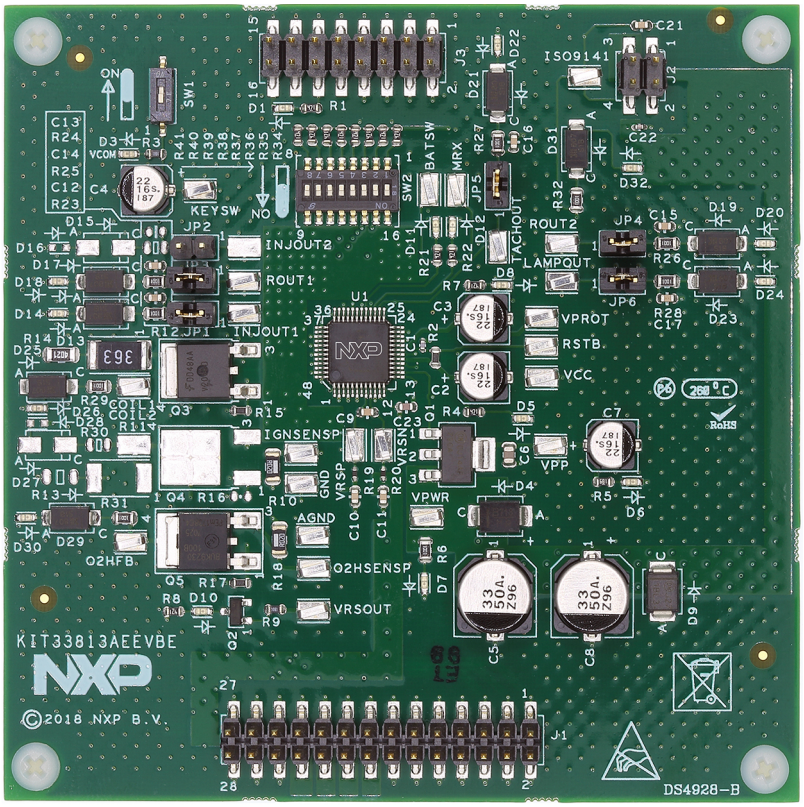
KT33813UG

KIT33813AEEVBE evaluation board

Rev. 3.0 — 2 October 2018 **User guide**

KIT33813AEEVBE

The KIT33813AEEVBE board is an easy-to-use circuit board that allows the user to exercise all the functions of the MC33813 one cylinder small engine control IC. A PC communicates to the evaluation board through a USB/SPI Dongle (KITUSBSPIDGLEVME) connected to the PC's USB port. The NXP SPIGen (version 7.1.8) program provides the user interface to the MC33813 SPI port and allows the user to send commands to the IC and receive status from the IC.



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1 Finding kit resources and information on the NXP web site

NXP Semiconductors provides online resources for this evaluation board and its supported device(s) on http://www.nxp.com.

The information page for KIT33813AEEVBE evaluation board is at http://www.nxp.com/KIT33813AEEVBE. The information page provides overview information, documentation, software and tools, parametrics, ordering information and a **Getting Started** tab. The **Getting Started** tab provides quick-reference information applicable to using the KIT33813AEEVBE evaluation board, including the downloadable assets referenced in this document.

1.1 Collaborate in the NXP community

The NXP community is for sharing ideas and tips, ask and answer technical questions, and receive input on just about any embedded design topic.

The NXP community is at http://community.nxp.com.

2 Getting ready

Working with the KIT33813AEEVBE requires the kit contents, additional hardware and a Windows PC workstation with installed software.

2.1 Kit contents

- Assembled and tested KIT33813AEEVBE board in an anti-static bag

2.2 Additional hardware

In addition to the kit contents, the following hardware is necessary or beneficial when working with this kit.

- Power supply 12 V with current limit set initially to 1.0 A
- Oscilloscope (4 channel preferably) with current probe
- Multimeter
- USB/SPI Dongle board (KITUSBSPIDGLEVME) plus 16-pin ribbon cable
- Typical loads (DC servo motor, fuel injectors, solenoids, lamps, relays and tachometer)

2.3 Windows PC workstation

This evaluation board requires a Windows PC workstation. Meeting these minimum specifications should produce great results when working with this evaluation board.

- USB-enabled computer with Windows XP or higher

2.4 Software

Installing software is necessary to work with this evaluation board. All listed software is available on the evaluation board's information page at http://www.nxp.com/KIT33813AEEVBE.

- SPI Generator (SPIGen) software, version 7.1.8 or later

3 Getting to know the hardware

The NXP analog product development boards provide an easy-to-use platform for evaluating NXP products. The boards support a range of analog, mixed-signal and power solutions. They incorporate monolithic integrated circuits and system-in-package devices that use proven high-volume technology. NXP products offer longer battery life, a smaller form factor, reduced component counts, lower cost and improved performance in powering state-of-the-art systems.

3.1 Kit overview

3.1.1 KIT33813AEEVBE features

This evaluation board consists of a MC33813 one cylinder small engine control IC, a USB to SPI Dongle interface, and power conditioning circuitry. All +5.0 V VCC power required by the board is obtained from the MC33813 built-in power regulator. A +12 V VBAT supply provides the power to the three internal voltage regulators.

3.1.2 KIT33813AEEVBE block diagram

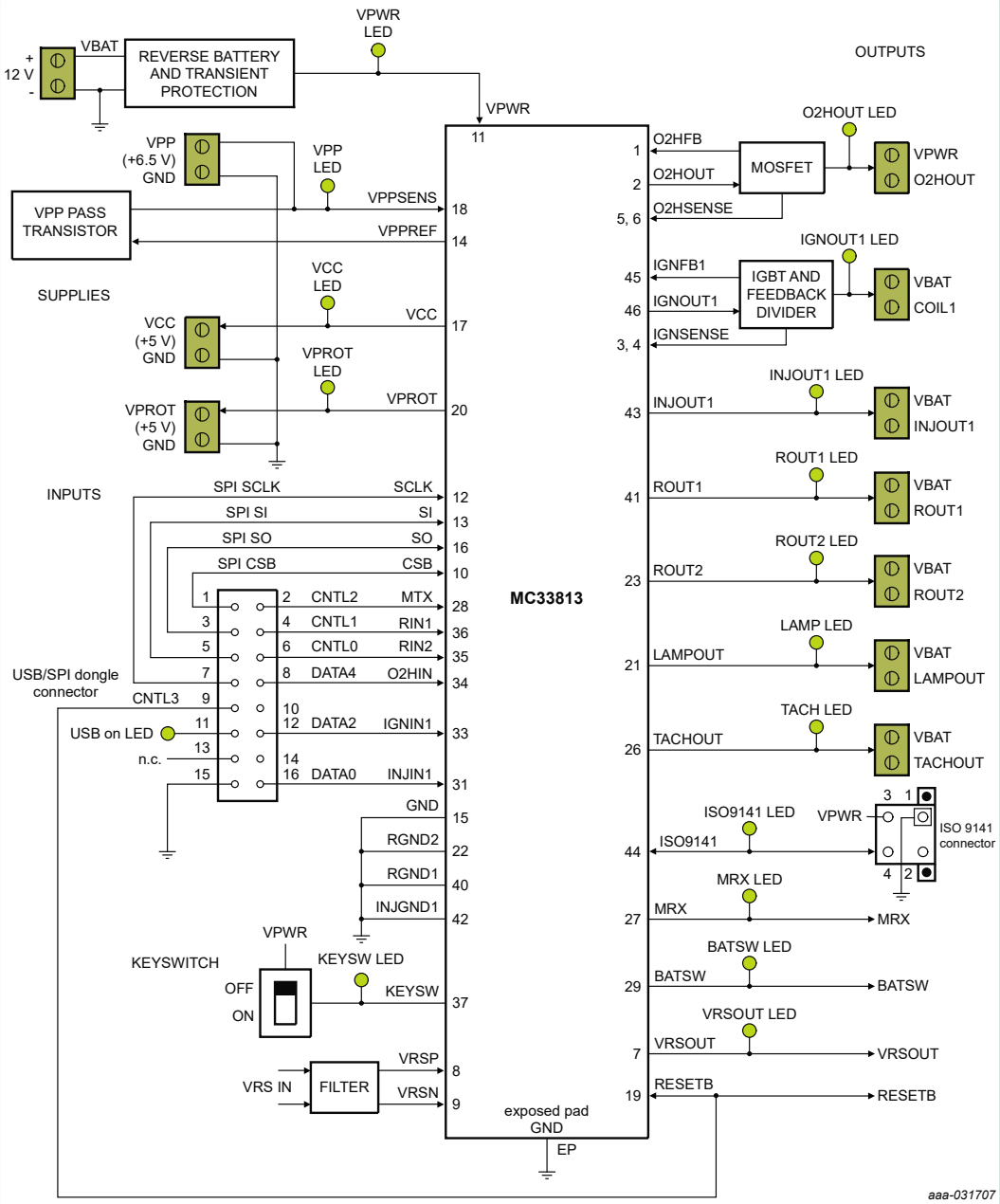


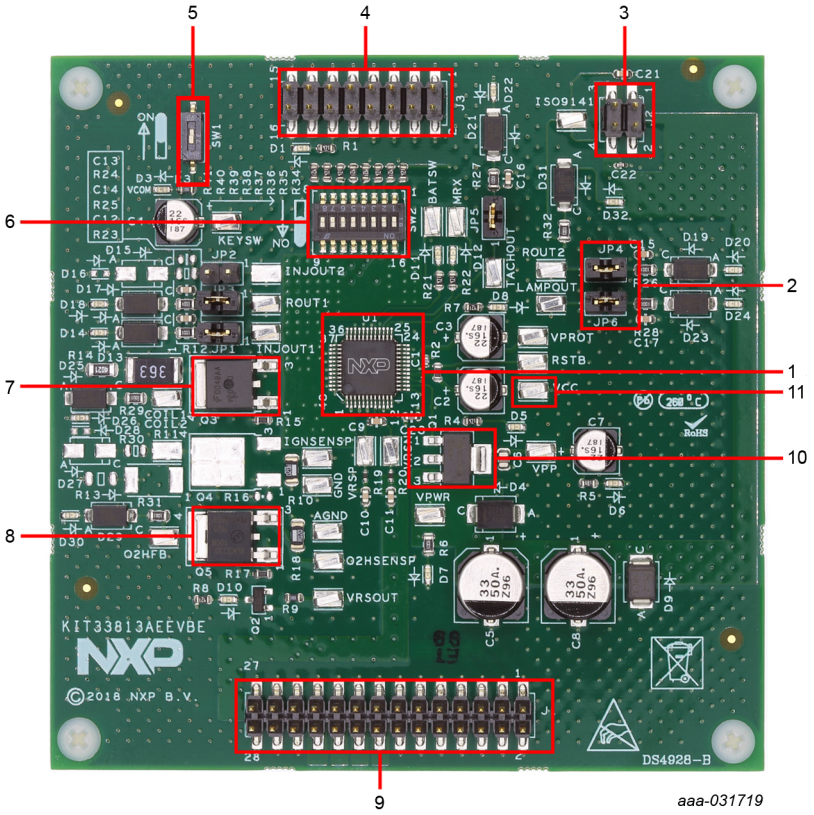
Figure 1. KIT33813AEEVBE block diagram

3.1.3 Schematic, board layout and bill of materials

The schematic, board layout and bill of materials for the KIT33813AEEVBE are available at http://www.nxp.com/KIT33813AEEVBE.

3.2 Featured components

Figure 2 identifies important components on the KIT33813AEEVBE board and Table 1 provides additional details on these components.



1. MC33813AE
2. Jumpers
3. ISO9141 connector
4. SPI dongle connector
5. KEYSW dip switch
6. Direct input dip switches
7. IGNOUT1 IGBT
8. O2HOUT MOSFET
9. Main connector
10. Pre-regulator external PNP
11. Test point

Figure 2. KIT33813AEEVBE featured component locations

Table 1. KIT33813AEEVBE board component descriptions

Name	Description
MC33813AE	one cylinder small engine control IC
Jumpers	used to disconnect LSD from loads to experience open load functionality
ISO9141 connector	connection to K-line transceiver
SPI dongle connector	compatible with USB/SPI dongle
KEYSW dip switch	used to wake the device up
Direct input dip switches	when no USB/SPI is connected, direct accesses to LSD and predriver inputs
IGNOUT1 IGBT	drives an ignition coil
O2HOUT MOSFET	can drive an O2 heater sensor
Main connector	connection to battery, GND, external loads and VRS
Test point	to probe different signals

3.2.1 MC33813: One cylinder small engine control IC

3.2.1.1 General description

Powered by SMARTMOS technology, the 33813 delivers a cost-optimized IC solution for managing one-cylinder engines. With five drivers, two pre-drivers, a 5.0 V regulator for the MCU, a protected external sensor supply and a high level of integration, the IC offers an ideal response to contemporary market requirements.

The innovative VRS system optimizes noise immunity under cranking conditions. Diagnostic and protection features present on all outputs allow applications to operate with greater safety.

3.2.1.2 Features

The MC33813 is an engine control analog power IC intended for one cylinder motorcycle and other small engine control applications. The device supports the following functionality:

- One fuel injector driver typical of 1.3 A
- One ignition IGBT or general purpose gate predriver
- One O2 sensor (HEGO) heater general purpose gate predriver
- Relay 1 driver, typically 2.0 A, can be used for fuel pump control
- Relay 2 driver, typically 1.0 A, can be used as power relay control
- Lamp driver, typically 1.0 A can also be used to drive an LED
- Independent fault protection with all faults reported via the SPI
- ISO 9141 K-line interface for communicating diagnostic messages
- Start-up/shutdown control and power sequence logic
- Interfaces directly to MCU using a 5.0 V SPI and logic I/O
- Differential/single-ended VRS conditioning circuit

3.3 Indicators

The following 17 LEDs are provided as visual output devices for the evaluation board:

Table 2. KIT33813AEEVBE indicator descriptions

Label	Description
VPWR	indicates when +12 V supply is connected to the evaluation board
VPP	indicates that the VPP pre-regulator is supplying +6.5 V to the two +5 V regulators, VCC and VPROT
VCC	indicates that the MC33813 internal +5 V regulator is running and providing the +5 V VCC voltage supply
VPROT	indicates that the VPROT +5 V regulator is turned ON and is supplying 5.0 V
KEYSW	indicates when the key switch is turned ON supplying +12 V to the KEYSW input
IGNOUT1	indicates that the ignition input, IGNIN1 or SPI bit, is active and the ignition 1 output driver is turned ON
O2HOUT	indicates that the O2HIN input or the SPI bit is active and the O2 heater driver output is turned ON
INJOUT1	indicates that the injector 1 input, INJIN1 or SPI bit, is active and the Injector 1 output is pulled low
ROUT1	indicates that the relay 1 input RIN1, or SPI bit, is active and the relay 1 output is pulled low
ROUT2	indicates that the relay 2 input RIN2, or SPI bit, is active and the relay 2 output is pulled low
LAMPOUT	indicates that the lamp SPI control bit is active and the LAMPOUT pin is pulled low
VRSOUT	indicates that there is activity on the VRSN and VRSP pins and that the VRS circuit has detected a valid VRS signal
TACHOUT	indicates the state of the TACHOUT output signal
MRX	indicates the state of the MRX line as a result of the data on the ISO9141 line
BATSW	indicates the state of the on-board key switch. When the key switch is ON, the BATSW LED is ON.
USB	indicates that the USB SPI dongle is connected properly and is attached to an active USB port on a PC
ISO9141	indicates the state of the ISO9141 line. When this LED is ON, the ISO9141 line is low and when the LED is OFF, the ISO9141 line is high.

3.4 Test points

The board contains 23 test point jumpers that provide access to various signals to and from the board.

Table 3. KIT33813AEEVBE test point descriptions

Test point name	Description
VPWR	12 V (VBAT minus Schottky diode drop)
GND	0 V
VPP	6.5 V
VCC	5.0 V
VPROT	5.0 V
BATSW	0 or 5.0 V depending on the state of KEYSW
KEYSW	0 or 12 V depending on the state of KEYSW
ISO9141	0 or 12 V depending on the state of MTX
MRX	0 or 5 V depending on the state of ISO9141 line
VRSOUT	0 or 5 V depending on the VRSN and VRSP inputs

Test point name	Description
TACHOUT	0 or 5 V depending on VRSOUT or internal SPI bits
LAMPOUT	0 or 12 V depending on the SPI bits
ROUT2	0 or 12 V depending on RIN2 or internal SPI bits
ROUT1	0 or 12 V depending on RIN1 or internal SPI bits
INJOUT1	0 or 12 V depending on INJIN1 or internal SPI bits
COIL1	0 or 12 V depending on IGNIN1 or internal SPI bits
O2HFB	0 or 12 V depending on O2HOUT or internal SPI bits
VRSN	−0.3 to 5 V (clamped internally) from VRS low-side
VRSP	−0.3 to 5 V (clamped internally) from VRS high-side
O2HSENSN	Ground side of O2H driver current sense resistor (.02 ohms)
O2HSENSP	High-side of O2H driver current sense resistor (.02 ohms)
IGNSENSN	Ground side of IGN1/2 driver current sense resistor (.02 ohms)
IGNSENSP	High-side of IGN1/2 driver current sense resistor (.02 ohms)

3.5 Input signal definitions

The following seven input signals control the outputs or functions inside the circuit.

Table 4. Input signal definitions

Input name	Description
O2HIN	controls the O2 heater predriver output
IGNIN1	controls the ignition 1 predriver output
INJIN1	controls the state of the INJOUT1 output
RIN1	controls the state of the ROUT1 output
RIN2	controls the state of the ROUT2 output
MTX	provides the transmit data to the ISO9141 line
RESETB	when the RESETB line is held low, the MC33813 inhibits the internal watchdog reset

The following signals are provided by the seven parallel outputs from the USB/SPI interface.

Table 5. USB/SPI direct control outputs connections

Input name	Description
O2HIN	connected to the DATA4 signal
IGNIN1	connected to the DATA2 signal
INJIN1	connected to the DATA0 signal
RIN1	connected to the CNTL1 signal
RIN2	connected to the CNTL0 signal
MTX	connected to the CNTL2 signal
RESETB	connected to the CNTL3 signal

DATA0-DATA4 and CNTL0-CNTL3 signals are logic level outputs from the USB/SPI Dongle that can be controlled directly from the SPIGen program. An example SPIGEN configuration file called KIT33813SW.spi is provided in the software bundle which contains several batch file examples.

If the user prefers to supply the various MC33813 input signals externally other than from the USB-SPI interface, the dip switch SW2 can be used with the following:

- 1: not used
- 2: RIN1
- 3: RIN2
- 4: O2HIN
- 5: not used
- 6: IGNIN1
- 7: not used
- 8: INJIN1

3.6 USB/SPI dongle connector

The USB/SPI dongle connector is a 16-pin, .1” center, dual-row connector that is designed to interface directly to the USB/SPI Dongle unit (KITUSBSPIDGLEVME). This connector mates with the 16-conductor flat cable that connects to the USB/SPI Dongle. The USB/SPI dongle connector consists of the following 16 pins.

Table 6. USB/SPI dongle pin description

Pin number	Name	Description
1	CNTL2	CNTL2 connected to MTX
2	CSB	SPI signal, chip select bar
3	CNTL1	CNTL1 connected to RIN1
4	SO	SPI signal, serial out
5	CNTL0	CNTL0 connected to RIN2
6	SI	SPI signal, serial in
7	DATA4	DATA4 connected to O2HIN
8	SCLK	SPI signal, serial clock
10	DATA3	n.c.
11	DATA2	DATA2 connected to IGNIN1
12	VDD	+5.0 V VDD from USB
13	DATA1	n.c.
14	+3.3V	+3.3 V from USB (not used on this evaluation board)
15	DATA0	DATA0 connected to INJIN1
16	GND	Signal ground

3.7 Screw terminal connections

The MC33813 board contains ten output and two input screw terminal connections and one 4 pin I/O connector to allow easy access to the MC33813’s circuits.

Figure 3 shows the locations of the screw terminals.

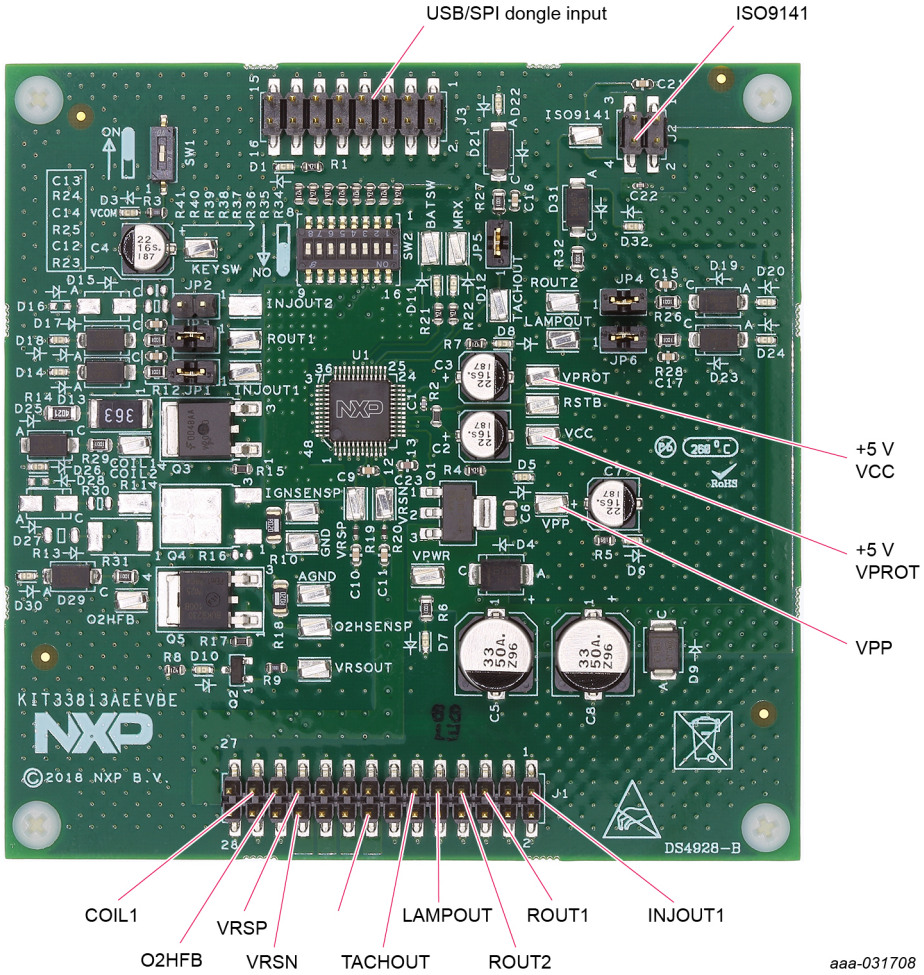


Figure 3. KIT33813AEEVBE screw terminal locations

3.8 Board connectors

Table 7. Main connector

Label	Pin numbers on main connector (J1)
INJOUT1	1
ROUT1	5
ROUT2	7
LAMPOUT	9
TACHOUT	11
VBAT	2, 4, 6, 8, 10, 12, 14, 24, 26, 28
GND	13, 15, 17, 19
VRSP	21
O2HFB	23
COIL1	25
VCC	16
VPROT	18

Label	Pin numbers on main connector (J1)
VPP	20
VRSN	22

Table 8. ISO9141 connector

Label	Pin numbers on ISO9141 connector (J2)
GND	1
VPWR	3
ISO9141	4

3.9 SPI dongle connector (J3)

Table 9. SPI dongle connector

Label	Pin numbers on USB/SPI connector (J3)
MTX	1
CSB	2
RIN1	3
SO	4
RIN2	5
SI	6
O2HIN	7
SCLK	8
IGNIN1	11
+5V	12
INJIN1	15
GND	16

4 Accessory board

The KITUSBSPIDGLEVME evaluation board provides a USB to SPI interface that features the MC68HC908JW32 with Dongle. It is a working hardware/software example that allows a user to become familiar with the MC68HC908JW32 microcontroller by means of an actual useful application, a USB to SPI and USB to parallel converter.

The main function provided by this kit is to allow a PC, that may not have a parallel port, to communicate with other NXP evaluation kits, via a USB port. The USB port is a standard feature on almost every new PC. This kit makes use of the MC68HC908JW32's built-in USB, SPI and parallel ports.

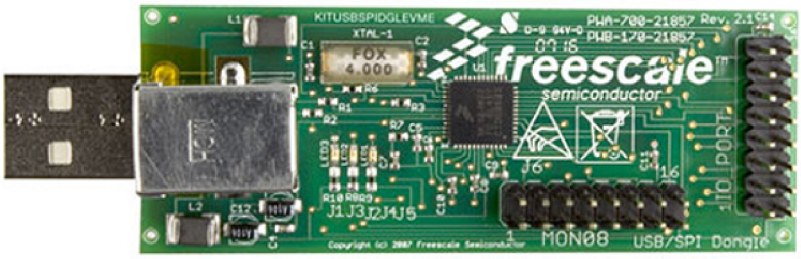


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Figure 4. KITUSBSPIDGLEVME evaluation kit

5 Installing and configuring software and tools

5.1 Installing SPIGen on your computer

The latest version of SPIGen supports the MC33813 and is designed to run on any Windows 10, Windows 8, or Windows 7-based operating system. To install the software, do the following:

1. Go to www.nxp.com/SPIGen and click **Download**.
2. When the SPIGEN: SPI Generator (SPIGen) software page appears, go to the **Lab and Test Software** section and click **Download** associated with the description of the selected environment. A wizard guides the user through the process.
3. If instructed for the SPIGen wizard to create a shortcut, a SPIGen icon appears on the desktop. By default, the SPIGen executable file is installed at **C:\Program Files (x86)\SPIGen**.
   Installing the device drivers overwrites any previous SPIGen installation and replaces it with a current version containing the MC33813 drivers. However, configuration files (.spi) from the previous version remain intact.

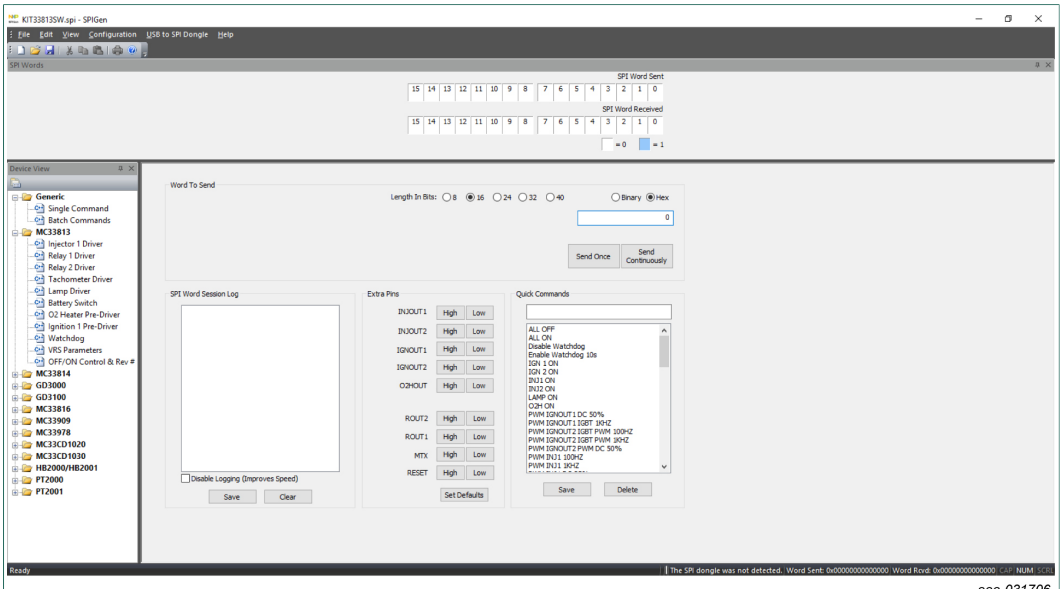

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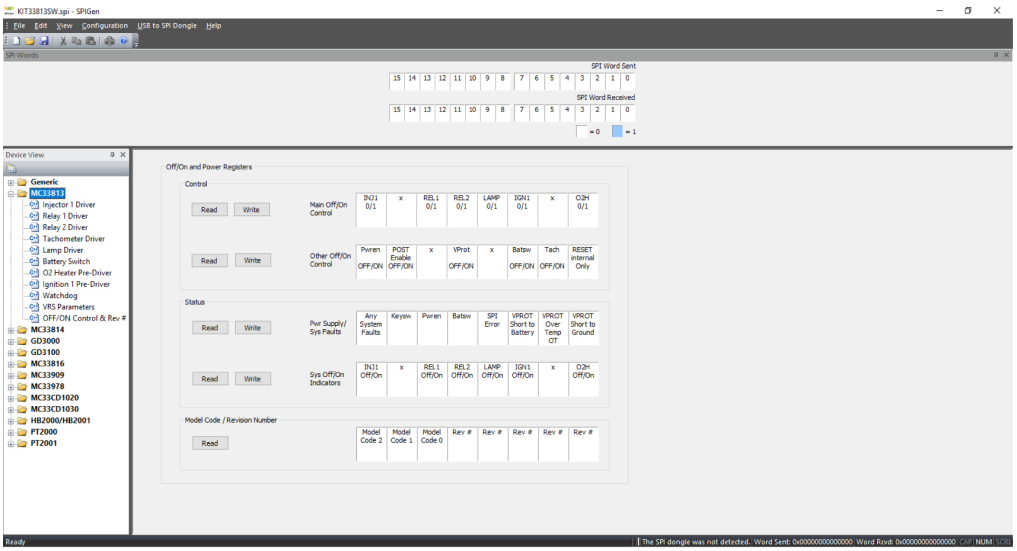
Figure 5. SPIGen GUI

The GUI is shown in Figure 5. The text at the top is the name of the configuration file loaded. The left side panel displays folders that group user interfaces. The interfaces in the pre-installed MC33813 folder pertain specifically to the board under discussion. Loading a specific configuration file, allows you to add a list of **Extra Pins** as well as a list of **Quick Commands**.

5.2 Using SPIGen graphical user interface

1. Launch SPIGen. The MC33813 device appears in the **Device View** panel.



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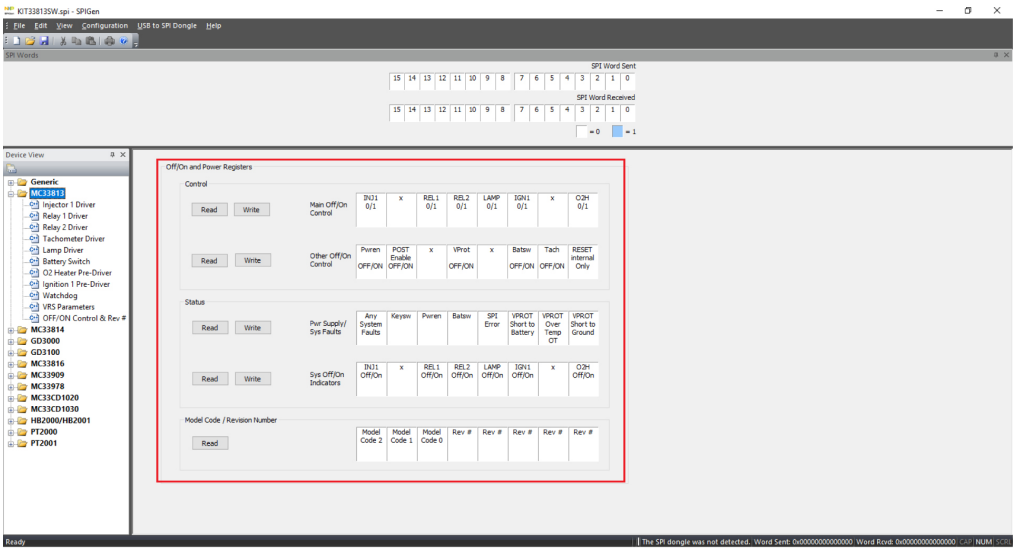
2. The registers can be accessed by choosing one register icon.



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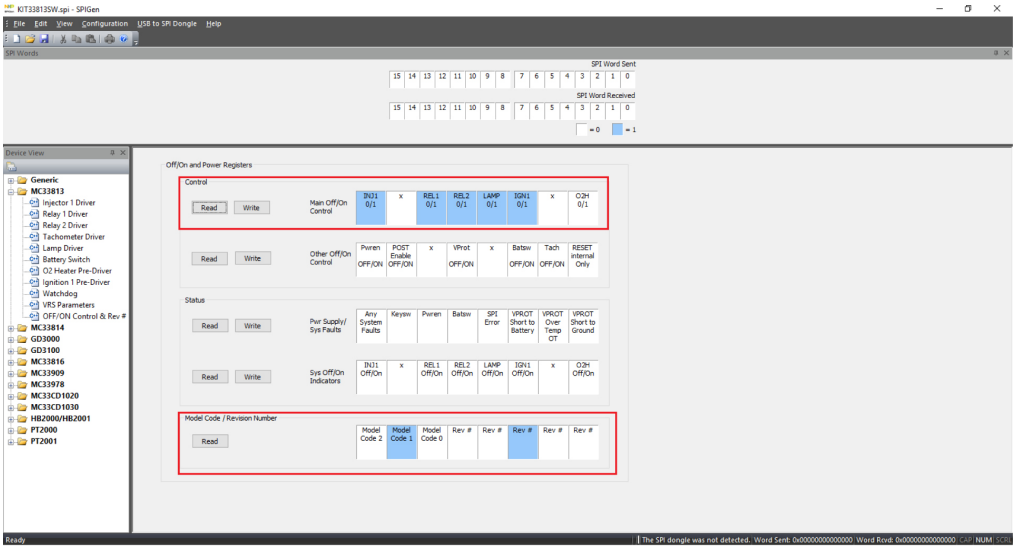
3. Reading the Model Code/Revision Number displays the following values. In the same tab, the LSD, and predrivers can be switched ON and OFF through SPI.



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6 Configuring the hardware

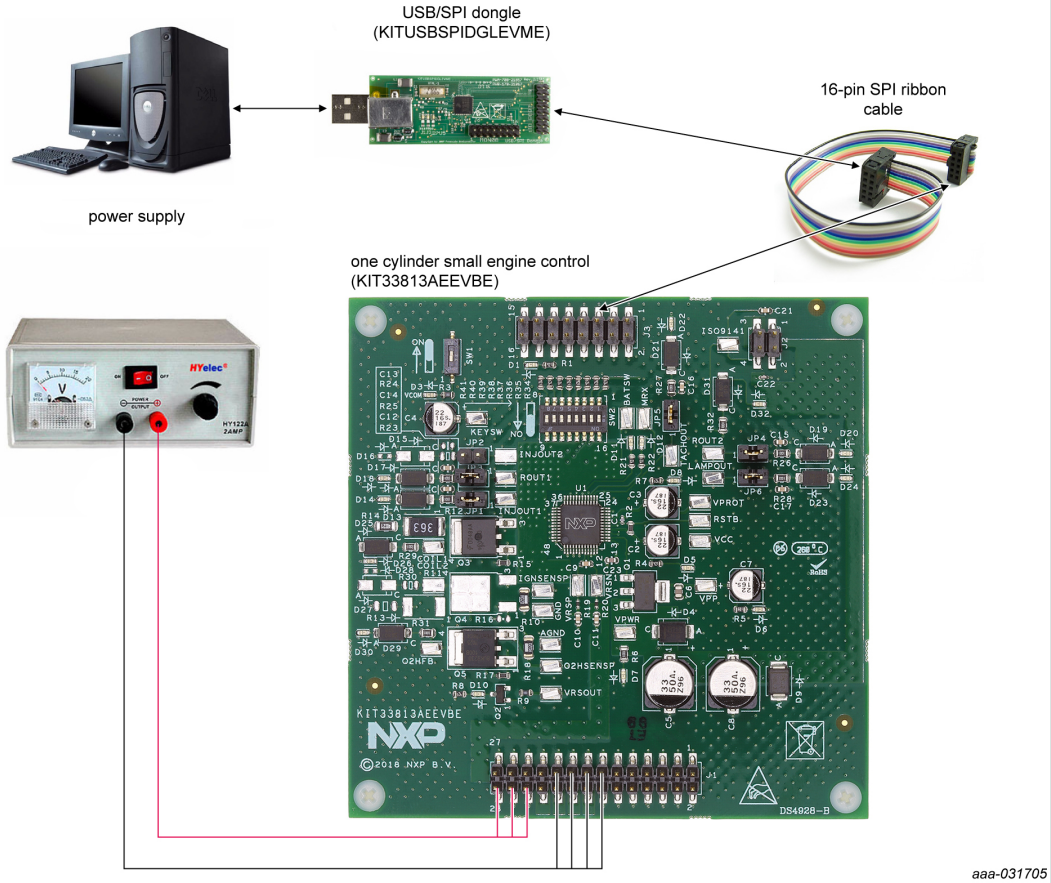

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Figure 6. KIT33813AEEVBE configured for use with KITUSBSPIDGLEVME

To perform the examples included in the software bundle, the following connections and setup must be performed:

1. Make sure the SPIGen (version 7.1.8 or greater) program is installed on the PC and it can communicate with the USB/SPI Dongle.
2. Connect the USB/SPI Dongle to the MC33813 evaluation board via a 16-pin ribbon cable. Make sure to orient the cable so that pin1 on both the USB/SPI Dongle and the MC33813 evaluation board are connected correctly, pin 1 to pin 1.
3. Connect the USB/SPI Dongle to a PC, LED 2 on the USB/SPI Dongle and the USB ON LED on the MC33813 board should both be illuminated.
4. Attach a +12 VDC supply (do not turn on power yet) to the VBAT input connector on the MC33813 evaluation board, making sure to observe the GND and +12 V terminals. The current capability of the +12 V supply should exceed the maximum total current that the number of simultaneously ON loads require.
5. Attach loads to the COIL1, O2HFB, INJOUT1, ROUT1, ROUT2, LAMPOUT, TACHOUT and ISO9141 output terminals as desired.
6. Launch SPIGen and from the **File** menu, select **Open** and browse to the location of the **KIT33813SW.spi** file.
7. Turn on the +12 V supply and set the KEYSW slide switch to the DOWN position. Verify that all is working correctly by observing the VPWR, VPP, VCC and VPROT LEDs which should all be illuminated. Click the **Extra Pins** button in the main SPIGen screen and then click the following buttons:
   a. Click INJIN1 **High**. The INJECTOR 1 load, INJOUT1, and LED should turn ON. Clicking INJIN1 **Low** should turn OFF the load and LED.
   b. Click RIN1 **High**. The RELAY 1 load, ROUT1 and LED should turn ON. Clicking RIN1 **Low** should turn OFF the RELAY 1 load, ROUT1 and LED.
   c. Click RIN2 **High**. The RELAY 2 load, ROUT2, and LED should turn ON. Clicking RIN2 **Low** button should turn OFF the RELAY 2 load, ROUT2 and LED.
   d. Click IGNIN1 **High** button. The COIL1 load and LED should turn ON. Clicking IGNIN1 **Low** should turn OFF the COIL1 load and LED.
   e. Click O2HIN **High** button. The O2 heater, O2HFB load and LED should turn ON. Clicking O2HIN **Low** should turn OFF the O2HFB load and LED.
   f. Click Data 3 **High** button. The LAMP load and LED should turn ON. Clicking DATA 3 **Low** should turn OFF the LAMP load and LED.
   g. Click Data 4 **High**. The ISO9141 load should turn ON. Clicking DATA 3 **Low** should turn OFF the ISO9141 load.

If everything described so far occurs, then you are ready to proceed with the remaining examples.

6.1 Example 1: running the example batch files

1. Click on the **Batch Commands** tab in the SPIGen main screen.
2. In the box below the Commands to Send: column is a pull-down menu containing several batch file names. One of these example batch files is labeled **TOGGLE ALL OUTPUTS**.
3. Click on this label to load it. You should see a list of commands in the **Command to Send** box.
4. Click **Continuous** and observe that the loads and LEDs attached to the MC33813 evaluation board are blinking ON and then going out in succession.

There are other demo batch examples that can be run and examined for learning how to use the evaluation board.

7 References

[1] **KIT33813AEEVBE** — detailed information on this board, including documentation, downloads, and software and tools
http://www.nxp.com/KIT33813AEEVBE

[2] **One cylinder small engine control IC** — product information on One cylinder small engine control IC, MC33813
http://www.nxp.com/MC33813

[3] **SPIGen** — SPI generator software
http://www.nxp.com/SPIGEN

8 Revision history

Revision history

Rev	Date	Description
v.1	20121211	• Initial version
v.2	20130409	• Added Jump Start link for downloading software and/or documents • Updated SPIGen section to match latest template
v.3	20181002	• The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Added Section 3.9 and Section 5.2 • Section 6: updated Figure 6 • Section 3.4 and Section 3.8: updated • Section 3.6: updated Table 6 • Section 3.7: updated Figure 3 • Schematic, board layout, bill of material: replaced by Section 3.1.3

9 Important notice

NXP 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 evaluation board 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 evaluation board 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.

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Date of release: 2 October 2018
Document identifier: KT33813UG