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What: Linear Technology Micropower SwitcherCAD Manual, Chapter 2

My Role: Author/Designer

THE Micropower SwitcherCAD DESIGN SPECIFICATION DIALOG BOX

The Design Specification Dialog Box (Figure 2.1) is the entry point into Micropower SwitcherCAD. It appears whenever you start the program or select New from the File menu. Use the Design Specification Dialog Box to enter the basic parameters of your switching power supply design, including input voltage (V_{IN}), output voltage (V_{OUT}), load current (I_{LOAD}), and ambient temperature. In addition to these controls, the Design Specification Dialog Box contains the "Select" button and two check boxes labeled "Autoselect Parts" and "Surface Mount" (described below).

Note: the Ambient Temperature parameter is used only to evaluate whether the IC is operating within its safe operating range. It does not otherwise affect the circuit simulation.

Input Voltage Selection

Choose the "Select" button to open the Input Voltage Dialog Box (Figure 2.2). Use this dialog box to specify the input voltage for your switching power supply. You can select from a variety of popular battery types, in which case Micropower SwitcherCAD calculates the input voltage and source impedance, or you can manually enter voltage and impedance values. For a battery supply, you can also specify the number of cells (the default is one) and the state of charge (the default is 100%); these values also affect the input voltage and source impedance values.

Autoselecting Parts

Micropower SwitcherCAD's most important feature is its ability to specify all the components required for a switching power supply circuit. You enter a specification and Micropower SwitcherCAD selects the topology, allows you to choose from a selection of appropriate Linear Technology switching regulators ICs, and then selects all other circuit components for the design. To enable this feature, check the "Autoselect Parts" check box in the Design Specification Dialog Box. If you manually change the value of a circuit component or cancel the inductor calculation after a design change, automatic component selection will be disabled.

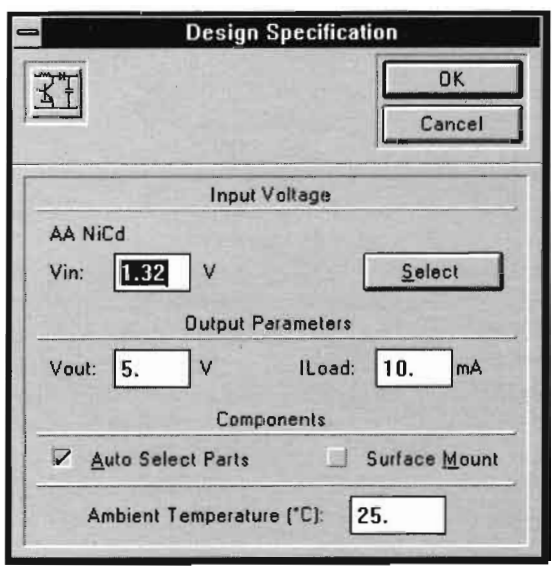

Figure 2.1. Design Specification Dialog Box

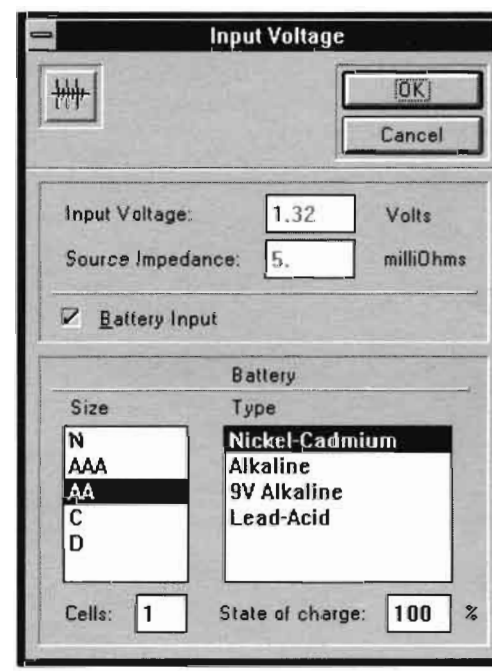

Figure 2.2. Input Voltage Selection Dialog Box

Surface Mount or Through-hole?

Use the "Surface Mount" check box to specify whether Switcher CAD will use surface-mount or through-hole components in the switcher design.

Note: most of the controls in the Design Specification Dialog Box are also available in the Circuit Setup Dialog Box, accessible via the Circuit Menu, described later in this chapter. Use the Circuit Setup Dialog Box to modify the parameters of a circuit in progress.

THE IC SELECTION DIALOG BOX

When you have finished specifying your power supply's parameters in the Design Specification and Input Voltage dialog boxes, Micropower SwitcherCAD opens the IC Selection Dialog Box (Figure 2.3). The IC Selection Dialog Box displays a list of parts suitable for the specifications you have entered, and a series of check boxes indicating the features of the part that is currently highlighted. Moving the highlight to a different part will change the status of the check boxes to match the highlighted part. Conversely, checking or unchecking Features check boxes will cause the highlight to move to a part that has the specified features, if one is available. A scrolling text box entitled "Applications" displays a description of the selected part and its common uses.

Once you choose "OK" to confirm your IC selection, Micropower SwitcherCAD performs several operations in rapid succession to implement your design specification with real-world components. If successful, the end result is four cascaded windows open on the screen: the Switcher Document Window, the Simulation Chart Window, the Report Window, and, if you have specified a battery supply, the Battery Life Window (the functions and features of these four windows comprise the bulk of this chapter).

Inductor Simulation

A suitable inductor is often the most difficult part to select. Micropower SwitcherCAD starts by using some calculations to come up with a rough first cut for an inductor value. This value is then plugged into the circuit and one steady-state switch cycle is simulated. During this simulation, Micropower SwitcherCAD displays a progress window that shows the inductor value being tried.

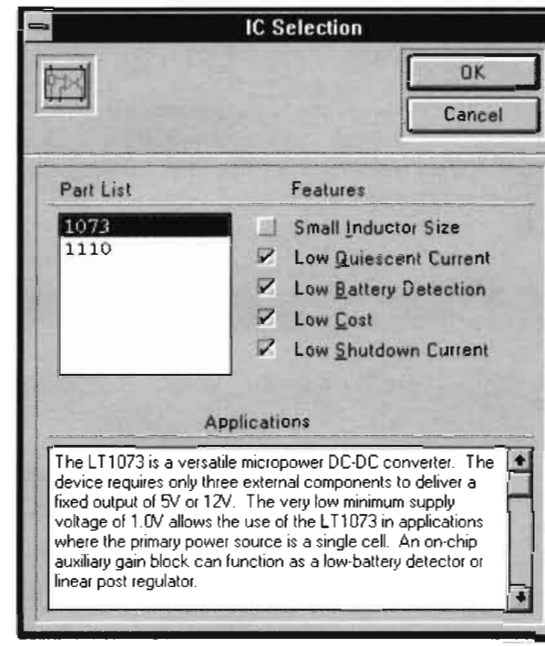

Figure 2.3. IC Selection Dialog Box

Micropower SwitcherCAD analyzes the simulation data to see if this inductor value will work. If it fails, the program selects a higher or lower value, depending on the results of the simulation. It then repeats the evaluation using the new value. This process continues until Micropower SwitcherCAD finds an inductor that will satisfy the design requirements. If a real-world inductor cannot be found, Micropower SwitcherCAD offers you the option of viewing the schematics of typical applications for the IC you selected. If you don't choose to view the schematics, you will be returned to the IC Selection Dialog Box, where you can select a different part and try the simulation again. If no available part is suitable for your design, the program displays an alert box with the message "Cannot regulate selected current/voltage. Try reducing the output current." When you select "OK" to close the alert box, you will be returned to the Design Specification Dialog Box, where you can alter your specifications.

If Micropower SwitcherCAD succeeds with an inductor simulation, it then simulates a Burst Mode cycle to calculate the circuit's efficiency and displays the voltage at the output node in a chart Window. Next, Micropower SwitcherCAD opens a Report Window with a parts list and simulation parameters for your design. Finally, if you have specified a battery supply, the program performs a battery life simulation and displays the results in the Battery Life Window. All of these windows and their features are described in greater detail below.

Editing Window Titles

When Micropower SwitcherCAD performs the operations described above, it titles the windows that it opens based on your initial specifications, for example, "9V to 5V at 100mA." If you edit your specifications later, the program does not update the window titles. To edit a window title, click in the title area, immediately below the title bar, type the new title, and press **[Enter]**.

THE SWITCHER DOCUMENT WINDOW

The Switcher Document Window (Figure 2.4) contains a schematic diagram of your switching power supply design. You can use this window to edit selected component values and/or create and view charts of voltage responses at those nodes marked with circled numerals. When the Switcher Document Window is active, the Circuit Menu appears on the program's menu bar. The options available on the Circuit Menu are duplicated by the speed buttons that appear on the left border of the window.

Viewing Node Voltage Responses

Depending on the topology that Micropower SwitcherCAD selected for your switching power supply design, three or four nodes on the schematic in the Switcher Document Window will be labeled with circled numerals. When you move the mouse pointer over one of these nodes, the size of the pointer changes and the word "View" appears beneath it. When the pointer is in this state, click the left mouse button to view the voltage response at the selected node. Micropower SwitcherCAD responds by opening a Chart Window containing a graph of the voltage response. See "Chart Window," below, for a detailed description of the operations you can perform on this chart.

Note: you can also create a chart by selecting the Chart speed button on the left border of the Switcher Document Window. A chart created this way will initially be blank, but you can add traces for node voltages and/or device currents by means of the appropriate speed buttons or submenus (see "The Simulation Chart Window," below).

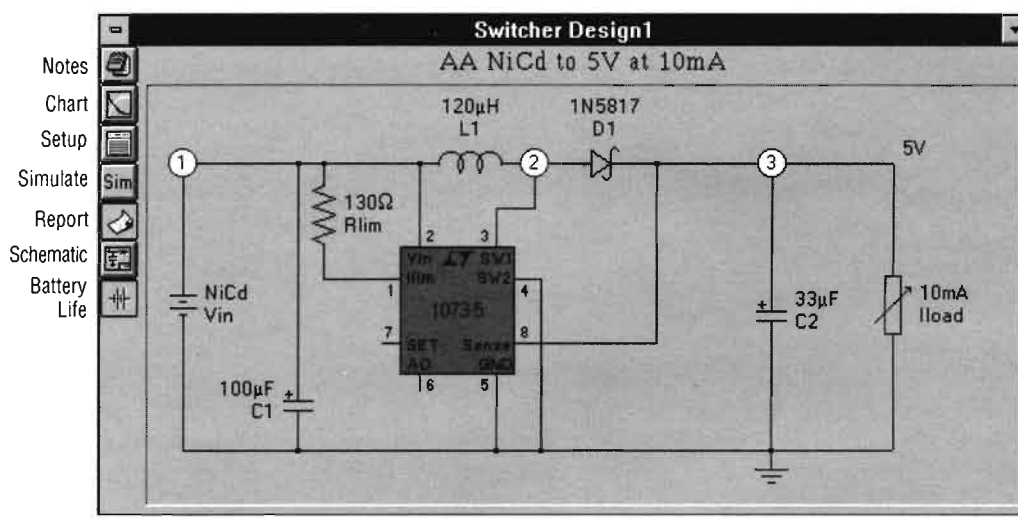

Figure 2.4. Switcher Document Window

Editing Components

The Switcher Document Window allows you to play "what if" by editing the values of the critical components in your design. When you move the mouse pointer over one of these components on the schematic, the size of the pointer changes and the word "Edit" appears beneath it. When the pointer is in this state, click the left mouse button to edit the value of the selected component. Micropower SwitcherCAD will respond by opening the appropriate dialog box for the component you have chosen.

Note: to see the effect of a component change on your circuit's performance, you must run a new simulation (see below).

Switching Regulator IC

When you select the switching regulator IC, the dialog box that appears will vary, depending on the particular IC that Micropower SwitcherCAD has selected. Most Linear Technology micropower switching regulators, including those listed in Table 2-1, below, use a version of the Fixed Off-Time Switcher Setup Dialog Box in Figure 2.5.

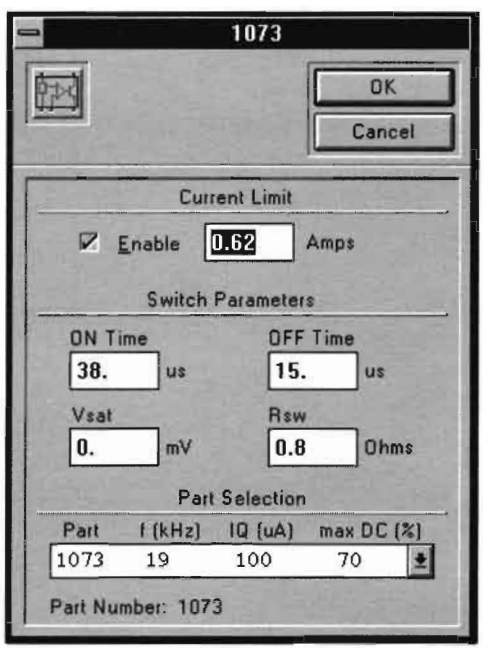

Figure 2.5. Fixed Off-Time Switcher Dialog Box

Table 2-1. Fixed Off-Time Switching Regulator ICs

LT1073	LT1110
LT1173	LT1111
LT1107	LT1108
LT1109	LT1109A
LT1300	LT1301
LT1303	

Use this dialog box to change the parameters of a fixed off-time switching regulator. For switchers with current limit programmed by an R_{LIM} resistor, the current limit value is coupled to the value of this resistor. If you change the resistor in the circuit (by means of the Resistor Setup Dialog Box—described below), the corresponding current limit will appear in this dialog box. Conversely, when you enter a current-limit value in the switcher dialog box, Micropower SwitcherCAD assigns a corresponding value to the R_{LIM} resistor. Note, however, that this resistor value may not produce exactly the current-limit value you entered in the edit box, since Micropower SwitcherCAD chooses from a list of standard resistor values. Thus, the next time you open the dialog box, the current-limit edit box may contain a different value than that which you previously entered. If you uncheck the Enable check box for Current Limit, the program will remove the R_{LIM} resistor from the circuit. Rechecking the box will restore the resistor.

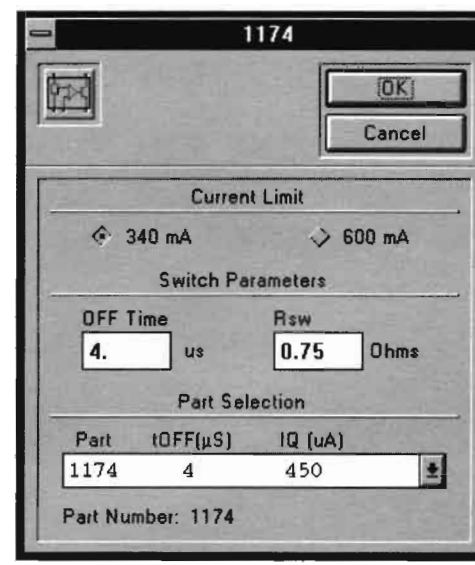

Figure 2.6. LTC1174 Dialog Box

The other parameters in the dialog box, ON Time, OFF Time, switch resistance (R_{SW}) and switch saturation voltage (V_{SAT}) are fixed properties of the selected switching regulator IC. Changing any of these parameters will cause Micropower SwitcherCAD to substitute a generic fixed off-time switcher for the selected LTC regulator.

The Part Selection drop down list box at the bottom of the switcher dialog box contains a list of LTC switching regulator ICs suitable for the topology Micropower SwitcherCAD has selected. Selecting a different LTC part will reset the parameters in the dialog box as appropriate, and may substitute a different dialog box.

The LTC1174 has a unique topology, and hence requires a unique edit dialog box (see Figure 2.6. The LTC1174 has two fixed current limits, selectable via the I_{LIM} pin. Selecting the 340mA radio button sets a 340mA current limit by connecting the I_{LIM} pin to ground; Selecting the 600mA radio button sets a 600mA current limit by connecting the I_{LIM} pin to V_{IN}. Changing the OFF Time or switch resistance parameter will cause Micropower SwitcherCAD to substitute a generic fixed off-time switcher for the LTC1174 and replace the 1174 Dialog Box with the Generic Fixed Off-Time Switcher Dialog Box. Use this dialog box to change the parameters of a generic, fixed off-time switching regulator. The generic part has programmable current limit capability, but the program makes no assumption as to how this is implemented.

Figure 2.7. Inductor Setup Dialog Box

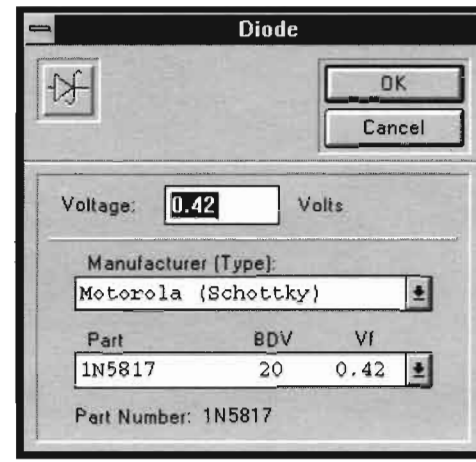

Figure 2.8 Diode Setup Dialog Box

Inductor

Clicking on the inductor opens the Inductor Setup Dialog Box (Figure 2.7). Use this dialog box to choose a real-world inductor or to enter custom values for inductance and DC resistance. The Manufacturer drop-down list box contains a list of manufacturer databases containing suitable parts for your design. The part selection drop-down list box contains a list of components for the manufacturer currently selected in the Manufacturer drop-down list box. If you enter a value for either inductance or DC resistance, the manufacturer and part selections (if any) will be cleared. Choosing a real-world inductor from the part-selection box will update the inductance and DC resistance edit boxes to reflect the values of this selection.

Diode

Clicking on the diode opens the Diode Setup Dialog Box (Figure 2.8). Use this dialog box to choose a real-world diode or to enter a custom value for the diode threshold voltage. The Manufacturer drop-down list box displays a list of manufacturer databases containing suitable parts for your design. The part selection drop-down list box contains a list of components for the manufacturer currently selected in the Manufacturer drop-down list box. If

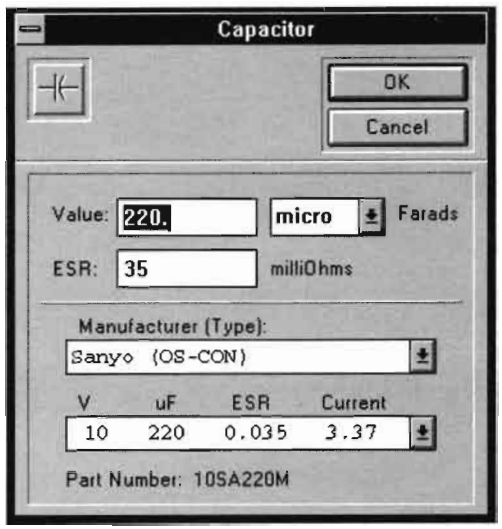

Figure 2.9. Capacitor Setup Dialog Box

you enter a value for threshold voltage, the manufacturer and part selections (if any) will be cleared. Choosing a real-world diode from the part-selection drop-down list box will change the threshold voltage edit box to reflect the value of the selection.

Capacitor(s)

Clicking on a capacitor opens the Capacitor Setup Dialog Box (Figure 2.9). Use this dialog box to choose a real-world capacitor or to enter custom values for capacitance and ESR. The Manufacturer drop-down list box displays a list of manufacturer databases containing suitable parts for your design. The part selection drop-down list box contains a list of components for the manufacturer currently selected in the Manufacturer drop-down list box. If you enter a value for either capacitance or ESR, the manufacturer and part selections (if any) will be cleared. Choosing a real-world capacitor from the part-selection drop-down list box will update the capacitance and ESR edit boxes to reflect the values of the selection.

Resistor

Clicking on a resistor opens the Resistor Setup Dialog Box (Figure 2.10). Use this dialog box to choose a standard or custom resistor value. The Standard value drop-down list

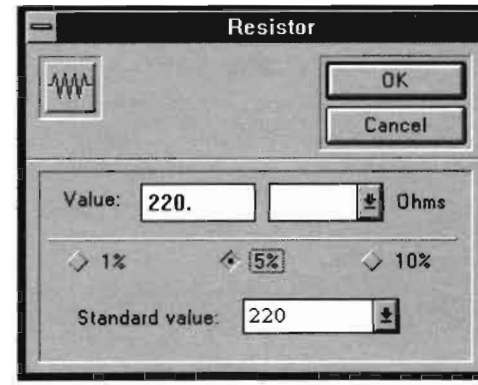

Figure 2.10. Resistor Setup Dialog Box

box contains 1%, 5%, or 10% standard resistor values, depending on which precision radio button is selected. Selecting a different precision radio button updates the standard value list and selects the value nearest to the number in the edit box. If you enter a value in the edit box, this will clear any standard value currently selected. Select the standard-value drop-down list box to substitute the closest standard value for a custom value you have previously entered. Selecting any standard value from the drop-down list will also update the edit box.

Input Voltage

Clicking on the battery opens the Input Voltage Dialog Box, identical to that described earlier in this chapter under the heading "Input Voltage Selection." Use this dialog box to modify the input voltage parameter and/or select a different battery configuration.

Load Current

Selecting the load opens the Load Current Dialog Box (Figure 2.11). Use this dialog box to specify the load current. The load current, represented by the Duty Cycle graph, can switch between two values, i_1 and i_2, at transition times that you specify, t_1 and t_2. This allows you to simulate circuit behavior under changing load conditions. You can enter the transition times in the t_1 and t_2 edit boxes, or drag the two Duty Cycle Cursors to change the times. At the beginning of a cycle (t_0), the load has the value i_2; at the first transition time, t_1, it switches to i_1. The

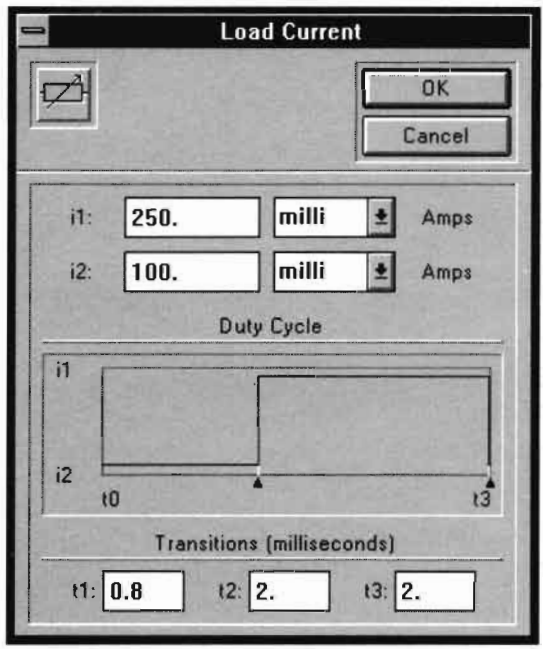

Figure 2.11. Load Current Dialog Box

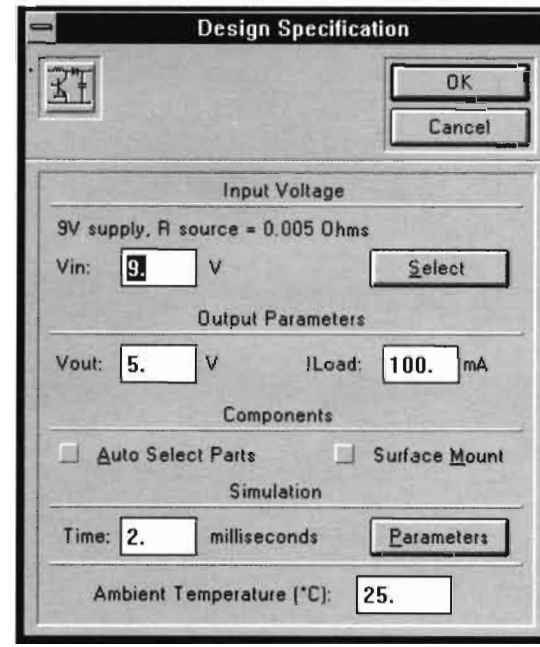

Figure 2.12. Circuit Setup Dialog Box

load remains at i_1 until the second transition time, t_2, at which time it switches back to i_2. The load value remains at i_2 until the end of the cycle (t_3). The total time for a cycle is determined by the setting of t_3, or by the Simulation Time setting in the Circuit Setup Dialog Box.

Notes: In the Load Current dialog box, the wave form does not represent the load current values. I_1 always appears higher, even if it has been assigned a lower value.

Micropower SwitcherCAD does not perform battery simulation correctly with a stepped load.

The Circuit Menu

The Circuit Menu appears on the Micropower SwitcherCAD menu bar only when the Switcher Document Window is active. The commands on the Circuit Menu are duplicated by the speed buttons on the left border of the window; they occur in the same order from top to bottom in both locations.

Notes

This option opens a window in which you can write or edit notes about your circuit. Text typed in this window is saved as part of a Micropower SwitcherCAD document (.upw) file.

Chart

This option opens a Chart Window in which you can view selected node voltage responses and device currents from your circuit. See the major section entitled "The Chart Window," later in this chapter, for a detailed description of the features and uses of this window.

Setup

This command opens the Circuit Setup Dialog Box (Figure 2.12). The options in this dialog box set the basic parameters of your circuit, and largely duplicate the controls in the Design Specification Dialog Box, described earlier. In addition, the Circuit Setup Dialog Box contains controls

for Micropower SwitcherCAD's simulation engine. Selecting the "Parameters" button opens the Simulation Setup Dialog Box (Figure 2.13).

When you first create a switching power supply design with Micropower SwitcherCAD, the program performs a steady state simulation to select the inductor and a simulates one Burst Mode cycle to calculate the efficiency of the design. Whenever you change any of the parameters or component values for your circuit, you should perform a new simulation and generate a new simulation chart and/or report to see the results of the change(s). Micropower SwitcherCAD can perform several types of simulations:

Steady State Simulation—Configures the simulator to simulate the steady state operation of the switcher circuit.

Simulate 1 Burst Mode Cycle—Configures the simulator to simulate one steady state Burst Mode cycle of the switcher circuit.

Simulate [*n*] Switch Cycles—Configures the simulator to simulate a specific number of switch cycles.

Simulate Start Up—Configures the simulator to simulate the switcher circuit from start up.

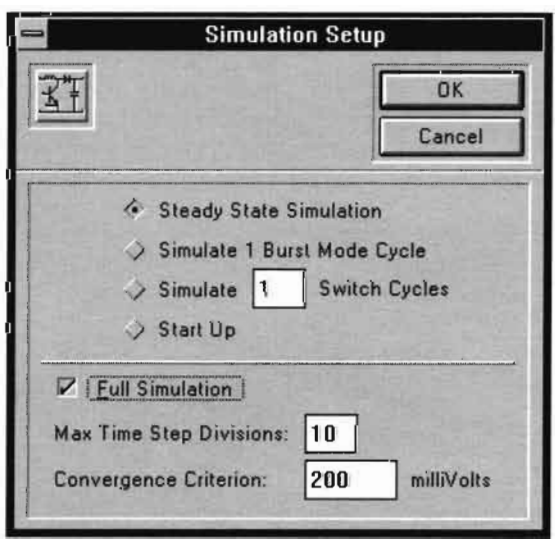

Figure 2.13. Simulation Setup Dialog Box

Full Simulation—by default, Micropower SwitcherCAD uses a constant time-step simulation. This method produces quick results, but omits some details in the switcher circuit waveforms. Checking the Full Simulation check box enables variable time-step operation for whichever of simulations listed above is selected. Micropower SwitcherCAD will calculate more closely spaced data points (determined by the Maximum Time Step Divisions and the Convergence Criterion) for those portions of the cycle where there is more activity, resulting in a more realistic representation of the switching circuit's behavior, but increasing simulation time.

Maximum Time Step Divisions—the maximum number of times the simulation time step can be reduced during a full simulation.

Convergence Criterion—in a full simulation, the amount (in millivolts) by which voltage must change over a time step to cause the simulation engine to reduce the time step and repeat that portion of the simulation. The time step is reduced until this criterion is met or a minimum time step is reached. If the simulation is converging (the voltage changes becoming smaller) the time step is increased. The smaller the convergence criterion, the more detailed the simulation, and the longer the simulation time.

Note: although a full simulation calculates more data points than a fixed-time-step simulation, Micropower SwitcherCAD doesn't necessarily use all of the data points in constructing a simulation chart; it may skip some of the data points in order to maintain a reasonable level of performance. (In any case, the resolution of your display will limit the detail that can be displayed.) If you zoom in on areas of special interest, Micropower SwitcherCAD will use the additional data to draw the magnified area in greater detail.

Simulate!

Runs the simulation engine to analyze the circuit with the parameters selected in the Simulation Setup Dialog Box. Any chart windows currently open for the circuit will be updated when the simulation is complete.

Note: if you select the Cancel button at the top of the Simulation dialog box while the simulation is in progress, Micropower SwitcherCAD will display the results of the part of the simulation that has been completed in a chart window.

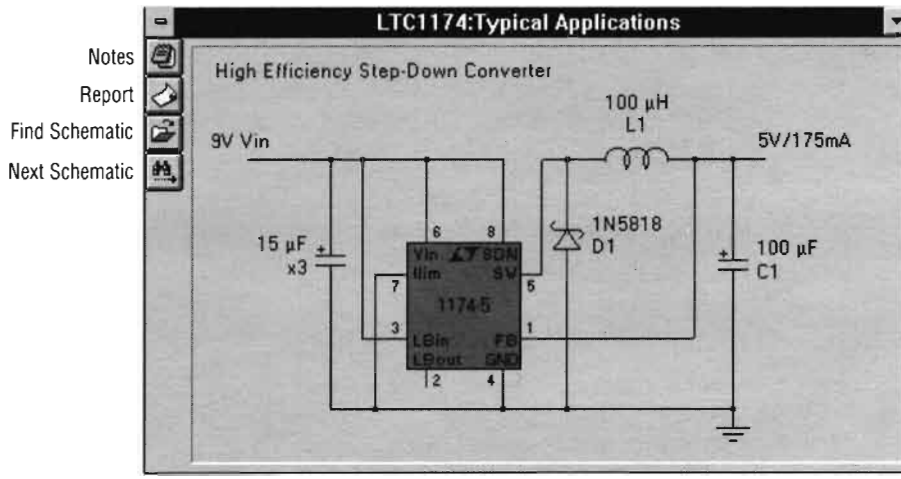

Figure 2.14. Schematic Browser Window

Report

This command creates a report containing a parts list and simulation parameters for your circuit and displays it in a Report Window. If you have edited any circuit components, Micropower SwitcherCAD will simulate one Burst Mode cycle before displaying the report. For a detailed description of the report, see the section entitled "The Report Window," later in this chapter.

Schematics

Use this command to view a series of schematics of typical applications for the switching regulator IC used in your design. The Schematic Browser Window (Figure 2.14) has it's own set of speed buttons and Circuit Menu commands. The first two, "Notes" and "Report," function identically to those described previously. The next, "Find Schematic," allows you to select a schematic to view by name from a dialog box. Use the last, "Next Schematic," to step through the schematics sequentially.

Battery Life

This command performs a battery simulation on your circuit and displays the results in a Battery Life Window. It is available only if you have specified a battery supply. For a detailed description of this feature, see the section entitled "The Battery Life Window," later in this chapter.

THE SWITCHER CIRCUIT REPORT WINDOW

The Switcher Circuit Report Window displays a report on your switching power supply design. A typical switcher circuit report is illustrated in Figure 2.15.

"Document Version" indicates the revision of the program that generated the report. The "Circuit Parameters" section describes the type of components (through-hole or surface mount) that you have selected, and the design specifications of the circuit.

The "Parts List" section describes each component in the circuit. These are real-world components specified by Micropower SwitcherCAD. If automatic component selection is not enabled, the component table will not be included in the report.

The "Simulation Parameters" section lists component data calculated from the simulation data. The simulation consists of data from one Burst Mode cycle of the switching circuit.

Note: In addition to viewing the report on the screen, you can print a hard copy of the report by selecting the Print command from the File menu.

The Report Menu

When the Switcher Circuit Report Window is active, the Report Menu appears on Micropower SwitcherCAD's menu bar. The Report Menu contains only one command, Font. This command selects the font used to display and print the report.

Note: the Font command supports only TrueType™ fonts (i.e., not Adobe type 1 fonts installed under Adobe Type Manager™).

Title: AA NiCd to 5V at 10mA
Document Version: 2.0

Circuit Parameters:

Type: through hole

Vin: AA NiCd cell(s), 100% charge, R source = 0.005 Ohms
Vout: 5V
Iout: 10mA

Parts List:

Device	Value	–
L1	120µH	Caddell-Burns 7070-24, DCR = 0.32 Ohms
C2	33µF	Sanyo 10SA33M, ESR = 0.13 Ohms, Irms = 1.37 Amps
Iload	10mA	–
Vin	1.32V	AA NiCd cell(s), 100% charge, R source = 0.005 Ohms
D1	420mV	Motorola 1N5817
C1	100µF	Sanyo 10SA100M, ESR = 0.05 Ohms, Irms = 2.67 Amps
Switch	0.62V	Linear Technology LT1073CN8-5
Rlim	130 Ohms	5%

Simulation Parameters:

Efficiency = 74 %
Switch Junction Temp. = 26°C

Device	Iavg	I RMS	I peak	Power	Other
L1	49.8mA	111mA	368mA	3.97mW	–
C2	287nA	46.9mA	340mA	275µW	–
Iload	10.0mA	10.0mA	10.2mA	50.4mW	–
Vin	51.2mA	113mA	376mA	67.6mW	Battery life time 9.87hrs
D1	10.0mA	48.0mA	349mA	4.22mW	–
C1	23.0µA	3.49mA	14.4mA	5.48nW	–
Switch	39.8mA	99.6mA	368mA	4.26mW	Iq loss 1.88mW, input current 1.42mA

Figure 2.15. Micropower SwitcherCAD Report

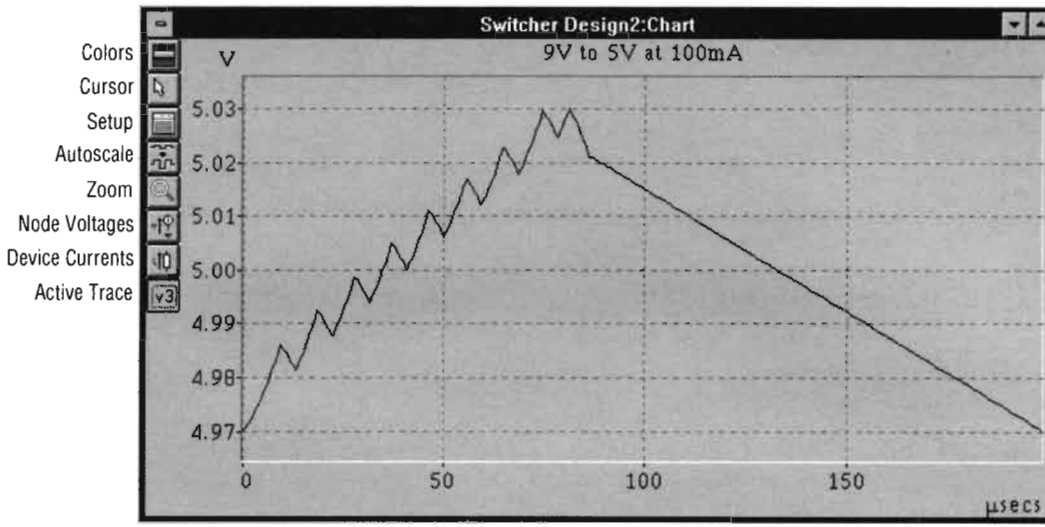

Figure 2.16. Simulation Chart Window

THE SIMULATION CHART WINDOW

Use the Simulation Chart Window to display and manipulate simulation data. You can view the voltage responses of the nodes annotated in the Switcher Document Window, or the currents through critical components, in this window. You can change trace colors, display one or two cursors, display one or two y-axes and zoom in or out.

When Micropower SwitcherCAD implements a new design, it simulates one Burst Mode cycle and creates a Chart Window showing the voltage at the output node, V3 (Figure 2.16). Clicking on a node number in the Switcher Document Window creates a new Chart Window with the voltage response of that node as the active trace. You can add further traces to an existing chart by selecting node voltages from the Node Voltage submenu of the Chart menu, or by selecting a device name from the Device Current submenu, or via the equivalent speed buttons (see below). A new trace automatically becomes the active trace and is autoscaled to fill the grid area.

Each trace displayed in the Chart Window has a corresponding speed button. These speed buttons are added at the bottom of the column of standard speed buttons at the left border of the window. The label inside the button indicates the node voltage or the first two characters of the device name, depending on whether the trace represents a voltage or a current. The active trace is indicated by a dotted rectangle around the speed button label. If you click on the active trace's speed button, the corresponding trace will be deleted and the speed button will be removed. Clicking on a speed button for an inactive trace will make that trace active. The active rectangle will move to the new speed button and the y-axis labels will change color to match the color of the active trace.

The Chart Menu

When a Simulation Chart Window is active, the Chart Menu appears on the Micropower SwitcherCAD menu bar. The commands on the Chart Menu are duplicated by a series of speed buttons, which appear on the left border of the window.

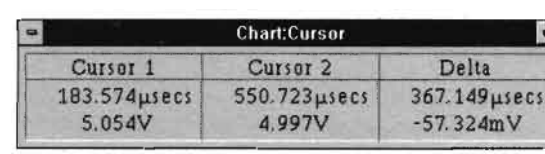

Figure 2.17. Chart Cursor Window

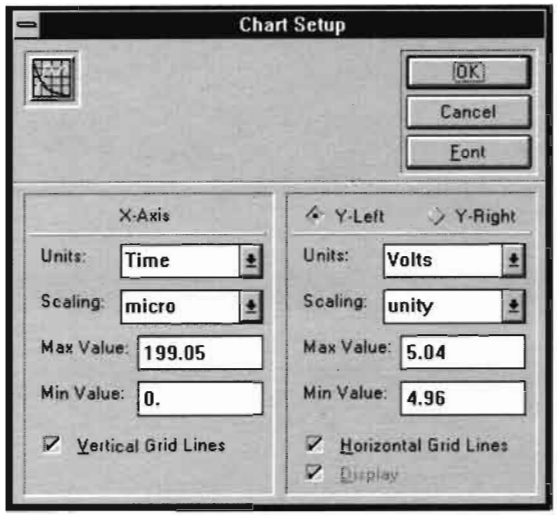

Figure 2.18. Chart Setup Window

Color

This command opens a submenu of color bars from which you can select a new color for the active trace on the chart. The y-axis labels for the trace also change to the new color.

Cursor

The Chart Window can display one or two chart cursors, which you can use to examine the value of the active trace at a specific x-axis (time) position. The cursor command enables or disables these chart cursors. If no cursors are enabled, the command turns on a single cursor. If one cursor is enabled, it turns on the second cursor. If both cursors are enabled, it turns them both off.

If only one cursor is enabled, the cursor values are displayed in the upper right-hand corner of the chart. The top value, shown in black, is the x-axis position of the cursor. The second value is the voltage or current value of the active trace at the cursor position, and is shown in the same color as the trace.

If both cursors are enabled, Micropower SwitcherCAD displays the cursor data in a Cursor Window that it opens above and to the left of the Chart Window (Figure 2.17). The Cursor Window is divided into three columns: the first two columns display cursor information, in the same format as described above, and the third displays the difference (Delta) between the two cursor positions.

To move a cursor, click on the arrow above the cursor line and drag the cursor to the left or right. Observe that the cursor values are updated as the cursor moves.

Setup

This cornmand opens the Chart Setup Dialog Box (Figure 2.18), in which you can change the scaling of the x- and y-axes, or to enable or disable a second (right) y-axis (the left y-axis is always enabled). You can also specify whether the chart will display grid lines for the x- and/or y-axes.

To enable the second y-axis, select the Y-Right radio button and check the Display check box. Select OK and the chart will display a second y-axis to the right of the grid, with the units and scaling you have specified.

Any new trace activated on a chart with multiple y-axes will be attached to the active axis. The active axis is indicated by a dotted focus rectangle around the axis' units label (located at the upper left- or right-hand corner of the chart). To make an axis active, click the left mouse button anywhere in the axis area. The focus rectangle will move to that axis's units label. To attach a trace to a different y-axis, make the trace active and double click the left mouse button in the new axis's label area. The axis's tick marks will change color to match the trace color and the trace will be rescaled to the new axis values.

Autoscale Y-Axis

This command autoscales the range and units of the y-axis to match the values of the current trace. If the trace is zoomed, only the points visible are used to determine the minimum and maximum values displayed.

Zoom In/Out

Use the Zoom-In command to magnify a selected portion of the chart. Move the mouse pointer over the grid area; the pointer will change to a "crosshair" cursor. Move the crosshair to one corner of the area you wish to magnify.

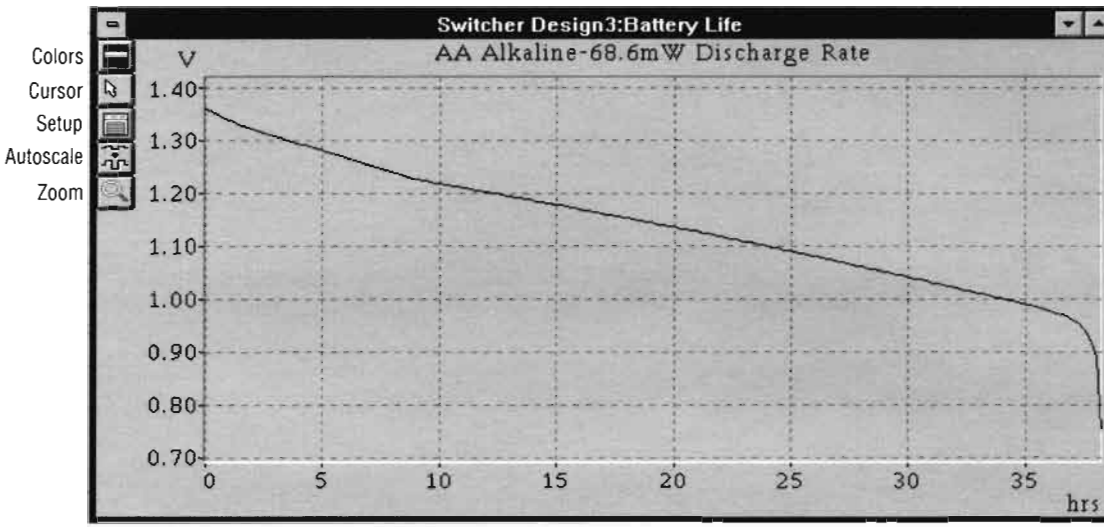

Figure 2.19. Battery Life Window

Click the left mouse button—the pointer will change to a magnifying glass icon—and drag to stretch a "zoom rectangle" around the area you wish to magnify, then release the button. You can zoom in repeatedly to view smaller areas in greater detail.

Note: zooming in is most likely to reveal added detail if you have performed a full simulation.

To zoom out to the previous, lower level of magnification, select Zoom Out from the menu or click the zoom speed button. You can zoom out only if you have previously zoomed in.

Displaying Node Voltages and Device Currents

The Node Voltage and Device Current commands open submenus showing the voltages and currents in your switching power supply design that are available for viewing on the chart. Selecting a voltage or current that is not currently displayed adds a trace for that voltage or current to the chart and makes it the active trace. Selecting an inactive trace makes it active. Selecting the active trace deletes it from the chart.

The Battery Life Window

If you specify a battery supply in the Input Voltage Selection Dialog Box (see above) Micropower SwitcherCAD performs a battery simulation and displays the results in the Battery Life Window (see Figure 2.19).

The battery simulation uses a simplified battery model and simulates a constant power drain from the battery. This power is calculated from a simulation of one Burst Mode cycle. The power value can be found in the "Simulation Parameters" section of the Report window. The power value for V_{IN} is the same as that shown in the Battery Life window title.

Note: the battery simulation is separate from the main circuit simulation.

The Chart Menu

Like the Simulation Chart Window, the Battery Life Window has a Chart Menu and a corresponding set of speed buttons. The commands available on the Chart Menu—Color, Cursor, Setup, Autoscale Y-Axis, and Zoom In/Out—are identical to those described previously for the Chart Window.