

bq26100 Evaluation Software

The bq26100 provides a method to authenticate battery packs and other peripherals. The bq26100 uses a 128 bit unique device key and a 160 bit SHA-1/HMAC response to provide authentication. The device key is stored securely in each bq26100 device, allowing the host to authenticate each pack or peripheral.

The purpose of the evaluation software (EVSU) is to demonstrate the functionality of the bq26100. This user's guide is intended for the operation of the software and does not necessarily explain in detail the operation of the bq26100. Refer to datasheet for any detailed information regarding operation of the device.

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1 Kit Contents

1. bq26100, HPA170 board
2. PC interface board EV2300
3. CD-ROM including Windows-based PC software and support documentation
4. USB Cable

2 EVM Board Description

2.1 Schematic

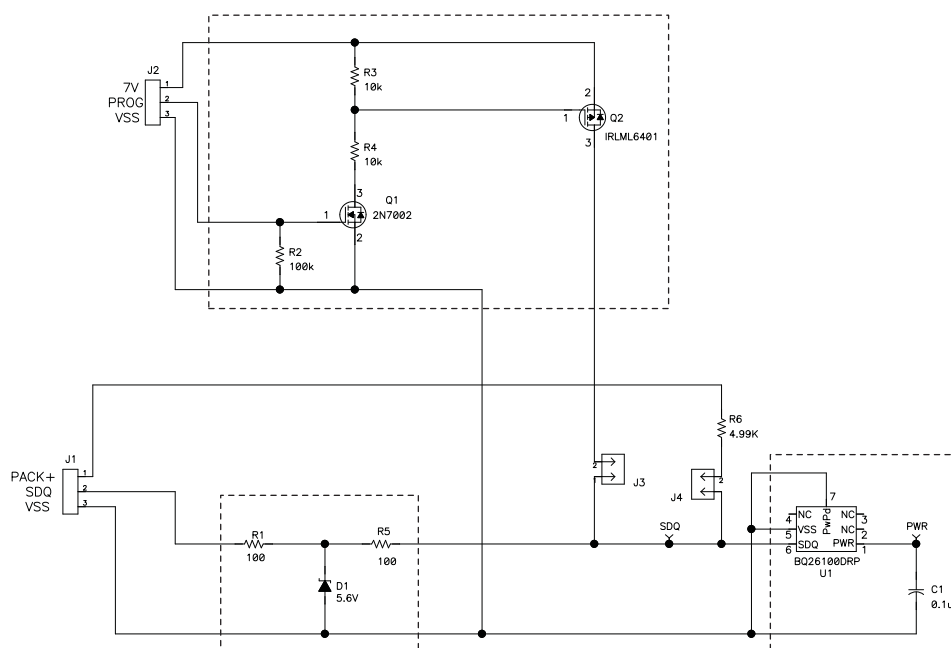


Figure 1. EVM Schematic

2.2 Bill of Materials

Table 1. Bill of Materials

REFDES	QTY	DESCRIPTION	MFR	PART NUMBER
C1	1	Capacitor, Ceramic, 0.1-uF, 16-V, [X7R]	Std	Std
D1	1	Diode, Zener, 5.6-V, 350-mW	Diodes, Inc.	BZX84C5V6
TP1,TP2,TP3,TP4	4	Test Point, Black, 1mm	Keystone	5001
J1,J2	2	Terminal Block, 3-pin, 6-A, 3.5mm	OST	ED1515
J3,J4	2	Header, 2-pin, 100mil spacing, (36-pin strip)	Sullins	PTC36SAAN
Q1	1	MOSFET, N-ch, 60-V, 115-mA, 1.2-Ohms	Vishay-Liteon	2N7002DICT
Q2	1	MOSFET, Pch, -12V,-3.4A, 50 milliohm	IR	IRLML6401
R1, R5	2	Resistor, Chip, 100-Ohms, 1/16-W, 1%	Std	Std
R6	1	Resistor, Chip, 4.99k-Ohms, 1/16-W, 1%	Std	Std
R2	1	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	Std	Std
R3,R4	2	Resistor, Chip, 10k-Ohms, 1/16-W, 1%	Std	Std
N/A	2	Shunt, 100mil, Black	3M	929950-00
U1	1	IC, Authentication IC using SHA-1/HMAC, SDQ communication	TI	BQ26100DRP

2.3 Layout

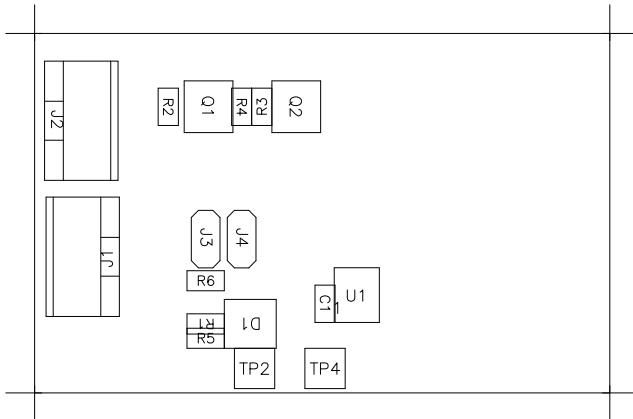


Figure 2. PC Board Assembly

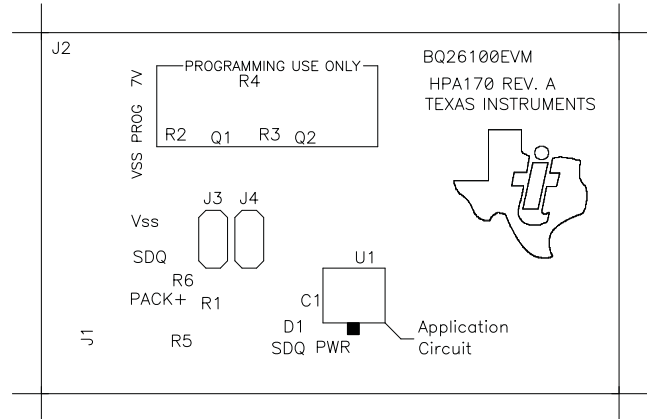


Figure 3. PC Board Silkscreen

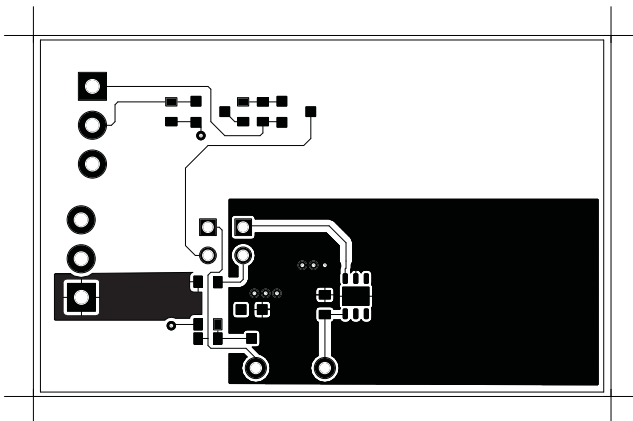


Figure 4. PC Board Top Layer

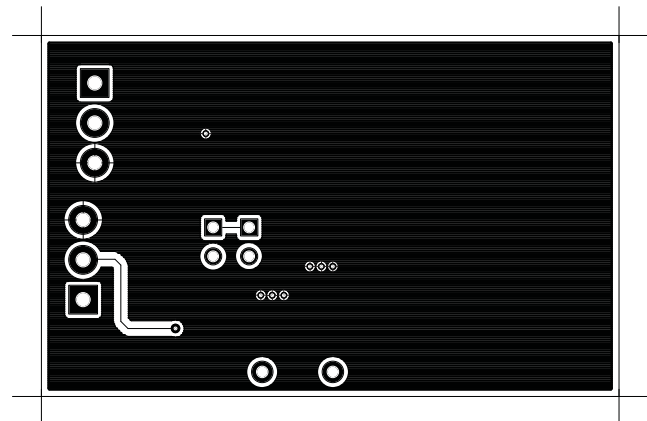


Figure 5. PC Board Bottom Layer

3 EVM Hardware and Software Setup

3.1 Software Installation

This section describes how to install the bq26100EVM PC software and how to connect the different components of the EVM.

The following steps install the bq26100 evaluation software:

1. Insert CD ROM into a CD ROM drive.
2. Select the CD ROM drive using **My Computer** or **File Manager**.
3. Select the ReadMeFirst.txt file.
4. Follow the instructions to install USB drivers for EV2300.
5. After installing the USB drivers for EV2300, double-click on the Setup.exe icon that is under the bq26100 Evaluation Software folder.
6. Follow the instructions on screen during the installation of evaluation software
7. The setup program installs a windows application group

3.2 Hardware Connection

There are three hardware components to the bq26100EVM:

- The bq26100EVM circuit module, (HPA170)
- The PC interface board, (EV2300)
- And the PC.

The following steps configure the hardware for interface to the PC:

1. Connect colored wires that are included with EV2300 to bq26100EVM using [Table 2](#) as a guide. Ensure that if a red wire is included on the connector that the wire is shielded or cut off given that when connected to EV2300 this wire gives access to a 3.3V regulated output.
2. Connect the connector with colored wires to the HDQ connector that is on EV2300. HDQ connection is located on the top right of EV2300.
3. Connect the PC USB cable to the EV2300 and the PC USB port.

Table 2. Wire Connection

bq26100 EVM	Wire Color
SDQ	Brown
VSS	Black
PROG	White

To program the OTP of bq26100 a 7V pulse must be generated on the SDQ line. The HPA170 board has an additional circuit included that permits generating this pulse when using a Power Supply set to 7V and the VOUT output of the EV2300. The evaluation software controls this pulse for OTP programming.

When programming of OTP is expected the 7V supply must be connected to the HPA170 board at the 7V input of the board. Ensure that the ground of the power supply is connected to VSS of the board. When programming the key (see section 4.5 Key PGM) an additional power supply at about 3.3V with a 100 Ω resistor in series with a diode must be connected to the PWR pin of the bq26100 ([Figure 6](#)). The test point (PWR) gives access to the PWR pin. When programming the 5 pages of OTP memory and the STATUS bytes the additional 3.3V power supply is not needed.

There are two jumpers that can be connected. If programming OTP then J3 must be connected. When not using an EV2300 to evaluate the bq26100 and a pull-up resistor is required then J4 must be connected and a pull-up voltage must be provided on the PACK+ terminal.

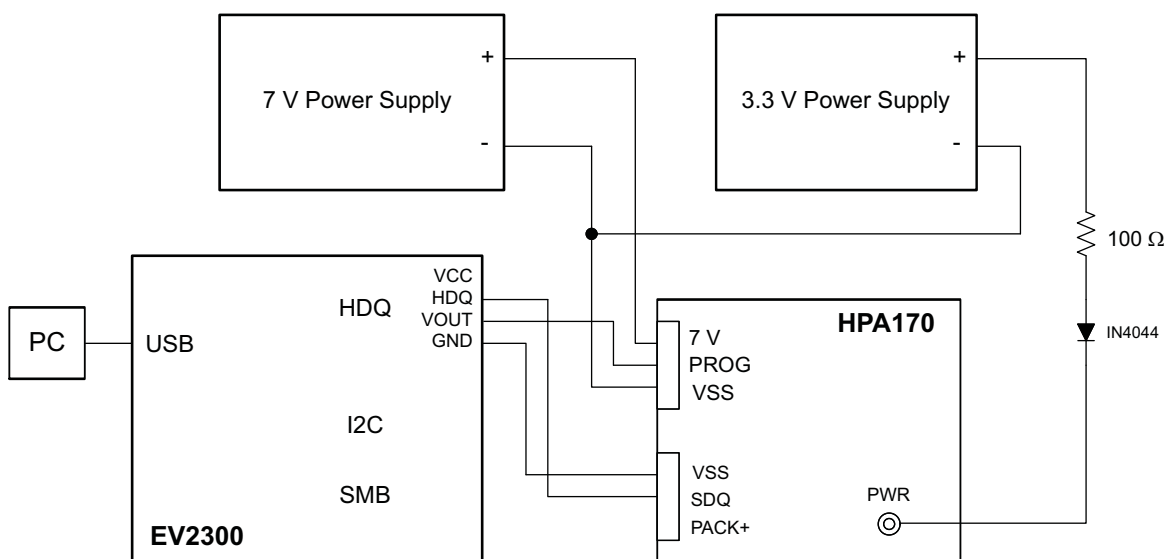


Figure 6. Full Connection Set Up

3.2.1 Normal Operation

Normal operation includes reading registers from bq26100, writing to RAM and EEPROM registers. If using the EV2300 to communicate with the bq26100 do not connect J4. This jumper is for using a pull-up resistor on the SDQ line. The EV2300 already provides a 10kΩ pull-up resistor that allows SDQ communication.

3.2.2 OTP Programming

To program OTP registers it is required to send a 7V pulse across the SDQ line after reading the corresponding CRC value. See data sheet for specific description of OTP programming requirements. When programming OTP registers is expected, the following must be ensured:

- J3 jumper is connected
- VOUT output of EV2300 is connected to PROG input of HPA170 board.
- Power supply set to 7V is connected across the 7V and VSS inputs of HPA170 board.

4 Software Operation

Run the program from the **Start|Programs|Texas Instruments|bq26100 Evaluation Software** menu sequence. If the EV2300 is not connected to a USB port, the program will display a USB error message and then display the ROM Commands page.

Evaluation Software Pages

This section describes the function of each page of the EVSW

4.1 ROM CMD

Within this page all the ID ROM commands can be tested for the bq26100 ([Figure 7](#)).

Sections within the ROM CMD page

Application – This section is to select how many bq26100 devices are on the SDQ bus. If only one device is used then select *Single Device*. This option causes that SKIP ROM command is sent before any communication attempt with the device. If more than one device is used then select *Multiple Devices*. This option causes that MATCH ROM command is sent before any communication attempt with the desired device.

Search ROM – This section demonstrates the SEARCH ROM command. When there are multiple devices on the SDQ bus the ROM ID of the devices that share the bus will be listed.

Match ROM – This section is only available when the *Multiple Devices* option is selected at the Application section. To use the MATCH ROM enter in the text box the ROM ID of the device of interest and then click on *Select Device* button. This will cause that MATCH ROM commands with the desired ROM ID will be sent whenever communication is attempted with the desired device. If SEARCH ROM was used, the desired ID can be copied from the SEARCH ROM list and then pasted into the MATCH ROM text box. Ensure that only the ID numbers are pasted into the text box and not the whole line referring to the device.

Read ROM – This section is only available when the *Single Device* option is selected at the Application section. The ID ROM of the device on the SDQ communication line will be displayed.

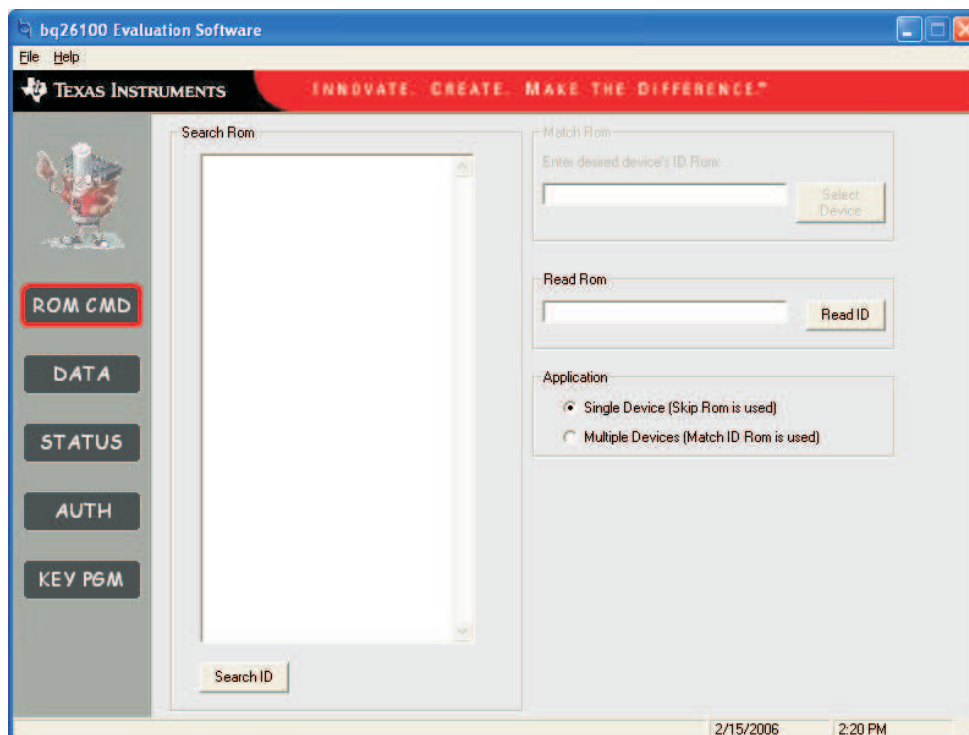


Figure 7. ROM CMD Page

4.2 DATA

4.2.1 OTP

This page (Figure 8) allows the user to program the OTP with desired values. It requires that the hardware is setup as described in section 3.2 of this user's guide for OTP programming.

The OTP memory map is organized in 5 pages of 32 bytes each. All registers can be read by clicking on the *Read OTP* button. As the registers of a specific page are being read, the page number will be highlighted in red.

Once the data is displayed on the grid after reading the OTP, the data can be compared with a data file to verify that the data contained in OTP is as expected. Click on the *Compare w/File* command button so that the data file against which the data will be compared is selected from a directory. The data file must be of extension type .otp. An example of a data file is included with the EVSW. It will be found under the directory C:\Program Files\EV26100. As the data is being compared an address location at a time, there will be a message indicating if data is not the same for a specific address. Also if there is a mismatch of data then the user will be asked if he or she desires to continue comparing the data with file or if to cancel. As long as one address contains data that is not equal to the data file a fail message will be displayed at end of data comparison.

There are two methods of programming the OTP using the EVSW. One is by clicking on a specific grid that corresponds to the register that needs to be written. Write the hex value of the data that needs to be written and then hit ENTER.

The other method of programming the OTP is by importing a data file that contains all the values to be programmed. The data file is of file extension .otp. The data file format follows along with the data file used for *Compare w/File* command. To create additional data files, modify the example file so that the values on the right side represent the desired values and save the file with a different name ensuring that the extension .otp is used. To import a file into the grid, go to File | Open OTP File and select the appropriate file. Once the file is opened the grid will be filled in with the values contained in the data file. Click on *Write OTP* button so that the values get programmed into the OTP.

A data file also can be saved by going to File | Save OTP File. The data that will be saved in the file is whatever is displayed on the grids representing the OTP memory map.

4.2.2 EEPROM

The DATA page also allows the user to program the 16-byte EEPROM with desired values. It is not required to use an external high voltage programming pulse to write the EEPROM.

The EEPROM memory map is organized in one row of 16 bytes. All registers can be read by clicking on the *Read EEPROM* button. The EEPROM also has a data compare with file feature similar to the OTP's. The data file for EEPROM must be of extension .eep. The EVSW includes an example of the file. It may be found under the directory C:\Program Files\EV26100.

There are two methods of programming the EEPROM using the EVSW. One is by clicking on a specific grid that corresponds to the register that needs to be written. Write the hex value of the data that needs to be written and then hit ENTER.

The other method of programming the EEPROM is by importing a data file that contains all the values to be programmed. The data file is of the same type as the one used for EEPROM compare with file feature. To create additional data files, modify the example file so that the values on the right side of the file represent the desired values and save the file with a different name ensuring that the extension .eep is used. To import a file into the grid, go to File | Open EEPROM File and select the appropriate file. Once the file is opened the grid will be filled in with the values contained in the data file. Click on *Write EEPROM* button so that the values get programmed into the EEPROM.

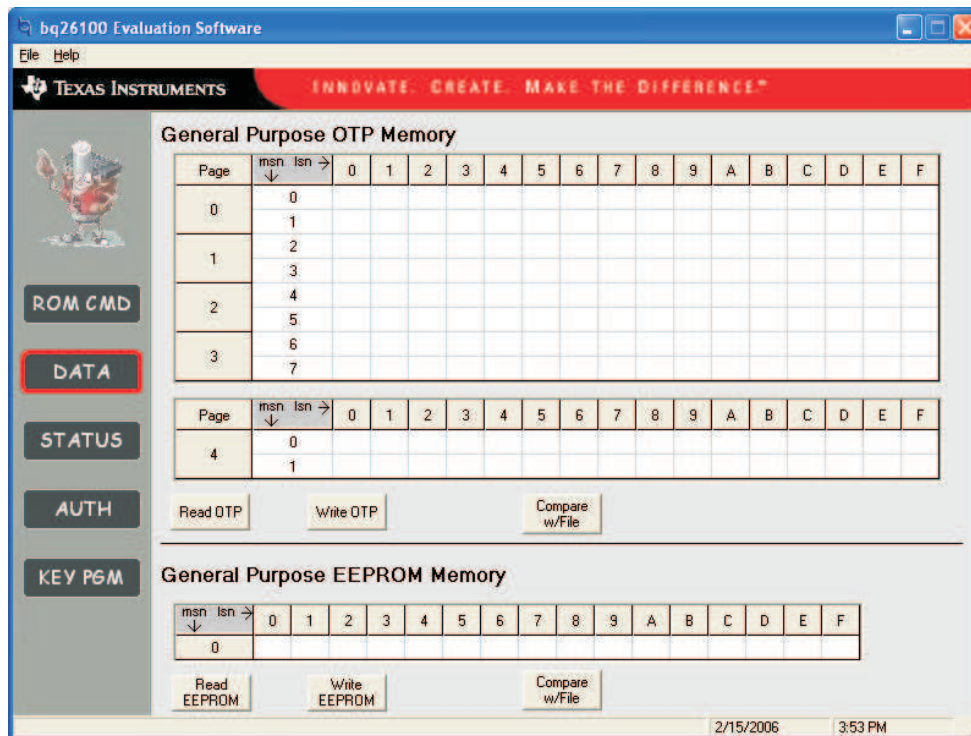


Figure 8. DATA Page

4.3 STATUS

This page (Figure 9) allows the user to read or write the OTP Status bytes of bq26100. The registers can be programmed by clicking on the appropriate grid; entering the desired value and pressing ENTER.

There are buttons that are provided so that the user can select specific pages for write protection. By selecting any of the Write Protection Bits button, register 0x00 of Status registers is written automatically so that the corresponding bit is set.

Note that the Status registers are OTP. Once a bit has been set it can not be cleared.

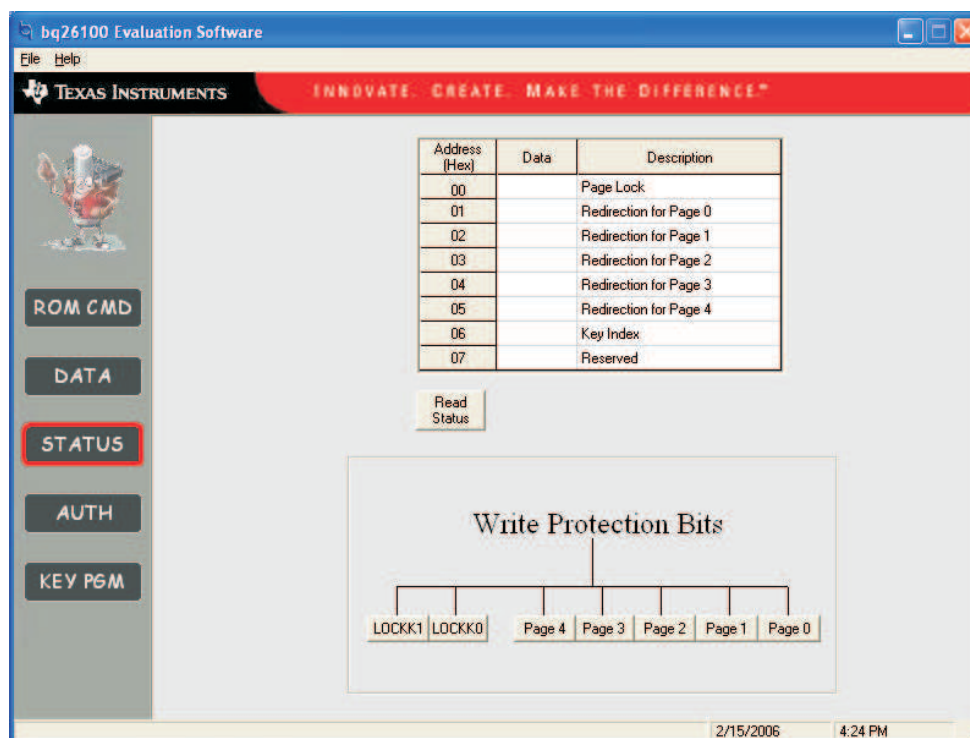


Figure 9. STATUS Page

4.4 AUTH

All the authentication process occurs at the AUTH page (Figure 10). The user must know the 128 bit Authentication Key that is stored in the bq26100. See section 4.5 for further information. Once the Authentication Key is entered (in HEX format), proceed by generating a random Message and send it to bq26100 by activating the appropriate command buttons. After sending the message to bq26100 hit the AUTH button that automatically executes a write into the CONTROL register and sets the AUTH bit. This will initiate the SHA-1/HMAC calculation by the IC and also by the evaluation software based on the 160-bit Message and the 128-bit Key. Once the authentication is done the result obtained by the bq26100 (DIGEST Register) and the evaluation software will be displayed. A message in the bottom will indicate if the authentication is successful or not.

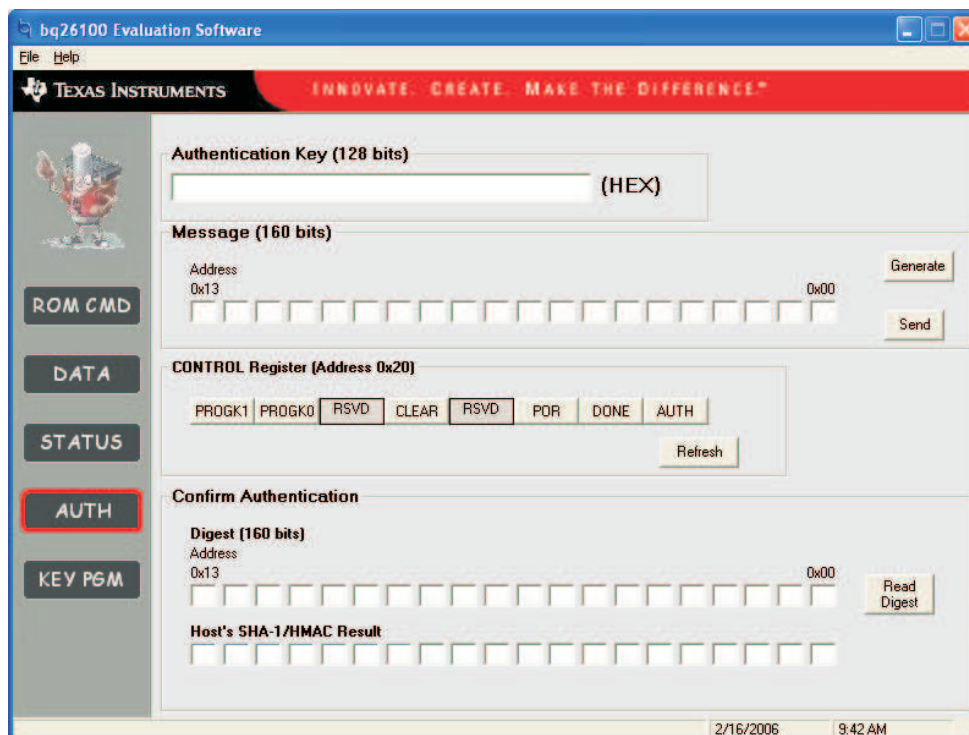


Figure 10. AUTH Page

Make variations to the steps described above to prove that only a correct combination of Authentication Key and Message are needed so that authentication is successful.

4.5 KEY PGM

This page (Figure 11 and Figure 12) allows the user to program the 128-bit Authentication Key into the bq26100. To program the key it must be ensured that it is setup as described in section 3.2 given that OTP memory is written into during the process.

To generate and program the key, two 64-bit messages are sent to the bq26100. For specifics on how to program the key for a bq26100 refer to the *Key Programming Description* section on the bq26100 datasheet.

A key can be generated with the EVSW either by providing specific messages or by generating random messages

If using random messages (Figure 11) then select *Random* on the Message Generation section of the KEY PGM page. The software provides the capability of programming the whole 128-bit key or just programming exclusively either the higher or lower 64 bits of the key. In the *Key to program* section make a check on the sections of the key that programming is required. To program the key, click on the *Generate Key* command button. The key generation and programming process ends by displaying the key that was programmed into private OTP memory of the bq26100 in the bottom text field.

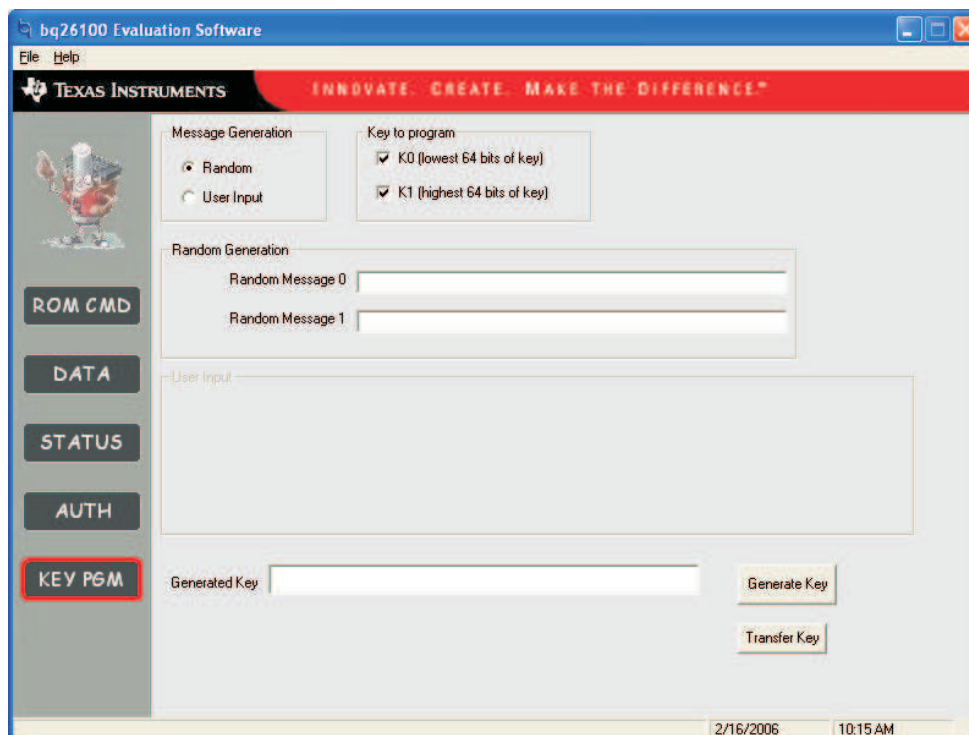


Figure 11. KEY PGM With Random Message Generation

If using a specific message (Figure 12) then select *User Input* on the Message Generation section of the KEY PGM page. Select the portions of the key (lower 64 bits, higher 64 bits or both) to be programmed. Input hex byte values corresponding to each appropriate message needed for the key generation. The most significant byte is always to the left. After the message(s) is/are input then the *Generate Key* button is clicked to initiate the key generation and programming process. The key programmed to the bq26100 will be displayed on the *Generated Key* text field.

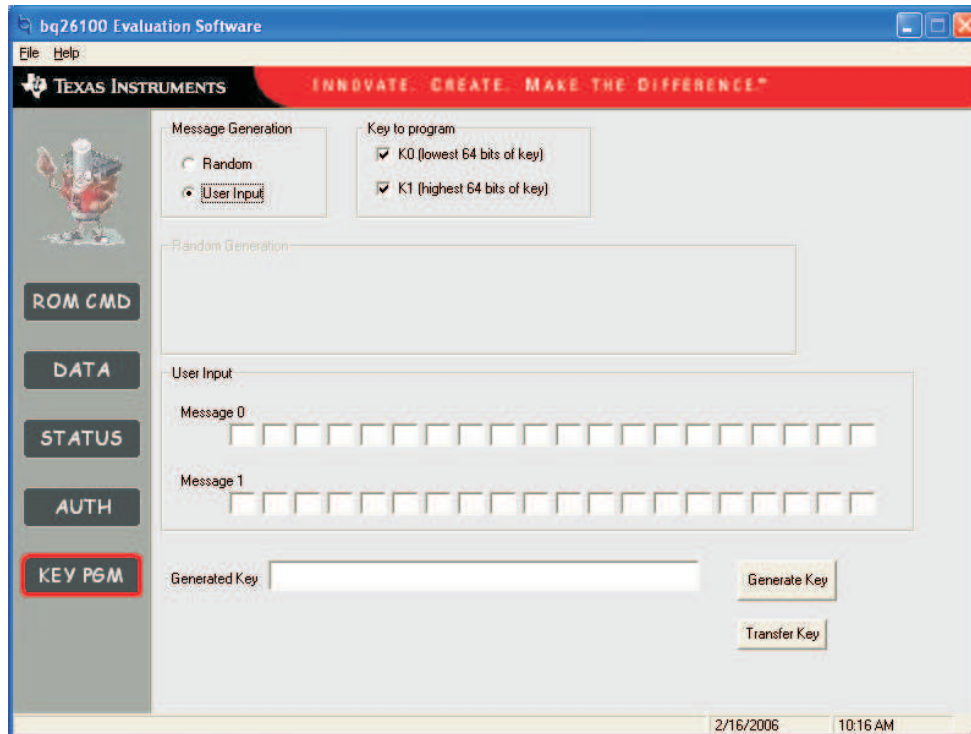


Figure 12. KEY PGM Page with User Input

Once a key is programmed into device, regardless if using the random message or user input methods, there's not a direct way to retrieve the data. Ensure that you record the Key that is generated. By hitting the *TransferKey* command button a copy of the Key is placed automatically on the Authentication Key text box that's in the AUTH page of the evaluation software to facilitate the use for authentication. Be aware though that if the evaluation software is terminated that the key will not be stored. It is imperative that the key is recorded once generated.

For every half of the key that is programmed using the EVSW, the EVSW will perform a lock key on the device. For example if the lower 64 bits of the key are programmed then the LOCKK0 bit from the STATUS bytes is set. During normal operation this is not performed automatically by the bq26100. The EVSW is written to do so to avoid reprogramming the key with unknown data.

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