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Document Number: KT34844UG
Rev. 1.0, 10/2008

KIT34844EPEVME Evaluation Board

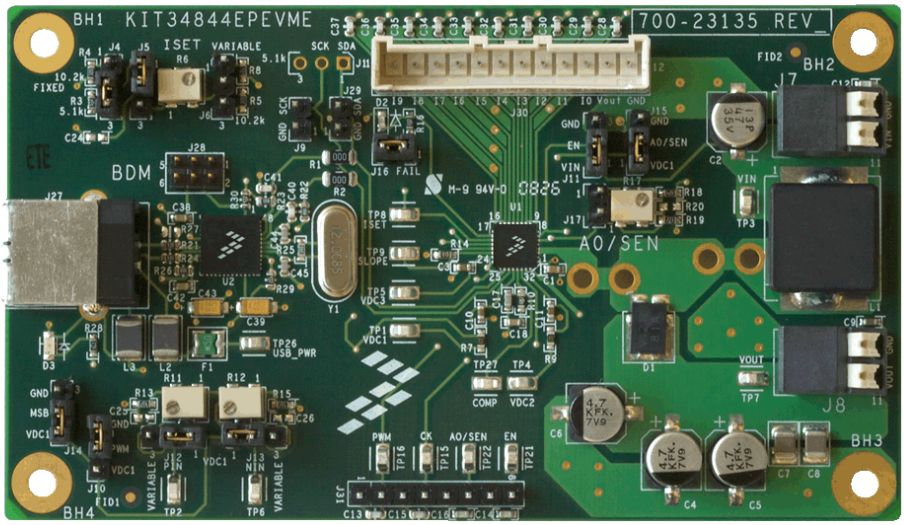

Figure 1. Evaluation Board (EVB)

Table of Contents

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1 Kit Contents / Packing List

- EVB - KIT34844EPEVME
- USB Cable Type A - B
- Cable for LED board connection
- CD

2 Important Notice

Freescale 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.

Should this evaluation kit not meet the specifications indicated in the kit, it may be returned within 30 days from the date of delivery and will be replaced by a new kit.

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3 EVB Introduction

This EVB shows the functionality of MC34844 set it up under specific operation parameters.

MC34844 which is a high efficiency, LED driver for use in backlighting LCD displays from 10” to 20”+ can operate in this demo board from a supply of 24V, the device is capable of driving up to 160 LEDs in 10 parallel strings. The current through these 10 channels is matched to within ±2% and can be programmed via the I^2C/SM-bus interface.

For evaluation purposes this Demo Board includes a USB to I^2C bridge that allows control of the EVB via USB communication through a PC. All these control fuctions are gathered in a friendly GUI (Graphical Unit Interface) also provided along with the Demo Board.

This EVB allows the user to test this device on its three operational modes: Master Mode, Slave Mode and Stand Alone Mode by facilitating access to all pins and providing different possible component configuration.

3.1 EVB operation parameters.

Input Voltage (Vin) = 24 V +/- 10%

Expected Output Voltage (Vout) = around 47V

LED Load = 16 Leds x 10 Channels

Duty Cycle = All range.

Peak Current on all channels = all range up to 50mA

OVP = 55V (For 16Leds)

Boost Frequency = 600KHz

Master Mode PWM Frequency = From 100Hz to 25KHz

Slave Mode PWM Frequency = From 1KHz to 25KHz

(In Slave Mode some considerations should be taken into accout from 100Hz to 1KHz, please refer to the “Functional Device Operation” Section from the Data Sheet.)

Since the demo board goes into ‘Default Configuration’ every time it is powered up, the OVP level should be changed to 55V using the Graphical unit interface. This way the device’s performance can be optimized.

3.2 EVB Features

- Bridge that Allows control of the EVB
- USB communication through a PC
- Four Layer Board
- Low Noise Design
- Top Layer Placement
- USB to I^2C Interface Added
- Terminal Block and Connector for the 10 LED channels
- Terminal Blocks for Input Voltage, Output Voltage, and Control Signals (EN, A0SEN, CK, PWM)
- Jumper Configuration and resitors arrays for signals Adjusting.
- Test Holes for SW Currrent Measurements

3.3 MC34844 Features

- Input voltage of 7V to 28V
- Output Voltage up to 60V, with auto Vout selection
- 3.0A integrated boost
- Up to 50mA LED current per channel
- 90% efficiency (DC:DC)
- 10-channel current mirror with ±2% current matching
- I^2C/SM-bus interface
- 8-bit programmable current DAC
- PWM frequency programmable or synchronizable from 100 Hz to 25 KHz
- User programmable OVP
- LED failure detection and OTP/OCP/UVLO lockout
- 32-Ld 5x5x0.8mm TQFN Pb-Free packaging

3.4 MCU (MC9S08JM60) Features - USB & I^2C

For this EVB it is important to highlight the following MCU features:

- USB - USB2.0 full-speed (12Mbps) device controller with dedicated on-chip USB transceiver, 3.3-V regulator and USBDP pull-up resistor; supports control, interrupt, asynchronous, and bulk transfers; supports endpoint 0 and up to 6 additional endpoints; endpoints 5 and 6 can be combined to provide double buffering capability.
- I^2C - Inter-integrated circuit BUS module to operate at up to 100kbps with maximum BUS loading; multi-master operation; programmable slave address; interrupt-driven byte-by-byte data transfer; 10-bit addressing and broadcast modes support.

Since the loading on the BUS is not significat for this application, it is then possible reach up to 400kbps.

For more information about this MCU please refer to :

http://www.freescale.com/files/microcontrollers/doc/data_sheet/MC9S08JM60.pdf

3.5 GUI Description/Features

This GUI allows the user to control and program all Registers related to the following Functions:

- Chip Enable
- OVP Voltage
- PWM (Frequency, Duty Cycle)
- Channel Enable
- Boost Frequency
- Clear FAIL
- Strobe Mode
- Channel Current Program

4 Required Equipment

4.1 System Requirements

These requirements apply if the graphical unit interface will be used for controlling the I^2C communication.

- HARDWARE
  - 400MHz Pentium® II processor or AMD-K6® class processor,
  - 128MB of RAM
  - CD-ROM drive
  - USB Port
- SOFTWARE - Microsoft .NET Framework Version 2.0 (x86)
- OPERATING SYSTEM - Microsoft® Windows® 98 SE/2000/XP (Service Pack 2)
- DISK SPACE Full: 500 MB

If I^2C communication is provided from a different source, this communication should comply with I^2C standards at 100/400 kbps. (Device Address = 76h)

4.2 Hardware Requirements

- Power Supply (up to 30V @ 3A)
- LED Board
- USB Cable Type A-B or 3 Wire Cable for I^2C Communication
- 12 Wires cable for LED board connection

5 EVB Setup Configuration Diagram

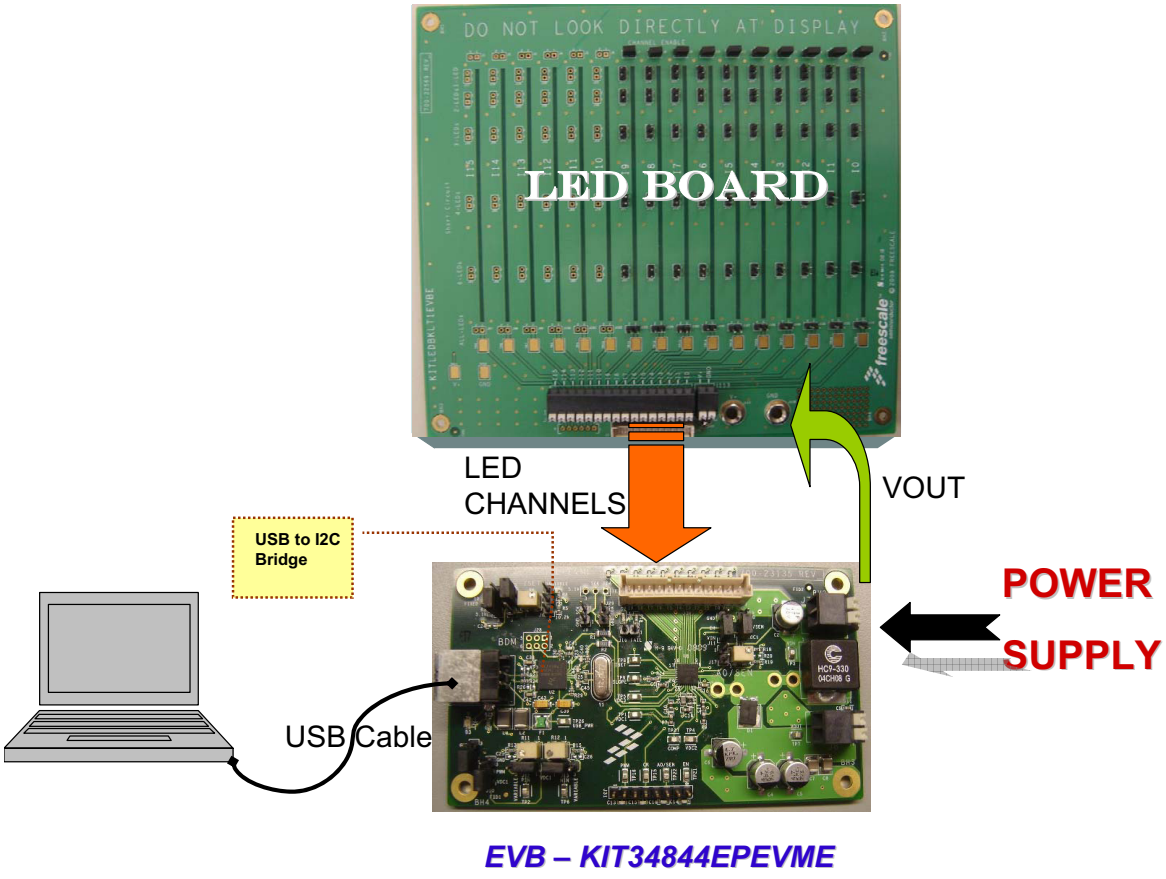


Figure 1. EVB Setup Configuration Diagram

6 Using Demo Board

6.1 Demo Board Jumper Connections

JUMPER CONNECTION	FUNCTION	DESCRIPTION
J4(1-2) + J5(1-2)	10.2kΩ for PIN+NIN	These two Jumpers will set the ISET resistor at 10.2kΩ allowing a maximum current through all channels up to 50mA when PIN and NIN modes are enabled at the same time. If PIN and NIN modes are disabled the maximum current will be 25mA.
J4(2-3) + J5(1-2)	5.1kΩ for PIN or NIN	This configuration is ideal for getting maximum current through all channels (50mA) when PIN and NIN modes are disabled.
J5(2-3) + J6(1-2)	ISET variable resistor for PIN or NIN	In this configuration, one can vary the value of ISET resistor to control the maximum current through all channels. To avoid damaging this part, Do not use this configuration if PIN + NIN mode is active.
J5(1-2) + J6(2-3)	ISET variable resistor for PIN+NIN	In this configuration, one can vary the value of ISET resistor to control the maximum current through all channels. This mode is intended to be used even when PIN + NIN mode is active because it will limit the current at 50mA.
J12(1-2)	PIN pin to VDC1	PIN mode Disable.
J13(1-2)	NIN pin to VDC1	NIN mode Disable.
J12(2-3)	PIN pin to Variable Resistor	Simulates PIN mode by varying the voltage across this pin from 0 to VDC1.
J13(2-3)	NIN pin to Variable Resistor	Simulates NIN mode by varying the voltage across this pin from 0 to VDC1.
J17	OVP - HW Controlled	This jumper connects A0SEN pin to a resistor divider which sets the OVP value respect to the internal threshold of 6.5V. This Resistor divider is connected from Vout to GND. Please refer to Schematic to set the correct resistance value based on your needs. For HW OVP the jumper on J15 must be disconnected.
J9, J29	I^2C clock and data to GND	I^2C mode disabled. (Do not connect USB cable if one of these two jumpers are connected)
J10(1-2)	PWM pin to VDC1	Sets PWM pin to HIGH level.
J10(2-3)	PWM pin to GND	Sets PWM pin to LOW level
J11(1-2)	Chip Enable	CHIP Enabled by Hardware. It takes EN pin to HIGH
J11(2-3)	Chip Disable	CHIP Disabled by Hardware. It takes EN pin to LOW
J14(1-2)	Master Mode	M/~S pin tied to HIGH for Master Mode
J14(2-3)	Slave Mode	M/~S pin tied to LOW for Salve Mode
J15(1-2)	A0SEN to VDC1	This Jumper allows the IC to receive I^2C data. (J17 must be disconnected)
J15(2-3)	A0SEN to GND	This Jumper configures the IC to reject I^2C data.(J17 must be disconnected)
J16	Fail pin LED	Connect LED for Fail condition indicator. (LED ON = Fail Condition, LED OFF = OK)

Note: Jumpers J15 & J17 can not be connected at the same time.

Operation Mode based on jumper connections

- ***Yellow:*** MASTER MODE (Default Configuration) -These jumpers should be connected in order to start up the part in Master Mode.
  PIN and NIN functions are disabled.
- ***Blue***: SLAVE MODE - To start up the part in Slave Mode, all jumpers should be connected for a master mode operation, expect J14 that should be connected in J14(2-3) position.
  In Slave Mode an external clock should be provided to CK pin of the Terminal Block (J31).
- Green: MANUAL MODE - Configure the part as in Master mode, but remove jumper on J15 and connect jumper J17.
  (Remember to set a correct OVP value before turning on the part)
  Do not forget set a 10.2K resistor on ISET pin if PIN and NIN modes are used at the same time.
- ***Red:*** If an external I^2C communication is desired for an specific application, clock and data should be connected to the jumper highlighted in red.
  For this external I^2C "communictaion", USB cable must be disconnected to avoid damage the MCU.

Jumper description is shown above in *Demo Board Jumper Connections.*

Under these configurations the PWM pin is set LOW in order to allow programming the part before turning all LED channels ON.

If PIN and NIN Mode are enabled at the same time, J4(1-2) and J5(1-2) must be connected to avoid damaged the part.

6.2 Start up sequence for MASTER MODE (Default)

1. Make sure jumper connections are as specified above for Master Mode and the LED load board is correctly connected to the EVB.
2. Set the power supply (24V@3A).
3. Turn power supply off and connect it to the Demo board
4. Connect USB cable. (Diode "D3" should be ON)
   (Refer to Section 10 - KIT34844 Installer Instructions)
5. Turn power supply on. (Diode "D2" should be OFF)
6. Program the part and make sure to set OVP = 55V. (please refer to the GUI section - Home Page)
   DO NOT change the Boost Frequency, remember that all external components are calculated for 600KHz.
7. Take PWM pin HIGH [J10 (1-2)].
8. All LEDs should be ON.

6.3 Start up sequence for SLAVE MODE

1. Make sure jumper connections are as specified above for Slave Mode and the LED load board is correctly connected to the EVB.
2. Set the power supply (24V@3A).
3. Turn power supply off and connect it to the Demo board
4. Set an external Master Clock and connect it to CK pin through the connector J31.
5. Connect USB cable. (Diode “D3” should be ON)
   (Refer to Section 10 - KIT34844 Installer Instructions)
6. Turn power supply on. (Diode “D2” should be OFF)
7. Program the part and make sure to set OVP = 55V. (please refer to the GUI section - Home Page)
   DO NOT change the Boost Frequency, remember that all external components are calculated for 600KHz.
8. Take PWM pin HIGH [J10 (1-2)].
9. All LEDs should be ON.

6.4 Start up sequence for MANUAL MODE

1. Make sure jumper connections are as specified above for Manual Mode and the LED load board is correctly connected to the EVB. (Jumpers J15 and J17 can not be connected at the same time)
2. Set the power supply (24V@3A).
3. Turn power supply off and connect it to the Demo board.
4. Turn power supply on. (Diode “D2” should be OFF).
5. Verify that the voltage on A0/SEN pin (TP22) to 2.8V, if not please set it by adjusting trimpot R17. (It only applies to set OVP = 55V when Vin = 24V)
6. If PIN and NIN modes want to be used at the same time please continue with step #7 and #8, if not skip them.
7. Move jumper J4 to position 1-2, and jumpers J12 and J13 to position 2-3.
8. Verify that the voltage on PIN pin (TP2) is around 2V and NIN pin (TP6) is around 0.1V , if not please set them by adjusting trimpots R11 and R12.
9. Take PWM pin HIGH [J10 (1-2)].
10. All LEDs should be ON.

I^2C communication can be used in this mode, if so please make sure to set an OVP = 55V. (please refer to the GUI section - Home Page)
DO NOT change the Boost Frequency, remember that all external components are calculated for 600KHz.

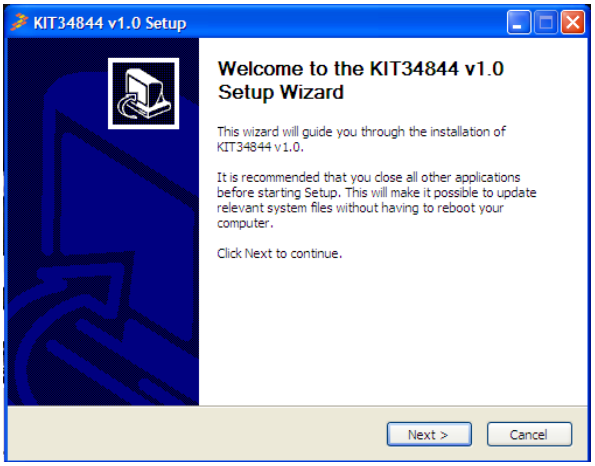
7 KIT34844 Installer Instructions

This EVB is preloaded with a firmware that allows USB communication with the PC and allows the user to write devices using I^2C signals

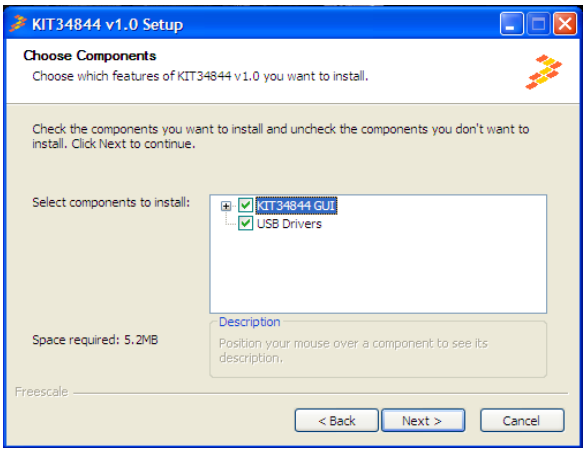
A graphical Unit interface (GUI) is provided by Freescale in order to achive communication with the KIT34844 board. This GUI allows the user to control all the funtions of the board.

INSTALLER INTRUCTIONS:

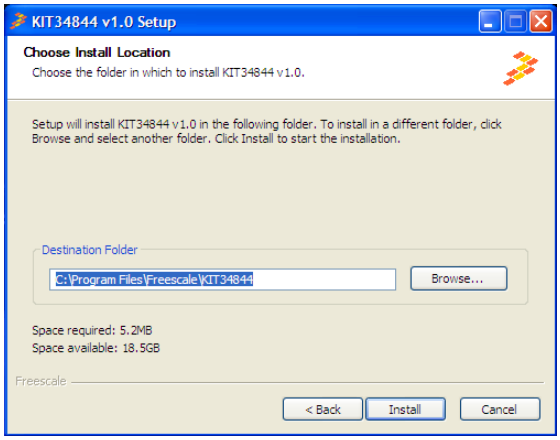
1. On the CD provided, open folder named KIT34844 Setup
2. Execute “KIT34844_Setup.exe” and Click Next.



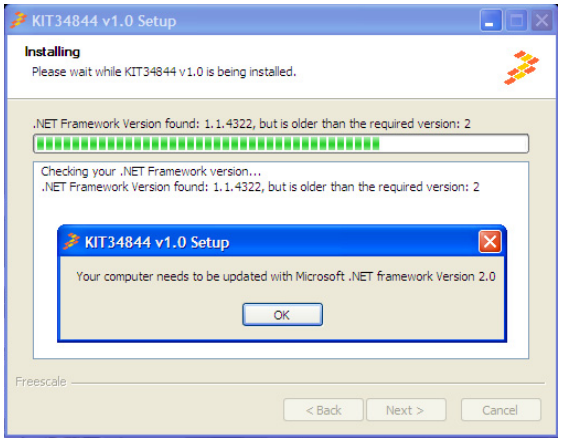
3. Please make sure that KIT34844EPEVME is NOT connected.
4. Read Freescale“License Agreement” and press “I Agree”.
5. Select components to install.



6. Choose Install Location. It is recommended to choose the default destination folder “C:\Program Files\Freescale\KIT34844”.

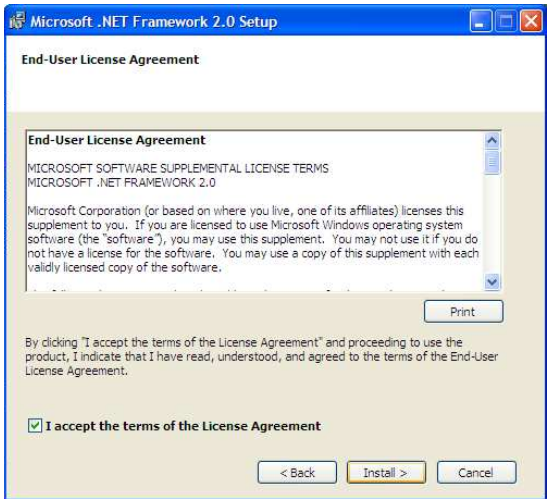


7. If Microsoft . NET Framework 2.0 is already installed, skip intructions 8 and 9
8. A pop up window will appear to install “Microsoft .NET Framework 2.0”. Click “OK” to install it.

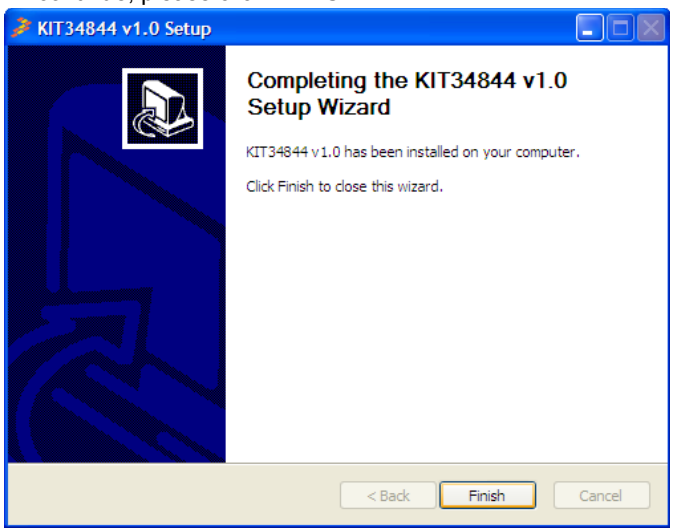


9. Microsof .NET Framework 2.0 Setup will start, click NEXT button.

10. Please read Microsoft License Agreement and check the box if you do accept the terms.



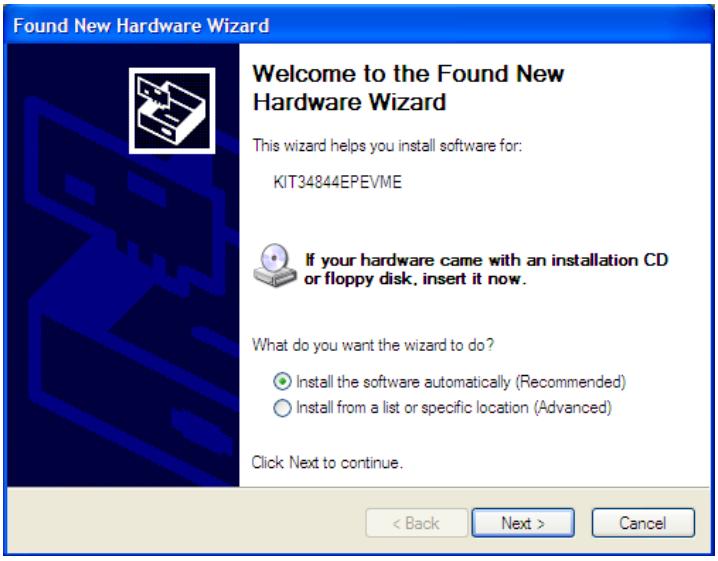
11. Click “Install” .
12. Once Framework installation is done, press “FINISH”.
13. GUI installation will continue, please click “FINISH”.



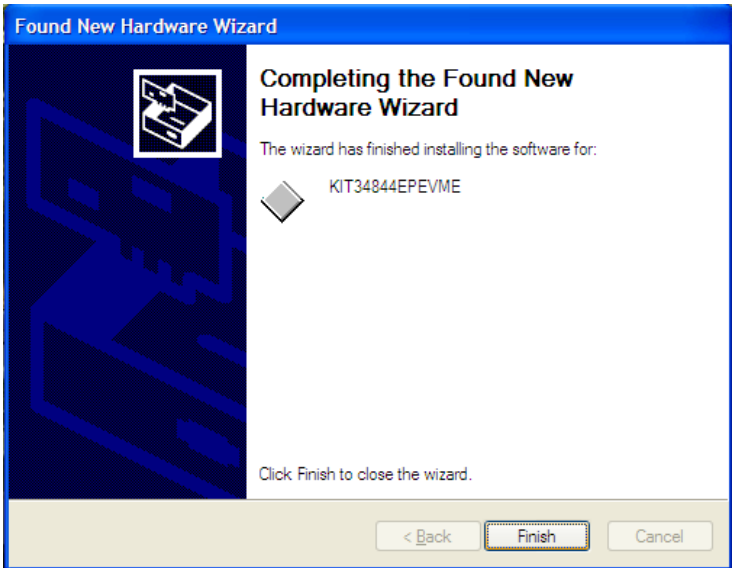
14. You can now connect the KIT34844 board to your computer. Click “OK”
15. Now the GUI is succesfully installed in Programs Files and also a shortcut is created on your Desktop.

Installing EVB Driver

16. Connect EVB to the PC with an USB cable Type A-B.
17. When the “Found new hardware wizard”appears, select “Install the software automatically (Recommended)”



18. Click NEXT.
19. Wait for the installation to finish and click ‘Finish’



20. Now you can LAUNCH the GUI.

Note: In order to use the GUI, the EVB must be Powered Up.

8 Using Graphical User Interface (GUI)

This Section describes an easy and detailed way of using the GUI. Write Register Table, Register Description and OVP table will be shown and explained.

Note: In order to use the GUI, the EVB must be Powered Up.

8.1 GUI Sections

8.1.1 Setting up I²C communication

In this Window you can set :

- The Baudrate of I²C communication: 100kbps or 400kbps
- The current set on ISET (**Eqn. 2**).

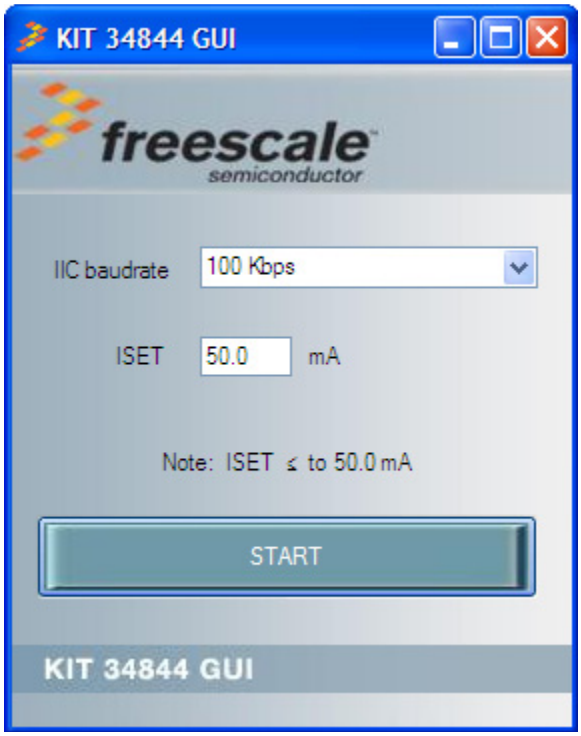


Figure 2. I²C **set up Window**

8.1.2 Home Page

This Window is splitted in two main sections:

a) SELECTORS

It allows the user to set up the following functions:

- Enable or Disable the following modes:
  - I^2C
  - PIN
  - NIN
  - STROBE
- Select from a Drop list:
  - OVP Value. For this EVB please set it at 55V.
  - Boost Frequency (Components on EVB are calculated for 600KHz).

Do not change Boost Frequency. All compensation network is calculated for 600KHz of boost frequency.

- Set from a Sliding Bar:
  - PWM Frequency
  - PWM Duty Cycle
  - Maximum Current on all channels

b) REAL TIME:

This Section allows the user to change in real time :

- Enable Status
- Turn ON/OFF all channels
- Clear FAIL Status

Also the user can call the following functions:

- Current Control
- Register Table
- Default Configuration (IC Default Values)
- Tests

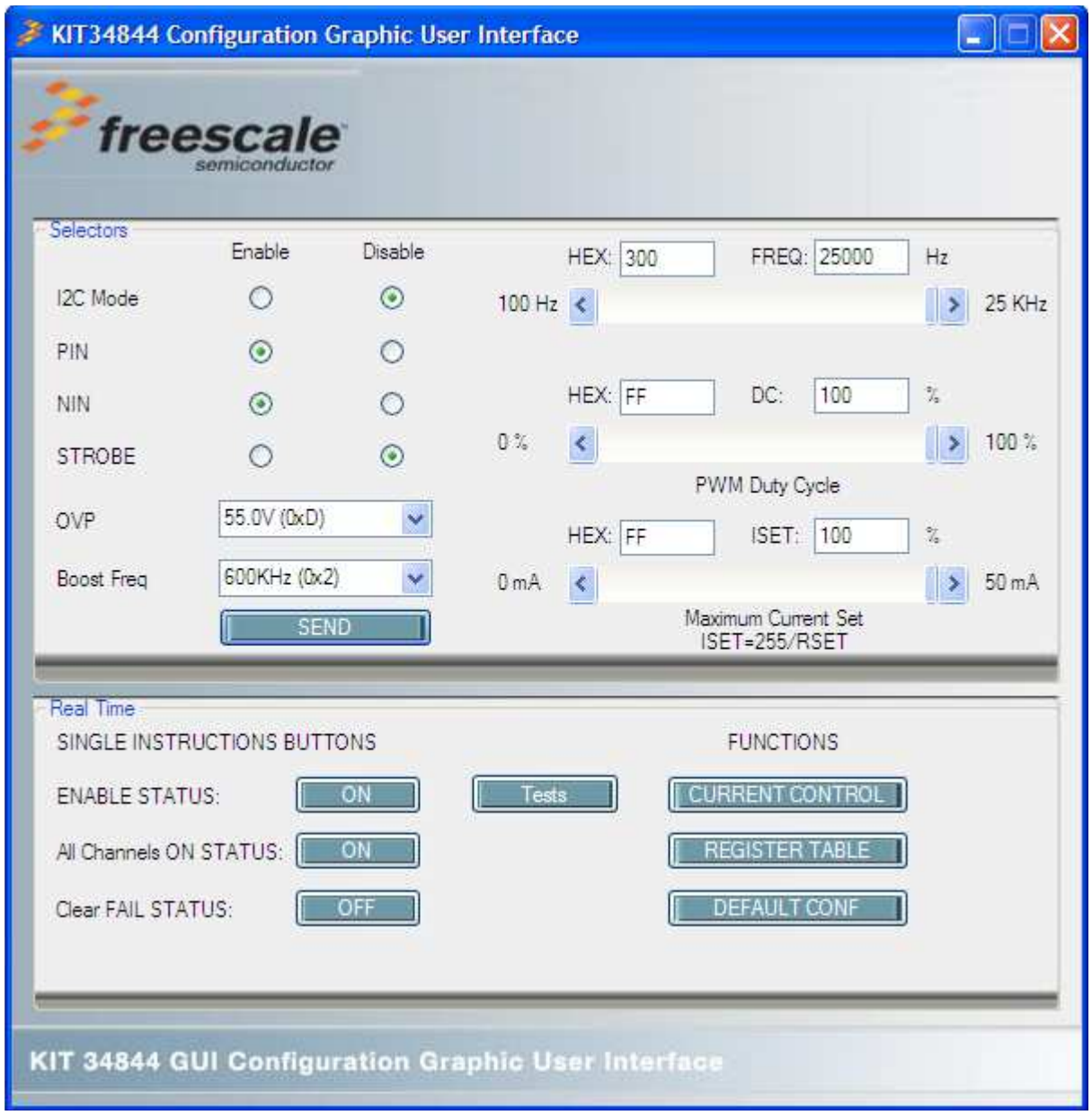


Figure 3. GUI - Home Page

8.1.3 Current Control Window

This window allows the user to control the following Registers automatically. It provides an easy and quick way of programming all the registers:

- All_OFF bit
- CHEN[9:0]
- ICH#
- ICHG

The global current control should be first set and then send the information by pressing SEND button.

Independent current control should also be first set and then send by pressing SEND button. It can also be sent automatically with a default update time at 1 second by pressing the OFF button at the bottom. This update time could be changed as needed.

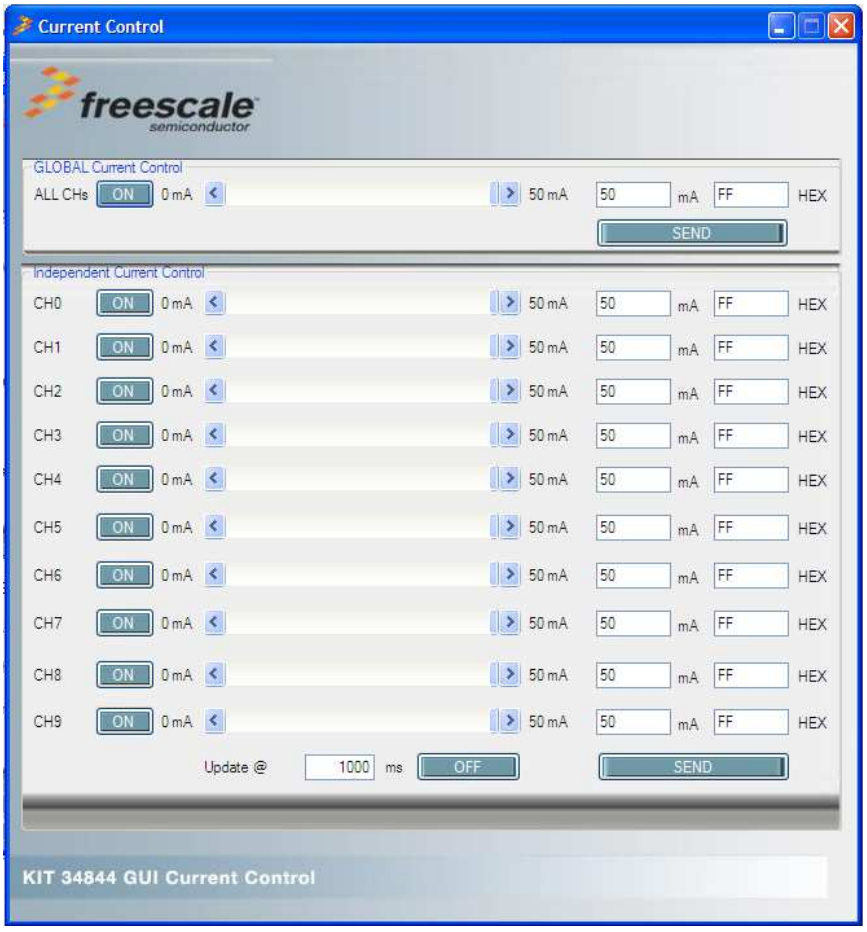


Figure 4. GUI - Current Control Window

8.1.4 Register Table Window

In this window the user can change the logic value of each bit independently. This can be done either by pressing the bit or changing all Registers at the right side of the desired HEX value.

- Light Blue means the bit is a logic cero.
- Dark Blue means the bit is a logic one.

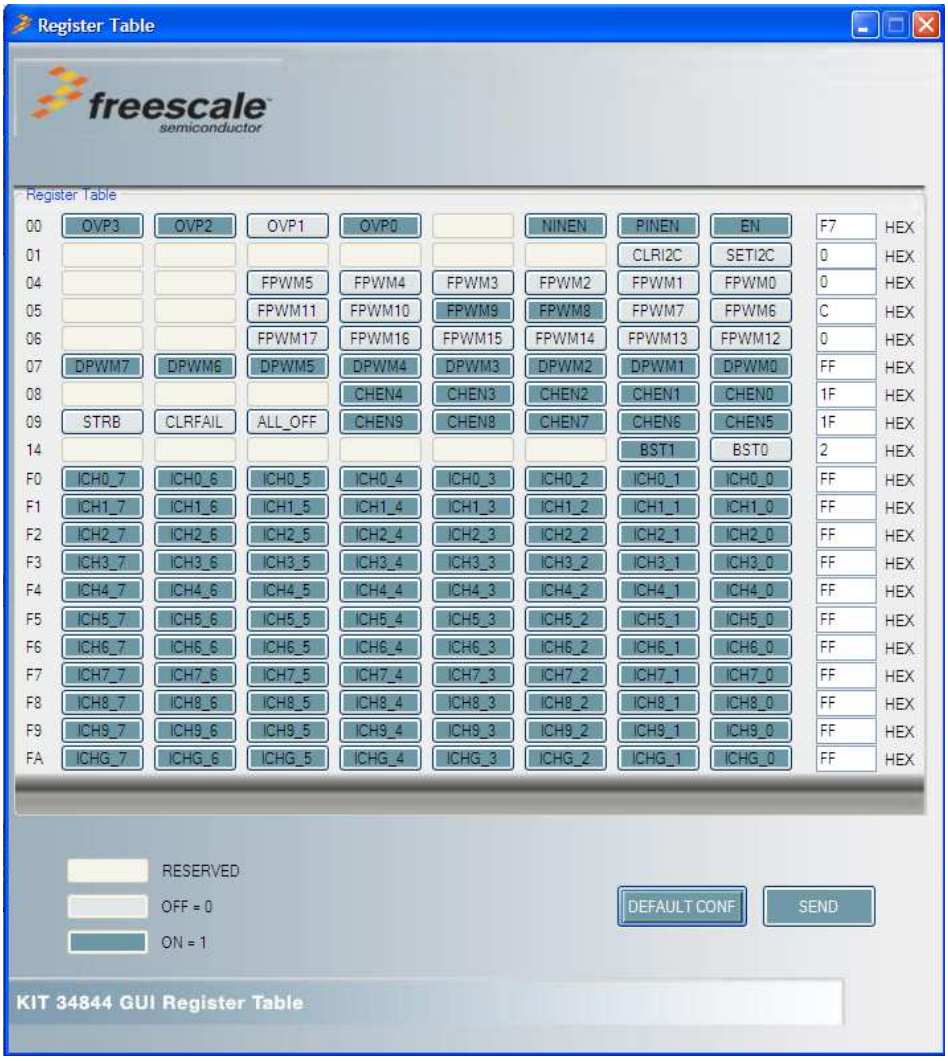


Figure 5. Register Table Window

8.1.5 TEST Window

This window allows the User to program the following Sequences:

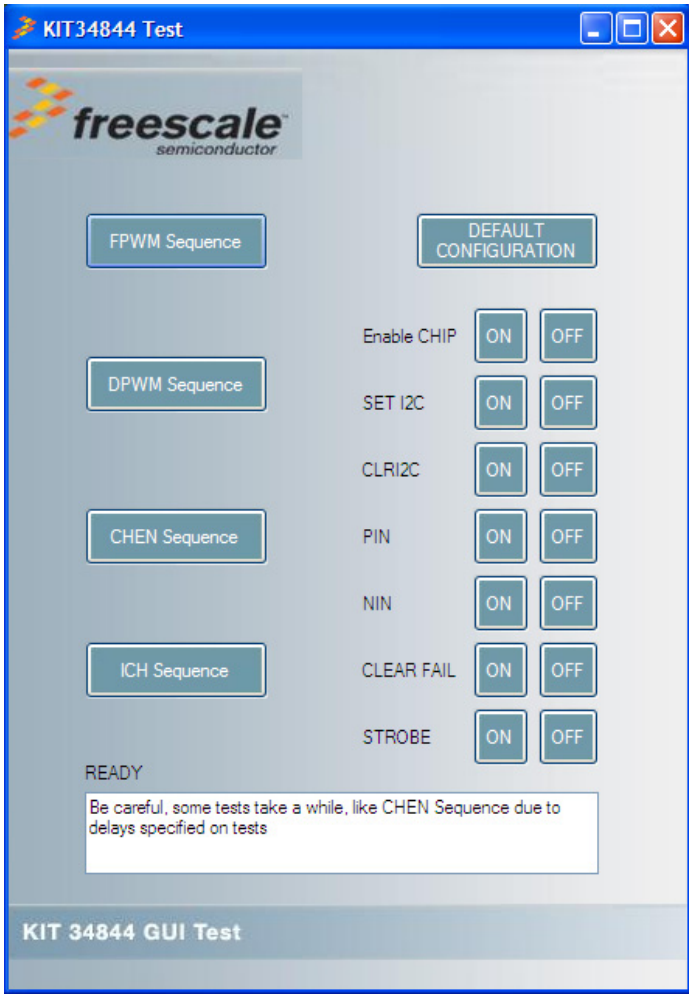


Figure 6. Test Window

- FPWM: Increments Frequency over the whole PWM Range in all channels (100 to 25000 Hz)
- DPWM: Performs a sweep of the Duty Cycle on all the channels from 0 to 100%
- CHEN Sequence: Turns on one channel at the time.
- ICH Sequence: Turn on one channel at the time and increases the LED current gradually in the channel being turn on.
- STROBE: This Button activates Strobe Mode.

8.2 Write Registers

Following table shows all write registers. Registers in grey are reserved.

Register values are in Hexadecimal. [I^2C Device Address = 76h (1110110b)]

REG / DB	D7	D6	D5	D4	D3	D2	D1	D0
00	OVP3	OVP2	OVP1	OVP0		NINEN	PINEN	EN
01							CLRI2C	SETI2C
04			FPWM5	FPWM4	FPWM3	FPWM2	FPWM1	FPWM0
05			FPWM11	FPWM10	FPWM9	FPWM8	FPWM7	FPWM6
06			FPWM17	FPWM16	FPWM15	FPWM14	FPWM13	FPWM12
07	DPWM7	DPWM6	DPWM5	DPWM4	DPWM3	DPWM2	DPWM1	DPWM0
08				CHEN4	CHEN3	CHEN2	CHEN1	CHEN0
09	STRB	CLRFAIL	ALL_OFF	CHEN9	CHEN8	CHEN7	CHEN6	CHEN5
14							BST1	BST0
F0	ICH0_7	ICH0_6	ICH0_5	ICH0_4	ICH0_3	ICH0_2	ICH0_1	ICH0_0
F1	ICH1_7	ICH1_6	ICH1_5	ICH1_4	ICH1_3	ICH1_2	ICH1_1	ICH1_0
F2	ICH2_7	ICH2_6	ICH2_5	ICH2_4	ICH2_3	ICH2_2	ICH2_1	ICH2_0
F3	ICH3_7	ICH3_6	ICH3_5	ICH3_4	ICHG_3	ICH3_2	ICH3_1	ICH3_0
F4	ICH4_7	ICH4_6	ICH4_5	ICH4_4	ICH4_3	ICH4_2	ICH4_1	ICH4_0
F5	ICH5_7	ICH5_6	ICH5_5	ICH5_4	ICH5_3	ICH5_2	ICH5_1	ICH5_0
F6	ICH6_7	ICH6_6	ICH6_5	ICH6_4	ICH6_3	ICH6_2	ICH6_1	ICH6_0
F7	ICH7_7	ICH7_6	ICH7_5	ICH7_4	ICH7_3	ICH7_2	ICH7_1	ICH7_0
F8	ICH8_7	ICH8_6	ICH8_5	ICH8_4	ICH8_3	ICH8_2	ICH8_1	ICH8_0
F9	ICH9_7	ICH9_6	ICH9_5	ICH9_4	ICH9_3	ICH9_2	ICH9_1	ICH9_0
FA	ICHG_7	ICHG_6	ICHG_5	ICHG_4	ICHG_3	ICHG_2	ICHG_1	ICHG_0

8.3 Register Description

REGISTER NAME	DEFAULT VALUE (HEX)	DESCRIPTION
EN	1	Chip Enable by software. This signal is 'OR'ed with external EN (0=off, 1 =on)
PINEN	1	PIN pin enable (0=off, 1 =on) (**Equation 3** & **Equation 5**)
NINEN	1	NIN pin enable (0=off, 1 =on) (**Equation 4** & **Equation 5**)
OVP[3:0]	F	OVP voltage
SETI2C	0	SET I^2C communication (Disable SM-Bus Mode)
CLRI2C	0	Clear set I^2C
FPWM[17:0]	300	PWM Frequency (**Equation 1**)
DPWM[7:0]	FF	PWM Duty Cycle (FFh =100%)
CHEN[9:0]	3FF	Channel Enable (0=off, 1=on)
ALL_OFF	0	All 10 channels OFF at the same. In order to reactivate channels this bit should be clear.
CLRFAIL	0	Clear fail if channels are re-enable.
STRB	0	Strobe MODE (0=Parallel, 1=Strobe)
BST[1:0]	2	Boost Frequency (150,300,600,1200 kHz) [0h=150Hz]
ICH#[7:0]	FF	Channel Current Program (FFh = Maximum Current)
ICHG[7:0]	FF	Global Current Program (**Equation 2**)

8.4 OVP Table

REGISTER (HEX)	OVP VALUE (VOLTS)
2	11
3	15
4	19
5	23
6	27
7	31
8	35
9	39
A	43
B	47
C	51
D	55
E	59
F	62

8.5 Current and Frequency Equations

In the following equations all registers values should be in Decimal. Do not set a current higher than 50mA through LED Channels.

PWM Frequency **Eqn. 1**

$$PWMFrequency[Hz] = \frac{19.2Mhz}{FPWM[RegisterValue]}$$

Current on LED Channel (PIN and NIN mode disable) **Eqn. 2**

$$Current[A] = \frac{ICH[RegisterValue]}{RSET[ohms]}$$

Current on LED Channel (PIN mode) **Eqn. 3**

$$Current[A] = \frac{VPIN[Volts] \times ICH[RegisterValue]}{RSET[ohms]}$$

Current on LED Channel (NIN mode) **Eqn. 4**

$$Current[A] = \frac{(2.048 - VNIN)[Volts] \times ICH[RegisterValue]}{RSET[ohms]}$$

Current on LED Channel (PIN+NIN mode) **Eqn. 5**

$$Current[A] = \frac{(2.048 - VNIN + VPIN)[Volts] \times ICH[RegisterValue]}{RSET[ohms]}$$

9 LED Load Board Configuration (10 Channels x 16 LEDs)

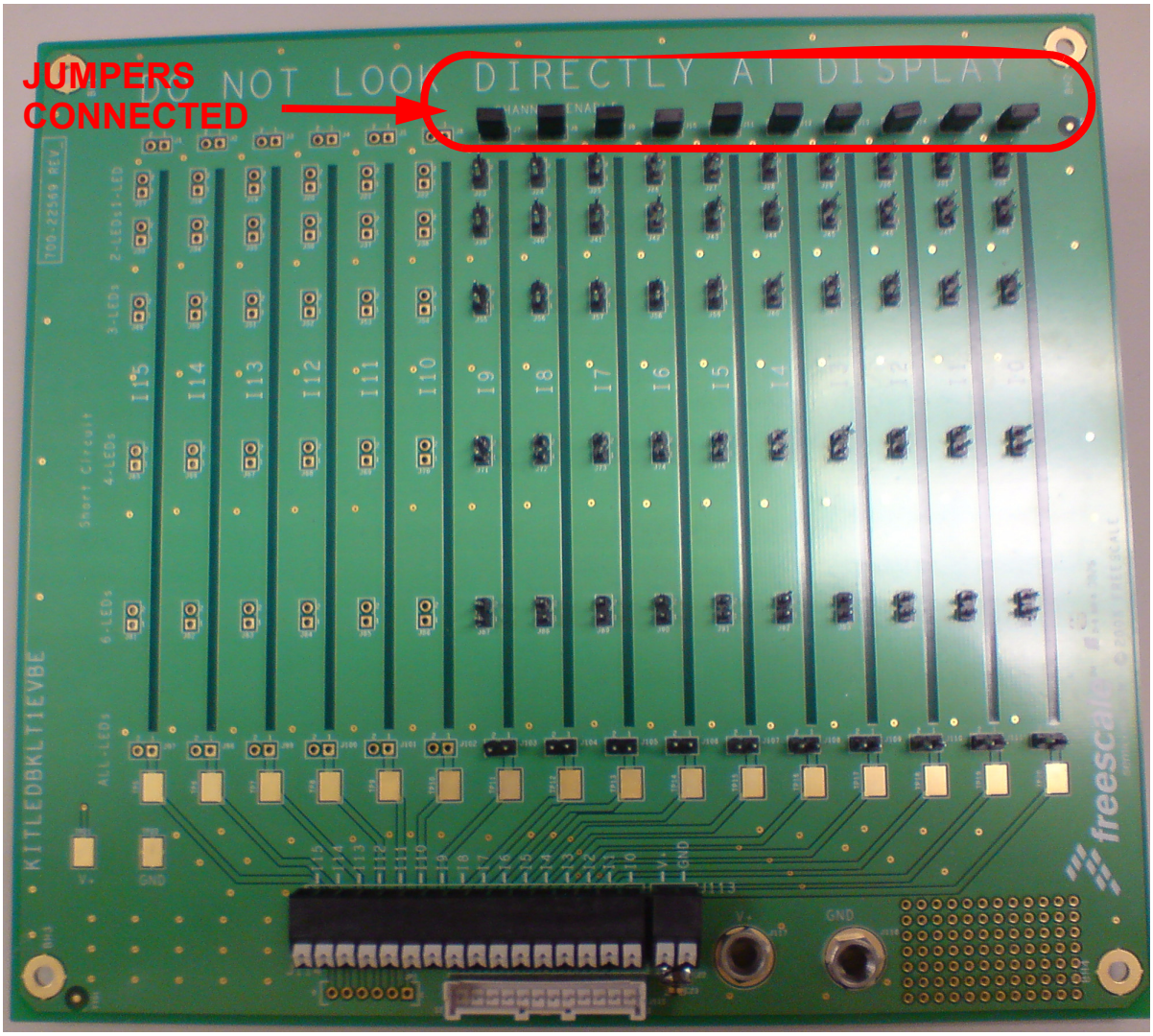


Figure 7. LED Load Board

Jumper Function:

- Top horizontal jumpers: Channel strings enabled. This LED Load Board has only 10 Channels populated.
- Bottom horizontal jumpers : Connect the LED Channels to the voltage at the boost.
- Vertical jumpers: Short circuit LEDs

10 EVB Schematic (1) - MC34844 Section

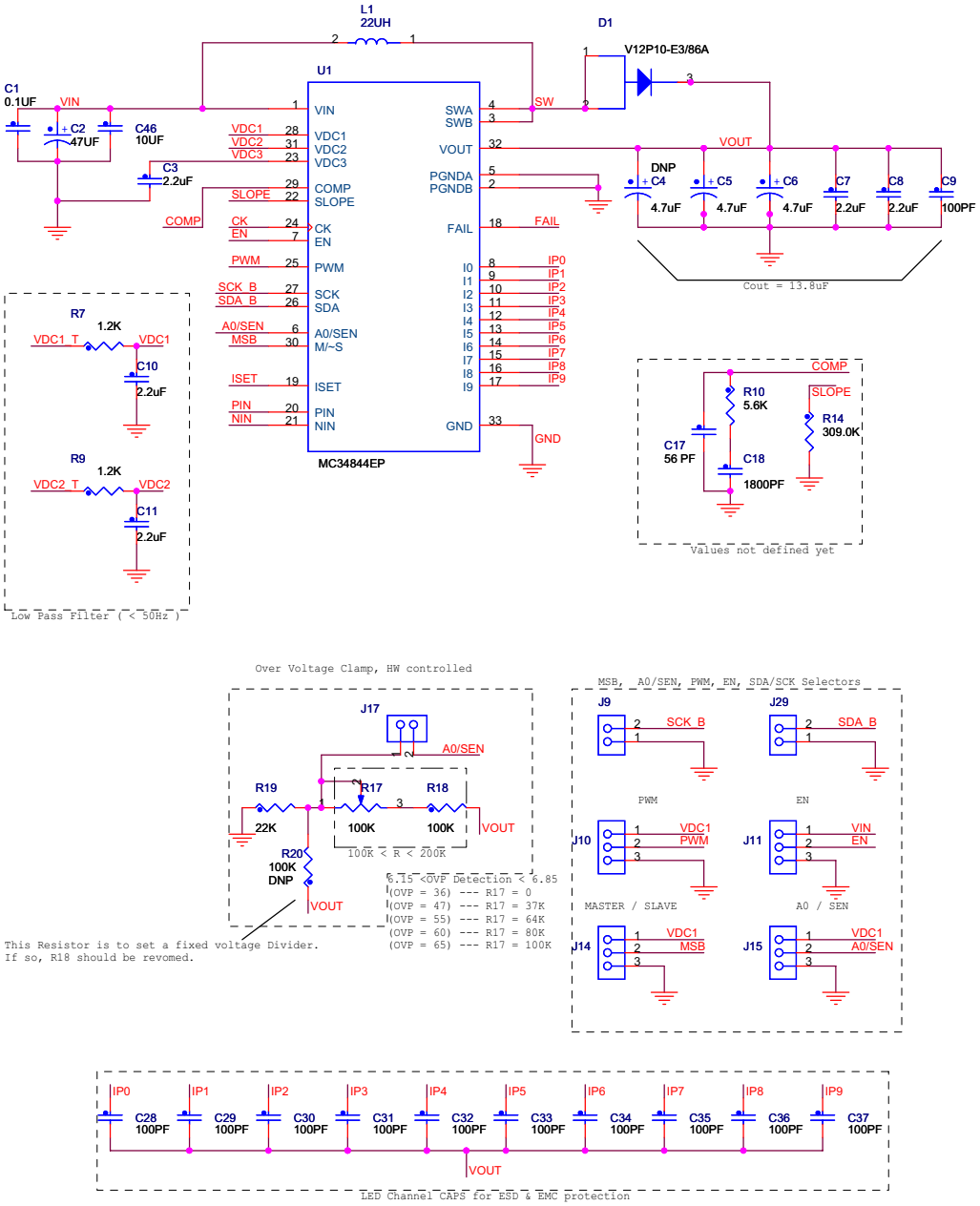


Figure 8. EVB Schematic (1)