



The Complete Electronics Lab for Windows

Teacher's Guide

DesignSoft

www.designsoftware.com

COPYRIGHTS

© *Copyright 1990-2020 DesignSoft, Inc.* All rights reserved.

All programs recorded on the original release CD of *TINA* and the accompanying documentation are copyrighted. *TINA* is provided under a License Agreement and may be used or copied only in accordance with its terms and conditions.

LIMITED LIABILITY

TINA, together with all accompanying materials, is provided on an “as is” basis, without warranty of any kind.

DesignSoft, Inc., its distributors, and dealers make no warranty, either expressed, implied, or statutory, including but not limited to any implied warranties of merchantability or fitness for any purpose.

In no event will DesignSoft Inc., its distributor or dealer be liable to anyone for direct, indirect, incidental or consequential damages or losses arising from the purchase of *TINA* or from use or inability to use *TINA*.

TRADEMARKS

IBM PC/AT, PS/2 are registered trademarks of *International Business Machines Corporation*

Windows, Windows 9x/ME/NT/2000/XP/Vista / Windows 7/8/10 are trademarks of *Microsoft Corporation*

P Spice is a registered trademark of *MicroSim Corporation*

Corel Draw is a registered trademark of *Corel Inc.*

TINA is a registered trademark of *DesignSoft, Inc.*

TABLE OF CONTENTS

| | |
|--|------------|
| 1. TINA IN TRAINING/EXAMINATION | 1-1 |
| 1.1 Introduction | 1-1 |
| 1.2 Starting TINA in Exam/Train Mode | 1-1 |
| 1.3 Choosing a Problem | 1-2 |
| 1.4 Problem Types & Support Functions | 1-3 |
| 1.4.1 Selections | 1-3 |
| 1.4.2 DC and AC Problems | 1-3 |
| 1.4.3 Troubleshooting | 1-3 |
| 1.5 Using the Examination/Training Panel | 1-4 |
| 1.5.1 The Tasks List | 1-4 |
| 1.5.2 The Current Tasks | 1-4 |
| 1.5.3 The Advisor | 1-5 |
| 1.5.4 Notes on CD and AC Problems | 1-5 |
| 1.5.5 Notes on Troubleshooting | 1-6 |

| | | |
|-------|---------------------------------|-----|
| 1.6 | Finishing Problem Solving | 1-6 |
| 1.7 | Examples | 1-7 |
| 1.7.1 | Notes on Troubleshooting | 1-7 |
| 1.7.2 | DC Problem | 1-7 |
| 1.7.3 | AC Problem | 1-8 |
| 1.7.4 | Troubleshooting | 1-9 |

2. EDUCATIONAL APPLICATIONS 2-1

| | | |
|-------|---|-----|
| 2.1 | Introduction | 2-1 |
| 2.2 | Problem construction | 2-1 |
| 2.2.1 | The Exam Manager in TINA | 2-2 |
| 2.3 | General considerations | 2-4 |
| 2.4 | Working with the Advisor | 2-5 |
| 2.5 | Problem types | 2-5 |
| 2.5.1 | Multiple Choice | 2-5 |
| 2.5.2 | DC Problems | 2-5 |
| 2.5.3 | AC problems | 2-6 |
| 2.5.4 | Troubleshooting | 2-7 |
| 2.6 | Problem set construction with the TTask | 2-8 |
| 2.6.1 | Running TTasks | 2-8 |
| 2.6.2 | Parameters of problems | 2-9 |

3. SUPERVISING TRAINING AND EXAMINATION 3-1

| | | |
|-----|---------------------------------------|-----|
| 3.1 | Installing and running TSuper | 3-1 |
| 3.2 | Using TSuper in a network | 3-2 |
| 3.3 | Single user operation of TSuper | 3-2 |

| | |
|-----------------------------------|------------|
| 4. TUTORIAL | 4-1 |
| 4.1 Multiple Choice | 4-2 |
| 4.1.1 TINA | 4-2 |
| 4.1.2 TTASK | 4-3 |
| 4.2 DC Problem | 4-3 |
| 4.2.1 TINA | 4-4 |
| 4.2.2 TTASK | 4-4 |
| 4.3 AC Problem | 4-5 |
| 4.3.1 TINA | 4-5 |
| 4.3.2 TTASK | 4-6 |
| 4.4 Troubleshooting | 4-6 |
| 4.4.1 TINA | 4-6 |
| 4.4.2 TTASK | 4-7 |
| 4.5 Preparations & Starting | 4-8 |

TRAINING, EXAMINATION

1.1 Introduction

This chapter describes how to use TINA in **training/examination mode**. For advice on preparing problem sets, see the next chapter.

TINA has two special modes for educational purposes. In **examination mode**, the student has to solve a series of problems (*a problem set*) either by traditional pencil-and-paper methods or by using the Interpreter and analysis functions. When the student finds the answer, the program sends it immediately to the teacher's machine, where it is promptly displayed by the TSuper supervision utility. Operation is similar in **training mode**, except that TINA gives the student feedback about the correctness of his answer. In **both modes**, the student may turn to the **Advisor** to get help prepared by the teacher.

1.2 Starting TINA In Exam/Train Mode

You can set TINA in one of the special educational modes by running TINA with a command line switch. The general format is:

```
TINA [mode switch] [filename]
```

where [mode switch] is either /EXAM or /TRAIN, and the [filename] is the relative path and filename (with the optional .EXA extension) of the problem set descriptor file. This file must have been prepared using the TTask program, and should give the names of the problems

in the set, along with their train/exam options. This path is *always relative to the TINA home directory*; that is, the descriptor file must reside in the TINA directory (where TINA was installed) or one of its subdirectories.

Example:

Assuming that the descriptor file is TEST_B.EXA and that it resides in the TEST subdirectory, the program can be started with the commands:


TINA /EXAM TEST\TEST_B

or

TINA /TRAIN TEST\TEST_B

For your convenience, there are two icons provided in the TINA program group to start the program in training/examination mode. To start TINA in one of the special educational modes click on

the  (training) or

the  (examination) icon

in the TINA program group (in Windows 3.1) or select the appropriate Start menu option under Windows 10/9x/NT/2000. TINA will prompt for the descriptor file.

When the program is started, it will request the student's name. Although this can be as short as one character, it's best to use the full name.

1.3 Choosing a Problem

The student can select a problem to work on with the Tasks List on the Examination/Training Panel.

The Tasks List has two columns. The first column contains status information about the problem, as follows:

- empty: the problem has not yet been attempted;
- ?: the problem was visited but no answer was given;

- ü: a solution has already been given (the program *does not* indicate whether this solution was correct or not).
- The second column contains the name of the problem.

1.4 Problem Types & Support Functions of *TINA*

The program distinguishes the following problem types:

- Selections (multiple choice)
- DC problems
- AC problems
- Troubleshooting

To assist the student, different problem types enable various functions; however, other general functions of *TINA* are disabled.

1.4.1 Selections

In this problem type, the student has to choose the right answer from a list of alternatives (multiple choice). *TINA*'s general functions are not available.

1.4.2 DC and AC Problems

DC and AC problems are similar, but both a phase solution and an amplitude solution are required for AC problems. In this mode, only a limited set of commands are available.

1.4.3 Troubleshooting

In this mode, a fault has been inserted into the circuit, and the student's goal is to identify the faulty component (and optionally to replace it). The program permits a variety of options; the teacher controls which option can be used for a given problem. The possibilities are:

- Editing the circuit. This is limited to the deletion and addition of wires and meters. Other components cannot be modified.
- Replacing components. This function is available only in this mode of the program. You can activate it with the **Replace** command. The student has to select the suspected component, and it will be replaced by a good one.

- **Analysis.** The analysis menu may be enabled to facilitate problem discovery and solution. The **Analysis | Faults Enabled** switch plays an important role here. In the **Off** (unchecked) state, only the good circuit is analyzed. In the **On** state, only the faulty circuit is analyzed.
- **Measurement.** Measurement can be used in a manner similar to the that described above for the Analysis option. The **Faults Enabled** switch plays the same role as above.

1.5 Using the Examination/Training Panel

The Examination/Training Panel appears automatically when TINA is started in examination or training mode. The current mode (Training or Examination) is displayed at the top of the panel. Beneath the mode display is the total accumulated time display. This starts counting when the student selects the first task.

The two methods of giving the answer are:

- A method particular to the problem type (e.g. typing, pointing, etc.). These are described later in this chapter.
- Multiple choice (selection). The student is presented with a list of possible answers and has to select the correct one.

The teacher determines which way the student will be required to give the answer.

It is possible that the student will give several answers in succession. The TSuper program evaluates only the *last* solution.

1.5.1 The Tasks List

The student can select a task from the Tasks list. The indicators to the right of the task names will contain a green question mark if the student has visited the problem but has not attempted to give a solution. A red check mark will appear if the student has submitted a solution (regardless of the validity of the solution).

1.5.2 The Current Tasks

The Current Task panel allows the student to prepare and submit a solution to the problem. The contents of this panel are dependent on the type of the problem. The Interpreter standard button will call up the built-in interpreter of TINA. The Submit standard button will validate the solution and file it in the student records.

TINA will only accept as correct those solutions that are formally valid; e.g., in DC problems both the numerical value and units must be correct. If the answer is a numerical/symbolic expression, the correct units must also be given. When using the training mode, TINA will either confirm the answer or tell the student how the solution is incorrect (e.g., missing unit, syntax problem, etc.).

A portion of the Current Task panel varies with the type of task and whether the problem has been given in multiple choice form:

- If the problem is in multiple choice form, a listing of possible choices is displayed. The student must highlight one alternative and press the Submit button.
- For DC and AC optimization problems, the student must submit one result and its unit (dimension).
- For AC problems of a non-optimization nature, two values (amplitude and phase) and their corresponding units must be specified.
- For fault insertion problems, two buttons become available: Select Faulty will let the student point to the component he/she considers to be faulty; Replace will replace the selected component with a guaranteed non-faulty one. The student still must press the Submit button to submit her solution.

1.5.3 The Advisor

The Advisor panel gives access to the hints that were prepared by the teacher. Some advice items carry a penalty, in which case the student will be warned that a penalty applies. You can navigate in the advice set with the left and right arrows.

1.5.4 Notes on CD and AC Problems

After the student presses the Submit button, TINA calculates the correct result, then requests the student's solution. In exam mode, TINA only does formal checking (missing dimension and syntax). In training mode, it also checks the dimension, the numerical value, the order of magnitude, etc.

In DC mode, the program requests only one value. This is generally the indicated value of a meter or an equivalent component (e.g., a current arrow).

In AC mode, while the requested value is also a meter's value, it is a *complex peak value*. Both the amplitude and the phase are required.

It is possible to give the answer in symbolic form. Some examples are shown later.

Pressing the Interpreter button will invoke the **Interpreter** with its arsenal of useful and powerful functions to facilitate the solution. The answer can be given with the **Result(solution [unit])** or the **Result2(solution [unit], solution [unit])** commands. You can also use **Submit(solution [unit])** or **Submit2(solution [unit], solution [unit])** to submit the result automatically. If you use the **Result** or **Result2** commands, you have to push the Submit button to submit the solution manually. Some examples are shown later.

NOTE:

The unit must be specified in the drop-down unit field. You must respect the case of the unit (e.g. Ampere is A and not a).
Remember that TINA expects the complex **peak** value and not the **effective** value in AC problems. The phase can be specified in degrees or radians. Its unit is [] or [deg] or [rad], respectively.
The program has a 1 % tolerance in the accuracy of the result.

1.5.5 Notes on Troubleshooting

In training mode, TINA tells the student if his answer is correct.

The program will report how many components were replaced, inserted, or deleted as the student searched for the faulty one. The teacher may use this as a basis for a penalty.

1.6 Finishing Problem Solving

A problem solving session can be concluded by exiting TINA using the **File|Exit** command. The program signals completion to the teacher's machine and exits.

The student should be careful not to quit the program by accident. If this happens, he should restart *TINA* using the same options as

before, give his name as before, and continue the solution where he left off. TSuper will display the student's scores in two lines below each other (in alphabetical order). These scores must be summarized manually.

1.7 Examples

1.7.1 Notes on Troubleshooting

Problem:

What is Ohm's Law?

A: $R=U*I$

B: $U=I*R$

C: $I=U*R$

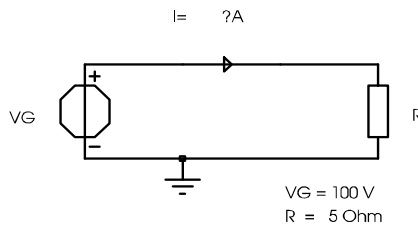
Solution:

The correct answer must be selected from the list of possibilities presented. Here, the correct answer is B ($U=I*R$)

1.7.2 DC Problem

Problem:

Ohm's Law



Calculate the current (I) through R.

Solution:

The solution can be determined by using Ohm's Law:

$$V_G = IR$$

Then we have:

$$I = \frac{V_G}{R} = \frac{100V}{5\Omega} = 20A$$

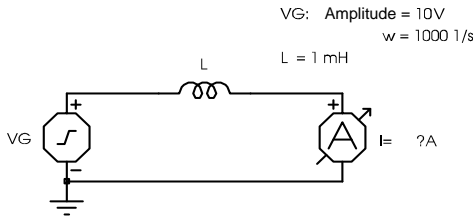
This solution can be given

- numerically:
20 [A]
- symbolically:
VG/R [A]
- with the Interpreter:
i := VG/R
Result(i [A])

1.7.3 AC Problem

Problem:

AC Problem



Determine the complex current through L (amplitude & phase).

Solution:

The solution is similar to the previous example, but we have to deal with complex peak values and impedance:

$$\hat{V}_G = \hat{I}Z, \text{ where } Z = j\omega L$$

By substituting the numerical values:

$$\hat{I} = \frac{\hat{V}_G}{Z} = \frac{\hat{V}_G}{j\omega L} = \frac{10\text{V}}{j1000\frac{1}{s}1\text{mH}} = \frac{10}{j}\text{A} = -10j\text{A}$$

This solution can be given

· numerically:

10 [A]

-90 [deg]

· symbolically:

Abs(VGA / (j*VGw*L) [A]

Arc(VGA / (j*VGw*L) [rad]

· with the Interpreter:

i := VG/R

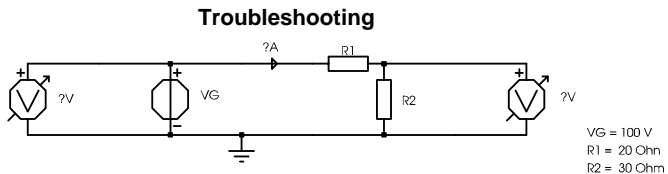
Z := j*VGw*L

I := VGA / Z

Result2(Abs(I) [A], Arc(I) [rad])

1.7.4 Troubleshooting

Problem:



Determine which component is faulty.

Solution:

First we have to see what the symptoms are:

1. Set **Analysis | Faults Enabled** to Off (not checked): only the good circuit's results will be displayed.

2. Execute **Analysis | DC Analysis | Calculate nodal voltages**. This will display the electronic status of the good circuit.
3. Set **Analysis | Faults Enabled** to On (checked): only the faulty circuit's results will be displayed.
4. Execute **Analysis | DC Analysis | Calculate nodal voltages**. This will display the electronic status of the faulty circuit.
5. Examining the results and discover the symptoms:
 - the current is unexpected (3.33 A instead of 2 A), and
 - the voltage on R2 is unexpected (33.33 V instead of 60 V).

Now, since we are confident that the voltage generator will not have been given a fault and is working correctly, the faulty component must be one of the resistors. None of the resistors are shorted or open (that wouldn't give the results we see here), so the value of one of the resistors must be wrong. By applying Ohm's Law for each resistor, we get:

$$R_{1F} = \frac{V_{R_{1F}}}{I_{R_{1F}}} = \frac{66.66 \text{ V}}{3.33 \text{ A}} = 20 \Omega$$

$$R_{2F} = \frac{V_{R_{2F}}}{I_{R_{2F}}} = \frac{33.33 \text{ V}}{3.33 \text{ A}} = 10 \Omega$$

Since according to the specification R2 must be 30Ω it is clear that the faulty component is **R2**.

EDUCATIONAL APPLICATIONS

2.1 Introduction

The material in this chapter will help you apply the *TINA* software package in education. Here you will find more information about problem construction, training, and examination.

In addition to the *TINA* program, the software package contains two more utilities specifically for use in education.

With **TINA** you can create individual problems. Through **TSuper**, the teacher can directly monitor how the students are getting on with the problems and can configure **TINA** for either training or examination. The problem sets can be assembled (from the individual problem files) with **TTask**.

2.2 Problem construction (TINA & TTASK)

TINA supports problem construction and solving in a unique and useful way: a separate authoring system is not required. Problems can be created and tested using *TINA* in the normal analysis or measurement mode with the help of the **Exam Manager (View | Exam Manager)**. Problems prepared in this way are ready to use without change in the training or examination mode. When used in these modes, *TINA* will evaluate the student's solution and compare it with the correct answer instead of displaying the solution. While in the training and examination mode, the student can use the entire range of *TINA*'s analysis and measurement services to check and/or help find the solution. This is much more flexible than the usual authoring systems.

2.2.1 The Exam Manager in TINA

The Exam Manager can be activated from the Schematic Editor's View menu. Its task is to help the teacher prepare a problem solving task by inserting faults into the circuit, specifying possible alternatives for a multiple-choice solution, and/or to develop hints (advice) for the given problem.

2.2.1.1 Fault Management

The Fault Insertion panel allows you to insert and remove faults. Before you can insert a fault, you have to create a new version of the circuit to contain the fault. To do this, select an unused version from the Current Circuit list box. You can delete the current version by pressing the Delete Version button (you cannot delete the original circuit).

To insert a fault:

1. Select the version you want to insert the fault into (you cannot insert faults into the original circuit).
2. Click on the Insert Fault button. The cursor shape will change indicating that you are now in fault insertion mode.
3. Click on the component into which you wish to insert the fault. The Component Attribute Editor will appear.
4. Make your changes to the component (you should limit your changes only to one parameter of the component in general). Press OK when ready. The component will change color to indicate its faulty state.

To revert a faulty circuit component to its original version:

1. Click on the Revert to Original button. The cursor shape will change indicating that you are now in reverting mode.
2. Click on the component in the circuit you want to be restored to its original version. Click only on a faulty (specially colored) component. The color of the component will return to original.

To revert all components in the current version to their original version press the Revert All button.

If you have a TINALab testcard for the simulated circuit, you will have to map the different circuit versions to the hardware through the Map Fault to Hardware dialog. Press the Map to Hardware button to activate this dialog.

2.2.1.2 Multiple Choice (Selection) Management

Use the selection management panel to prepare alternate solutions for a problem. The student will be able to select one of these alternatives at examination/training time.

For DC and AC problems TINA will actually determine each time which is the right answer by analyzing the solution strings. This means that the solution alternatives you give must obey the solution interpreter syntax.

For other types of problems, you will have to specify explicitly in the selection editor dialog which answer is correct. Of course, you can designate only one answer as right. It will be denoted with an » in the selection list.

To add a new selection alternative, press the Add... button. The selection editor dialog will appear. You can specify whether this is the right solution by (un)checking the This is the good answer field.

To edit an already-added selection, press the Edit... button. The same editor dialog will appear.

To delete a solution, highlight it and press the Delete button.

The order in which you enter the alternatives does not matter since TINA will re-order them randomly when presenting the list to the student.

2.2.1.3 Advice Management

You can use the advice management panel to prepare hints for the student. Each item of advice may or may not carry a penalty. If it does, the student's score will be discounted (both scores and penalties are measured in percent).

The upper right corner of the advice manager displays the number of the current advice and the total number of advices. You can move among the advices with the left and right arrow. The order of advices is important: the student will be able to access them in the same sequence as they are ordered in the Exam Manager.

To add a new advice at the end of the advice list, press the Add button. The advice editor dialog will appear.

You can enter the advice and the penalty (in percent) in this dialog.

To insert a new advice before the current advice, press the Insert button. The same advice editor dialog will appear.

To delete the current advice, press the Delete button.

To edit the current advice, press the Edit button.

2.3 General considerations

The circuit files containing the problems (**.SCH** files) must be placed into the *TINA* directory or one of its subdirectories. Files corresponding to the same problem set should be kept with the problem descriptor file (**.EXA**) in a separate subdirectory. However, if troubleshooting is going to be done in conjunction with the data acquisition card, the SCH files of these circuits must be placed in the **MEAS_SCH** subdirectory.

All the files (including those of problems and problem sets) should be multiply shareable. For this, you must use one of the following commands:

- **Novell 3.x:**
FLAG *.* SRO SUB
- **Novell 4.x:**
FLAG *.* +SH /S
- **WindowsNT:**
CACLS *.* /e /t /p <username> | <groupname>:c

NOTE:

Depending of the setup of your NT System, you will have to give every user (<username>) separately access with the CALCS command or you can give the rights to a group (<groupname>) which members will then have the appropriate rights automatically.

The teacher may pose problems in two forms. In one form, the answer must be given numerically, with units. In the second case, the right solution must be chosen from a multiple choice list.

The student can seek help from the **Advisor**, whose content and access can be controlled by the teacher.

The construction of problems can be done in the normal operating mode of *TINA* Problem sets can be compiled by **TTask**.

2.4 Working with the Advisor

We recommend that the text fit entirely in the Advisor hint box. Another consideration is that the sum of the percentages in all the hints for a given problem can not exceed 100. A hint with a percentage of 0 means that it is free. Students can only get to the hints sequentially.

In DC and AC problems of the multiple choice type, the hints should be placed into the main circuit (because, of course, the shadow circuits have no role). In trouble-shooting problems, hints should be put in the circuit version containing the fault. In these circuits, a series of hints can be attached to each fault.

The teacher can always deny the student access to hints on a particular problem by using **TTask** to disable the **Advisor**.

2.5 Problem types

There are several different problem solving modes in *TINA*

- 1 Multiple Choice by selection of the right answer from a list.
- 2 Solution of DC problems.
- 3 Solution of AC problems.
- 4 Troubleshooting.

2.5.1 Multiple Choice (Selection from a list)

In this mode, the analysis functions of *TINA* have no role and there is only one correct answer. During training/examination mode, the answers will not appear in the order they were given in the text file; instead, each time the problem is visited, a randomly ordered set of solutions will be displayed. We recommend that you provide no more than 7 multiple choice answers. You may find it useful to place further text (questions, hints, etc.) or explanatory figures directly onto the problem's circuit diagram.

2.5.2 DC Problems

The program will execute an **Analysis | DC Analysis | Calculate nodal voltages** command and will compare its result with the student's answer. *TINA* will ask about the values displayed by the measurement instruments. The present version handles only one instrument at a

time, so restrict your problems to only one instrument. The unit (dimension) is determined by the type of instrument:

| | |
|--------------------------------|---------------|
| voltmeter or voltage tap: | Volt [V]; |
| ampere meter or current arrow: | Ampere [A]; |
| impedance meter: | Ohm [Ohm]; |
| power meter: | Watt [W]. |

You can pose DC problems in Multiple Choice form.

If a multiple choice menu is associated with a problem, then it will appear instead of a request for a numerical answer. Since the program will analyze (parse) the text of the each of the answers to determine which one is right, you should be sure that the right answer in the multiple choice menu exactly matches the one expected by *TINA*, both in syntax and semantically. Since *TINA* is checking the answers in the text, you don't need to specify which is the good answer. Be sure to enter the correct unit, and remember that if you change the problem, you must also change the corresponding text.

2.5.3 AC Problems

As in the case of DC problems, the program asks for the value that would be shown on a meter. Here, however, the student must give the answer in complex form, with magnitude and phase angle. *TINA* executes the **Analysis | AC Analysis | Calculate nodal voltages** command at a specific frequency, and that frequency cannot be altered. Since *TINA* uses this frequency during problem solving, it must be set when creating the problem.

Note that, while angular frequency (ω) is traditionally used in network equations, *TINA* asks for frequency (f) data in units of Hz. The well-known formula relating the two units is $\omega = 2\pi f$. For instance, $\omega = 1000$ radians/s is used in the example (see the description of the exam/train mode), so the frequency in the analysis is 159.1549 Hz.

Selection (multiple choice) menus can also be used with AC problems in the same manner described for DC problems. The only difference is that the student must choose an answer correct in phase as well as in voltage. The unit of phase is [deg] or [$^{\circ}$].

2.5.4 Troubleshooting

First, the teacher should decide whether the troubleshooting will be run as a computer simulation or as a real measurement. If as a real measurement, the teacher must provide an adequate test device.

When simulation and measurement are used on the same circuit, there may be problems because of the difference between modeling and reality and because of measurement transients. For instance, although the simulation can easily swap circuit versions with no delay, the measurement equipment cannot. As an example, if a capacitor is charged up in one circuit version, it will tend to hold that charge through the swap. False results from such effects can be avoided by careful design (e.g., with a suitable shunt resistor in this example).

The construction of the circuit in *TINA* consists of the following steps:

- Drawing the reference (faultless) circuit (Original).
- Selection of the Version #1 circuit on the Exam Manager panel.
- Fault insertion with the Insert Fault button. You will be prompted to modify the component values or set the Fault attribute.
- Addition of Advisor and/or selection texts.
- Repeating the steps above to create other faulty versions.
- Checking by analysis to verify that the versions operate as intended. To do this, the faulty circuit should be displayed and the **Analysis | Faults Enabled** switch used to switch between good and the faulty circuit.

Consider the following aspects of the construction of circuits for troubleshooting:

- The maximum number of circuits is 16, so the maximum number of possible faulty versions is 15.
- The analysis parameters should be set appropriately to minimize student difficulties. The reference and faulty circuit versions will all use the same analysis parameters.
- You may choose to allow students to place meters and wires into the circuit while they troubleshoot. Keep that in mind as you develop the circuits.

Remember that *Advisor texts* (hints) that you want to insert should be placed in the faulty (shadow) circuit versions. You can allow the student to use the selection option to choose where the fault lies. To

do so, you must place one error description (selection) line marked good in each faulty circuit version. In addition, place several extra selection lines into the reference circuit. The program collects and mixes all these lines and displays them as one collection from which the student may choose in examination/training mode.

2.6 Problem set construction with the TTask program

TTask is a utility for compiling problem sets for the examination/training mode of *TINA*.

TTask and its auxiliary files are automatically installed by the *TINA* installation program into the **TINA** directory.

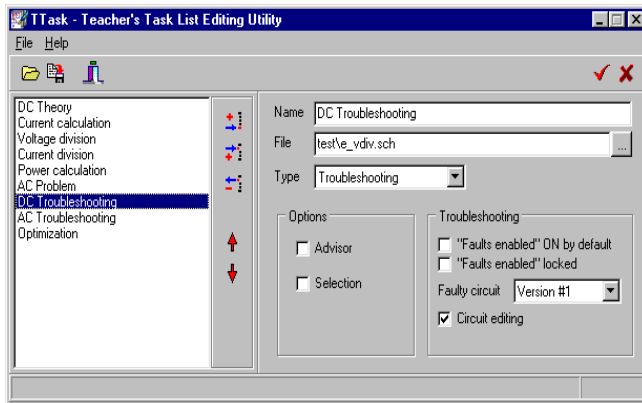
In the exam/training mode of *TINA*, the students will be asked to solve a set of problems. Each problem set is stored in a file with **”.EXA”** extension. This file and the corresponding problems should be stored in a separate subdirectory of the **TINA** directory.




2.6.1 Running TTasks

The program can be started by double-clicking on the Ttask icon or by selecting Ttask from the Start menu.

Task List Panel

Task Editing Panel



To modify an existing problem set, use the **File | Open** command. Once you open a problem description file (**.EXA**), the Task List Panel will present the problem names included in the problem set. When you select a problem (by clicking on its name in the Task List Panel), you will see the parameters of the selected problem in the Task Editing Panel. These parameters will be described in the following section. You can also create a new problem set using the **File | New** command. An empty Task List Panel will appear. Use the  **Add** command button to create a new entry and specify the problem file (**.SCH**) name, the problem name, and some further parameters (described in the following subsection). When you are finished with the current problem, press the  **Task OK** command button to save it back to the problem set (navigating away from the current problem and saving the problem set will imply a Task OK for the currently edited task). If you decide you don't want to use the latest changes, you can discard your modifications by pressing  **Task Cancel**.

The operation of TTask is simple and there is detailed **Help** available by pressing the **[F1]** key. In the lower line of the TTask window (*status line*), the commands and other useful information are given.

2.6.2 Parameters of problems

In the Task Editing Panel, you set the parameters of the problems:

Name which can be a character string of no more than 30 characters. A problem name can give a clue as to the subject (1. Ohm's law), or can be more general (Problem 1).

File the name of the circuit file made with *TINA* (**.SCH** file). The name can contain a relative path to the **TINA** main directory.

Type which can be one of the following: selection (multiple choice), DC, AC, troubleshooting.

In the **Options** group

Advisor selecting this option **[X]** allows the use of the Advisor. Of course, you must create the necessary hints if you're using the Advisor.

Selection by selecting this option, **[X]** you can enable/disable the selection list for a particular problem.

For **Troubleshooting** problems, you can set the following additional parameters:

“Faults enabled” ON by default: You can set the parameter (**On / Off**) for the initial state of the Faults enabled switch.

“Faults enabled” locked: You can disallow the student to change the state of the “Faults enabled” switch by checking this checkbox. If it is not checked, the student can switch between the “good” and “bad” versions of the circuit. If checked, the student can study the circuit only in the state depending on the previous switch (“Faults enabled” ON by default).

Faulty circuit: This can be a number between 1 and 15, or the random number variable, **Random**. This is simply the version number of the shadow circuit. If the random variable was chosen, the program will select a different faulty circuit for each student at random. Be sure to use circuit version numbers that correspond to an existing problem. If a wrong number is entered here, *TINA* will select **Random**.

Circuit editing: Enables/disables circuit editing. If enabled, the student can delete or place wires and meters, simulating real world troubleshooting. The student can also use the **Edit.Replace** command (in *TINA*) to replace the faulty element.

Different types of problems can be mixed arbitrarily within one set of problems, but keep the number of problems in a set to 15 or less.

It is helpful to establish a naming convention for the problem description files. For example: *[year][class][date of test][group].EXA*.

SUPERVISING TRAINING AND EXAMINATION

With the **TSuper** utility, the teacher can supervise (monitor) the training and examination process. Using a Novell Network, the program works in real time (on-line), so the teacher can follow all the students simultaneously. When single workstations are used, the student's work can be evaluated with **TSuper** after the exam/training session (off-line).

3.1 Installing and running TSuper

TSuper and its auxiliary files are automatically installed by the *TINA* installation program into the **TINA** directory.

The program can be started by double-clicking on the **TSuper** icon or by selecting **TSuper** from the Start menu.

After starting the program, the class window with the list of students appears on the screen. To see a window containing detailed information on a particular student, double-click on the student and the student window will open.

The operation of **TSuper** is simple, and there is detailed **Help** available by pressing the **[F1]** key. In the lower line of the **TSuper** window (*status line*), commands and other useful information are given.

3.2 Using TSuper in a network

The students' results (**USRNAMES.LST** and **U*.RES**) are taken by the program from the **EXAM** subdirectory. Without the **EXAM** subdirectory, the program cannot run. Before running a test, this subdirectory should be deleted; otherwise, the results of earlier tests saved here will appear on the screen. This can be done by the **File | Delete All** command in TSuper. Note that students should not be allowed to start work until **File | Delete All** has been used to delete the **EXAM** subdirectory. Otherwise the results obtained before the deletion will be lost.

You can optionally restrict TINA to running only in certain modes by the **File | Startup Settings** command. By checking/un-checking any of the three available modes (Normal, Training, Examination) you can enable/restrict TINA operations. For examination sessions, it is a good idea to restrict TINA to running only in Examination mode (only this option checked) so that students cannot cheat by examining the circuit files.

During a training or examination session, data is constantly and automatically stored on the hard disk independently of TSuper. This means that TSuper can be started and exited at any time during or after the session without loss of data.

If results are to be archived, the entire contents of the **EXAM** subdirectory should be copied to an appropriate archive location (e.g. floppy disk). It is also a good idea to save the related problems (**.SCH** files) and task list (**.EXA** file) as well.

3.3 Single user operation of TSuper

You can still use TSuper even if students are working on separate workstations not connected to a network. In this case:

- each workstation should have an **EXAM** subdirectory.
- after running the training/examination session, TSuper should be started in the TINA directory on each workstation.

Then follow all the suggestions for using TSuper with a network.

Note that in this case copying the results onto a floppy disk may be risky, since the names and the result files (**U1.RES** and **USRNAMES.LST**) are the same on each workstation. One way to archive the results on a single floppy disk is to store the data of each workstation in a different subdirectory on the floppy.

CHAPTER 4

TUTORIAL

To round out the discussion above, we will present a tutorial section of

- creating the four problems with TINA that were presented in the previous chapter,
- collecting these separate problems into one problem set with TTask,
- preparing for and starting an examination session with TINA and TSuper, and archiving the results for later reference.

The TEST subdirectory of TINA is an ideal place to store problem sets. To avoid clutter, we decide to create a sub-sub directory here called '4A-1998-11-06-Basic Electricity' (4A stands for the class ID, 1998-11-06 is the exam date, and Basic Electricity is the name of the course). We will save all our schematics files and the task list into this directory. Please note, that this is only one possible naming convention. Please feel free to develop a naming convention that suits you the most.

In the following sections we will show you the creation of each problem and the problem set itself in parallel (to make things more understandable), but this is not necessary: you can first create the problems with TINA and then the problem set (task list) with TTask. So let's start by double-clicking on the TINA and TTask icons. When TINA has started, go to the **View** menu and click on **Exam Manager** to make the Exam Manager visible on the right. In TTask, make sure you start a new problem set by using the **File | New** command. It is a good idea to save your (still empty) problem set right away in our T:\TINA\TEST\4A-1998-11-06-Basic Electricity\ directory under a name of Exam.EXA (or any other name you wish) so that you can just press the Save button later.

Caution! In order to making sure that students will see problems as designed, it is recommended that you use the same screen resolution for authoring as the students will use for the training/exam session. The Exam Manager is exactly the same width and position as the Examination/Training Panel the student sees in training/exam mode so you are advised to leave it displayed during the whole authoring session.

4.1 Multiple Choice (Selection)

What is Ohm's Law?

A: $R=U*I$

B: $U=I*R$

C: $I=U*R$

4.1.1 TINA

Execute a **File | New** command.

Use the **Insert | Text** command to enter, format, and position the text "What is Ohm's Law?". Position the text so that it is approximately in the middle of the screen.

Go to the **Selection** tab on the Exam Manager and press the **Add** button. Enter " $U=I*R$ " without the quotation marks and **check** the "This is the good answer" checkbox. Press **Add** again, and enter " $R=U*I$ ", now leaving the "This is the good answer" checkbox **unchecked**. Press **Add** once more, and enter " $I=U*R$ ", again leaving the "This is the good answer" checkbox **unchecked**.

At this point you may add additional text, graphics, even circuit elements to the circuit to further illustrate the question, at your liking. Optionally, you may want to add Advisor text as well. We will show you how to do this in the next example.

You have finished editing this problem. Use the **File | Save** command to save the circuit in T:\TINA\TEST\4A-1998-11-06-Basic Electricity\OhmsLaw.SCH.

4.1.2 TTASK

Press the **Add task** command button. Select the newly added task in the Task List Panel. TTask will display the task parameters in the Task Editing Panel.

In the **Name** field, enter "Ohm's Law" (without the quotation marks).

In the **File** field, click on the ellipsis (...) button and select the OhmsLaw.SCH file just saved in TINA. Please note that in the File edit box you will see *only the relative path* (to the TINA directory) of the file. This is so, because TINA will automatically add its home directory to the beginning of the path. This means that all train/exam schematics files must be located in the TINA directory, or one of its subdirectories.

Set the **Type** to Selection.

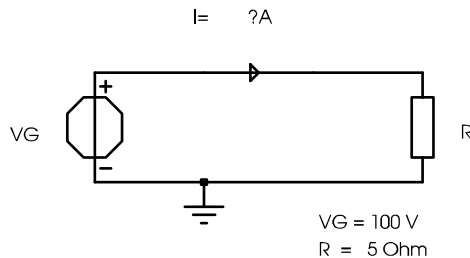
If you have included advisor hints in the circuit, and want to let the students to access these hints, then check the **Advisor** checkbox.

Leave the **Selection** checkbox checked.

You are done with this task. Press the **Task OK** button to add your changes to the task list, then press the **Save** button to save your work. (Please note that pressing Task OK is optional: pressing Save will implicitly add your changes to the task list before saving it.)

4.2 DC Problem

Ohm's Law



Calculate the current (I) through R.

4.2.1 TINA

Execute a **File | New** command.

Now use the **Insert** and **Edit** commands as usual to build the circuit on the figure above. Add the text "Calculate the current (I) through R." as well. You may want to include the "VG=..." and "R=..." texts as well, so that the student does not have to explore these values herself/himself. You may decide not to add the "Ohm's Law" text since it can be considered already to be an advice (hint). There is one particular component that is worth some special attention: the Ammeter. TINA will compute the value that should be displayed by the Ammeter, but won't display it in Train/Exam mode (as it would in Normal mode), instead, it will compare this to the value entered by the student. So it is a good idea to make sure that this value is some "nice" number (e.g. 3.75) and not some difficult-to-enter value, like 1.666666666... You can use the full analysis power of TINA to help your imagination to come up with such circuits. It is also important to note, that for these types of problems (DC and AC), there may be only **one** meter in the circuit: TINA will request the value of this meter.

Go to the **Advisor** tab on the Exam Manager and press the **Add** button. In the Edit Advice dialog enter "Use Ohm's law" without the quotation marks into the Advice box, and enter 10 into the penalty box. So now, when the student requests an advice she/he will be charged 10% for the first hint (a warning dialog will appear for the student). Press Add again, and enter "Ohm's law is: $U=I \cdot R$ ", and 40, respectively. Press Add once more, and enter " $I=VG/R$ ", and 35, respectively. Now after using all hints, the student still can score $100-10-40-35=15\%$ for entering the right answer (if the dimension is good as well).

At this point you may add additional text, and graphics, (but not circuit elements) to the circuit to further illustrate the question, at your liking.

You have finished editing this problem. Use the **File | Save** command to save the circuit in T:\TINA\TEST\4A-1998-11-06-Basic Electricity\DC.SCH.

4.2.2 TTASK

Press the **Add task** command button. Select the newly added task in the Task List Panel. TTask will display the task parameters in the Task Editing Panel.

In the **Name** field, enter "DC Problem" (without the quotation marks).

In the **File** field, click on the ellipsis (...) button and select the DC.SCH file just saved in TINA again, please note the relative pathname.

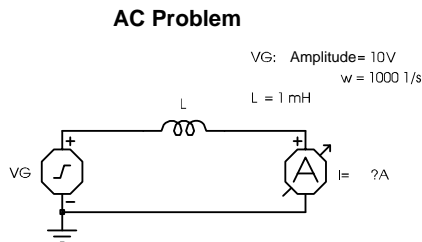
Set the **Type** to DC problem.

Check the **Advisor** checkbox.

Un-check the **Selection** checkbox.

You are done with this task. **Save** your work.

4.3 AC Problem



**Determine the complex current
through L (amplitude & phase).**

4.3.1 TINA

Execute a **File | New** command.

Now use the **Insert** and **Edit** commands as usual to build the circuit on the figure above. You have to handle the voltage generator with care (in order to get 10 A and -90 degree on the Ammeter): set DC level to 0, set Signal to Sinusoidal, and set (in the Signal Editor) Amplitude to 10 V, Frequency to 159.15 Hz ($159.15 \text{ Hz} \cdot 2 \cdot \pi = 1000 \text{ 1/s}$), and Phase to 90 degree.

At this point you may add additional text, and graphics, (but not circuit elements) to the circuit to further illustrate the question, at your liking.

You have finished editing this problem. Use the **File | Save** command to save the circuit in T:\TINA\TEST\4A-1998-11-06-Basic Electricity\AC.SCH.

4.3.2 TASK

Press the **Add task** command button. Select the newly added task in the Task List Panel. TTask will display the task parameters in the Task Editing Panel.

In the **Name** field, enter "AC Problem" (without the quotation marks).

In the **File** field, click on the ellipsis (...) button and select the AC.SCH file just saved in TINA again, please note the relative pathname.

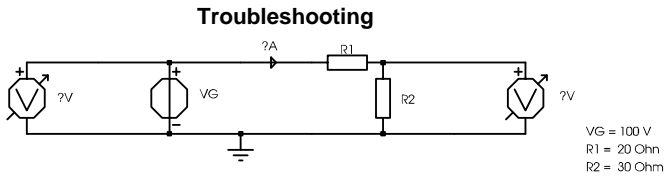
Set the **Type** to AC problem.

Un-check the **Advisor** checkbox (it is not a problem if you leave it checked, but it may be a good practice to turn this off if you don't have any advice hints in the circuit).

Un-check the **Selection** checkbox.

You are done with this task. **Save** your work.

4.4 Troubleshooting



Determine which component is faulty.

4.4.1 TINA

Execute a **File | New** command.

Now use the **Insert** and **Edit** commands as usual to build the circuit on the figure above. Before continuing, make sure that the circuit works as expected by using the Analysis features of TINA. It is always a good idea to design troubleshooting circuits in three steps: (a) design the good circuit; (b) fine-tune (debug) the good circuit; (c) add faults.

If we had an appropriate Test-card for this circuit, we could use the Map to hardware dialog to set the fault generator switches for the Original version now.

At this point you may add additional text, and graphics, (but not circuit elements) to the circuit to further illustrate the question, at your liking.

Now let's insert one fault. Go to Exam Manager, Fault Insertion, and from the **Current Circuit** list select **Version #1**. Please note, that all editing functions are disabled: you cannot edit the circuit in any version, except in the Original version. Click on the **Insert Fault** button, then click on R1. Let's set the Fault parameter to Short. Now, if we had an appropriate Test-card for this circuit, we could use the Map to hardware dialog to set the fault generator switches appropriately.

You can create additional faults at your liking, by repeating the steps (from setting the Current Circuit to a new Version) above.

You have finished editing this problem. Use the **File | Save** command to save the circuit in T:\TINA\TEST\4A-1998-11-06-Basic Electricity\Trouble.SCH.

You can exit TINA now.

4.4.2 TTASK

Press the **Add task** command button. Select the newly added task in the Task List Panel. TTask will display the task parameters in the Task Editing Panel.

In the **Name** field, enter "Troubleshooting" (without the quotation marks).

In the **File** field, click on the ellipsis (...) button and select the Trouble.SCH file just saved in TINA. Again, please note the relative pathname.

Set the **Type** to Troubleshooting.

Un-check the **Advisor** checkbox.

Un-check the **Selection** checkbox.

Check the "**Faults enabled**" **ON by default** checkbox: this way the student will see the faulty operation when she/he opens the problem.

Un-check the "**Faults enabled**" **locked** checkbox so that the student can study both the "good" and "bad" circuit versions.

Set **Faulty circuit** to Version #1 (the faulty version we have just created).

Un-check Circuit editing: right now we don't allow the students to add meters to the circuit.

You are done with this task and the whole authoring project. **Save** your work and exit TTask.

4.5 Preparations & Starting the Exam Session

Now that we have prepared the problem set, it's time to do an exam session. (It is probably good to test a new problem set with a small group of students to see if everything works as expected.)

Make sure that no one is using TINA in either training or examination mode.

Start **TSuper**. Execute the **File | Delete All** command. Select **File | Startup settings**, and in the configuration dialog **un-check** Normal and Training mode, and **check** Examination mode. Press OK. This way TINA can be started only with the /EXAM switch.

You may want to tune the evaluation rules at this time with the **File | Evaluation** command.

Before the students can start TINA there are some considerations that should be reviewed (mostly by the computer system/network administrator):

- students must have write permissions to the T:\TINA\EXAM directory
- students should not have permission to run the TTask and TSuper programs
- students should not have permission to modify files in the TINA directory tree (except for the EXAM subdirectory)

Now you can ask the students to start TINA in examination mode on their workstations by clicking on the Examination icon or selecting the appropriate option from the Start menu.

The Examination Logon dialog will appear. Each student should enter her/his own name. Now the Open Exam/Train Control File dialog will appear, with T:\TINA\TEST as the default directory (of course, where T:\TINA depends on your setup). Tell the students to open the "4A-1998-11-06-Basic Electricity\Exam.EXA" file and press OK.

Now the students can work on the problems. You will be able to monitor the students through TSuper's Class window.

At the end of the exam session ask all the students to **File | Exit** from TINA to properly finalize their exam results. After a short period of time, all the students' status will change to "Finished" in the Class window in TSuper. Now you can print out each student's result by double-clicking on the student in the Class window, and then while the student's detail window is active, by pressing the Print button..

After the exam is over, it is a good idea to archive the results for later reference. You can do this simply by copying the files in the T:\TINA\EXAM directory to a backup location. When doing so, please consider the privacy issues: don't copy the results to a publicly available directory. It is best to copy the results to floppies or to a secure private network directory.