CHAPTER 2 SETUP AND INSTALLATION

INSTALLING THE SOFTWARE

The software for the Smart Battery Charger Evaluation Board is stored on the enclosed diskette.

NOTE: Refer to the README.TXT file on the diskette. (The *.TXT files are easily accessed by using the Microsoft Windows "Notepad" program.)

Smart Battery Charger Diskette Installation

NOTE: If you are using the Zilog Macro Cross Assembler (or other assembler), install the appropriate diskette *before* installing the Smart Battery Charger diskette.

1. For Windows 3.1, select the Run command from the File menu under Microsoft Windows Program Manager.

   For Windows 95, select the Run command from the Windows Start button.

2. Insert the Smart Battery Charger diskette into drive A (or drive B, if appropriate).
3. Type a:\setup and press ENTER. (Type b:\setup if drive B is used.)

   A dialog box now prompts you for the directory to install the software into. (The default is C:\ZBAT. The setup program copies the files into the target directory, creating a Smart Battery Charger icon in the Windows environment. When the installation is finished, you can move the Smart Battery Charger icon into any program group of your choice.

   NOTE: The Smart Battery Charger icon is placed in the window that is currently selected.

4. Follow the on-screen instructions.
5. Remove diskette and store in a safe place when installation is complete.

CONFIGURING THE EVALUATION BOARD

Matching the Hardware and Batteries

Before attempting to power up the evaluation board, first configure the hardware to match the battery you will be using. This constitutes picking three resistors from look-up tables based on the number of cells. You may also decide to change the charge and discharge rates. First, reference Table 2-1, V_{BAT} Sense Voltage Scaling, for the number of cells and nominal voltage for your battery. The table cross references three resistor values. These resistors set the scaling for the battery voltage ADC. Rs1 and Rs2 scale the battery voltage to two cells equivalent to keep the voltage within the 0.5V–3.8V range of the ADC. The third resistor is the missing battery detect pull-up resistor. The resistor needs to be scaled based on the V_{IN} supplied by your supply and the values of Rs1 and Rs2. (Refer to the table that follows for the formula.) The table contains values that are suitable for the transformer supplied with the kit. This resistor needs to be as large as practical to prevent the battery being charged through it.

Table 2-1. ***V_{BAT}* Sense Voltage Scaling**

Cells (#)	Nom. V	Rs1 (1%)[1]	Rs2 (1%)[1]	Rpu [1,2]
2	2.4	(open)	(short)	10M
3	3.6	20k	10k	68k
4 (default)	4.8 (default)	20k (default)	20k (default)	56k (default)
5	6.0	20k	30.1k	47k
6	7.2	20k	40.2k	39k
7	8.4	20k	49.9k	30k
8	9.6	20k	60.4k	20k
9[3]	10.8	20k	69.8k	10k
10[3]	12.0	20k	80.6k	(1k)
11[3]	13.2	20k	90.9k	(-10k)

Notes:
1. (Rs1+Rs2)/Rs1 = Number of cells/2. R_{PU} <= (V_{IN}/4)(Rs1) - (Rs2+Rs1)
2. Appropriate pull-up resistors for the included transformer which generates about 22V DC on V_{IN}. This resistor should as large as possible to prevent charging the battery when the charger is off. (Ipu = (V_{IN}-V_{BAT})/R_{PU}).
3. For cell counts above 8, the input power supply will need to be increased. The circuit is designed for a supply voltage up to 25V DC maximum. Any higher supply voltage will require the replacement of several components. For all configurations, the open circuit supply voltage, after scaling, must produce at least 4V at the P31 input. Failure to meet this condition causes the missing battery detection to fail.

Setting the Charger Current

After matching the hardware and batteries, refer to the Charge Current Selection Table, which follows, for the correct Rch resistance to set the charger current to a value applicable to your battery. The software is written around a 1C (60-minute) charge rate, but can work with other rates as well. If your battery has a rated mA-Hr capacity on the label, simply look up this value and find the appropriate resistor on the table. If you do not know the capacity rating, pick a low charge current at first and charge then discharge and recharge the battery. Time the second charge cycle to figure an approximate capacity rating. (Do not include the discharge or rest time.)

EXAMPLE: If the battery charged in 60 minutes, the charge current setting approximately equals the C rate of the battery.

Because of the safety timeout built into the software, if the charge cycle stopped after approximately 90 minutes, you should increase the charge current to the next step, discharge the battery, and time the cycle again.

Table 2-2. ***Charge Current Selection***

Current (A)	Rch (Ohm)
1.9	150
1.55	120
1.3	100
1.0 (default)	75 (default)
0.67	51
0.52	39
0.48	36
0.27	20
0.2	15

NOTES:

1. You can change the discharge rate as well, although the discharger circuit is not socketed for easy changes. R30 controls the discharge current. To determine how much current the default circuit draws from your battery, look up the cell count of your battery on the Discharge Current Look-Up Table, which follows. The value read will be the current drawn from the battery when full. Since this is a resistive discharge, the current will be proportional to the battery voltage.

2. For high currents, the user is responsible for ensuring that heat sinking is adequate on Q1 and Q4. For currents above 2A, several components must be replaced.

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If the current is not adequate, the formula printed below the table can be used to calculate the resistance that will draw any given current from your battery. The discharge current should normally be around a C/10 rate (10 hours for full discharge) in order to avoid shortening the battery life.

Table 2-3. ***Discharge Current (W/Supplied R30)***

Cells (#)	V_{BAT} (V)	I_{DIS} Max (mA)	Power (mW/W)
2	2.4	29	70
3	3.6	44	158
4	4.8	59	281
5	6.0	73	439
6	7.2	88	632
7	8.4	102	860
8	9.6	117	1.12W
9	10.8	132	1.42W
10	12	146	1.76W

$I_{DIS} = (V_{BAT} - 0.5)/R30$

$R30 = (V_{BAT} - 0.5)/I_{DIS}$

Power (W) = $I_{DIS} \times (V_{BAT} - 0.5)$

NOTE: For high currents, the user is responsible for ensuring that heat sinking is adequate on Q1 and Q4. For currents above 2A, several components must be replaced.

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Configuring the Jumpers

JP1: Charger and Discharger Circuits

JP1 connects the charger and discharger circuits together. On some battery packs, the charge terminal and the discharge terminal are separate. The charge terminal will typically have a diode in the line to prevent the charger from drawing current from the battery. This will cause problems for the preconditioning discharge. With that type of pack, JP1 can be left off if both the charge and discharge terminals will be connected. (Refer to the evaluation board schematics.) If only one terminal is to be used, it should be the one without the diode protection, and JP1 should be installed. This is also true for battery packs that do not have separate charge and discharge terminals.

JP1	
On (Default)	Single Terminal
Off	Separate CHG and DIS

JP2: Preconditioning Discharge Request

JP2 selects the preconditioning discharge request method. It can be hard -jumpered to V_{CC} or ground to disable the discharger or to force discharge before every charge, respectively. The middle position connects the input to a switch that allows the user to select the discharge cycle only when the battery will not be used for several hours. NiCd chargers will often have this type of setup. NiMH battery chargers, on the other hand, typically have the discharger removed and the input tied high (jumper setting 1-2) since the NiMH chemistry does not suffer from the memory effect as NiCd does.

JP2	
1-2	Never Discharge
3-4 (Default)	Button Starts Discharge
5-6	Always Discharge

JP3: Chemistry

JP3 selects the chemistry of the pack. If the jumper is installed, it signals to the Z8® MCU that a NiMH battery will be charged. Normally, a production board will have this pulled either to V_{CC} or to ground since the user would not be expected to change it on the fly. It is possible to add some circuitry around this point to allow a battery to automatically signal which chemistry it is at insertion time. The software already handles this, but due to the wide variety of battery packs on the market, the exact sensing circuitry needs to be carefully tailored to the batteries. See Appendix B.

JP3	
On	NiMH Chemistry
Off (Default)	NiCd Chemistry

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CONNECTING THE Z8 CCP EMULATOR (OPTIONAL)

NOTE: The Smart Battery Charger Evaluation Board is shipped with a programmed Z86E08 device in the socket. If you want to use the supplied code, you may skip this section and proceed to the section entitled “Connecting the Charger for Stand-Alone Operation”.

1. Ensure that the emulator power supply and evaluation board wall transformer are unplugged.
2. Ensure that the emulator is configured with an 8-MHz crystal or ceramic resonator.
3. Configure the emulator with the following jumper options:

Table 2-4. ***CCP Emulator Jumper Configuration***

Jumper	Position	Description
J1	Open	Emulator power supply isolated from the evaluation board
J2, J3	Open	Emulator XTAL1/2 pins not connected to evaluation board
J4	1–2	Connects P02 for Z86x08 pin out
J5	1–2	Connects P01 for Z86x08 pin out
J6	1–2	Connects P00 for Z86x08 pin out
J11	2–3	Regulates emulator V_{CC} to 5.2V DC

4. Power up the emulator using a regulated DC power supply.

CAUTION!

Do not use an AC adapter. Although an AC adapter is fine for many applications, the 12-bit A/D scheme used in the charging controller is especially sensitive to 120-Hz ripple on the Z8 V_{CC} supply. In your final charger design, zener regulation of the Z8 V_{CC} will be suitable, but the emulator operates the charging circuitry through a ribbon cable, and it is especially sensitive to power supply variations. A poorly regulated supply may result in sporadic, large A/D variations when AC loads on the same branch circuit are switched ON/OFF. This can cause false terminations of battery charging.

NOTE: Step function increases or decreases in battery A/D during data logging may suggest emulator power supply integrity problems. It is recommended that you use a regulated supply for the emulator. If necessary, provide 5V DC directly to capacitor C3 on the emulator.

5. Connect the emulator to your personal computer. Connect one end of the 18-pin ribbon cable into the P1 socket on the emulator (with the ribbon cable's pin 1 stripe toward socket P2). Plug the other end of the cable into the U1 socket on the evaluation board, making sure that the pin 1 end is oriented toward the U1 socket’s pin 1 (away from the prototyping area).

NOTE: Refer to the Z8 CCP Emulator User's Manual for proper configuration of the emulator.

POWERING UP/DOWN PROCEDURES

Powering Up

1. Turn on the emulator power supply.
2. Press the emulator MASTER RESET button.
3. Connect the 18-pin ribbon cable, if not already connected.
4. Start the emulator GUI software.
5. Download the Smart Battery Charger software into the emulator.
6. Plug in the evaluation board wall transformer.
7. *Immediately* press GO or Step through the initialization code (six lines).
8. Begin program execution or other emulation tasks.

WARNING!

Never allow the evaluation board to sit with power on and no 18-pin cable in the socket. Also, do not allow the emulator to sit in the Reset state. Either of these conditions will cause both the charge and discharge circuits to be on and may damage the evaluation board, the battery, or both.

Powering Down

1. Unplug the evaluation board wall transformer.
2. Press the emulator TARGET RESET button.
3. Unplug the 18-pin ribbon cable.
4. Turn off the emulator power supply.

CONNECTING THE CHARGER FOR STAND-ALONE OPERATION

The Smart Battery Charger Evaluation Board can be used in Stand-Alone Mode if a One-Time Programmable (OTP) Z86E08 or masked ROM Z86C07 is inserted into its U1 socket. This permits operation *without* connecting a Z8 CCP emulator. When you are satisfied with charger operation using the emulator, you can use the emulator to program an OTP part. Download your operating hex file into the emulator code space.

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NOTE: Refer to the OTP instructions in your Z8 CCP Emulator User's Manual to program and verify a blank Z86E08 OTP device. Also, program the Autolatch Disable option bit.

1. Before installing the programmed OTP or masked ROM Z8 device, ensure that the evaluation board's wall transformer is disconnected.
2. Plug the OTP or masked ROM Z8 into the evaluation board's U1 DIP socket, observing proper orientation.
3. Plug in the evaluation board's wall transformer. The Z8 executes a power-on reset and begins normal program execution.

WARNING!

Never allow the evaluation board to sit idle with power on and no part in the socket. Both the charge and discharge circuits will be On and may damage the evaluation board, the battery, or both.

DATA LOGGING OF BATTERY CHARGING CYCLES

CHGPLT Program Description

Zilog's charging cycle logging program, CHGPLTxx.EXE (replace xx with the two-digit revision number) included on the Smart Battery Charger diskette is a powerful, easy-to-use tool for observing battery charging performance. The CHGPLT program features an on-screen command menu. When the charging program is executing in Test Mode, a serial data stream is output from the Z8 MCU via the DB-25 connector on the charger evaluation board. After a charging cycle is completed, the CHGPLT program gives you the option to apply a text title to the graphed data, and save the data as a file. The data files can be later retrieved and displayed.

Using the CHGPLT Program is a good way to see how the charger responds to different batteries with varying characteristics, such as charge levels, types, and voltages.

Starting the Program

1. Ensure proper installation of all software and hardware before proceeding.
2. Ensure that a serial cable is connected between the evaluation board and your computer's COM1 or COM2 serial ports. (COM3 and COM4 are not supported.)
3. Place the charger into Test mode (see below).
4. Enter CHGPLTxx at the DOS prompt to start the program and follow on-screen instructions.

NOTE: xx is a two-digit number, with the digits representing the revision for this program.

Example: 10 would represent version 1.0; 11 would represent version 1.1, and so on.

During the first use, the program asks a few questions to configure the program for your system, such as COM port number, choice of display, and so on.

Entering Test Mode

When preparing to datalog a charge cycle, it is first necessary to place the charger board into manufacturing test mode. Entering test mode causes the charger to output its status once per second on the green LED output. The evaluation kit has a TTL to RS232C-level shifter circuit on board so that the data output can be easily captured by a PC.

To enter test mode, the battery should be disconnected from the charger, and the power turned off. Test point TP3 should be shorted to ground and the board powered on. If the jumper is left attached to JP3, the charger will enter a factory calibration mode. (For more information, see Chapter 5 at the end of this manual.)

It does not charge batteries in this mode. When the test point is released, the charger enters standard test mode, and becomes ready for datalogging a charger cycle.

Description of Commands

T (TEST) The T command, when the charger evaluation board is operating, initiates a data-logging sequence.

1. You must press T before the battery is inserted to trap the complete charging cycle.
2. If the emulator is halted, or the serial port is not connected (or is connected to the wrong COM port), or for some other reason Z8 serial data is not being received by your computer, the CHGPLT program times out after approximately 15 seconds and returns to the main program shell.

S (SAVE) The S command saves datalog information to a file.

L (LOAD) The L command, from the main program shell, displays a menu of the .DAT files found in the working directory. The desired file is selected with the cursor up/down keys. <ENTER> retrieves and displays the file.

V (VIEW) The V command allows you to scroll left/right and display the actual A/D data and temperature information.

Q (QUIT) The Q commands exits the program. You can also use the <Esc> key.

C (CONFIG) The C command changes the display type, COM port, and number of battery cells settings.

A (ALARM SILENCE) If, during a charge cycle, the data logger detects a pending termination, it will start beeping. This is to alert the user that a -ΔV termination is imminent in case incorrect modifications have prevented the software from terminating the charge properly. Pressing and holding the <A> key until the computer beeps (about 1/2 second) will silence the alarm.

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