bq27x00 Single-Cell Battery Fuel Gauge Module Tester and Programmer

The Texas Instruments bq27x00 Tester Kit tests and programs bq27000 and bq27200 single-cell Li-ion and Li-polymer battery gas gauge devices. The kit includes a bq27x00 Test and Program PC interface board for gas gauge testing, one RS-232 cable, a CD ROM including Windows™-based PC software, and support documentation.

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1 Introduction

The Texas Instruments bq27x00 Tester Kit tests and programs bq27000 and bq27200 single-cell Li-ion and Li-polymer battery gas gauge devices. The kit includes a bq27x00 Test and Program PC interface board for gas gauge testing, one RS-232 cable, a CD ROM including Windows™-based PC software, and support documentation. This kit tests the electronic modules prior to pack installation.

1.1 Features

- Complete test and program system for the bq27000 and bq27200 battery gas gauge
- PC software and interface board for production test
- Software allows EEPROM programming and production data logging.

1.2 Kit Contents

1. HPA048 PC interface test board (bq27x00 Test and Program) for RS-232
2. CD ROM including Windows-based PC software and support documentation
3. RS-232 cable

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1.3 Ordering Information

Kit Part Number	PC Interface Board	Chemistry	Pack Voltage
bq27x00 Tester-Kit	RS-232	Li-ion	2.6 V to 4.5 V

2 Installation and Setup

2.1 Minimum System Requirements

- Operating system: Windows 98, 2000, or XP
- Video: Super VGA– 1024 × 768 minimum resolution
- RAM: 16M bytes
- Hard drive space: 5M bytes
- RS-232 port: 1 available

2.2 Final Test Board Specifications

- +9 V to +12 V DC minimum 1 A
- Analog inputs: ±6 V
- Digital inputs: 0 V to + 5 V

Note: Values greater than these limits entered into the final test system connections to the hardware may cause permanent damage to the final test board.

2.3 Interface Connections

The bq27x00 Test and Program system requires the host PC to be connected to the final test board using RS-232. The power supply is connected to the connector on the side of the final test board, as shown in Figure 1. The test head (test fixture) can be constructed following the interface connection table in section 2.3.1 using a schematic and assembly drawing for the module to be tested. It is recommended that test head cables not exceed 12 inches in length. Spring-loaded test pins are recommended for module testing. Connection of test head to module requires precision contacts to ensure good electrical contact.

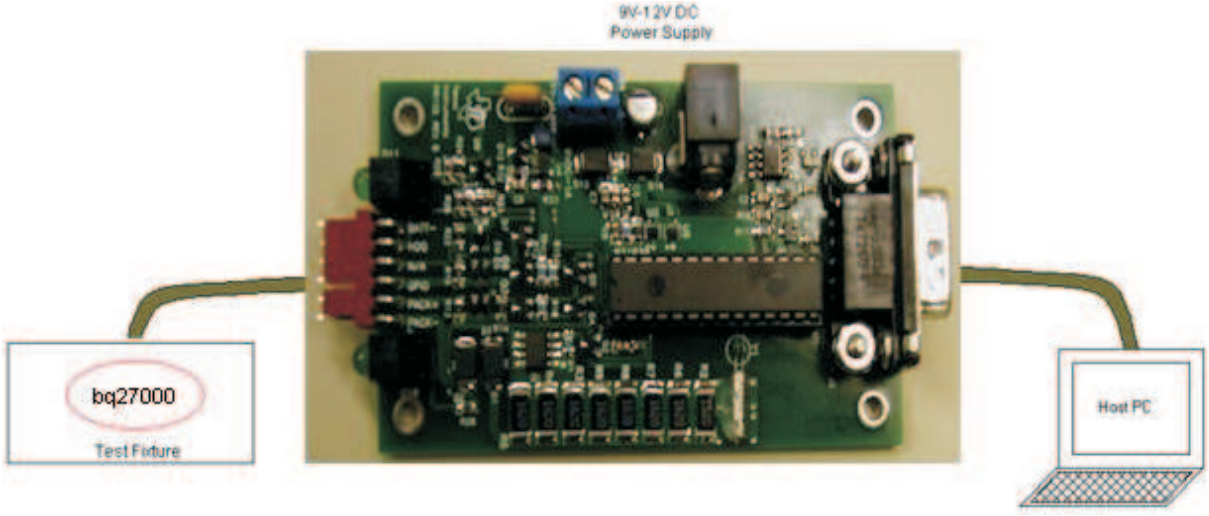

Figure 1. bq27x00 Test and Program Board

2.3.1 Test Head Fixture Interface

The test head interface for the bq27x00 Test and Program board requires a Molex female 6-pin connector #22-01-3067 with crimp terminals (tin) #08-50-0114. Table 1 contains data pertaining to the test points. If testing bq27000 modules, then the wire used for the SCL communication pin is not connected.

Table 1. Test Points

MOLEX CONNECTOR PIN	DESCRIPTION	bq27000		bq27200	
		COLOR CODE	WIRE GAUGE INSULATED (12 INCHES)	COLOR CODE	WIRE GAUGE INSULATED (12 INCHES)
1	BATT–	Black	22 AWG	Black	22 AWG
2	HDQ/SDA	Brown	22 AWG	Brown	22 AWG
3	SCL	N/A	N/A	Blue	22 AWG
4	PROG	White	22 AWG	White	22 AWG
5	PACK+	Red	22 AWG	Red	22 AWG
6	PACK–	Black	22 AWG	Black	22 AWG

2.3.2 Computer to Test System Interface

Connect the bq27x00 Test and Program board to the computer communication port using the RS-232 cable.

2.4 System Power Up

After all connections are made, the final test board is powered with a power supply that provides +9 V to +12 V DC (minimum 1 A) into the jack located on the side of the test board. Visually verify the green LED labeled D11 is ON. Power can also be applied using an external power supply between +9 V to +12 V DC (minimum 1 A).

3 Software Contents and Installation

3.1 Software Contents

The bq27x00 Tester Kit contains all software on a CD ROM as follows:

1. Documentation
   a. bq27x00 User's Guide (SLUU227A)
   b. bq27000, bq27200 Data Sheet (SLUS556)
   c. HPA048 Schematic
   d. HPA048 Top Assembly
   e. HPA048 Bill of Materials
   f. PIC Program V402 hex
2. Install Executable Program
   a. CAB Files
   b. *setup.exe*
   c. *bq27x00.gg* Default EEPROM File
3. Visual Basic Source Code
4. *ReadMeFirst.txt* File

3.2 Software Installation

Use the following steps to install the bq27x00 Test and Program software:

1. Insert the 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. Follow the instructions in file.
4. The setup program installs a Windows application group.

4 Operation

The bq27x00 Test and Program board verifies assembly functions for the RBI pin, Sense Resistor, and Battery pin, while also programming EEPROM data.

Perform module tests before pack tests so that complete calibration and functional testing is accomplished prior to pack assembly. The bq27x00 test board is for module test only. Do not attempt to use for pack test.

4.1 Starting the Program

Run the program from the **Start|Programs|Texas Instruments|bq27x00 Tester** menu sequence. If the bq27x00 Test and Program board is connected to the RS-232 port, the program loads and displays the initial Test Menu Screen shown in Figure 2. The Options menu may be used to select the communication port and to select the product (bq27000 or bq27200) to be tested. The product type to be tested will be displayed on the Test Menu screen.

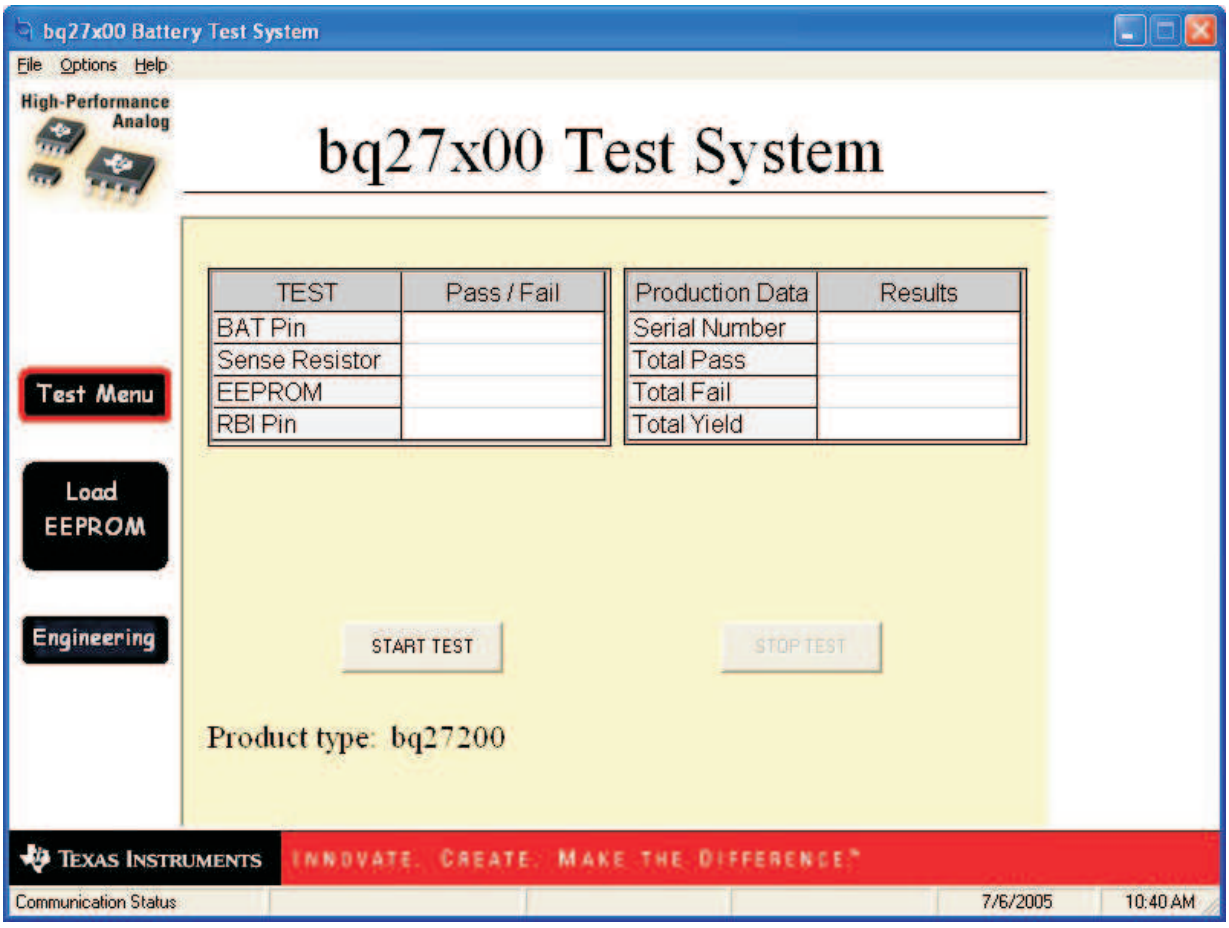

Figure 2. Test Menu Screen

4.2 Initialization

This section describes the settings that must be made before testing with bq27x00.

4.2.1 Load EEPROM

Click on the Load EEPROM selection. The Load EEPROM screen appears as shown in Figure 3. From the menu bar, select File → Open Gas Gauge EEPROM Constants. Find the directory where the desired configuration file is located, and select the file. Once you have selected the configuration file, click on Test Menu, and skip to section 4.4 to begin testing. The Native_example.gg and Engineering_example.gg files are provided as examples of what format must the EEPROM files follow.

Note: Do not attempt to change the configuration data while in the Load EEPROM menu selection. See section 4.3.2 to modify and save configuration files.

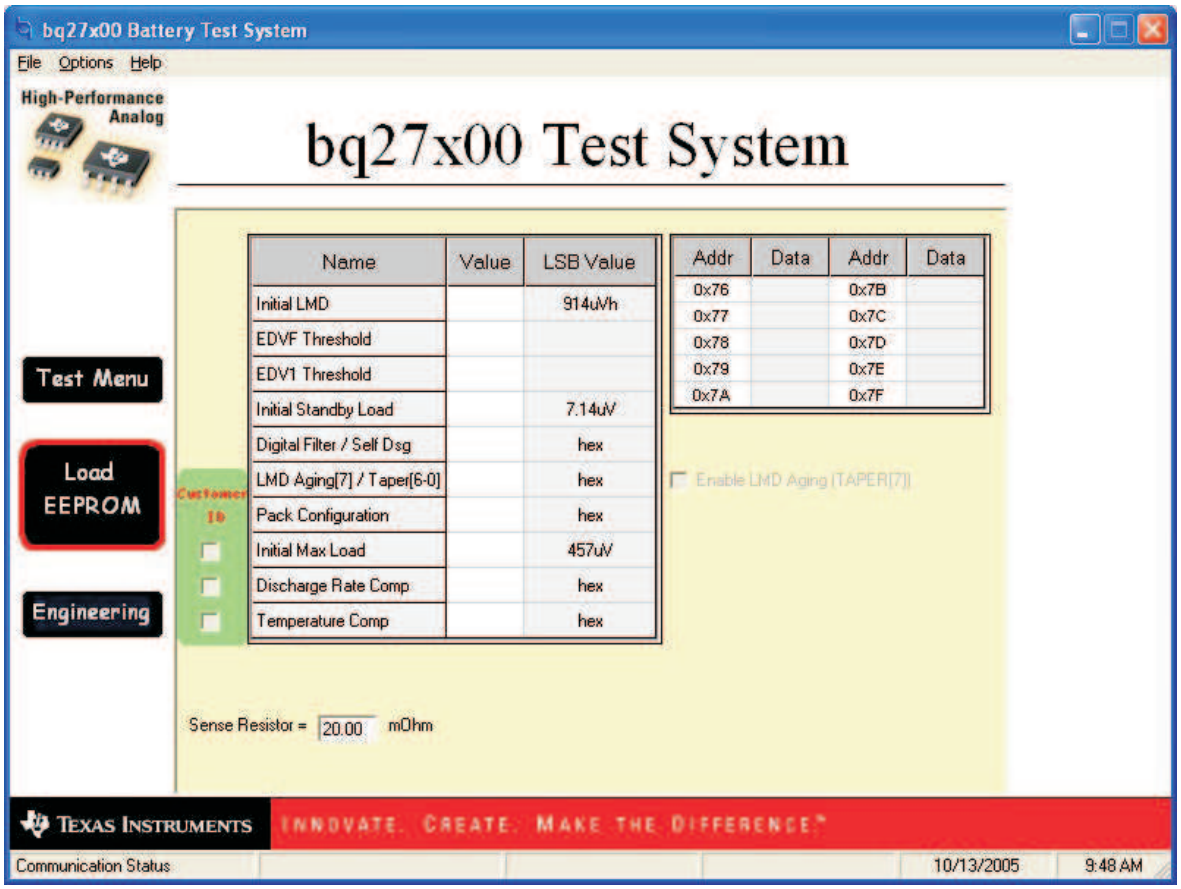

Figure 3. Load EEPROM Screen

4.3 Engineering

The Engineering section is a password-protected menu providing the opportunity to change the configuration file or enable/disable specific tests. This menu is for engineering debugging in a production test environment.

4.3.1 Password

Selecting the Engineering option brings up a password entry selection. Enter *bmrq* in the password field; the User ID field is left blank. It is recommended that the password be changed once the system is ready for production test. Use the menu bar, and select Options to change the password.

If the password is modified and the new password is not known, the bq27x00.exe must be reloaded where the password is now the default.

4.3.2 Test Selection Options

The Engineering screen is now present as shown in Figure 4. In this section, use the menu bar to select File → Open Gas Gauge EEPROM Constants. Find the directory where the *bq27x00.gg* file is located, and select the file. Configuration data can be modified and saved to a file but only in the Engineering menu selection. Using the mouse, click on the data to modify, and after updating the field, press the Enter key. Select Save Gas Gauge EEPROM Constants from the File menu, and enter a file name to save the new configuration file. Once the configuration file has been selected or saved, click on Test Menu, and go to section 4.4 to begin testing modules.

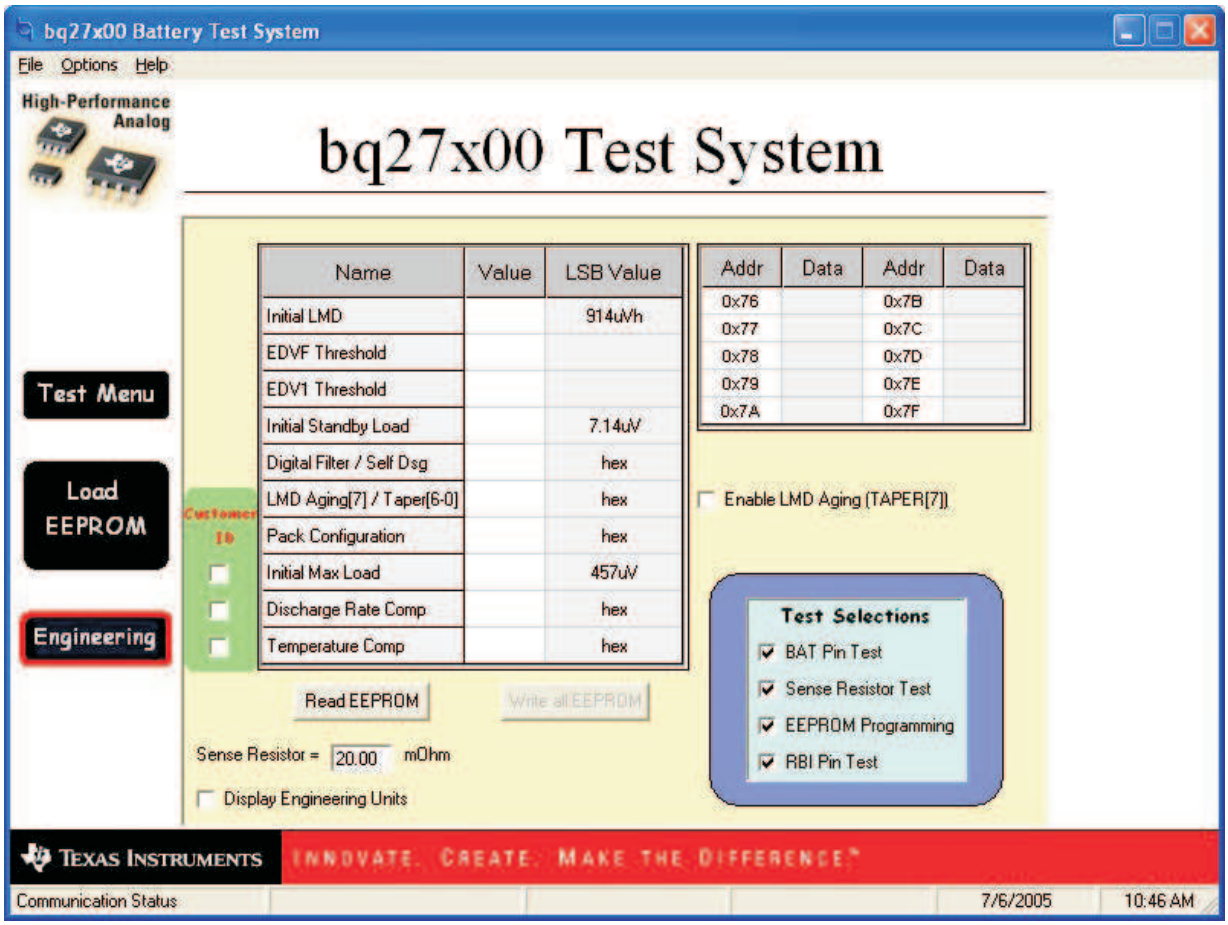

Figure 4. Engineering Screen

4.4 Production Test

At this time, power to the bq27x00 Test and Program board is on, and testing can begin. Figure 5 displays an example of the status and results when testing a passing module.

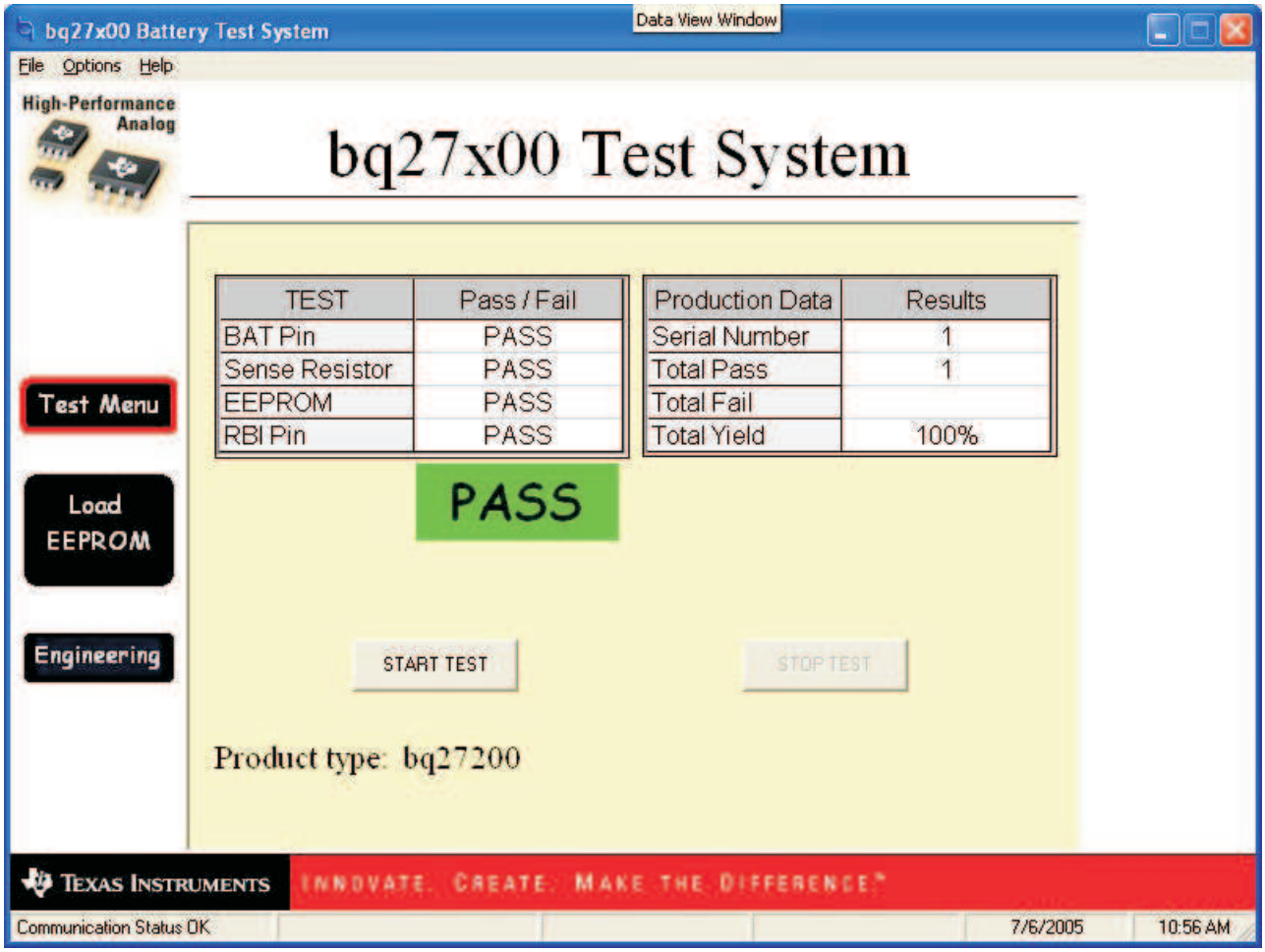

Figure 5. Test Menu Results Screen

4.4.1 Start and Stop Functions

The Start icon on the Test Menu screen is used to begin testing the module. The test results appear on the screen after each test selected with either a PASS or FAIL indication. The Stop icon immediately stops the test, and the Results section will not be updated.

4.4.2 Display Definitions

Completed status of the module under test is indicated with a green PASS or red FAIL condition.

Results: Displays and keeps running totals of modules tested.

1. Serial Number: Displays the last serial number tested.
2. Total Pass: Displays the total number of good modules.
3. Total Fail: Displays the total number of rejected modules.
4. Total Yield: Displays the total good divided by the total tested on a percentage basis.

4.5 Pass/Fail Status

4.5.1 Data Logging

Data is logged on the computer monitor and can also be placed in a lot summary data file. After all testing has been completed, the results can be stored in a .SUMMARY file. From the Menu bar, select → File Log Test Summary. A prompt asks for a file name; at this time, select a directory where the test summary data log file will be placed. The lot summary data log file is recommended during production test to keep information stored on a by-lot basis.

Note: The program does not log the data into a .SUMMARY file until all testing is complete.

4.5.2 Example Data Log .SUMMARY File

```
Texas Instruments bq27x00 Gas Gauge Production Test Summary
bq27x00 Version 1.0.0
9/24/2003 4:14:02 PM

[Production Test Summary]

Serial Number from 1 to 4

Total Pass=3
Total Fail=1
Total Tested=4
Yield=75%

[Module Pass/Fail Summary]

Pass = 3
Fail BAT Pin=0
Fail Sense Resistor=1
Fail EE Verification=0
Fail RBI Pin=0
```

5 Test Descriptions for bq27x00

5.1 Theory of Operation for bq27x00

This section contains a brief description of the bq27x00 Module Test procedures. Power supply voltage to Pack + (V_{CC}) equals 3.8 V ±20 mV.

5.1.1 BAT Pin Test

Verify the VOLTH and VOLTL registers contain the reported battery voltage measured on the BAT pin. It is important to wait for the device to complete a full conversion, approximately 2.56 seconds, before taking a measurement. The program is set up to read back 3.8 V ± 300 mV from the specified registers.

5.1.2 Sense Resistor Test

Verify that the sense resistor is functioning properly with the following procedure:

1. Read Discharge Counts Register (DCR) from address registers 0x30 and 0x31, record the values, and store in DCR counts *Original*.
2. Source current on Pack – to generate DCR counts.
3. Read DCR from address registers 0x30 and 0x31, record the values, and store in DCR counts *Final*.

4. Compare absolute DCR counts *Final* minus DCR counts *Original*, and check for a specified range of valid DCR counts for the sense resistor value used.

5.1.3 EEPROM Programming

1. Enable the programming mode by writing data 0xDD to the EE_EN register (addr 0x6E).
2. Latch data by performing a Write, then Read operation from the .gg configuration file.
3. Apply 21 V to PGM pin to program latched EEPROM data into the gas gauge.
4. Read verify from EEPROM registers for values equal to the .gg configuration file.
5. Disable the programming mode by writing data 0x00 to the EE_EN register (addr 0x6E).

5.1.4 RBI Pin Test

Verify that the RBI pin provides backup power to the internal registers when V_{CC} drops below the power-on-reset (POR) voltage. The test procedure is as follows:

1. Write data 0xA5 to At Rate register 0x02.
2. Write data 0x5A to At Rate register 0x03.
3. Enable WRTNAC bit in Mode register 0x01.
4. Write 0xA9 to Device Control register 0x00, which clears the POR bit.
5. Read Control Register 0x00 until the register has cleared.
6. Generate POR condition by turning Pack+ OFF for 200 ms.
7. Turn Pack+ ON, and read Mode register 0x01 to verify the POR bit has been set.
8. Read and store the values from NAC registers 0x0C and 0x0D.
9. Verify NAC register values retained the data written in the foregoing steps 1 and 2.

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