The Complete Electronics Lab

TINA
Design Suite

TINA Design Suite is a powerful yet affordable circuit simulation and PCB design software package for analyzing, designing, and real time testing of analog, digital, VHDL, MCU, and mixed electronic circuits and their PCB layouts. You can also analyze SMPS, RF, communication, and optoelectronic circuits; generate and debug MCU code using the integrated flowchart tool; and test microcontroller applications in a mixed circuit environment. A unique feature of TINA is that you can bring your circuit to life with the optional USB controlled TINALab II and LogiXplorer hardware, which turns your computer into a powerful, multifunction T&M instrument. Electrical engineers will find TINA, now enhanced with *super-fast multi-core engine*, an easy to use, high performance tool, while educators will welcome its unique features for the training environment.

Components

The TINA library includes over 20,000 parts and manufacturer models which can be modified by the user. In addition, you can create new TINA components from any Spice subcircuit or S-parameter table whether created by yourself, downloaded from the Internet, or obtained from a manufacturer's CD. TINA's intelligent Library Manager will help you to automatically convert manufacturer's data to TINA subcircuits.

Component models include:

Passive components: resistor, potentiometer, thermistor, lamp, capacitor, lossy capacitor, charged capacitor, inductor, energy-storing inductor, coupled inductors, nonlinear coil, transformer, relay, diodes (including Zener, multi-color LED, varicap, Schottky, Graetz, diode arrays), motor, transmission line, fuse.

Active components: bipolar transistor (NPN and PNP), darlington transistor, MOS transistor (including BSIM3 models), JFET (N and P channel), IGBT, thermistor, thyristor, triac, diac, ideal or nonlinear operational amplifier, transient and average SMPS models, manufacturer made Spice models, optoelectronic components: photodiode, phototransistor, solar cell, optocoupler.

Sources: current source, voltage source, current generator, voltage generator, standard and arbitrary user-defined waveforms, PWL, WAV file, linear and nonlinear controlled sources (CCCS, VCCS, CCVS, VCVS), digital pulse source, digital clock.

Basic digital components: AND, OR, NAND, NOR, and XOR gates with 2, 3 and 4 inputs, buffer, tri-state buffer, inverter, Schmitt inverter, D flip-flop, SR flip-flop, JK flip-flop, D latch

Digital ICs: MCU (PIC, AVR, ARM,8085), 4000 logic family, 74000 logic family, VHDL to test and build your own logic components, FPGA and CPLD libraries

Measuring instruments: voltage meter, voltage pin, test point (for real time measurement), ampere meter, current arrow, power meter, impedance meter.

Other components: time controlled switch, voltage controlled switch, AD and DA converter, timer, comparators, analog control blocks, pull-up resistor, seven-segment display, keypad, voltage regulator, vacuum tube, passive and active RF components, two ports (S, Z, Y, H).

Virtual Instruments: Digital multimeter, function generator, storage oscilloscope, XY recorder, digital signal generator, logic-, signal-, spectrum-, and network-analyzer

Supplementary Hardware: Expand TINA into a complete lab with the following hardware components:

TINALab II High Speed Multifunction PC Instrument, with USB interface
Multimeter, oscilloscope, logic analyzer, signal analyzer, spectrum analyzer, function generator, variable voltage power supply and digital signal generator function. Slot for plug-in electronics experiment modules

Logixplorer: High speed, small size Logic Analyzer, with USB interface.

Electronics Experiment Modules for TINALab II to illustrate the operation of circuits, to develop and evaluate troubleshooting skills

FPGA Development Kit for TINALab II provides an easy-to-use, low-cost evaluation platform for developing designs and applications based on the Xilinx Spartan-II FPGA family.

Licensing options: DesignSoft provides many licensing options, both for **industry** and **education** depending on your needs and environment. **For industrial users** beyond individual licenses, discounted second and site licenses are available with different capabilities and price points. **For education,** in addition to individual teacher and student licenses, a wide choice of site licenses are available including campus licenses for whole institutions. Along with campus licenses **downloadable student licenses for home use** and for the whole campus are also available. Contact DesignSoft or your local DesignSoft distributor for further details.
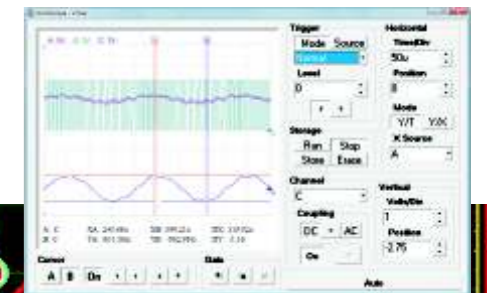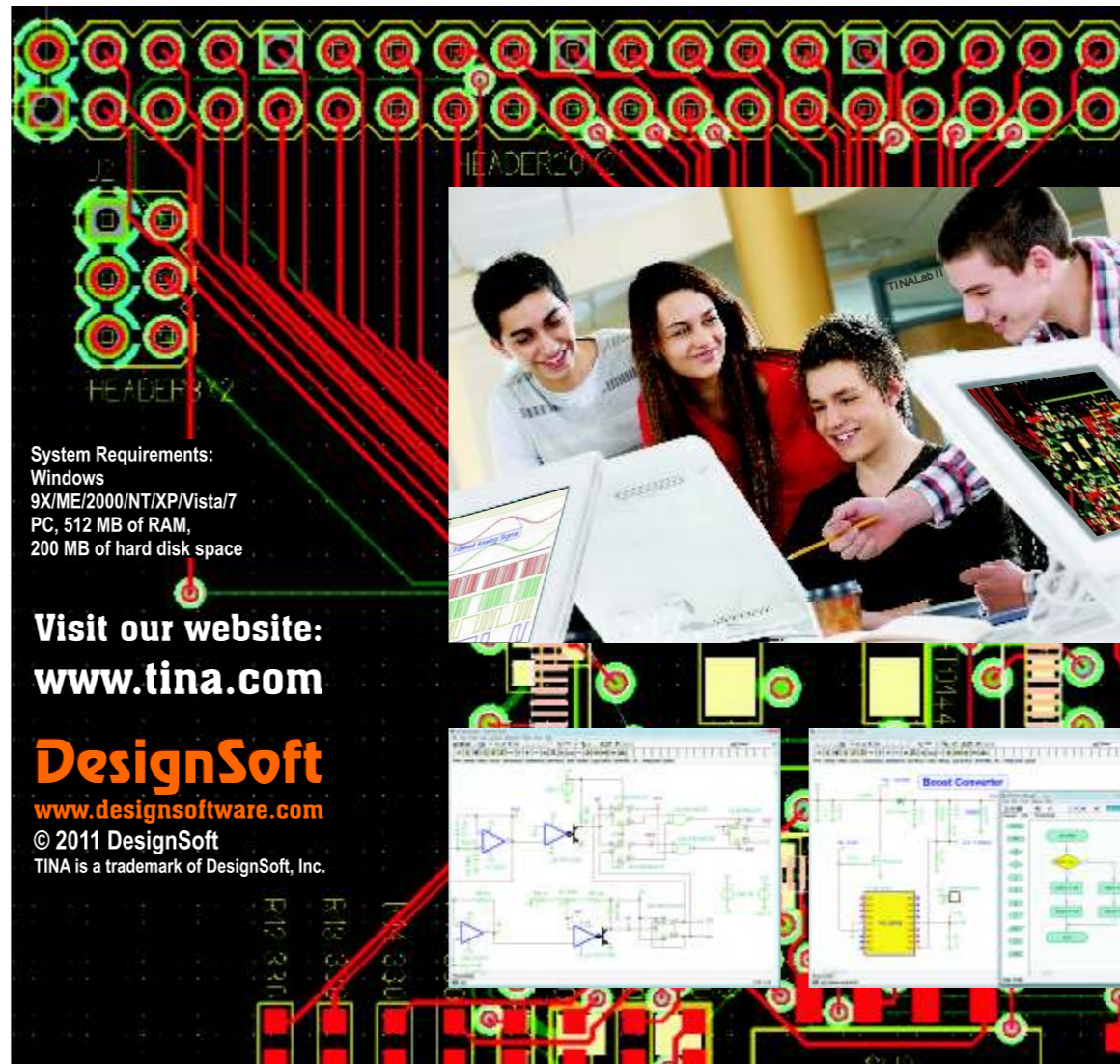
System Requirements:
Windows
9X/ME/2000/NT/XP/Vista/7
PC, 512 MB of RAM,
200 MB of hard disk space

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www.tina.com

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Analog
Digital
VHDL
RF
Symbolic
Mixed
Mode
Circuit
Analysis

PCB
Layout
Design
with
3D View

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DesignSoft
www.designsoftware.com

TINA makes it easy to create annotated schematics, 3D circuits, subcircuits, flowcharts, graphs, equations, and netlists that get your message across clearly and professionally.

Schematic-, Netlist-, and Symbol Editor

Circuits are entered with TINA's easy to use schematic editor. Standard Windows editing commands, including unlimited Undo and Redo, make it easy to create schematics of virtually any size. You can check schematics for errors with TINA's advanced ERC functions. The schematic editor supports complex hierarchical designs, design by teams, and version control. You can export your design to popular PCB packages and extract a Bill of Materials. With the integrated Schematic Symbol Editor, you can modify or create any component shape. You can also analyze Spice format netlists via the Netlist Editor. Now you can open TINA designs, models and libraries as well as Import Spice .CIR and .LIB files directly from the Web.

Open from the Web!

Schematic Editor

Text and Equation Editor

TINA includes a text and equation editor for annotating schematics, calculations, graphic output, and measurement results. Simply enter your text and set the format as you would in Windows (font, size, and color). With the embedded equation editor and an extensive assortment of templates, it is easy to enter mathematical formulas, preview the result, and place on TINA's Schematic Editor or Diagram Window. Engineers will appreciate the editor for documenting designs and simulations, while educators will find it an invaluable aid in preparing problems and examples.
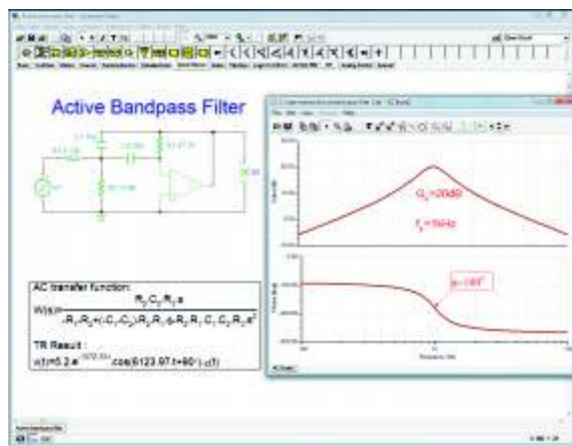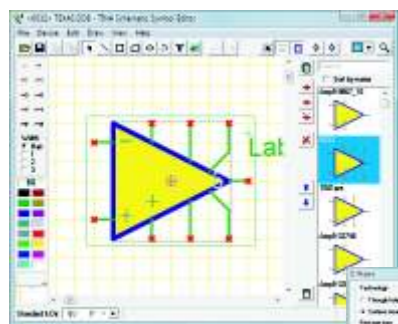
Text and Equation Editor

Schematic Symbol and Footprint Editor

Using TINA's Schematic Symbol Editor, you can create new schematic symbols and add them to your library of circuit components. When creating new symbols, you have a full set of tools with which to place lines, arcs, rectangles, and arbitrary characters.

You may select the font, line width, color, and area color fills. After drawing the symbol, add and define its external connections (pins). Using the Footprint Editor, you can create new footprint symbols to add to the footprint library. When faced with creating a complex multi-pin device (more and more common these days) and its footprint, TINA's IC Wizard can assist you.

Symbol Editor

IC Wizard

Macros and user defined components

You can create new TINA components from any Spice subcircuit, VHDL component, S-parameter table, or schematics whether created by yourself, downloaded from the Internet, or obtained from a manufacturer's CD. TINA's intelligent Library Manager will convert most available data automatically to TINA subcircuits. TINA automatically represents these subcircuits as a rectangular block, but you can create any shape you like with TINA's Schematic Symbol Editor. You can also use TINA's parameter extractor program to calculate model parameters from catalog or measurement data and then add the new devices to the catalog.
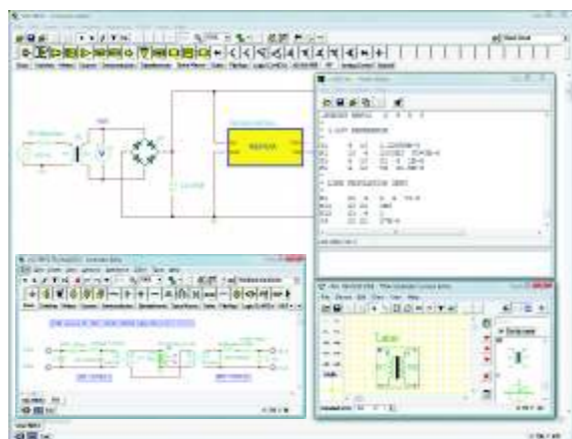
User Defined Components

Live 3D Breadboard view

Using the Live 3D Breadboard tool in TINA, you can automatically build a life-like 3D picture of a solderless breadboard. When you run TINA in interactive mode, components like switches, LEDs, instruments, etc. become "live" and will work on the virtual breadboard just as in reality. You can use this capability of TINA to prepare and document lab experiments. You can either assemble the circuit step-by-step or by generating the whole circuit on the breadboard. Pick up and move parts on the breadboard using the mouse, and TINA will automatically rearrange the wiring while retaining connectivity.
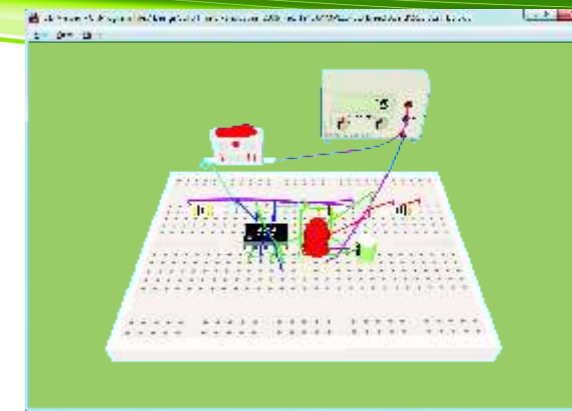
3D breadboard with animated LEDs

Interpreter

Another powerful feature of TINA is its interpreter. Using a text editor, you can enter arbitrary functions and solve systems of linear equations or evaluate integrals. The interpreter can also process and draw previous results and reference component parameters. Another use for TINA's interpreter is to define arbitrary analog and digital waveforms. You can also use the Interpreter to calculate and set component parameters. Finally, with the interpreter students can solve problems, simply working with the related component's name and intermediate quantities created with the interpreter.
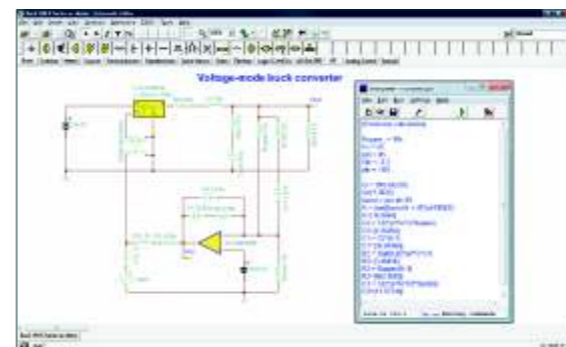
Component Parameter Calculation with the Interpeter

Flowchart Editor and Debugger

Writing MCU assembly code is often a hard and tedious task. You can simplify software development and gain more time to design the electronics hardware if, instead of manual coding, you use TINA's Flowchart editor and debugger. This will generate the MCU code, using just symbols and flow control lines. You then run and debug this code in a digital or mixed signal environment.

Flowchart Editor

Diagram Window
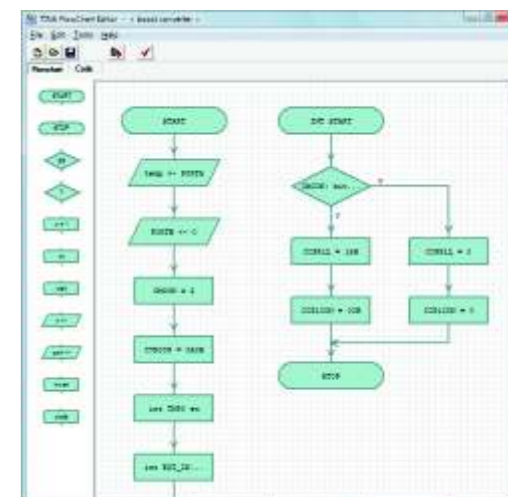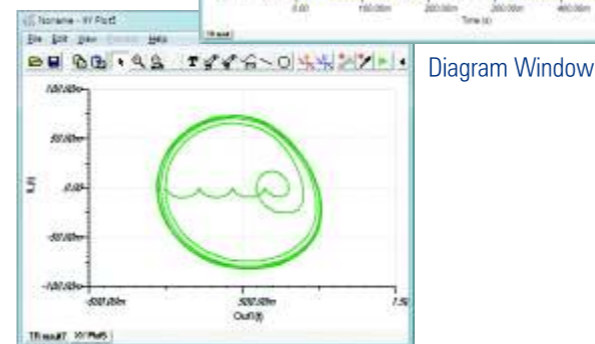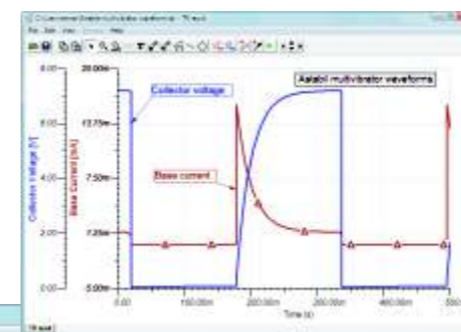
Trajectory Drawing

Sophisticated Diagram Tool with Post-processor

With TINA you can make quality documents incorporating Bode plots, Nyquist, polar and Smith diagrams, transient responses, digital waveforms, and other data using linear or logarithmic scales. Customize presentations using TINA's advanced drawing tools you can print your plots directly from TINA, cut and paste them into your favorite word processing package, or export them to popular standard formats. Customization includes complete control over fonts, texts and lines along with automatic or manual scaling for each axis.

With the Post-processor you can add new curves of virtually any node, component voltage or currents. In addition, you can process existing curves by applying mathematical functions or draw trajectories, i.e., draw any voltage or current as a function of another voltage or current.

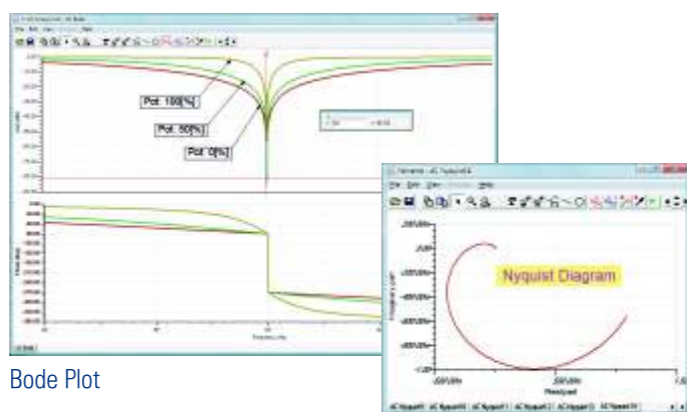**A comprehensive suite of analysis tools equip you to solve a wide range of analog and digital circuits**
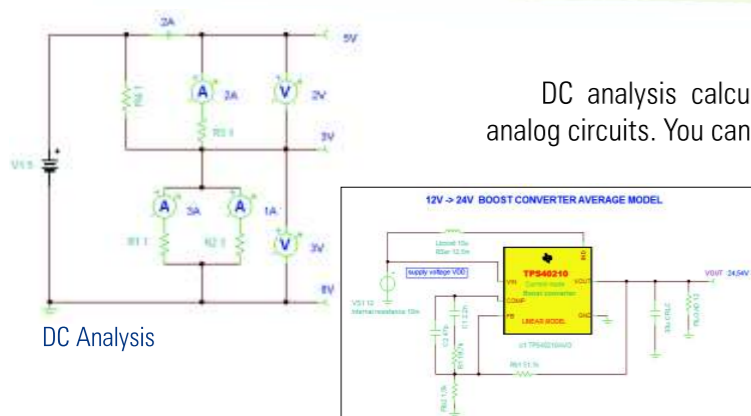
DC Analysis

DC analysis calculates the DC operating point and the transfer characteristic of analog circuits. You can display the calculated nodal voltages or component currents in a table or at any node by selecting the node with the cursor.

Powerful methods (source- and Gmin stepping, adaptive voltage and step-size limiting) are implemented to find the operating point even for strongly nonlinear cases with hard convergence properties. You can also calculate and display in a diagram the temperature dependence of any voltages or currents in your circuit.

DC Analysis

Microcontroller Support

TINA includes a wide range of microcontrollers (PIC, AVR, ARM, 8051) which you can test, debug and run interactively. TINA's integrated MCU assembler and debugger allows you to modify or debug your code and see the result promptly. You can also debug your code using TINA's flowchart tool following the code execution block-by-block. You can also use a binary (HEX) code and debug (LST) file made by any standard compiler e.g. with MPLAB for PICs.

MCU Circuit & Debugger

AC Analysis

AC analysis calculates RMS amplitude and phase of voltages and currents in your circuit and the complex power of selected parts. You can display the calculated complex nodal voltages or component currents in a table or at any node by selecting the node, part, or instrument with the cursor. In addition, Nyquist and Bode diagrams of amplitude & phase and group delay characteristics of analog circuits can be plotted You can also get the complex Phasor diagram. For non-linear circuits, the operating point linearization is done automatically.
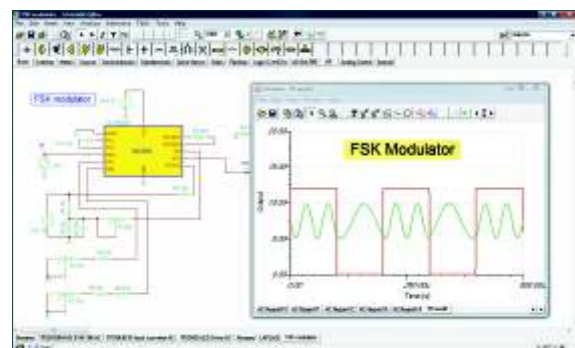
Bode Plot

Nyquist Diagram

Mixed mode simulation

TINA also includes a powerful mixed mode simulation engine. It is based on the XSPICE mixed mode algorithm, extended with MCU and VHDL components. In your circuits you may freely mix any analog or digital components of TINA, including microcontrollers (MCUs) and macros with Spice or VHDL content. You can modify these components on the fly along with the code in the MCUs. TINA will analyze the analog parts in analog, the digital parts in digital, and will automatically create the interfaces among the components. This ensures synchronization and fast convergence.
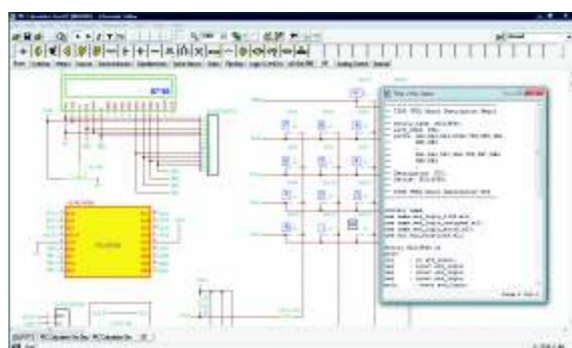
Mixed mode simulation

Transient Analysis

In the transient and mixed mode of TINA, you can calculate the circuit time response to the input waveform, including pulse, unit step, sinusoid, triangle, square, general trapezoidal waveform, Spice PWL table, .WAV files and user-defined excitation) parameterized as required. You can also use components with initial conditions to accelerate circuit startup. For digital parts, programmable clocks and digital signal generators are available.

Transient Analysis

Interactive mode

The ultimate test of your circuit is to try it in a "real life" situation using its interactive controls (such as keypads and switches) and watching its displays or other indicators. You can carry out such a test using *TINA's* interactive mode. Not only can you play with the controls, but you can also change component values and even add or delete components while the analysis is in progress. The interactive mode is also very useful for educational and demonstration purposes, for tuning circuits interactively, and for interactive circuits which you cannot test otherwise, e.g., circuits with switches, relays, or microcontrollers.

You can play with the controls both on the schematic or on the 3D view.

Interactive mode

Digital and VHDL Simulation

Digital Simulation. TINA includes a very fast and powerful simulator for digital circuits. You can trace circuit operation step-by-step, forward and backward, or view the complete time diagram in a special logic analyzer window. In addition to logic gates, there are ICs and other digital parts from TINA's large component library.
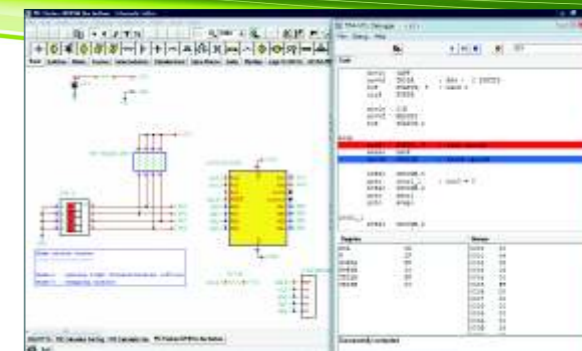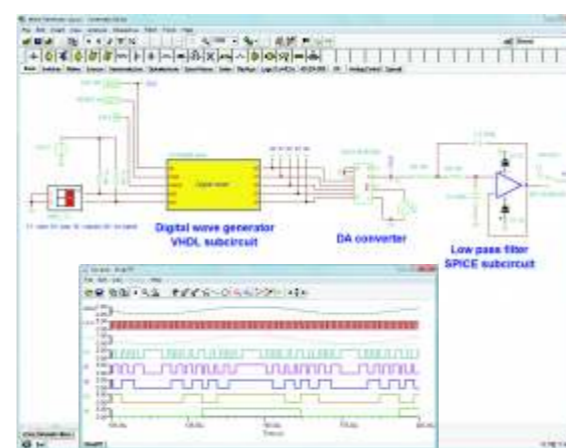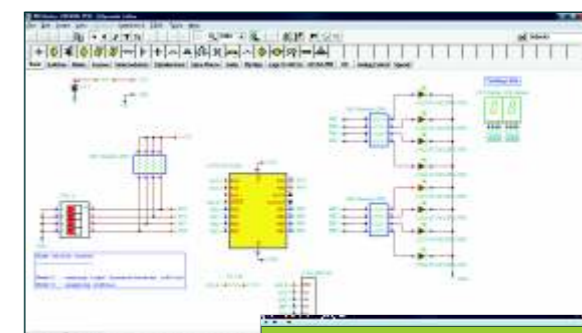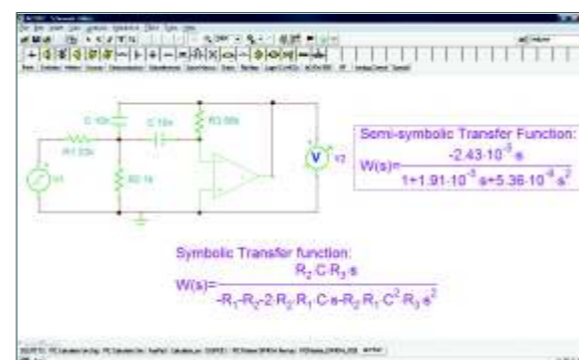
VHDL Simulation

TINA also includes an integrated VHDL simulator to verify VHDL designs both in digital and mixed-signal analog-digital environments. It supports the IEEE 1076-87 and 1076-93 language standards, 1164-93 Standard Logic, Vital, Simprim and Unisim. Your circuits can contain editable VHDL blocks from TINA's library, FPGAs & CPLDs, or VHDL components created by yourself or downloaded from the Internet. You can edit the VHDL source of any VHDL component and see the result instantly. With the optional external VHDL simulator, you can develop and debug your VHDL code both externally and inside TINA. The VHDL simulator includes Waveform Display, Project Management and Hierarchy Browser, and 64-bit time.

VHDL Analysis

Symbolic Analysis

Symbolic Analysis

Symbolic analysis produces the closed form expression of the transfer function, equivalent resistance, impedance, or response of analog linear networks. In DC and AC analysis mode, TINA derives formulas in full-symbolic or semi-symbolic form. In transient analysis, the response is determined as a function of time. Circuit variables can be referenced either as symbolic names or by value on a component-by-component basis. Through symbolic analysis, poles and zeros of linear circuits can be calculated and plotted. You can efficiently prepare classroom or textbook materials by printing or by copying and pasting your expressions to any Windows program.

You can work in a simulated electronics lab using a wide range of powerful, virtual instruments. Unlike lab instruments, however, these circuit simulation driven instruments cost nothing and require no maintenance

TINA is far more than a simulation software with virtual measurements you can install supplementary hardware that allows real time measurements controlled by TINA's on-screen virtual instruments

Digital Multimeter

Measure DC and AC voltage and current, resistance, and frequency with TINA's Digital Multimeter. You can use the multimeter in manual or in autoranging mode.

Storage Oscilloscope
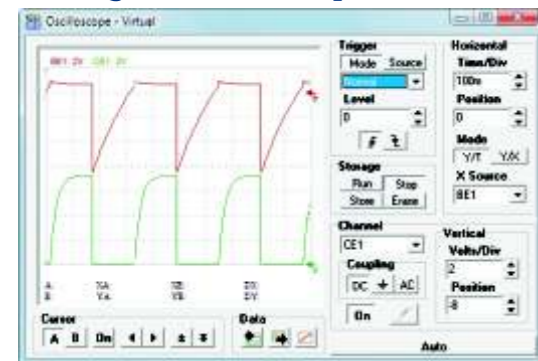
Display analog waveforms with TINA's multichannel analog Storage Oscilloscope. You can select external or internal triggering and a variety of trigger modes. You can also move graphics cursors to accurately measure voltage and time.

Digital Signal Generator
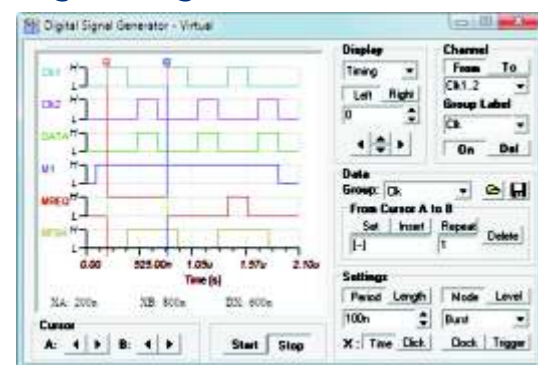
Use the Digital Signal Generator to create any number of arbitrary digital signals to serve as stimuli for your logic circuit. Set up timing patterns effortlessly using the built in editor with insert, repeat, and delete functions as well as graphics cursor editing.

Function Generator

Generate sinusoidal, square, triangular and arbitrary waveforms at virtually any frequency. The powerful sweep mode lets you choose start/stop frequencies, step size, step time, and single or continuous sweeps.
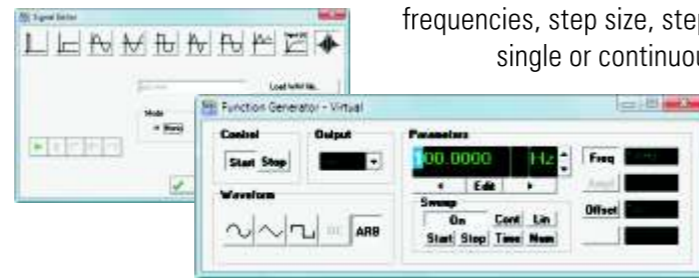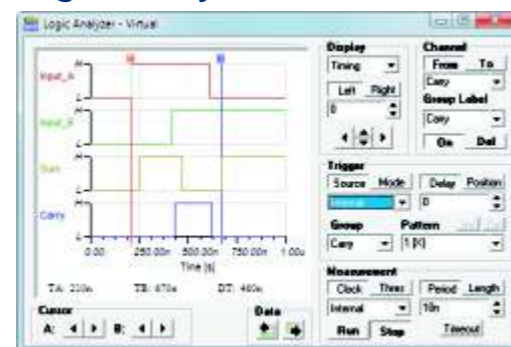
Signal and Network Analyzer
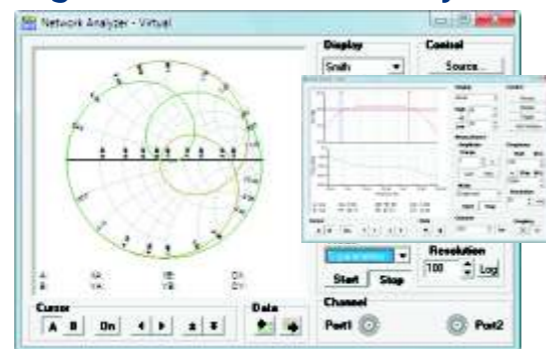
The signal analyzer measures and displays Bode amplitude and phase diagrams, Nyquist diagrams, Fourier Spectrum, and more. The Network Analyzer is similar to the Signal analyzer, but measures S, Z, Y and H parameters, displaying the results as Smith, Polar, or other diagrams.

Logic Analyzer

Debug your digital circuit with the advanced Logic Analyzer. Select any number of channels and arrange them into groups for easier viewing. You can also define trigger patterns so that the analyzer will capture a critical data segment.

Design & Simulation

Imagine the convenience of a uniform user interface for both the virtual measurements of circuit simulation

Build & Test Prototype

and computer controlled actual instruments of test and measurement!

Real-Time Test & Measurement

TINALab II Multifunction PC Instrument

With the TINALab II supplementary hardware you can turn your computer into a real-time multifuction T&M instrument integrated into TINA. Multimeter, oscilloscope, signal analyzer, logic analyzer, arbitrary waveform generator. You can also plug experimenter modules to study, simulate, measure, and troubleshoot virtually the whole range of analog and digital electronics.

Real-time Signal and Logic Analyzer
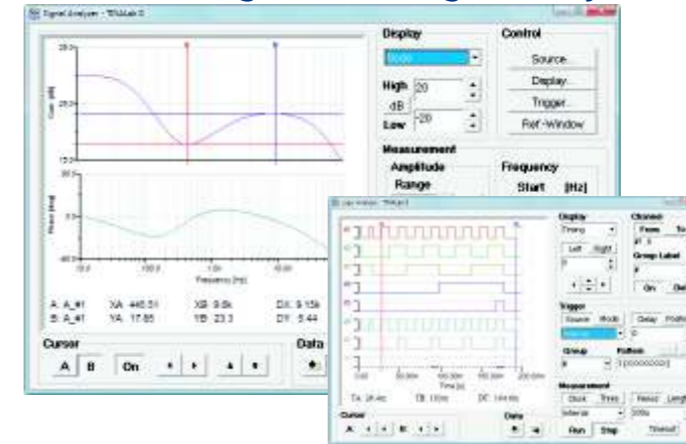
Measure the frequency response of your circuit in real-time. TINALab's Function Generator will generate a real swept-sine signal, capture the response, and display it on the Signal Analyzer, where it can be compared to the virtual (simulated) measurements. Set up the test stimulus for your logic circuit with the Digital Signal Generator and see 16 channels of your circuit's real-time digital response on the Logic Analyzer up to 40 MHz.

FPGA Development Board

The TINALab Spartan-II FPGA Development Board provides an easy-to-use, low-cost evaluation platform for developing designs intended for realization in the Xilinx Spartan-II FPGA family. Design your project in TINA using its VHDL tools, download to the TINALab Spartan-II board, and verify it using the switches, push buttons, LEDs and LCD on the Development Board. For a richer and more thorough verification, you can use the TINALab II Digital Signal Generator and Logic Analyzer to send data patterns to and from TINA.

Arbitrary Function Generator

The synthesized Function Generator provides sine, square, ramp, triangle and arbitrary waveforms from DC to 4MHz. Arbitrary waveforms can be programmed via the high level, easy to use language of TINA's Interpreter.
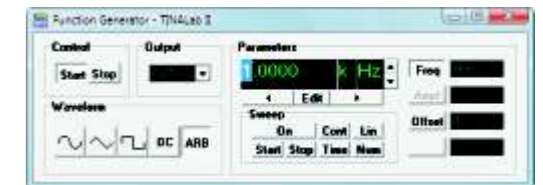
Real-time Storage Oscilloscope

TINALab II includes a DC to 50MHz bandwith,10/12 bit resolution, dual-channel Digital Storage Oscilloscope. Due to its advanced equivalent-time sampling technology, TINALab can acquire any repetitive signal with up to 4GS/s equivalent sampling rate, while in single shot mode the sampling rate is 20 MS/s.

LogiXplorer

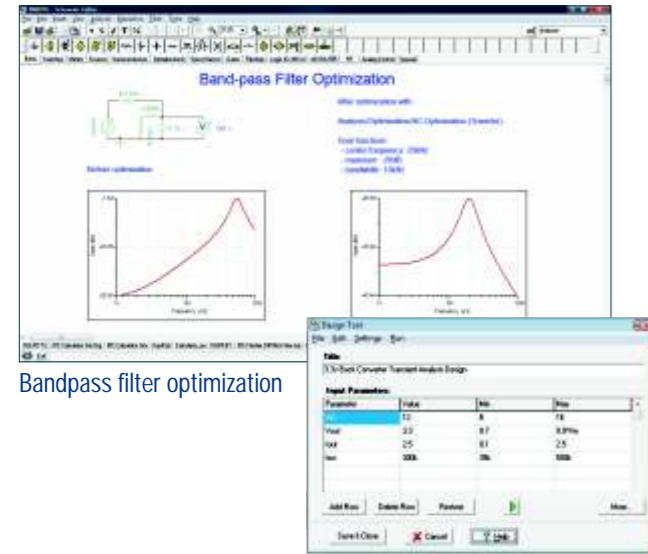## High speed, small size Logic Analyzer with USB interface

Measure digital signals with the LogiXplorer logic analyzer providing 32 channels sampled at high speed clock rates up to 500MHz with two additional state clock inputs. Offers dual-channel trigger threshold, multi-level triggering, frequency meter, protocol analyzer capability and real-time sample compression.
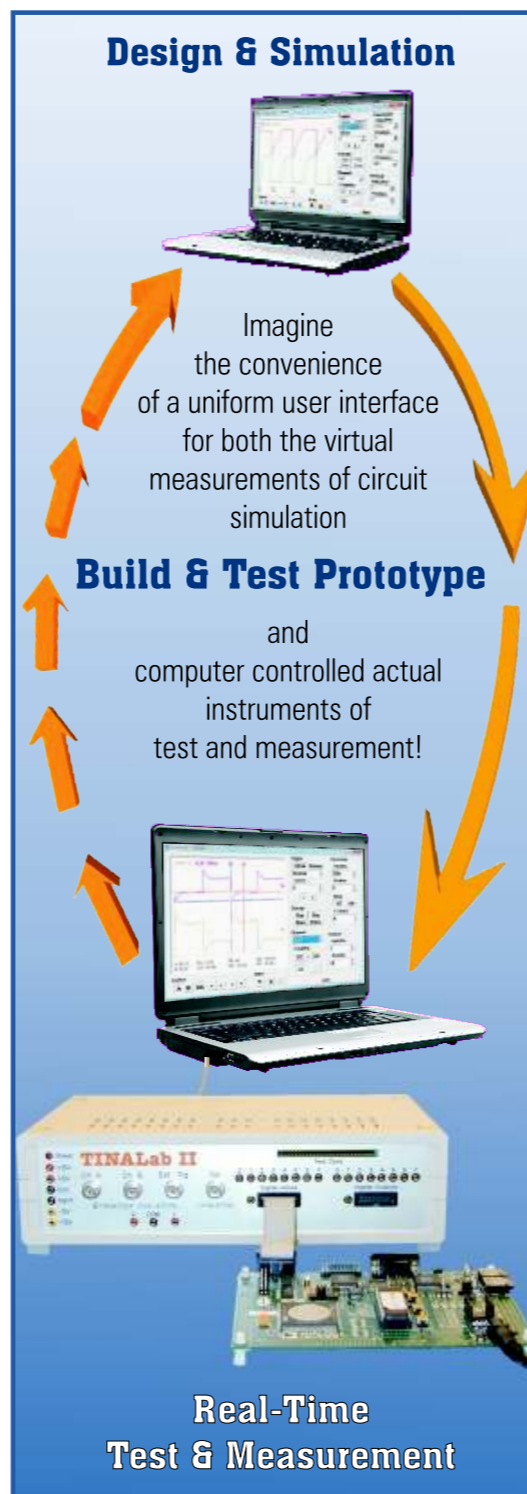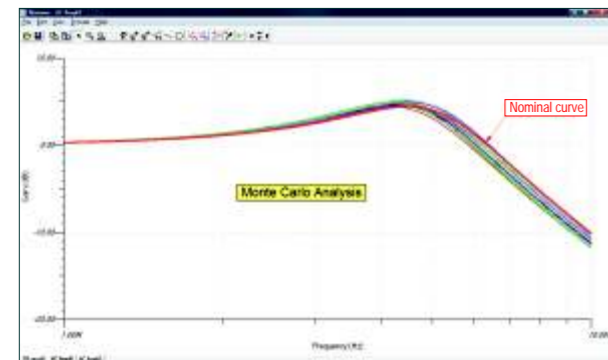
The advanced tools of TINA allow you to gain a deeper insight into circuit operation and optimize performance

Bandpass filter optimization

Design Tool

Multiparameter Optimization & Design Tool

Through optimization, TINA will optimize a circuit response to one or more predefined target values by automatically varying the values of one or more circuit parameters. The target circuit response (voltage, current, impedance, or power) must be "monitored" by a meter or meters previously inserted at the desired location(s). The unknown circuit parameter(s) will be determined automatically so that the circuit will produce the target output. Two alternative iterative methods (simple and pattern search) are used to find the optimum. Alternatively, you can use TINA's Design Tool which works with the design equations of your circuit to ensure that the specified inputs result in the specified output response.

Noise Analysis

TINA's noise analysis determines the noise spectrum of a circuit, and can refer the noise to either the input or the output. The noise power and the signal-to-noise ratio can also be calculated. TINA can also present noise as a curve of Total noise, at the output, as a function of frequency. In computing this curve, TINA sums all the noise from the start frequency up to the specified maximum frequency value and presents it as total noise. TINA's Noise analysis is based on AC Analysis and the results can be displayed and printed over a frequency range similar to the Bode diagram.
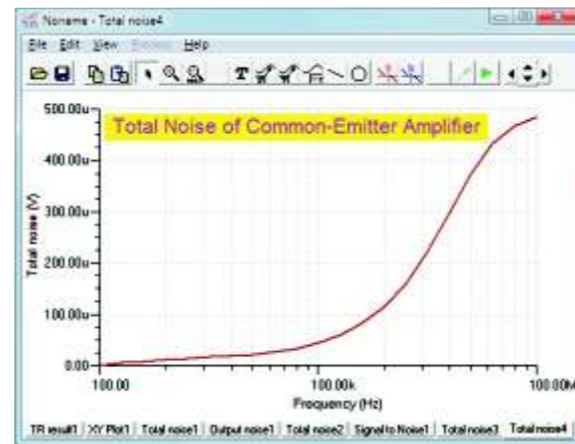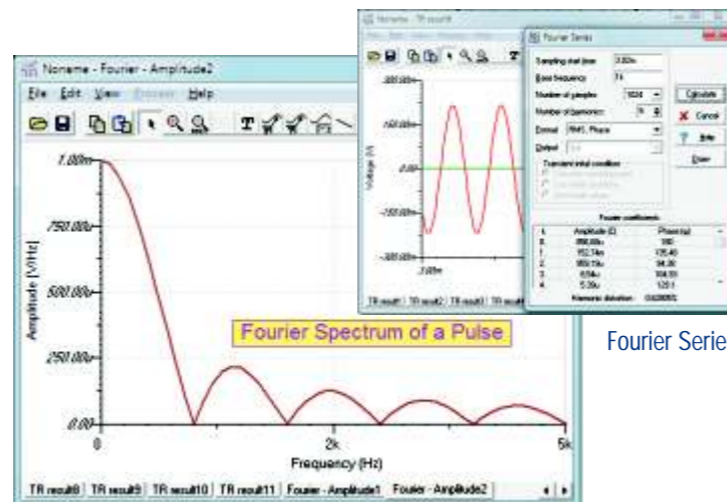

Total Noise Spectrum

Monte-Carlo Analysis

Monte Carlo and Worst Case Analysis

Tolerances can be assigned to the circuit elements for use in Monte-Carlo or worst-case analyses. The results can be evaluated statistically using expected means, standard deviations, and yields. Moving the cursor onto a particular curve retrieves the corresponding component values so that extreme results may be interpreted. The tolerance models provided for each component allow uniform, Gaussian, or general distribution. Using general distribution, you can define asymmetric tolerance as well as group tolerance.
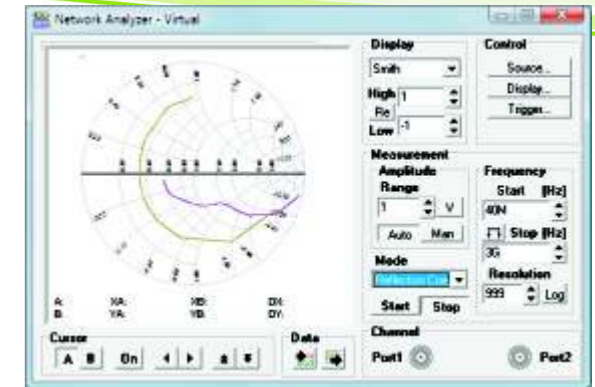
Fourier Analysis

TINA calculates both the Fourier series of periodic signals and the continuous spectrum of non-periodic signals. For periodic signals, TINA calculates the coefficients of the Fourier series as well as harmonic distortion. The Fourier series are presented both in exponential and trigonometric form, while the continuous spectrum is presented as amplitude density and phase or as amplitude density of cosinusoidal and sinusoidal components. You can carry out Fourier Analysis directly from the Analysis menu or after Transient Analysis for any curve in the diagram window.
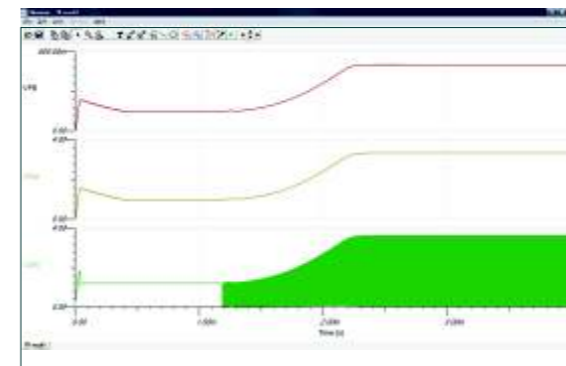

Fourier Series

Network Analysis

TINA's network analyzer allows you to determine the S, Z, Y and H parameters of networks. You can display the result of network analysis either in the diagram window or on the Network Analyzer screen. Results can be presented on Smith, polar, or orthogonal diagrams. You can move the cursor along a curve to display the value of the S, Z, Y, H network parameters. You can carry out network analysis both through AC analysis or with the Network analyzer virtual instrument.

Smith Diagram

Startup transient of an SMPS circuit

SMPS Analysis

SMPS or Switching-Mode Power Supply circuits are an important part of modern electronics. The heavy transient analysis needed to simulate such a circuit may take a lot of time and computer storage. In order to support the analysis of such circuits TINA provides powerful tools and analysis modes. The most time consuming part of an analysis of an SMPS circuit is to reach its steady state, when the DC level of the output voltage does not change and the output waveform has only a small periodic ripple. To find this state automatically, TINA has a powerful Steady State Solver. You can also make accelerated Input step and Load step analyses based on the initial values provided by the Steady State Solver.

Filter Design

TINA now includes a powerful filter design tool that accepts your filter specification (given in table or graphic form). TINA then determines the transfer function, the appropriate component values, and Bode diagram of the resulting filter. Next, if you intend to incorporate the filter into a larger project, you can transfer the schematic diagram of the filter to TINA's Schematic Editor where you can modify or analyze the circuit further and add it to your design. The filter tool can realize both passive and active filters with low pass, high pass, band pass, and band stop templates, using Butterworth, Chebyshev, Inverze Chebyshev and Elliptic approximations. You can select to realize the active filters with ideal Operational Amplifiers as well as simplified or manufacturer made Opamp models.
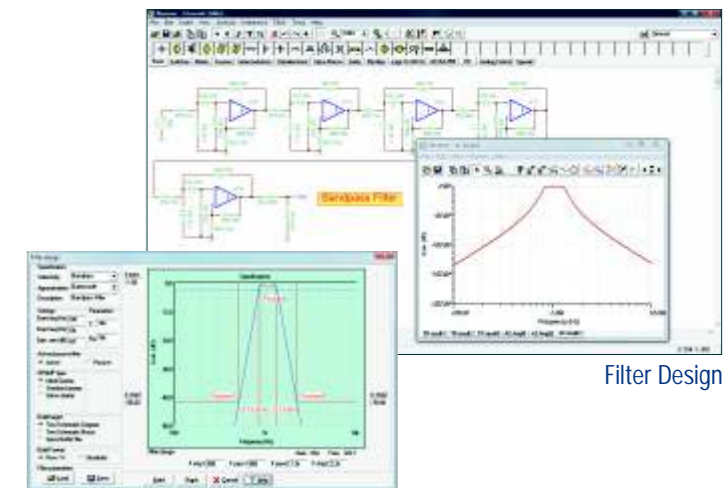
Filter Design
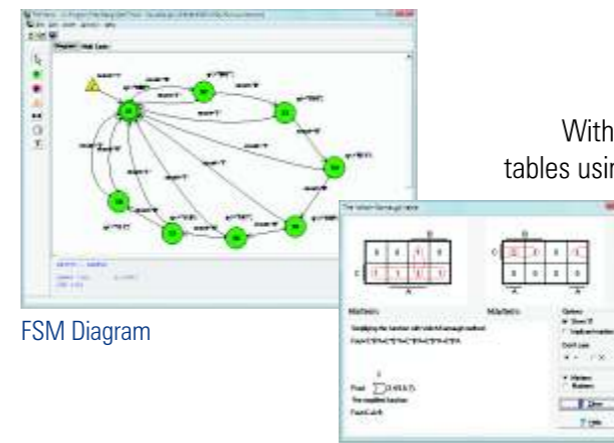
FSM Diagram

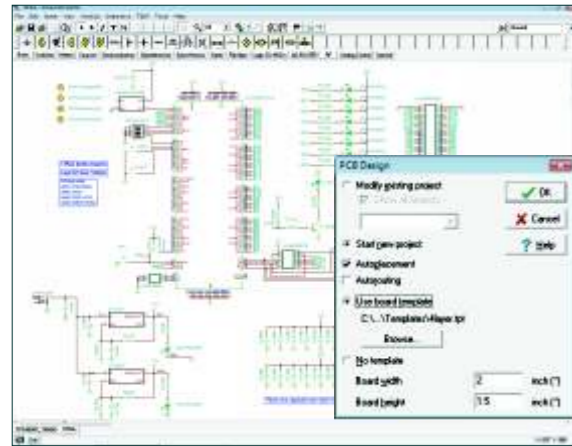## Logic and Finite State Machine Design

With the Logic Design module of TINA you can simplify logic expressions or Truth tables using several methods (Veitch-Karnaugh, Quine-McCluskey), draw the simplified schematic diagram and transfer into TINA to use, modify or connect with your circuit.

For educational purposes you can also determine minterms/maxterms or truth table from logic expressions or vice versa. With the Finite State Machine (FSM) Editor you can graphically design complex FSM diagrams, generate the corresponding VHDL macros then transfer and run them in TINA along with other macros and components.
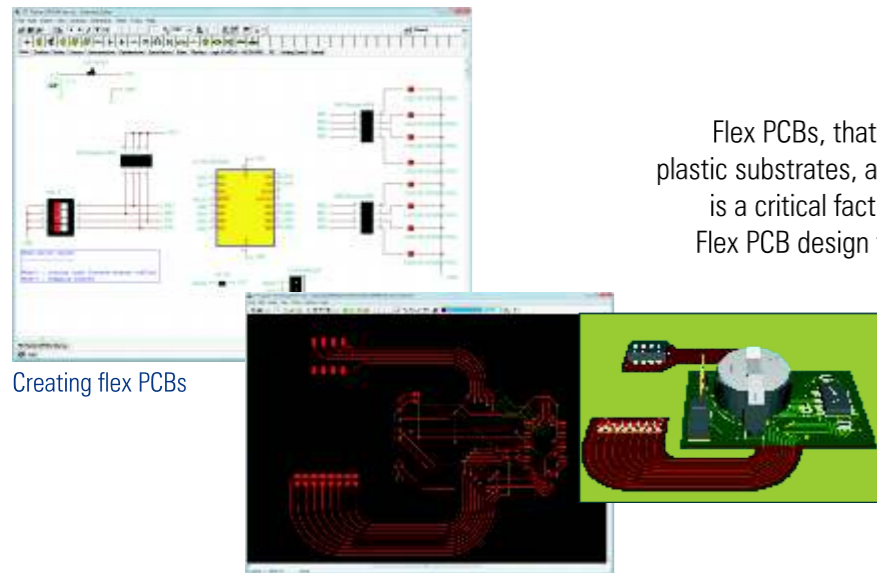

Karnaugh Map

PCB Layout Design

**The fully integrated PCB layout module of TINA
has all the features you need for advanced PCB design.**

PCB Design

PCB Design

The fully integrated PCB layout module of TINA has all the features you need for advanced PCB design. Once you have completed your schematic and run simulations, before starting PCB design, TINA will check each of the components in your design and verify its footprint. When you have finished checking footprints and shapes, use TINA's 2D/3D view button to see those parts which have been given a 3D view.. If there is some problem with a component you can change the physical view by double clicking the schematic symbol of the part and selecting the correct physical version.

Automatic and Manual Design Tools

TINA's advanced PCB designer has all the features you need for today's sophisticated PCB design, including multilayer PCBs with split power planes, powerful autoplacement & autorouting, rip-up and reroute, manual and "follow-me" trace placement, DRC, forward and back annotation, pin and gate swapping, keep-in and keep-out areas, thermal relief, fanout, plane layers, 3D view from any angle, Gerber file output and much more.

Creating flex PCBs

Flex PCBs, that is PCBs with electronic devices mounted on flexible plastic substrates, are very common in modern electronics where space is a critical factor e.g., cameras, mobile phones etc.. TINA supports Flex PCB design with various tools and makes them easier to design.

Creating flex PCBs

Using TINA's 3D viewer, you can visualize your design in 3D from any angle, along with the connected rigid PCB and the parts mounted both on the rigid and flexible part of the construction.
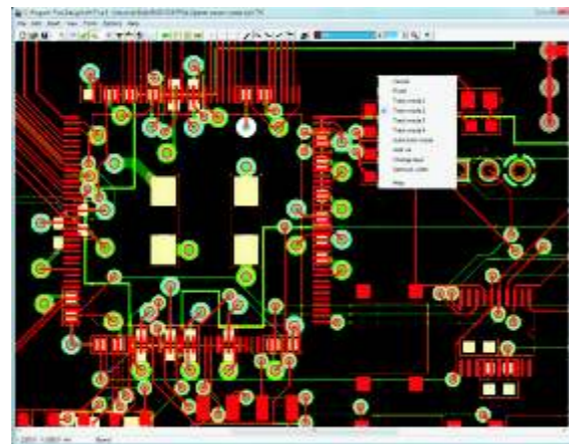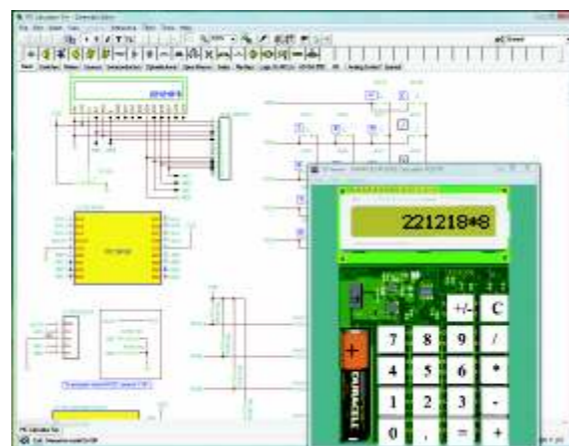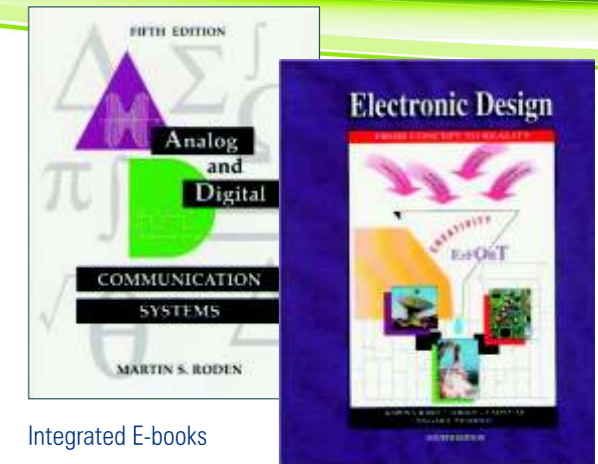
Animated 3D view

TINA has a powerful 3D Viewer for visualizing PCB designs and other parts connected to the PCB, such as batteries, instruments, wires etc.. The same viewer is used to show 3D virtual prototypes on breadboards. You can rotate the design with the mouse instantly into any direction and zoom in and out to check every detail of your construction. In addition you can bring the design to life by using interactive simulation in TINA. Now LEDs will light, LCDs will display and you can use all the interactive controls in your design. Using these features, you can evaluate user interfaces in advance of the real product hardware.

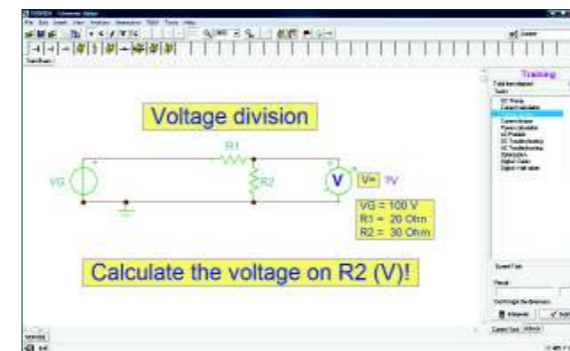**Animated 3D view**

Learning, Teaching and Training

**TINA's strong educationally oriented features give educators the tools
they need for effective computer-supported training.**

1200 circuits and Integrated E-books

TINA can be supplemented by a collection of 1200 example circuits and problems, covering virtually the entire world of electronics from DC to Analog and Digital circuits. In addition, several textbooks from leading authors are available, packed with circuits which come to life by just a mouse-click. Campus, site and student licenses are available for the e-Books, (which can be integrated with any version of TINA). Save the environment and learn from these paperless textbooks in the campus, classroom or at home.
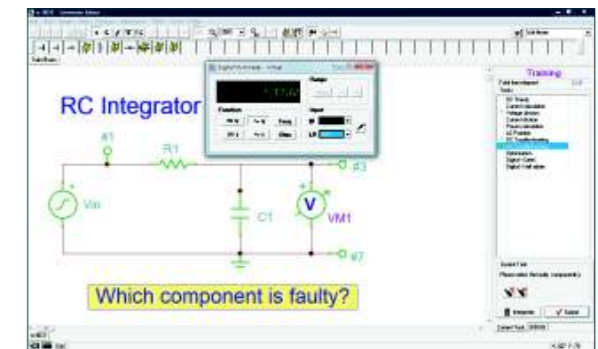

Integrated E-books

Problem Solving with TINA

Problem Solving with TINA

TINA has two special operating modes for training and examination. In these modes, the student works on problems under the supervision of TINA, which will solve the problems but wait and check the student's answer. A student can use symbolic names of components and answer with either formulas or numbers. In training mode, TINA warns the student of a wrong answer; in examination mode, it will simply evaluate and record the answer. A large collection of problems already worked out by teachers is available.

Teach and Learn Troubleshooting

There are several ways TINA can help teach troubleshooting. One way is through fault simulation in software. A circuit in TINA may have several 'shadow circuits', each containing one or more faulty components. The shadow circuits are hidden from the student, who can carry out virtual measurements to find and replace the faulty parts. Another option is to use the supplementary hardware, insert faults into the TINA Electronics Experiment Modules, and then find the faults with the aid of real and virtual measurements.

Troubleshooting with TINA

TINA as a Learning Management Tool

TINA automatically follows and records every problem solving and troubleshooting move made by a student, allowing the instructor to provide detailed and appropriate feedback. In a laboratory with multiple computers on a network, TINA's supervisor program allows the teacher to see all the students' activities and focus on a selected student's results. You can use the built-in Exam Manager to create your own sets of problem solving and troubleshooting exercises. You can also add multi-level hints to your problems.

TINA's Training Supervisor