BENCHMARQ

EV2014x

Gas Gauge and Fast Charge Evaluation Board

Introduction

The EV2014x evaluation system provides a development and evaluation environment for the bq2014 Gas Gauge IC and the bq2004 Fast Charge IC. The EV2014x incorporates a bq2014, a bq2004, and all the external components required to accurately monitor the capacity and reliably fast charge 4 to 10 NiCd or NiMH cells. The evaluation system includes a PC/AT interface to allow the monitoring of battery parameters. The board features:

- Jumper configuration for number of series cells and battery chemistry
- Complete fast charge control
- Battery capacity monitoring - LED display of available charge

Functional Description

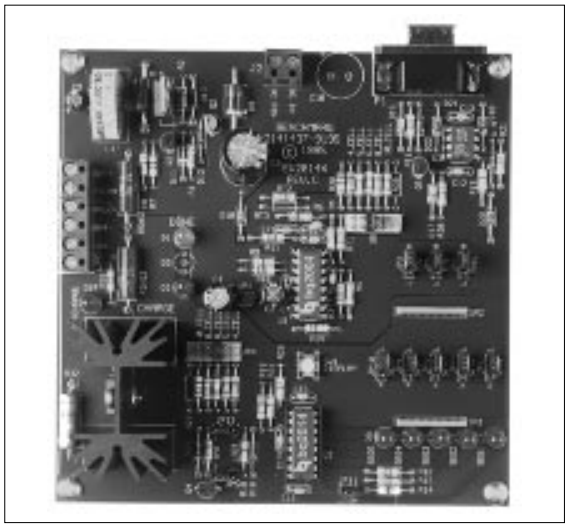
The EV2014x provides two main functions: fast charge control and battery capacity monitoring. The actual implementation of a bq2004/bq2014 design will be significantly smaller in size. See the bq2004 and the bq2014 data sheets for device functional descriptions.

Battery fast charge is terminated by any of the following: $\Delta T/\Delta t$ (the change in temperature versus time), $-\Delta V$ (negative voltage change) or PVD (peak voltage detect), maximum temperature, maximum time, and maximum voltage. The board provides a direct connection for an NTC thermistor for temperature charge terminations and safety qualifications. It also includes an RS232 interface for easy access to the battery state of charge information via the serial port of the bq2014. The menu driven gas gauge software provided displays charge/discharge activity and allows user interface to the bq2014 from any standard DOS PC.

The user supplies the power supply and the batteries. Onboard LEDs indicate charging status and remaining capacity. The capacity LEDs are activated by the push button switch.

Power Source

An onboard voltage regulator supplies the bq2004 fast charge chip with power from the DC charge input. The bq2014 derives its V_{CC} from the battery connected to the BAT+ (J1) and BAT- (J2) terminal blocks. The bias resistor (R17) for the bq2014 voltage regulator is 300K. For less than 6 cells, this value should be 100K. Refer to Table 4 in the application note entitled "Using the bq2010-A Tutorial for Gas Gauging" for a more detailed description of the bq2014 voltage regulator.



Current Path

The bq2014 uses a sense resistor (R16) on the negative terminal of the battery to measure charge and discharge activity. This resistor may be changed if necessary. The system load is connected between the BAT+ (J1) and PACK-(J2) terminal blocks (see the schematic in Appendix C).

During charge, the bq2004 buck mode regulator also uses a sense resistor to regulate the charge current. The board is shipped with a value of 0.100ohm which corresponds to a charge current of 2.25A. This resistor can be changed depending on the application.

Parameter Programming

The EV2014x is programmed with jumpers JP1-JP3 and JP6-JP10. The programming pins determine:

- Charge timeout limits
- Fast charge termination mode
- Programmed full count
- Scale factor
- Self-discharge rate

Dec. 1996

EV2014x Contents

Each package contains the following items:

1 EV2014x PC Board

This includes the bq2014 sample, current regulators, programming jumpers, battery divider resistors, and the PC serial port interface.

1 EV2014x DQ/RS-232 Cable

1 EV2014x (v2.0) User Interface Program Diskette

This program runs on *any AT-compatible computer* equipped with a standard RS-232 (COM1, COM2, COM3, or COM4) serial port, and provides the user with a complete menu-driven system to control, monitor, and log data from the EV2014xx Evaluation Board. The User Interface Program communicates with the bq2014 over the DQ serial I/O port using the RS-232 interface.

Please check to make sure that all items are present and in good condition. If you have any problems, please contact your Benchmarq representative or call Benchmarq.

EV2014x Connections

The connections for the EV2014x are described below. Please refer to the attached schematic in conjunction with these descriptions.

JP16	**TM1**	Fast charge timer setting 1
JP2	**VSEL**	Voltage termination select
JP3	**TM2**	Fast charge timer setting 2
JP4, JP12	**NOC**	Selects number of cells
JP5, JP13	**LBAT**	Gas gauge power supply
JP6-P10	**PROG#**	Gas gauge programming
JP11	**LCOM**	LED enable

EV2014x Fixed Configuration

The EV2014x board has the following fixed characteristics:

V_{CC} (4.75–5.25V) for the bq2004 is regulated onboard from the supply at connector J2 DC.

LEDs 1 and 2 indicate charge status.

LED3 can replace LED1 and LED2 and provide an optional tri-color LED feature.

LEDs D4 through D8 indicate battery capacity in 20% increments.

Charge initiates on the later application of the battery or DC, which provides V_{CC} to the bq2004.

As shipped from Benchmarq, the EV2014x buck-type switch-mode regulator is configured to a charging current of 2.25A. This current level is controlled by the value of sense resistor R_{SNS} by the relationship:

$$I_{CHG} = \frac{0.225V}{R_{SNS}}$$

The value of R_{SNS} at shipment is 0.100Ω. This resistor can be changed depending on the application.

The suggested maximum I_{CHG} for the EV2014x board is 3A. The maximum cell voltage (MCV) setting is 1.8V.

The EV2014x gas gauge uses a 0.100Ω sense resistor to measure charge and discharge current.

Zener diode D11 is used to limit Q4 V_{GS} per a given DC voltage. The board is shipped with D5 shorted. The user can modify this Zener diode for the application. Refer to Table 1 for suggested D5 values for DC voltages.

With the provided NTC thermistor connected between THERM and SNS, values are: LTF = 10°C, HTF = 45°C, and TCO = 50°C. The ΔT/Δt settings at 30°C (TΔt) are: minimum = 0.82°C/minute, typical = 1.10°C/minute.

The thermistor is identified by the serial number suffix as follows:

Table1. Lookup Table for D11 Selection

+VDC Input (Volts)	Motorola Part No.	Nominal Zener Voltage
Below 15	Shorted	0
15–18	1N749	4.3
18–21	1N755	7.5
21–24	1N758	10
24–27	1N964A	13
27–30	1N966A	16
30–32	1N967A	18
32–35	1N968A	20

Jumper-Selectable Configuration

The EV2014x must be configured as described below.

TM1 and TM2 (JP3): Select fast charge safety time/hold-off (see bq2004 data sheet, page 7).

Number of Cells (JP4, JP12): Two resistor-divider networks are provided to select 4 to 10 cells.

Identifier	Thermistor
K1	Keystone RL0703-5744-103-S1
(blank)	Philips 2322-640-63103
F1	Fenwal Type 16, 197-103LA6-A01
O1	Ozhumi 150-108-00(4)
S1	Semetic 103AT-2

Temperature Disable: Connecting a 10KΩ resistor between THERM and SNS disables temperature control.

VSEL (JP2): Selects -ΔV or peak-voltage detection, or disables voltage-based termination (see bq2004 data sheet, page 7).

Jumper Setting	Pin State
[1 2] 3	High
1 [2 3]	Low
1 2 3	Float

bq2014 V_{CC} Supply (JP5, JP13). These jumpers are used to enable the onboard voltage regulator to the bq2014 from the battery pack. If the battery pack consists of 3 or 4 series cells the gas gauge can be powered directly from the battery with no regulation. For a greater number of cells, the regulator should be enabled.

Closed Jumper on JP4, JP12	Number of Cells
RB25, R13	User-selectable
RB24, R26	10
RB23, R25	8
RB22, R24	6
RB21, R23	5
RB20, R22	4

Programming Pins (JP6–JP10). These jumpers are used to configure the gas gauge for battery capacity and self discharge rate. See the bq2014 data sheet for proper configuration. The board is shipped with all pins in the high impedance state.

LED Enable (JP11). JP11 enables the gas gauge LEDs. The board is shipped with the LEDs enabled.

Jumper Setting JP5, JP13	Regulator
1 [2 3], [1 2] 3	Enabled
[1 2] 3, 1 [2 3]	Disabled

EV2014x Setup

1. Configure VSEL, TM1, TM2, and NOC jumpers.

Jumper Setting	Pin State
[1 2] 3	High
1 [2 3]	Low
1 2 3	Float

2. Program the bq2014 with jumpers JP6–JP10.

Jumper Setting	LEDs
1 2	Disabled
[1 2]	Enabled

3. Enable/disable the voltage regulator with JP5, JP13.
4. Connect the provided thermistor between THERM and PACK-. A 10K resistor across THERM and PACK- disables temperature termination.
5. Connect the RS232 cable from the EV2014x board to the serial port of a standard PC. Please ensure that no memory resident programs use this port..
6. Connect the load across BAT+ and PACK-. A sense resistor RSNS2 is in series with the negative terminal of the battery. The EV2014x board is supplied with a 0.100ohm, 1% 3W resistor. Please ensure that the discharge load does not exceed the Vsr specification for the bq2014. RSNS2 may be changed to a different resistor value..
7. Connect the battery to BAT+ and BAT-. Important: Connect the battery ONLY after setting JP6–JP10 and JP5, JP13.
8. Attach the power supply to the DCIN and DC RTN connections in J2.

Installing the User Interface Program

The User Interface Program (named “EV2014x”) runs on any PC-compatible computer. The program may be run from the disk provided, or it may be installed on any directory on the computer's hard disk. To run the program from the hard disk, simply copy all the files from the disk supplied to the hard disk. All the files should reside in the same directory.

The User Interface Program installs a driver to control the DQ/RS-232 interface. This driver asks which COM port is connected to the EV2014x Evaluation board. If communication is not established with the EV2014x board, the Main Menu does not appear. Please refer to

Recommended DC Operating Conditions

Symbol	Description	Minimum	Typical	Maximum	Unit	Notes
I_{DC}	Maximum input current	-	-	2.4	A	
V_{DC}	Maximum input voltage	2.0 + V_{BAT} or 15		18 + V_{BAT} or 35	V	Note 1
V_{BAT}	BAT input voltage	-	-	24	V	
V_{THERM}	THERM input voltage	0	-	5	V	
I_{LOAD}	Load current	-	-	3	A	

Note: 1. The VDC+ limits consider the appropriate Zener diode at D11. The voltage at D11 is application-specific and limits the VGS of Q1 to a safe enhancement value during Q1 conduction. See Table 1 for recommended D11 selections per VDC+.

Appendix B (Troubleshooting) if the program does not establish communication with the EV2014x.

The EV2014x uses the PC-AT real-time clock to provide the proper bit timing for serial communication with the bq2014. The modem control lines are used as the single-wire serial interface to the bq2014. Any TSR that uses the PC real-time clock affects the operation of the EV2014x. For proper operation, the EV2014x should not be operated from a DOS shell program.

If the PC is a notebook or portable type, it may be configured to save battery power by adjusting the clocks according to the activity under way. Configure the notebook to run in “High Performance” mode for reliable communication between the EV2014x and the PC. The EV2014x UIP terminates if communication with the EV2014x board is lost.

Start the User Interface Program as follows:

C>EV2014x

Using the EV2014x Program

EV2014x is a menu-driven program. Almost all of the functions and entries are made by positioning the highlighted cursor on the function desired and pressing the ENTER key, or by typing a value and then pressing the ENTER key.

Key functions are as follows:

ARROW keys — Use the arrow keys to move the highlighted cursor around the screen.

ENTER key — Press the ENTER key to select the value currently being displayed for a parameter, or to perform a function selected by the highlighted cursor.

ESCAPE key — Press the ESCAPE key to escape from any function back to the main menu, or to escape from any parameter value screen back to the menu displaying that parameter.

F3 key — Press the F3 key to display a help file for the selected function or parameter.

Main Menu

The Main Menu appears after the EV2014x program has started. If this menu does not appear, communication with the EV2014x has not been established; please refer to Appendix B (Troubleshooting) if the EV2014x does not display the Main Menu.

The Main Menu shows six functions that may be activated; see Figure 1. Use the cursor keys (arrow keys) to position the highlighted cursor over the function to be activated and press the ENTER key. For help, press the F3 key, and a help note about the function appears. Press the ESCAPE key to exit from the EV2014x program.

The Main Menu functions are as follows:

<Initialize> — Sends a reset command to the bq2014

<Monitor> — Activates a screen from which the bq2014 activity is monitored on a real-time basis.

<Digital Filter> — Activates a screen from which the Digital Magnitude Filter can be changed. The default filter value is -0.3mV, +0.38mV. The bq2014 data sheet (Dec. 1994 B or later) defines valid options for this filter.

<Data Log> — Allows entering a file name to which bq2014 data will be logged, and the logging period in seconds. When the log is

	activated, the display changes to the Monitor screen with a top display of:
	Logging Record: xx
<Display Program Menu>	Activates a screen showing the current program settings for the bq2014.
<Measure V_{OS}>	This allows the user to determine the apparent offset voltage of the bq2014 under test. A minimum of 6 minutes are required to complete the V_{OS} measurement, which has a resolution of ±0.15mV per 6 minutes.

Monitor Screen

This screen monitors real-time changes of the bq2014; see Figure 2. The program continually updates the monitor screen. As conditions change, the new values are displayed.

Time	Time of day in HH:MM:DD, 24-hour notation.
Empty/Full	This indicates the current value for GG in the TMPGG register of the bq2014. The capacity value is given in $\frac{1}{16}$th steps.
Date	Current date in MM/DD/YY notation.
NAC	NAC register values multiplied by the scale value and divided by the sense resistor value to give mAh.
LMD	Last Measured Discharge expressed in terms of mAH. This is the 8-bit LMD register value multiplied by the scale value times 256 and divided by the sense resistor to give mAh.
Sense Resistor Value	This is the sense resistor value from the Programming menu.
Average V_{SR} Current	This is the average battery current.
Time Remaining	During discharge only, this is the time remaining at the average current (NAC / Avg. V_{SR} current)
Digital Filter Setting	This is the value of the digital magnitude filter.
Temp Step	This is a display of the active temperature step, which ranges from 0 (for temperatures <-30°C) to 12 for temperatures > 80°C).
Activity	This indicates the charging/discharging activity occurring with the battery. CHARGE is displayed if the battery is charging, while DISCHARGING is displayed if the battery is being discharged, or if it is idle (no charging taking place). OVERLOAD is displayed if the voltage drop across the sense resistor exceeds the V_{SR1} threshold. Please note that the appearance of CHARGE or DISCHARGE indicators is rate-dependent, and may take some time after the application of a charging current or a discharge load depending on the PFC and scale selected, and the rate of charge or discharge being applied.

```
Benchmarq bq2014 Evaluation Board Main Menu (v2.3)

        <Initialize>                <Monitor>

        <Digital Filter>            <Data Log>

        <Display Program>           <Measure Vos>


Please enter the SR, # of cells in Display Program for Proper Operation

---------------------------------------------------------------------------

                ESC to exit program     F3 for Help
```

Figure 1. Main Menu

VSR Step	This is the value of the V_{SR} current step as defined in the bq2014 data sheet.
GG Step	This is the lower four bits of the TMPGG register that correspond to the current NAC value relative to either the LMD or the original programmed full count (as determined by $PROG_{1-4}$). The GG step is reported as a step number from 0 to 15, with step 0 representing available capacity from 0 to $1/16$ of full, and 15 representing available capacity from $15/16$ full to full.
Charge Rate	Indicates whether the present charge is TRICKLE or FAST depending on the state of the charge rate (CR) bit in FLGS2.
First EDV	This is the state of the EDV1 flag as programmed in the Display Program Menu. The default is 1.05V. The EDV1 flag latches ON if V_{SB} drops below the EDV1 threshold value. It remains latched until charging is detected, at which time it is cleared.
Cell voltage	This is the cell voltage at the SB pin of the bq2014.
Battery voltage	This multiplies the cell voltage by the number of cells programmed in the Display Program Menu. The default is one cell.
Battery Removed	This is the state of the battery removed flag. It is set (BRM = yes) if one of the conditions indicating battery removed occurs. This flag is reset when the battery is replaced.
Valid Discharge	This is the state of the VDQ bit in FLGS1. VDQ = yes if the bq2014 is charged until NAC = LMD. VDQ = no indicates the present discharge is not valid for LMD update.

```
        Benchmarq bq2014 Evaluation Board Real-Time Monitor Screen

             Time: 99:99:99       EMPTY ****_____FULL      Date: 99-99-9999

             NAC: 99999 mAH       LMD:  99999 mAH   Sense Resistor Value: XXXmΩ

             Avg Vsr Current: ±9999mA              Time remaining: 9999 min.

             Digital Filter Setting:  -0.XXmV=Vsrd  +0.XXmV=Vsrq    Temp Step:  XX

             Activity: XXXXX        Vsr Current Step:  XX        GG Step: XX

             Charge Rate: XXXX      First EDV:  XXX              Batt. Rem'vd: XXX

             Valid Discharge: XXX   Final EDV:  XXX              Batt. Repl'd: XXX

             Cell Voltage: XXX V    Batt. Voltage: XXX V

             Capacity Inaccurate: XXX   Capacity Inaccurate Count: XXX

          FLGS1: X X X X X _ X X              FLGS2: X X X X _ _ _ X
                 C B B C V N E E                     C D D D N N N O
                 H R R I D / D D                     R R R R / / / V
                 G P M   Q U V V                       2 1 0 U U U L
                 S           1 F                                   D

            ESC to main menu       F1 to modify NAC       F2 to modify LMD
```

Figure 2. Real-Time Monitor Screen

Final EDV	This is the state of the EDVF flag as programmed in the Display Program Menu. The value of EDVF is 0.1V lower than EDV1. The EDVF flag latches ON if V_{SB} drops below the EDVF threshold value. It remains latched until charging is detected, at which time it is cleared.
Battery Replaced	This is the state of the battery replaced flag. It is set (BRP = yes) if the battery valid condition returns after setting the battery removed flag. The battery replaced flag is cleared if the battery is discharged to the EDV1 level or if it is charged to NAC = LMD. This flag is set after a EV2014x initialization.
Capacity Inaccurate	This is the state of the capacity inaccurate bit in FLGS1. It is set (CI = yes) to indicate that the battery capacity has not been updated during the last 64 charge cycles.
Capacity Inaccurate Count	This is the number of charge cycles between an LMD update. This counter is reset to zero when NAC = LMD after a valid LMD update.
FLGS1	This indicates the present state of the FLGS1 resistor.
FLGS2	This indicates the present state of the FLGS2 resistor.

Digital Magnitude Filter Menu

This menu sets the digital magnitude filter in the bq2014; see Figure 3. Any value from 1 to 255 is valid. Suggested values are displayed on the menu.

Modifying NAC and LMD

It is possible to change the values of the NAC and LMD parameters from the screen using the F1 and F2 function keys as follows.

Changing NAC (F1)

1) Press the F1 key. The NAC field is highlighted.
2) Enter the value in mAH and press the ENTER key to store the value.

Note: Changing NAC disqualifies a subsequent LMD update.

Changing LMD (F2)

1) Press the F2 key. The LMD field is highlighted.
2) Enter the value in mAH and press the ENTER key to store the value.

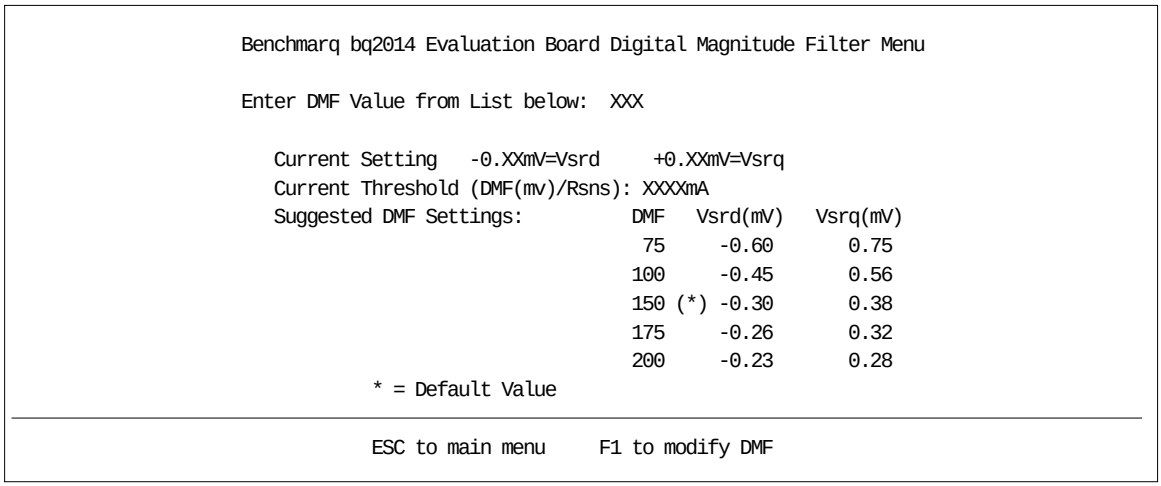


Figure 3. Digital Magnitude Filter Menu

Data Logging

The data log is activated from the Main Menu by selecting the Data Log function. A filename to be used and the log sample period must be entered. For example:

Log Data to Filename: <filename.ext>
Enter Sample Period (10 sec or greater):<xx>
Opening Data Log File

When the data log is started, the Monitor Screen displays the number of the current log record between the time and date fields at the top of the screen. To terminate the data log, press the ESCAPE key. The file is closed and data logging is terminated.

The data log record contains fields of ASCII data separated by tab characters. The field names and descriptions in record order are listed below.

TIME	Time record written in seconds
LMD	LMD value in mAh
NAC	NAC value in mAh
Avg. Discharge Current	Average V_{SR} battery current
BATV	Battery cell voltage
FLAGS1	Binary setting of FLAGS1 flags:

Bit	Meaning
0	EDVF flag state
1	EDV1 flag state
2	Not used
3	VDQ (valid discharge)
4	Capacity inaccurate
5	Battery removed flag state
6	Battery replaced flag state
7	Charge active flag state

FLAGS2 Binary setting of FLAGS2 flags:

Bit	Meaning
0	Overload flag state
1–3	Not used
4–6	Discharge rate
7	Charge rate

The log records should be readable by most spreadsheet programs.

Display Program Menu

This menu is accessed by selecting the <Display Program> function on the Main Menu. The programming menu allows the user to set and observe the program state of the bq2014; see Figure 4. To change the bq2014 PFC programming, reconfigure jumpers JP6–JP10 and initialize the bq2014. The reset allows the bq2014 to read the program pins.

Sense Resistor	Press F1 to enter the value of sense resistor in ohms. Typical values range from 0.02 to 0.1Ω. The sense resistor value is used by the EV2014x UIP to develop meaningful information in terms of A, mA, and mAH in relation to battery capacity and current. The default value is 0.1. Values from 0.005 to 0.256 are saved in the battery ID RAM byte of the bq2014. Values greater than 0.256 must be re-entered each time EV2014x is started.
Scale Factor	Select the scale factor from the available scales using JP8 and JP9. Like the sense resistor, the scale factor is used to develop meaningful information for the programmed full count tables, battery full, and available capacity indications.
PFC Count	Program full count from Table 2 from the bq2014 data sheet.
PFC	Select the programmed full count using JP6 and JP7. Note that the selected PFC and the sense resistor value are used to determine the initial battery full capacity (mAh) represented by the PFC.
Battery Capacity	This display indicates the battery capacity represented by dividing the PFC by the sense resistor. In practice, picking a PFC and sense resistor that provide a battery full value slightly lower than (within 5%) the rated battery capacity is recommended.
Self-Discharge Rate	Select one of two available self-discharge rates depending on the application and battery type using JP10.
Number of Cells	Press F2 to enter the number of cells in the battery stack. This shows the battery pack voltage on the monitor screen.
EDV1	Press F3 to enter the desired end of discharge voltage for the battery pack. The default value is 1.05V for the bq2014.

Programming Pin Configuration

This displays indicates the programming of the bq2014 by displaying H, Z, or L depending on the state of the program pins. Please refer to the bq2014 data sheet for further details.

Measure V_{OS} Screen

This screen is used to measure the V_{OS} of the bq2014; see Figure 5. A minimum of 360 seconds are required to perform this test. Pressing the ESC key terminates the test in progress. Operating the test for a longer period increases the resolution of the test. A "beep" signals test completion.

```
          Benchmarq bq2014  Programming Menu

Sense Resistor:     0.1 Ω          Scale Factor:      1/320

Display Full:       RELATIVE      PFC  Count: XXXXX
                                  PFC(mVH):   XXXX

Self-Discharge                    Battery Capacity   9999 mAH
Rate:               1/47 NAC/day
Number of Cells: X
EDV1:            X.XX
Programming Pin Configuration
  Prog-1  *    Prog-4  *
  Prog-2  *    Prog-5  *
  Prog-3  *    Prog-6  *

       F1 = SR, F2 = NOC, F3 = EDV1, ESC to main menu
```

Figure 4. Display Program Menu

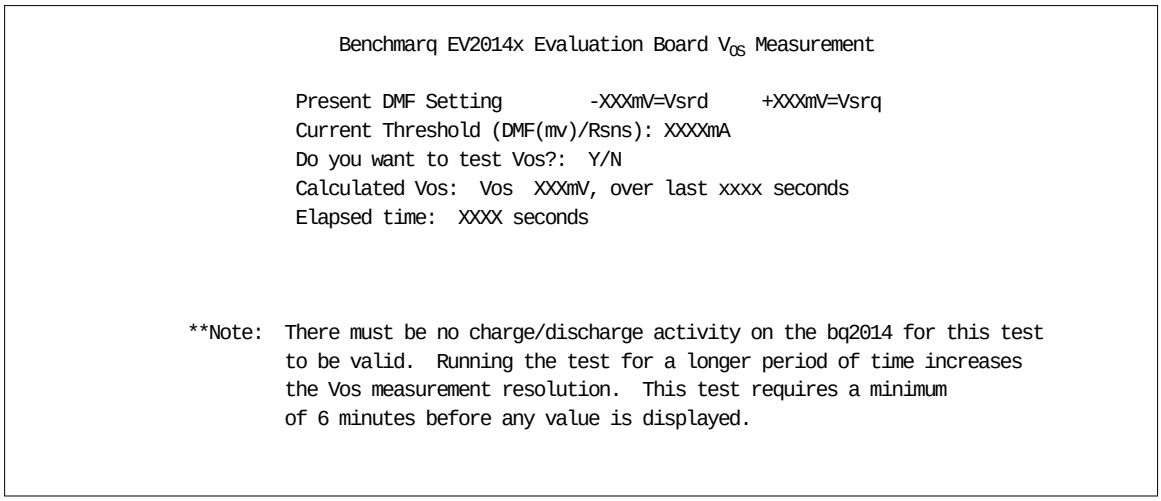


Figure 5. VOS Measurement Screen

Appendix A: AP14A User's Guide

The AP14 utility (AP14A.EXE) is used to communicate with the bq2014 on a register basis. AP14 uses a driver to communicate with the EV2014x over serial port on a PC-AT personal computer.

AP14

The AP14 utility is started by executing AP14A.EXE. After AP14 is started, the following prompt is displayed:

Select COM Port < 1 2 3 4 >

Commands

The user can respond with various commands at the prompt. Pressing "Q" causes the program to terminate.

–> ?

```
The following commands are available:
    ?          This display is shown.
    A          Send break.
    Q          Quit and return to DOS.
    R#         Read at address #.
    S#         Scan at address #.
    W# = **    Write at address # value **.
```

Pressing the ? key displays following menu:

These commands may be used to send or receive data from the EV2014x.

–> A

If A is entered in response to –>, then a break bit is sent to the EV2014x. This may be used to restart the communication if a problem appears. If the prompt does not return immediately, then proper communication has not been established; please refer to Appendix B for troubleshooting procedures.

–> R#

If R# is entered in response to –>, where # is an applicable address in HEX format, AP14 returns the value at that location from the EV2014x. The addresses are defined in the bq2014 data sheet. For example:

–> R03

causes the display to show:

R03= ##

where ## is the current NAC value in HEX format.

Address 00 is used to read and display all readable registers.

–> S#

If S# is entered in response to –>, where # is a valid bq2014 address in HEX format, AP14 continuously reads and displays the value at that location. The addressed are defined in the bq2014 data sheet. For example:

–> S03

causes the display to show:

Address 3 = ## after XXX.XX sec.

where ## is the value at location 03 and XXX.XX is the number of seconds between changes in this value.

–> W# = **

If W#=** is entered in response to –>, where # is an applicable address in HEX format and ** is the value to be written, AP14 writes the value to that location. The addresses are defined in the bq2014 data sheet. For example:

–> W05 = A0

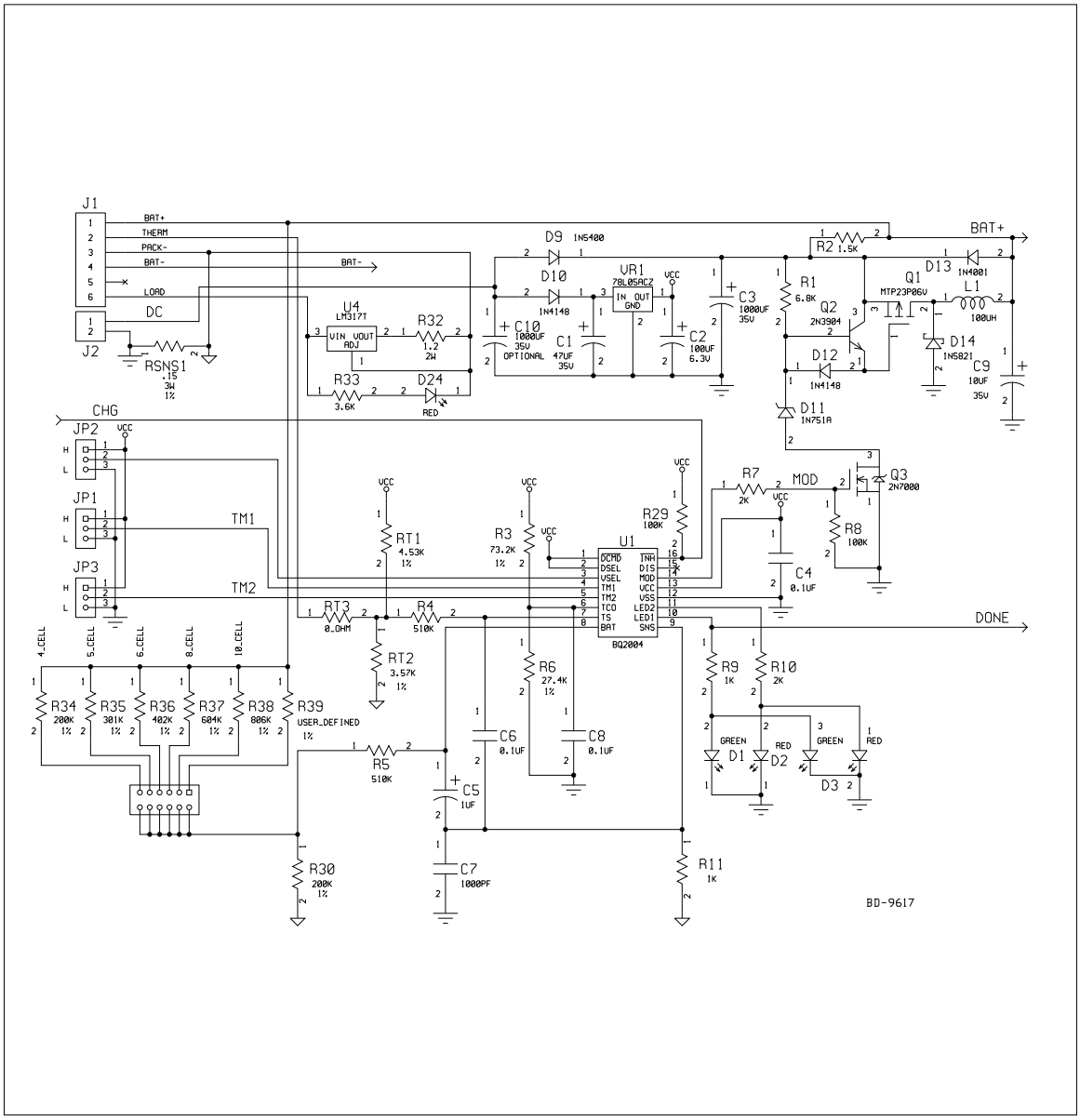
causes the program to write A0 in location 05hex (LMD register).

Appendix B: Troubleshooting

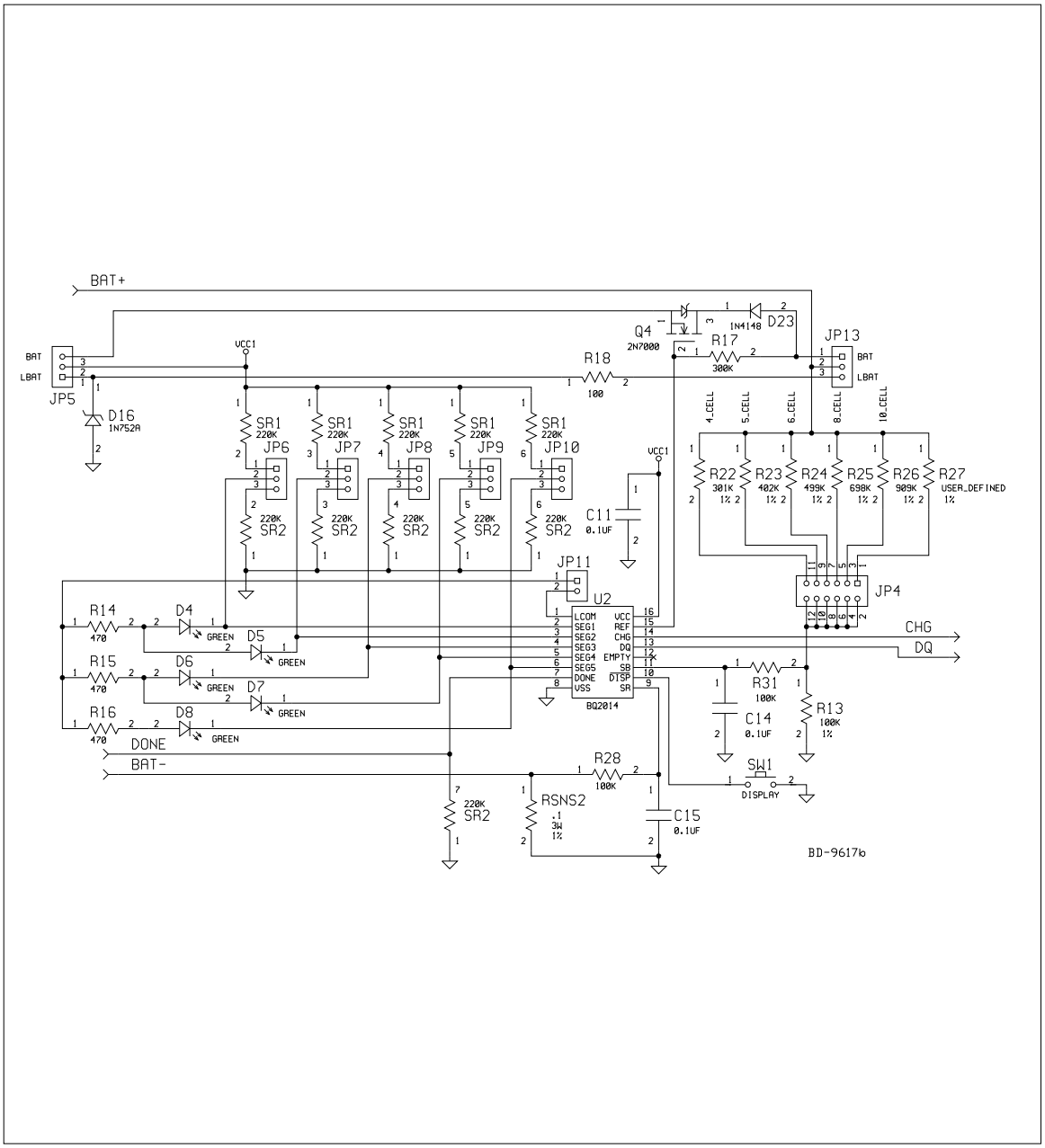
If the EV2014x Main Menu does not appear after starting EV2014x, then communication to the bq2014 has not been established. Please check the following:

1. Confirm the proper serial port is being used.
2. Confirm the battery divider is properly set for the number of cells in the battery pack.
3. Confirm JP5 and JP13 are properly set for either an external supply through LBAT+ (J1) or the microregulator.
4. Confirm the battery is attached between BAT+ and BAT– (J1 and J2).
5. Push S1. SEG1 LED should be on indicating that the bq2014 is properly powered.
6. If the LED is not on, check the battery voltage on pin 16 of the bq2014 to determine if it is above 3V but below 6.5V.
7. If the LED is on, and the EV2014x Main Menu still does not appear, try using AP14 to establish communication. Appendix A describes AP14.
8. If communication cannot be established using AP14, the problem is either the RS-232 port in the PC or the EV2014x interface section. Please contact Benchmarq if the interface section is not working properly on the EV2014x board.

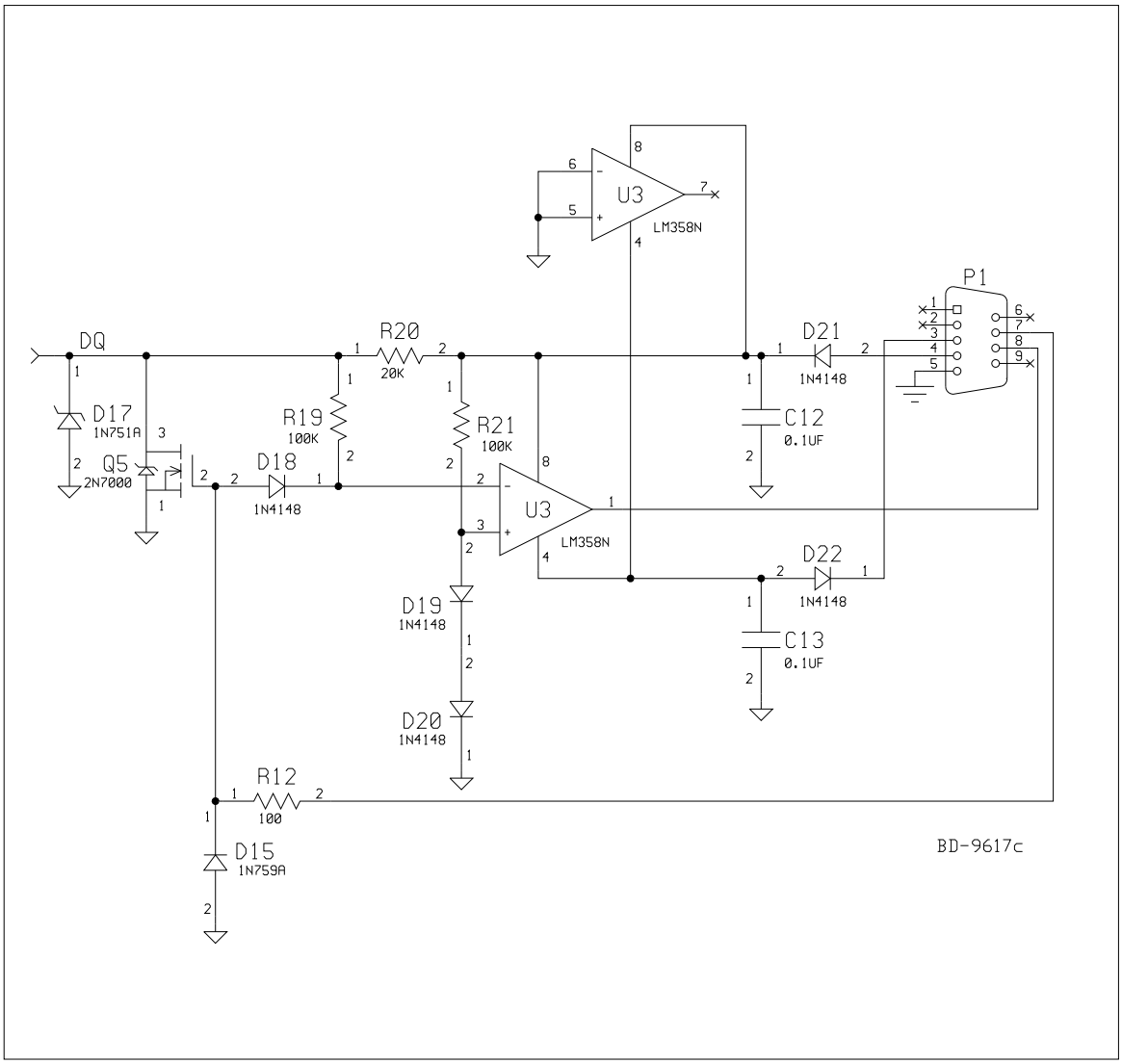
Appendix C: EV2014x Schematic



Appendix C: EV2014x Schematic Continued



Appendix C: EV2014x Schematic Continued



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