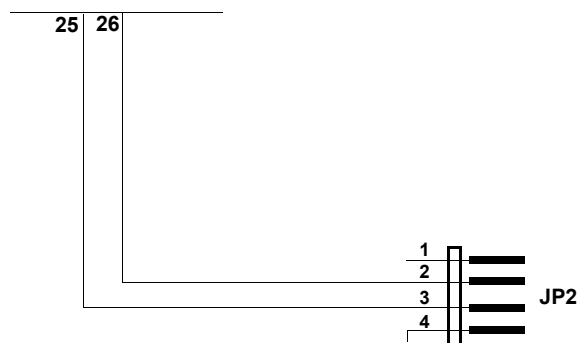


Figure 6. I²C Communication connector

8.2 Input/Output power supply terminal blocks

A three-pin terminal block serves as the input terminal for the main power between 2.7 and 5.5V to operate the KIT34704AEPEVBE, as well as providing access to the reference voltage VDDI generated by the MC34704A to supply configuration voltages.

Regulator 1 uses a three-pin terminal block to provide GND reference and VO1 output at 5V with a maximum current capability of 500mA. It also provide access to the internal Gate voltage VG for monitoring purposes

Regulator 2 through 8 use a two-pin terminal block to provide each GND reference and VOx respectively. To learn how to configure the output voltage on each regulator, please refer to the MC34704 datasheet that can be found at www.freescale.com

The following diagram shows each of the terminals and its respective output voltage identifier.

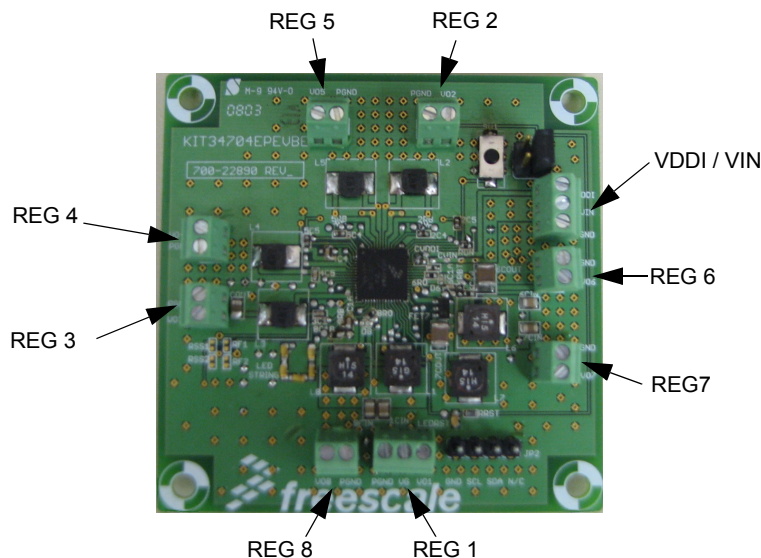


Figure 7. Input/Output terminal blocks

8.3 Starting up the KIT34704AEPEVBE

To Start working with the KIT34704AEPEVBE, provide an input voltage between 2.7V and 5.5V connecting the (+) probe to the VIN terminal and the (-) probe to the GDN terminal on the Input power terminal block. Turn on the power supply and the LEDRST should turn on.

At this moment the three stand alone regulators (REG2, REG3 and REG4) should be providing pre-configured output voltage. To operate the rest of the MC34704A functions, it is necessary to use I²C communication.

Section 11 will discuss how to interact with the KIT34704AEPEVBE using the Graphical User Interface developed by freescale to fully operate the MC34704A.

9 KITUSBI2CEVME - Using Hardware

The KITUSBI2CEVME Demo Board provides a way of communicating a PC with KIT34704EPEVBE or any device that uses I²C or SPI communication protocols.

9.1 Jumper Connections

9.1.1 J9

It is used to set the pull-up voltage of the I²C communication device.

- Pins 1 & 2 (Pin 3 open): set the I²C pull-up resistors at 3.3V
- Pins 2 & 3 (Pin 1 open): set the I²C pull-up resistors at 5V
- Pin header open: Leave the I²C pull-up resistors open. The slave device should pull up SCL2 and SDA2 signals to a voltage of 3.3V or 5V

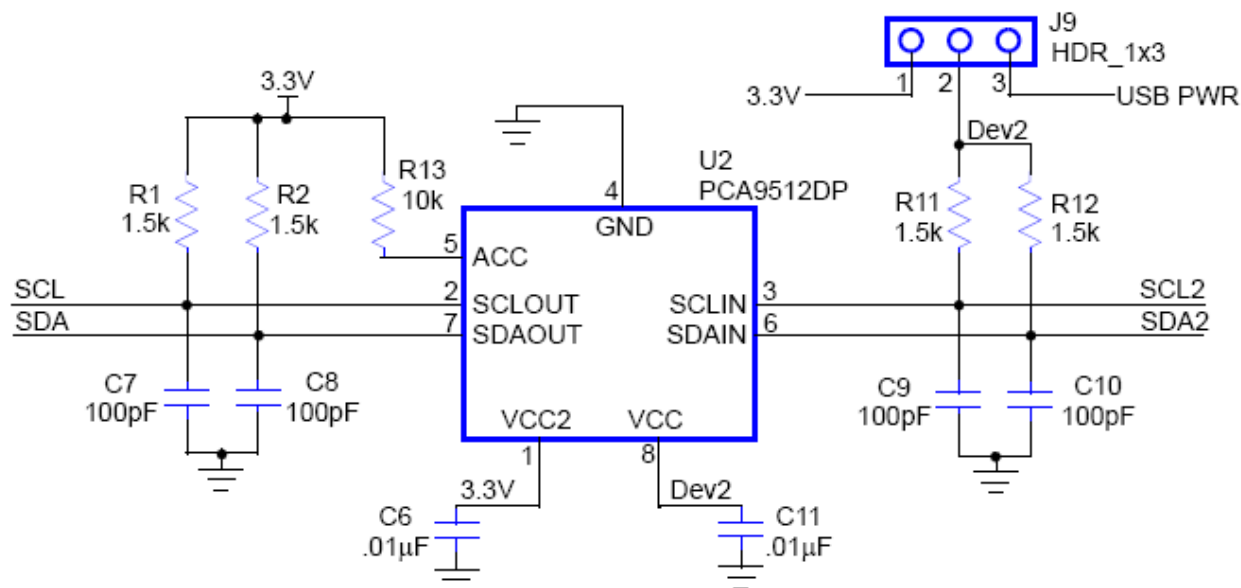


Figure 8. I²C Pull-up configuration

7

9.1.2 J8

This jumper is to enable the status indicator LED. The LED is ON when any operation is being performed by the MCU.

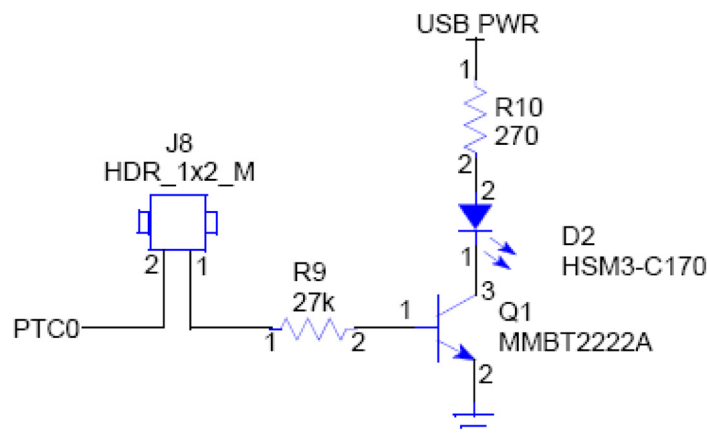


Figure 9. JB8 Status Indicator

9.1.3 J1

The J1 jumper should be disconnected only while JB8 is being programmed. Since the MCU is already programmed, J1 should be connected all the time, so the board operates properly. It is not recommended to program the JB8 due to pre loaded program will be erased and it will not longer operate correctly.

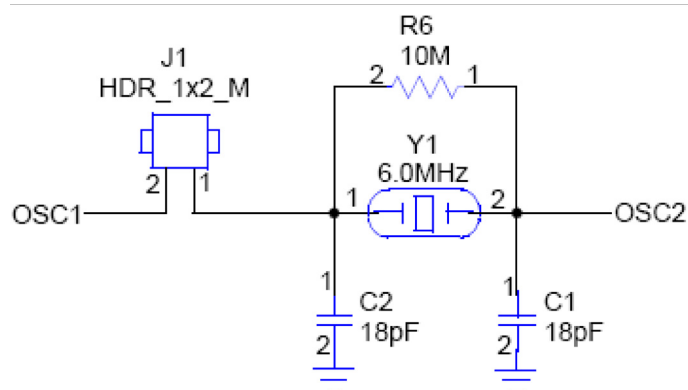


Figure 10. Crystal Circuitry

10 KIT34704EPEVBE Graphical User Interface

A graphical user interface has been developed to allow the user to fully interact with the KIT34704AEPEVBE using a Windows XP based computer.

10.1 Installing the KIT34704A GUI and KITUSB2CEVME driver

Before connecting the KITUSB2CEVME, install the Graphical User interface by double clicking into the Setup.exe file provided on the CD included with the kit; follow the instructions until the software is fully installed. Microsoft Frameworks 2.0 is required, if it is not previously installed the software will perform this installation prior to the MC34704A GUI software.

Connect the KITUSB2CEVME to the USB port on the host computer for the first time, and the PC will try to recognize the USB device; when the driver selection window appears select the option "Install from a list or specific Location".

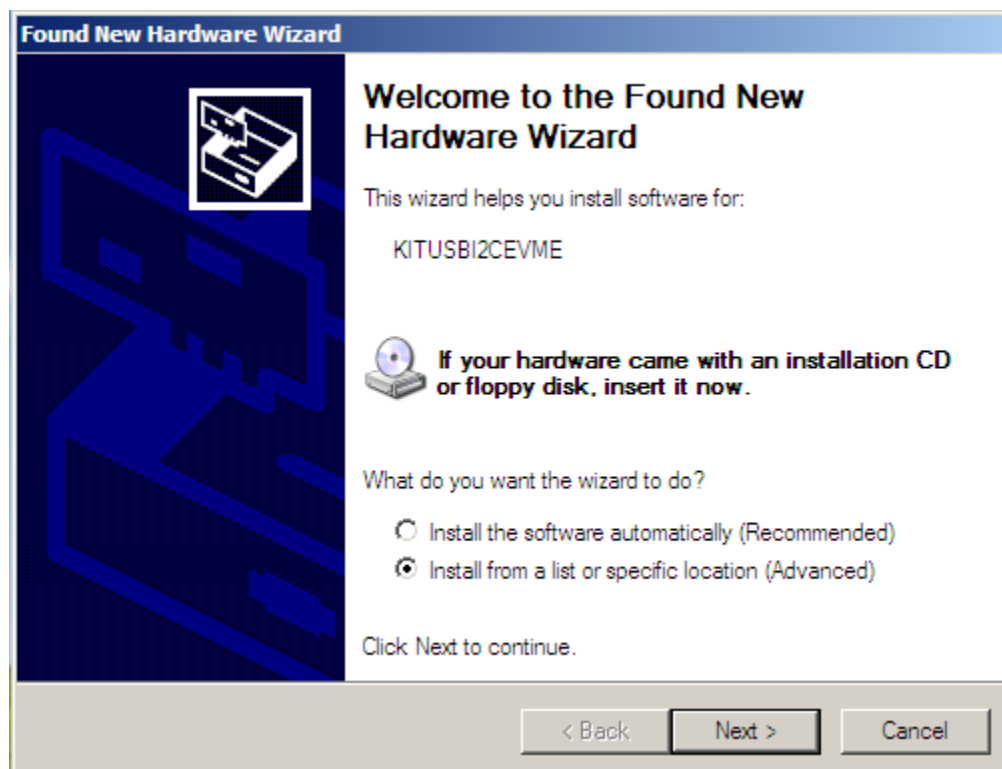


Figure 11. KITUSB2CEVME Driver installation Window.

In the next window browse the path where you installed the KIT34704GUI and click Next. At this time, the Computer should recognize the KITUSB2CEVME board and be ready to use the Graphical User Interface to control the KIT34704xEPEVBE

10.1.1 Working with KIT34704A Graphical User Interface

The Graphical User Interface (GUI) allows the user to program all I²C features by using a friendly interface as well as modifying the register table manually for advance users. To launch the GUI application, select the application icon from the Freescale folder in the Start menu as it is shown in the picture below.



Figure 12. Launching the GUI application

The following is a list of all buttons and their description:

- **General configurations**
 - a) **Device general ON/OFF button:** Allows the user to make a software OFF instruction by setting the SHTD flag. When a software shutdown is done, to turn the device back ON, first clear the SHTD bit by Pressing this button ON, and then do a hardware turn ON with a falling edge on the ONOFF terminal.
 - b) **GRPC/E Power Sequencing:** allows to change the power sequencing for regulators 5, 6 and 7, please refer to I²C register section on Datasheet for more details on how this works.
 - c) **Shutdown Hold time:** Program the waiting time for a shutdown after the Hardware shutdown push button is pressed.
 - d) **REG6/7/8 FSW:** program the internal FSW2 that serve as switching frequency for regulator 6, 7 and 8.

- e) **5/8 channel enable button:** This button allows the configuration for either the MC34704A (8 channel) or the MC34704B (5 channel) Evaluation Kit.
- **Group B**
 - f) **REGx DVS:** dynamic voltage scaling to modify the output voltage on each regulator up to $\pm 20\%$.
 - g) **REGx over/under voltage response:** setting the “Set flag on OV/UV” or “Sdown on OV/UV” option allows to turn on a fault flag only or completely shutdown the GRPB respectively when an over voltage or under voltage is present on one of the Regulator that belong to this group.
- **Group A**
 - h) **REG1 DVS:** dynamic voltage scaling to modify the output voltage on each regulator up to $\pm 20\%$.
 - i) **REG1 over/under voltage response:** setting the “Set flag on OV/UV” or “Sdown on OV/UV” option allows to turn on a fault flag only or shutdown the GRPA respectively when an over voltage or under voltage is present on REG1.
 - j) **REG1 ON/OFF button:** turns on/off regulator 1.
- **Group C/E**
 - k) **REGx DVS:** dynamic voltage scaling to modify the output voltage on each regulator up to $\pm 20\%$.
 - l) **REGx Soft Start:** Allows to independently control the soft start for each one of the regulators included in this group.
 - m) **REGx over/under voltage response:** setting the “Set flag on OV/UV” or “Sdown on OV/UV” option allows to turn on a fault flag only or completely shutdown the Group E/C, respectively, when an over voltage or under voltage is present on one of the Regulator that belong to this group.
 - n) **Group E ON/OFF button:** turns on/off REG5 when its set to turn on independently.
 - o) **Group C ON/OFF button:** If REG5 is set to turn on independently, this button only controls the on/off state of REG6 and REG7. If REG5 is set to turn on together with REG6 and 7, this button control the on/off state of all three regulators following the previously set power on sequence.
- **Group D**
 - p) **REG8 DVS:** dynamic voltage scaling to modify the output voltage on REG8 up to $\pm 20\%$ when voltage mode control is set.
 - q) **REG8 Soft Start:** Allows to independently control the soft start for REG8.
 - r) **REG8 control mode:** when set to “Volt” it uses a standard voltage divider to set the output voltage. when set to “Curr” it uses Rsens at the end of a LED string to set the desired current flowing through the LED string.
 - s) **REG8 over/under voltage response:** setting the “Set flag on OV/UV” or “Sdown on OV/UV” option allows to turn on a fault flag only or shuts down the GRPD,

respectively, when an over voltage or under voltage is present on one of the Regulator that belong to this group.

- t) **REG8 Current scaling:** Allows to select a fraction of the maximum current flowing through the LED string when the current mode control is selected.
- u) **REG8 ON/OFF button:** turns on/off regulator 8.
- **Special Registers**
 - v) **REG3 fine voltage Scaling:** allows to dynamically modify the output voltage on Regulator 3 in 0.5% variation steps.
 - w) **REG7 Independent ON/OFF:** allow to turn on Regulator 7 independently without having to turn on all Regulators on GRPC. REG7 features can still be configured using the boxes in Regulator 7 section.
- **Operating Buttons**
 - x) **Real time configuration Button:** start an infinite read/write cycle to allow the user to modify the registers and observe changes in real time.
 - y) **Stop Button:** Stop the real time cycle.
 - z) **Read Button:** Read all registers once in order to debug for latched flags.
 - aa) **Write Button:** write the register configurations Once, changes to the features do not have effect until next write cycle is done.
 - ab) **Register Table button:** shows the Register table, where the user can manually configure the registers. Before configuring the Register table manually, please refer to the Datasheet to learn full operation of each one of the Register
 - ac) **Help button:** Show the brief operating procedure for the GUI.
- **Fault Indicators**
 - TSD: Thermal Shutdown Flag
 - SCF: Short Circuit Flag
 - OVF: Over voltage Flag
 - UVF: Under Voltage Flag
 - ILIM: Over current Flag
 - DVS: Dynamic voltage Scaling flag

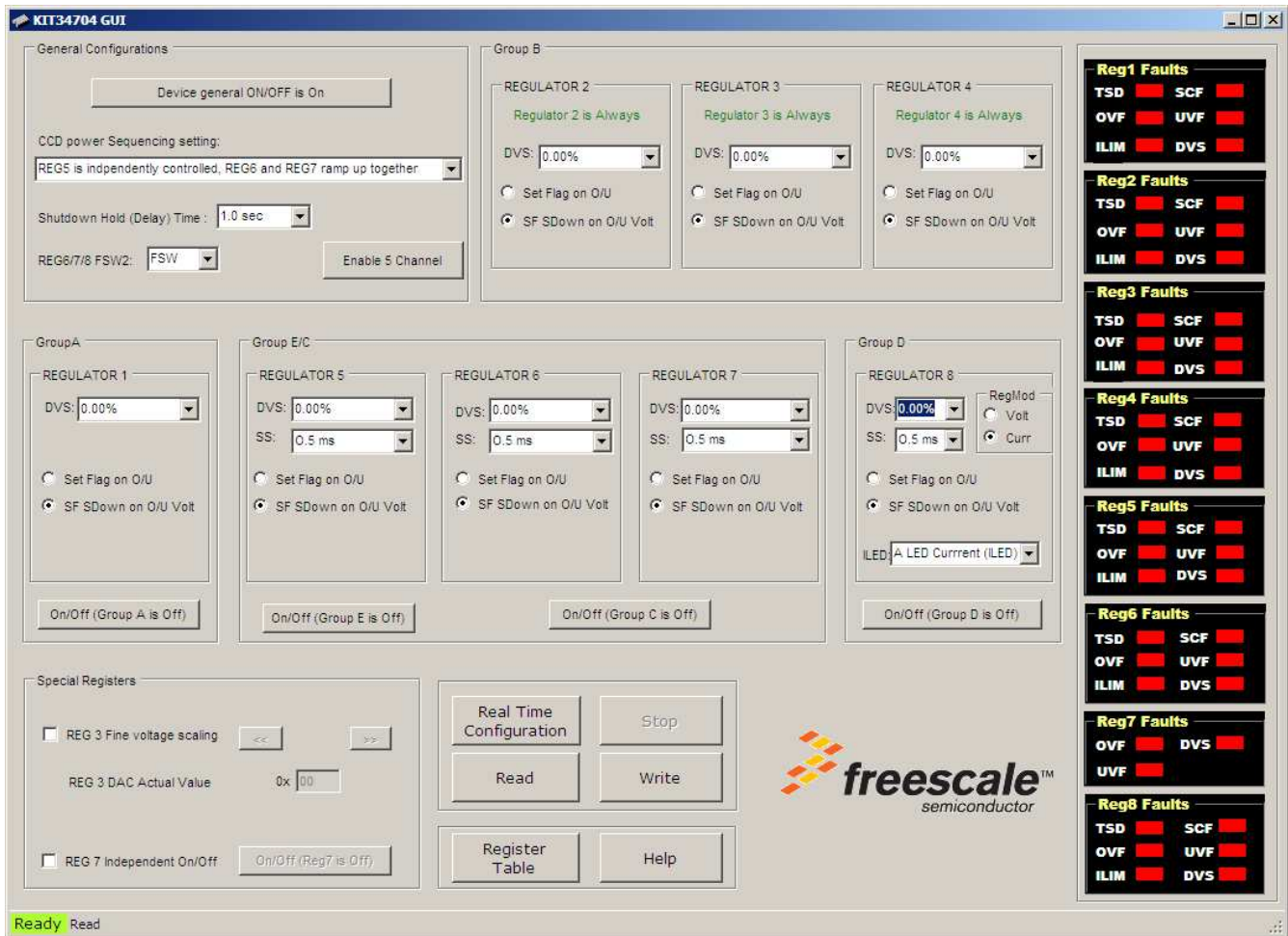


Figure 13. MC34704 GUI Main Screen.

Registers

Registers	ADDRESS	NAME	D7	D6	D5	D4	D3	D2	D1	D0	Data
	\$01	GENERAL1					<input type="checkbox"/> SDELAY1	<input type="checkbox"/> SDELAY0	<input type="checkbox"/> CCDSEQ1	<input type="checkbox"/> CCDSEQ0	<input type="text" value="00"/>
	\$02	GENERAL2				<input type="checkbox"/> ALLOFF	<input type="checkbox"/> ONOFFA	<input type="checkbox"/> ONOFFC	<input type="checkbox"/> ONOFFD	<input type="checkbox"/> ONOFFE,1	<input type="text" value="00"/>
	\$03	GENERAL3				<input type="checkbox"/> SHTD	<input type="checkbox"/> COLDF	<input type="checkbox"/> BATTYPE	<input type="checkbox"/> SSTM1	<input type="checkbox"/> SSTM0,0	<input type="text" value="00"/>
	\$04	REG1SET1				<input type="checkbox"/> DVSET1_3	<input type="checkbox"/> DVSET1_2	<input type="checkbox"/> DVSET1_1	<input type="checkbox"/> DVSET1_0	<input type="checkbox"/> OVUSET1,1	<input type="text" value="00"/>
	\$05	REG1SET2			<input type="checkbox"/> TSDF1	<input type="checkbox"/> SCF1	<input type="checkbox"/> ILIMF1	<input type="checkbox"/> UVF1	<input type="checkbox"/> OVF1	<input type="checkbox"/> DVSSTAT1,0	<input type="text" value="00"/>
	\$06	REG2SET1				<input type="checkbox"/> DVSET2_3	<input type="checkbox"/> DVSET2_2	<input type="checkbox"/> DVSET2_1	<input type="checkbox"/> DVSET2_0	<input type="checkbox"/> OVUSET2,1	<input type="text" value="00"/>
	\$07	REG2SET2			<input type="checkbox"/> TSDF2	<input type="checkbox"/> SCF2	<input type="checkbox"/> ILIMF2	<input type="checkbox"/> UVF2	<input type="checkbox"/> OVF2	<input type="checkbox"/> DVSSTAT2,0	<input type="text" value="00"/>
	\$08	REG3SET1				<input type="checkbox"/> DVSET3_3	<input type="checkbox"/> DVSET3_2	<input type="checkbox"/> DVSET3_1	<input type="checkbox"/> DVSET3_0	<input type="checkbox"/> OVUSET3,1	<input type="text" value="00"/>
	\$09	REG3SET2			<input type="checkbox"/> TSDF3	<input type="checkbox"/> SCF3	<input type="checkbox"/> ILIMF3	<input type="checkbox"/> UVF3	<input type="checkbox"/> OVF3	<input type="checkbox"/> DVSSTAT3,0	<input type="text" value="00"/>
	\$0A	REG4SET1				<input type="checkbox"/> DVSET4_3	<input type="checkbox"/> DVSET4_2	<input type="checkbox"/> DVSET4_1	<input type="checkbox"/> DVSET4_0	<input type="checkbox"/> OVUSET4,1	<input type="text" value="00"/>
	\$0B	REG4SET2			<input type="checkbox"/> TSDF4	<input type="checkbox"/> SCF4	<input type="checkbox"/> ILIMF4	<input type="checkbox"/> UVF4	<input type="checkbox"/> OVF4	<input type="checkbox"/> DVSSTAT4,0	<input type="text" value="00"/>
	\$0C	REG5SET1				<input type="checkbox"/> DVSET5_3	<input type="checkbox"/> DVSET5_2	<input type="checkbox"/> DVSET5_1	<input type="checkbox"/> DVSET5_0	<input type="checkbox"/> OVUSET5,1	<input type="text" value="00"/>
	\$0D	REG5SET2							<input type="checkbox"/> SSET5_1	<input type="checkbox"/> SSET5_0,1	<input type="text" value="00"/>
	\$0E	REG5SET3			<input type="checkbox"/> TSDF5	<input type="checkbox"/> SCF5	<input type="checkbox"/> ILIM5	<input type="checkbox"/> UVF5	<input type="checkbox"/> OVF5	<input type="checkbox"/> DVSSTAT5,0	<input type="text" value="00"/>
	\$0F	REG6SET1				<input type="checkbox"/> DVSET6_3	<input type="checkbox"/> DVSET6_2	<input type="checkbox"/> DVSET6_1	<input type="checkbox"/> DVSET6_0	<input type="checkbox"/> OVUSET6,1	<input type="text" value="00"/>
	\$10	REG6SET2							<input type="checkbox"/> SSET6_1	<input type="checkbox"/> SSET6_0,1	<input type="text" value="00"/>
	\$11	REG6SET3			<input type="checkbox"/> TSDF6	<input type="checkbox"/> SCF6	<input type="checkbox"/> ILIMF6	<input type="checkbox"/> UVF6	<input type="checkbox"/> OVF6	<input type="checkbox"/> DVSSTAT6,0	<input type="text" value="00"/>
	\$12	REG7SET1				<input type="checkbox"/> DVSET7_3	<input type="checkbox"/> DVSET7_2	<input type="checkbox"/> DVSET7_1	<input type="checkbox"/> DVSET7_0	<input type="checkbox"/> OVUSET7,1	<input type="text" value="00"/>
	\$13	REG7SET2					<input type="checkbox"/> REG7FSW2_1	<input type="checkbox"/> REG7FSW2_0	<input type="checkbox"/> SSET7_1	<input type="checkbox"/> SSET7_0,1	<input type="text" value="00"/>
	\$14	REG7SET3						<input type="checkbox"/> UVF7	<input type="checkbox"/> OVF7	<input type="checkbox"/> DVSSTAT7,0	<input type="text" value="00"/>
	\$15	REG8SET1				<input type="checkbox"/> DVSET8_3	<input type="checkbox"/> DVSET8_2	<input type="checkbox"/> DVSET8_1	<input type="checkbox"/> DVSET8_0	<input type="checkbox"/> OVUSET8,1	<input type="text" value="00"/>
	\$16	REG8SET2		<input type="checkbox"/> ILED_3	<input type="checkbox"/> ILED_2	<input type="checkbox"/> ILED_1	<input type="checkbox"/> ILED_0	<input type="checkbox"/> REG8MOD	<input type="checkbox"/> SSET8_1	<input type="checkbox"/> SSET8_0,1	<input type="text" value="00"/>
	\$17	REG8SET3			<input type="checkbox"/> TSDF8	<input type="checkbox"/> SCF8	<input type="checkbox"/> ILIMF8	<input type="checkbox"/> UVF8	<input type="checkbox"/> OVF8	<input type="checkbox"/> DVSSTAT8,0	<input type="text" value="00"/>
	\$18	FAULTS	<input type="checkbox"/> FLT8	<input type="checkbox"/> FLT7	<input type="checkbox"/> FLT6	<input type="checkbox"/> FLT5	<input type="checkbox"/> FLT4	<input type="checkbox"/> FLT3	<input type="checkbox"/> FLT2	<input type="checkbox"/> FLT1,0	<input type="text" value="00"/>
	\$19	12CSET1								<input type="checkbox"/> ACCURATE,1	<input type="text" value="00"/>
	\$49	REG3DAC	<input type="checkbox"/> 3DAC7	<input type="checkbox"/> 3DAC6	<input type="checkbox"/> 3DAC5	<input type="checkbox"/> 3DAC4	<input type="checkbox"/> 3DAC3	<input type="checkbox"/> 3DAC2	<input type="checkbox"/> 3DAC1	<input type="checkbox"/> 3DAC0	<input type="text" value="00"/>
	\$58	REG7CR0	<input type="checkbox"/> EN_1	<input type="checkbox"/> EN_0		<input type="checkbox"/> DISCHG_B					<input type="text" value="00"/>
	\$59	REG7DAC7	<input type="checkbox"/> 7DAC7	<input type="checkbox"/> 7DAC6	<input type="checkbox"/> 7DAC5	<input type="checkbox"/> 7DAC4	<input type="checkbox"/> 7DAC3	<input type="checkbox"/> 7DAC2	<input type="checkbox"/> 7DAC1	<input type="checkbox"/> 7DAC0	<input type="text" value="00"/>

Figure 14. MC34704 GUI Register Table Window.

11.2 Assembly Layer Bottom

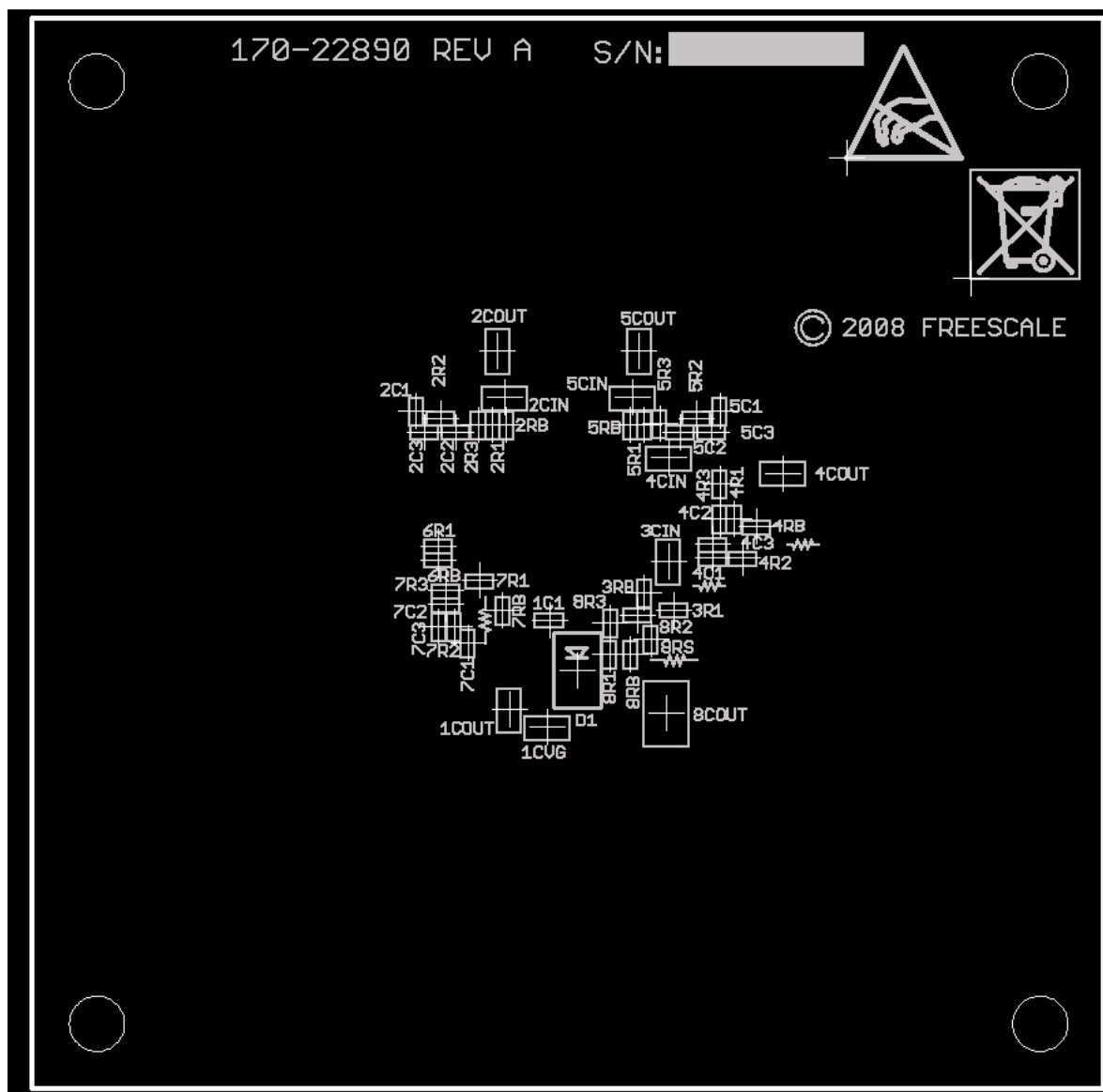


Figure 16. KIT34704AEPEVBE Assembly Layer Bottom

11.3 Top Layer Routing

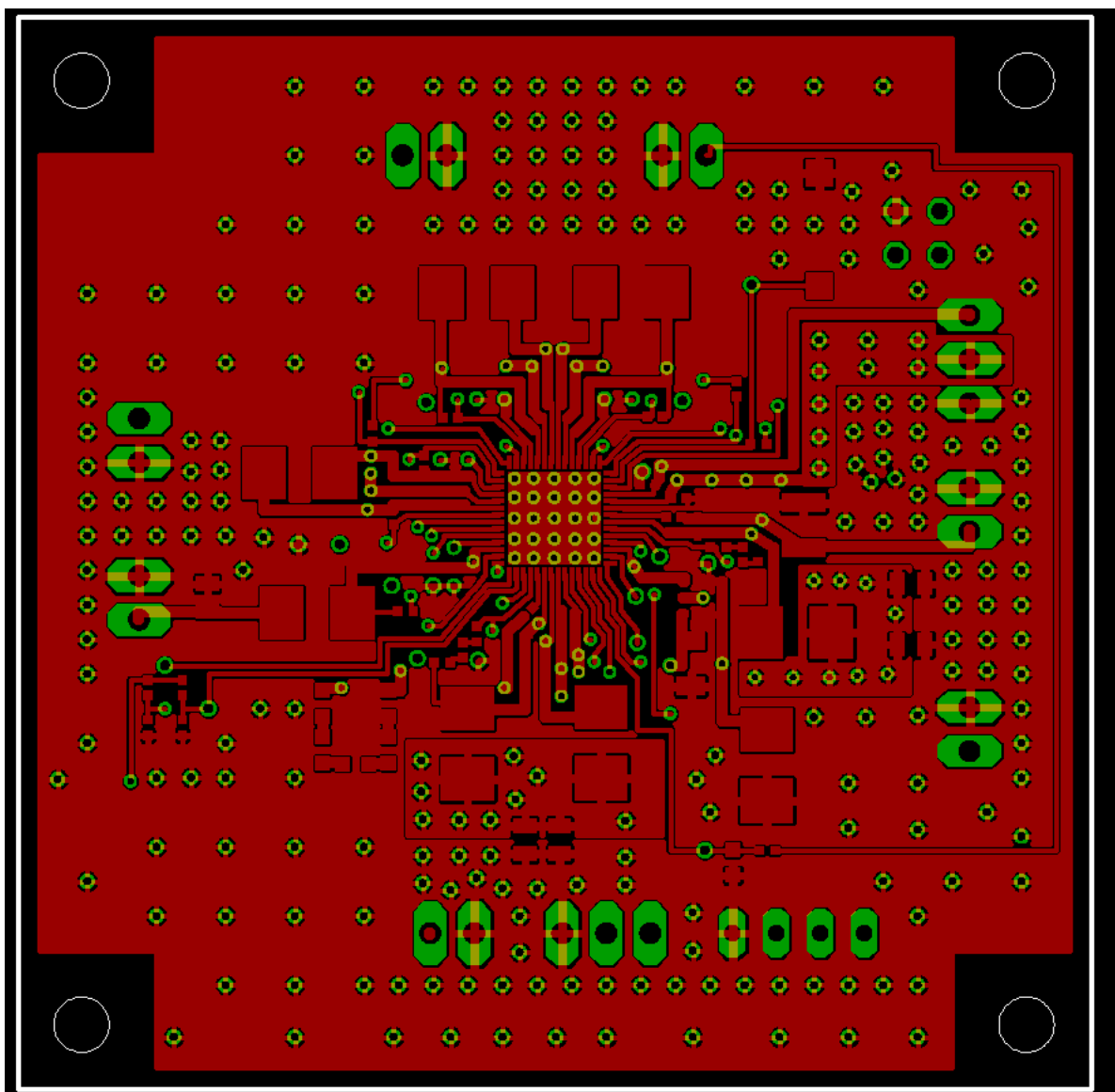


Figure 17. KIT34704AEPEVBE Top Layer Routing

11.4 Inner Layer 1 Routing

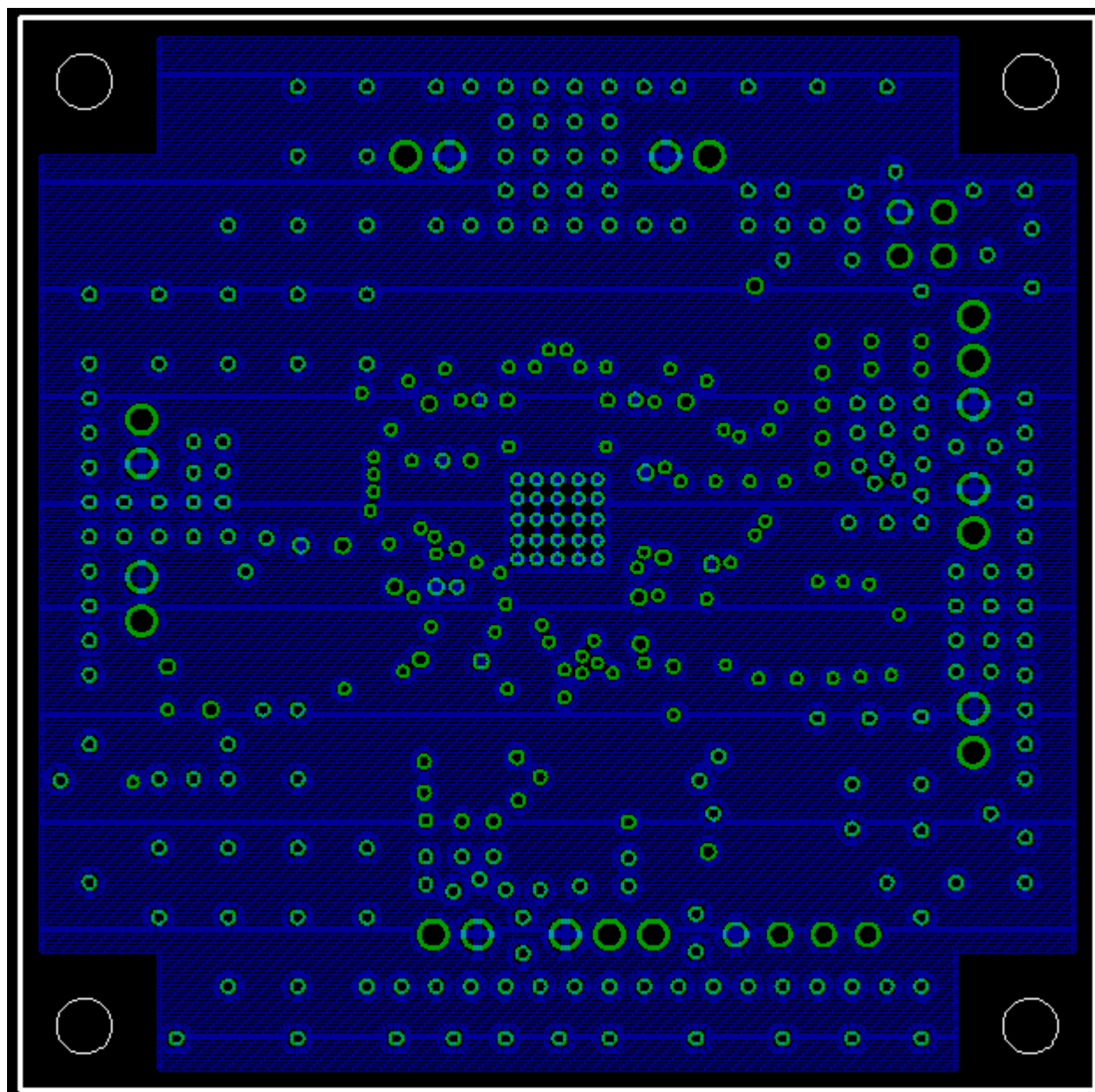


Figure 18. KIT34704AEPEVBE Inner Layer 1 Routing

11.5 Inner Layer 2 Routing

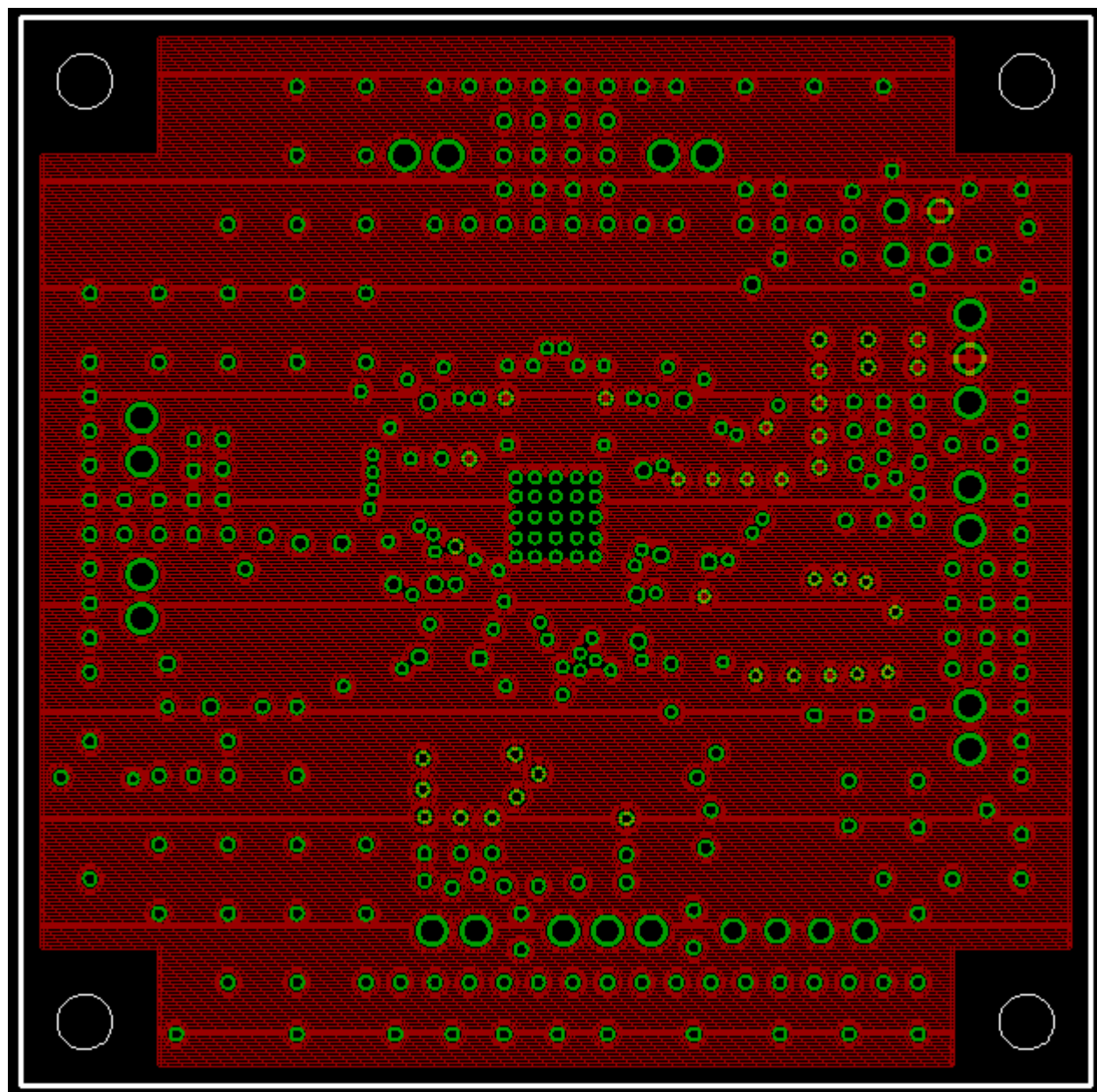


Figure 19. KIT34704AEPEVBE Inner Layer 2 Routing