

# Efficient Courseware Management using Tektronix Oscilloscope (TBS1000B-EDU)

## Application Note

### Summary

Laboratory classes are an integral part of an engineering curriculum. They enable students to hone hands-on skills by exploring the theoretical concepts taught in classrooms. Lab experiments also help students extend their knowledge by applying these concepts to real life applications. Engineering teachers play an important role in conducting these labs and surveys reveal that most of their efforts go into creating lab manuals, guiding students through the labs and evaluating lab reports.

The Tektronix TBS1000B-EDU series oscilloscope is the world's first dedicated teaching oscilloscope and this application note describes how this new instrument can help educators do their jobs more efficiently by providing an easier way to create basic electronic lab experiments and a method for students to review and complete the labs directly on the oscilloscope. The courseware feature enables teachers and lab assistants to package multiple lab experiments for a variety of subjects and classes together and upload the data onto the instrument. The resultant gain in efficiency and time can be used to tackle other student problems further enhancing the learning process.

## Typical Laboratory Class Workflow:

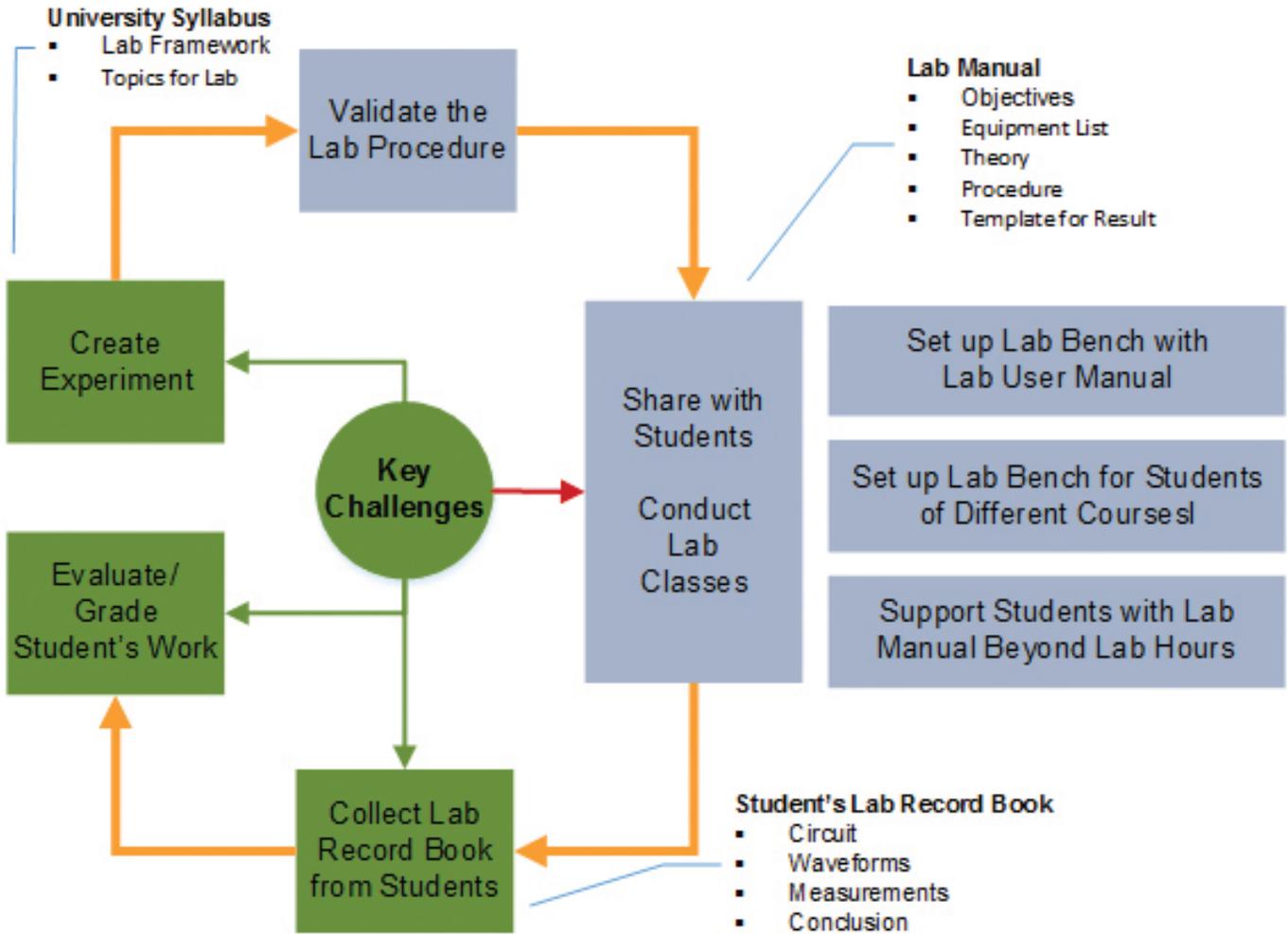


Figure 1. Educator (Teacher /Lab Admin) workflow for designing and conducting laboratory classes for engineering students.

## Introduction

Hands-on training is a key part of an engineering curriculum where knowledge of concepts is reinforced by the practical application of those concepts in a laboratory environment. A robust engineering curriculum has a good mix of theory classes (where concepts are taught) and laboratory classes (where theories are examined) to help students comprehend the information being taught.

To demonstrate key engineering concepts, educators will design lab experiments that support the class curriculum. Lab administrators then determine what instruments and

components are needed to support the lesson plan. Most often, multiple printed lab manuals are created and given out as reference guides for students to use as they conduct the experiments. The lab manual can include technical background, objectives and the step-by-step instructions required for completing experiments. During the lab, the teacher and/or lab administrator will assist students as they conduct experiments, solving problems and providing additional background for the material. When finished, the students will then submit a lab report documenting their work, which is graded based on the students' results.

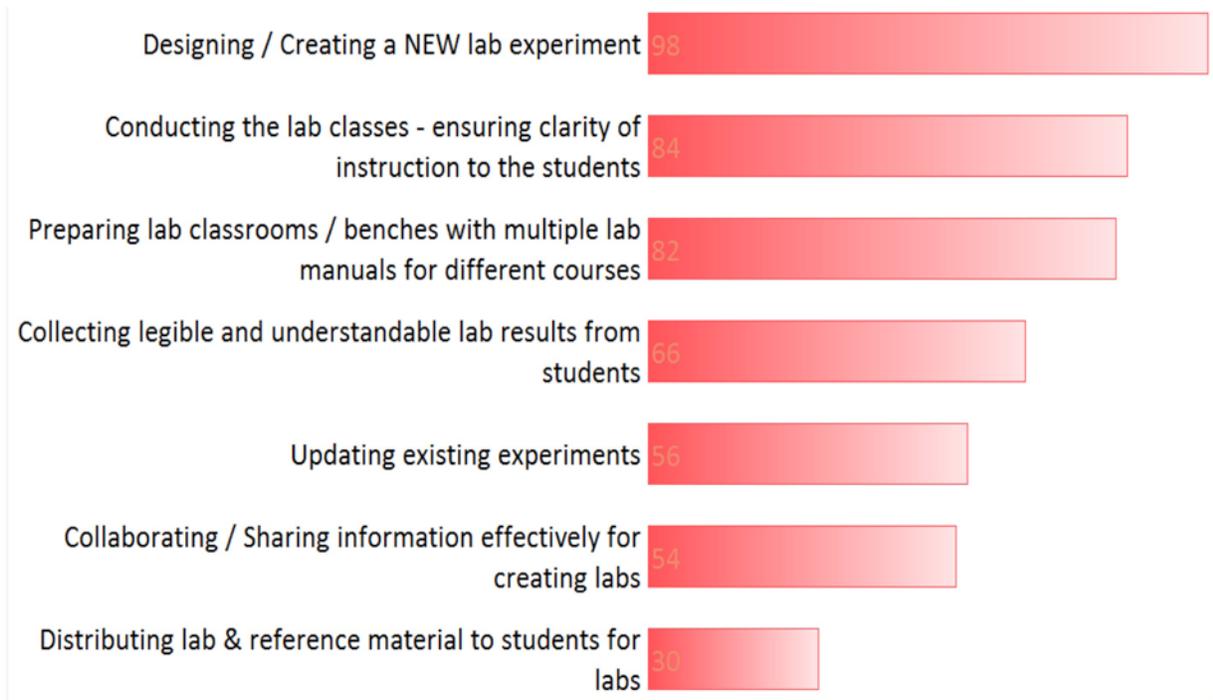


Figure 2. Relative ranking of challenges faced by teachers and students in basic EE laboratory classes.

## Key Challenges

In 2012, Tektronix conducted an independent survey among educators and students of electrical and electronics engineering departments from selected universities in China, India and the United States. The primary objective was to understand the equipment requirements of university teaching labs. Additionally, the survey investigated the key challenges faced by educators when conducting laboratory classes and students when performing lab experiments. The results indicated that there is an opportunity for improvement in the workflow of designing lab experiments, conducting lab classes and actually performing the lab experiments.

The survey revealed that designing and creating new lab experiments is the biggest challenge faced by educators. A related concern is the challenge of updating existing material to keep it current. When technologies change, lab equipment is upgraded or as class lectures take on new directions; educators felt that it is important to make sure lab exercises are updated to reflect these changes. Updates can be time consuming and expensive when labs are distributed via a workbook.

For lab courseware development many universities suggest that professors collaborate with each other and share information. Although this has proven to be beneficial, there is often a need to update material to a specific format

because there are no standard templates used throughout the institution.

The survey also identified that it is important to provide students with clear instructions for performing and completing lab experiments. For a laboratory that supports multiple courses it can be a challenge making sure that the appropriate lab manuals are available when a specific lab session begins. It can be a tedious task for lab administrators to setup lab benches with printed lab manuals each time students from different courses come to perform experiments.

For students, the key challenges are related to collecting measurement results, sketching waveforms, taking screenshots and organizing the data for lab reports, activities that can be very time consuming. For lab administrators, reviewing the lab reports can also be a challenge, the reports are rarely consistent and often, students do not clearly show what actual work was done to complete the experiment.

The survey identified a variety of key challenges faced by educators, lab administrators and students when designing and performing lab experiments. This application note will provide a brief introduction to the innovative courseware feature found on the TBS1000B-EDU series oscilloscopes and how this new capability addresses the challenges identified in the survey.

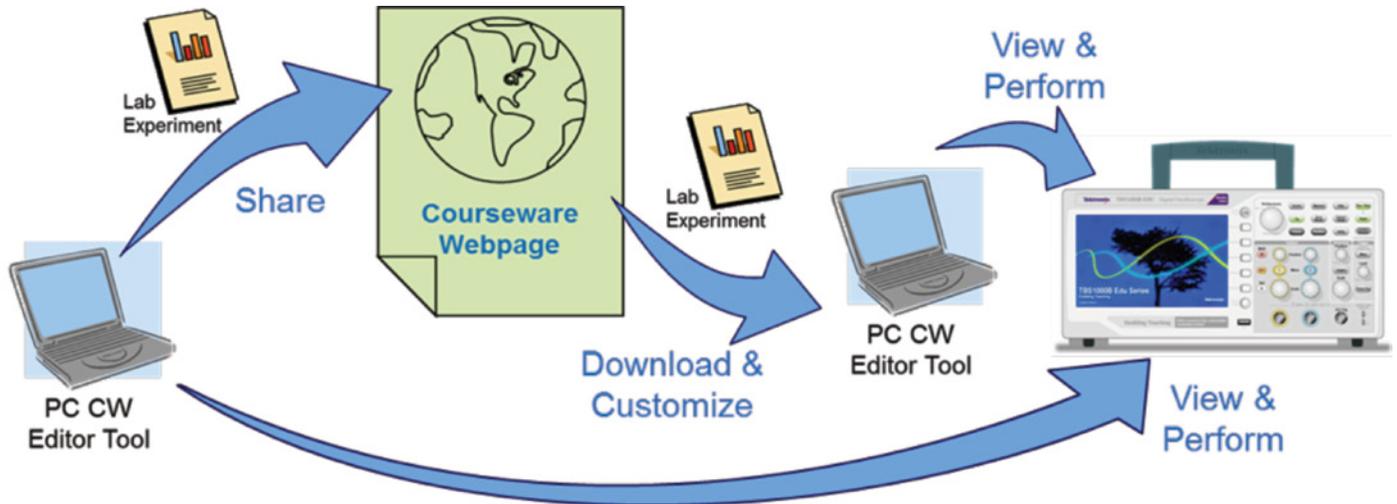


Figure 3. Courseware management solution available with TBS1000B-EDU series oscilloscopes.

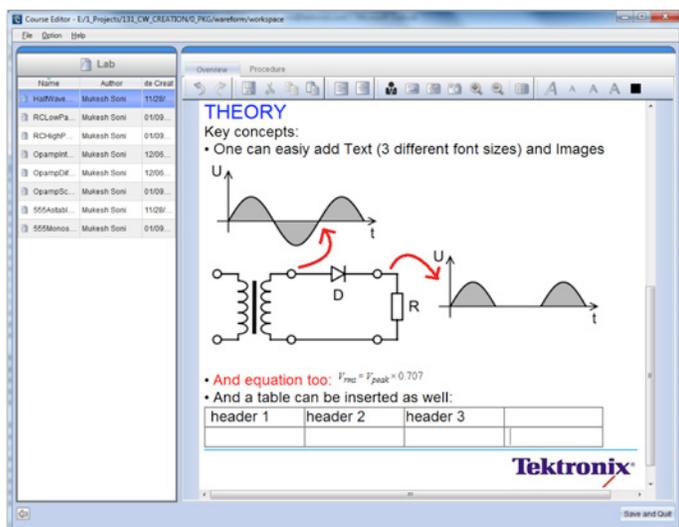
## Enabling Efficient Lab Courseware Management

The Tektronix TBS1000B-EDU series oscilloscopes offer a complete courseware development solution. It enables educators to create labs in a format that can be easily shared with students or other educators. Labs can be organized into courses and all of the information can be uploaded directly onto to a TBS1000B-EDU instrument. Students can review, perform, document and create reports for lab experiments, directly on the oscilloscope. And with the implementation of a web based Courseware Resource Center, dedicated to sharing lab content, Tektronix has created a courseware repository that can serve as an essential resource for educators from around the world.

The courseware management solution has three key elements:

1. **PC Courseware Editor Tool** – An MS Windows based tool that allows educators to create lab experiments (courseware) that are viewable on TBS1000B series oscilloscopes.
2. **Courseware Resource Center** – A web based, interactive, multi-lingual community platform for sharing lab courseware.
3. **TBS1000B-EDU Oscilloscope with Courseware Features** – Lab material created using the PC Courseware Editor Tool can be loaded directly onto a TBS1000B-EDU series oscilloscope using a USB memory drive.

Together, these three elements are combined to create a virtual courseware ecosystem that addresses the variety of challenges experienced by educators.



**Figure 4.** Create labs using the PC Courseware Editor Tool; easily add text, images, equation or tables.

## Designing/Creating a New Lab Experiments

The highest ranking challenge identified in the survey was the need to create new lab experiments. The TBS1000B-EDU addresses this challenge in several ways. Often, determining how to organize the lab is a major first step in starting the creation process. The PC Courseware Editor Tool standardizes

the lab format and includes powerful editing tools for creating and updating labs. The tool uses a familiar Windows interface that makes it easy to insert text descriptions and instructions either by typing the information or pasting it from a Word or .pdf document. The tool also has a variety of quick access buttons that include:

- An image insert tool
- A table insert tool
- A built in equation editor which can be used to replicate both simple and complex equations
- A handy screen capture tool that lets you instantly paste a section of your computer screen image into the application

Since the PC tool creates labs in a standard format it becomes much easier to share content with peers who use the same tool. You can easily open labs from colleagues and update them to support your specific class requirements. Also available is the web based Courseware Resource Center. At this site you'll be able to search for material on a variety of subjects which includes tutorials, educational kit based labs, industrial application notes and project case studies. You can download content and use it as-is or modify it to suit your needs. The TBS1000B-EDU Courseware management solution provides a variety of options for you to use as you develop new lab content for your curriculum.

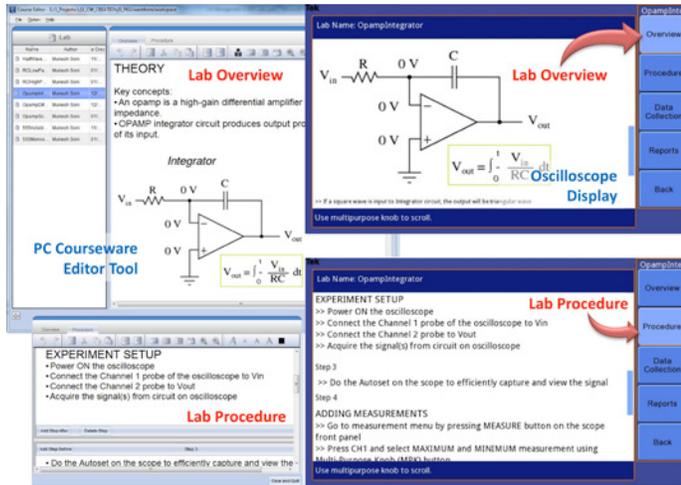


Figure 5. Information created using the PC Courseware Tool can be seen on the TBS1000B-EDU oscilloscope.

## Conducting Lab Classes – Ensuring Clarity of Instructions

Another key challenge is ensuring that students have clear instructions on how to perform assigned lab experiments. Due to printing costs, printed lab books will often only include step-by-step instructions and have little or no background material that helps explain the theory behind the lab. When faced with similar questions from multiple students an instructor may

sometimes have to stop the lab to remind students of material covered in class. When used in conjunction with the PC Courseware Editor Tool the TBS1000B-EDU can address all of these issues.

The PC Courseware Editor Software organizes Labs in two basic sections. First is the overview section, which is a free form area where any type of information can be included. Generally objectives and equipment requirements are added but it's also an area where background information, tips and tricks and responses to anticipated or frequently asked questions can also be placed. The second section is the procedure section, it's more structured because it's set-up to provide a format for entering step-by-step instructions. Although there are no limitations to what type of information can be added to a step it's generally a good idea to focus on information needed to carry out the experiment.

All of the overview and procedure information created in the PC Tool can be uploaded directly onto the TBS1000B-EDU instrument. The courseware application running on the oscilloscope organizes data using the same structure so students will be able to see all of the information in the overview and procedure sections just as it appears in the PC Tool. This provides quick access to not only the step by step procedures but also any supporting or background information that will help them complete the lab.

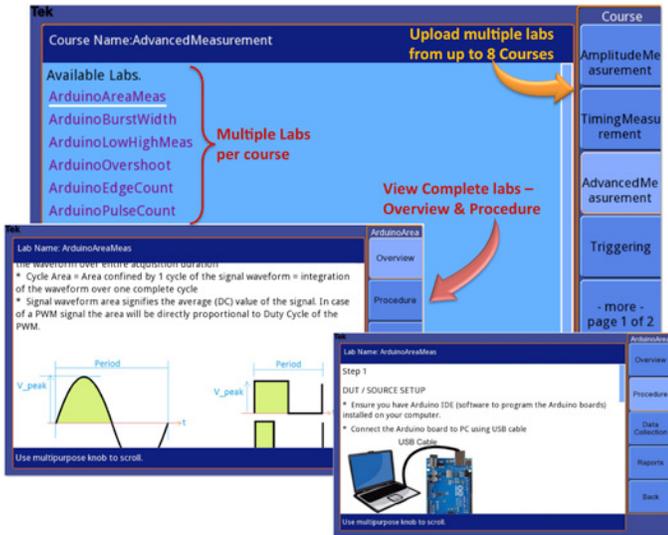


Figure 6. Upload multiple labs for up to 8 different courses and view them on the oscilloscope screen.

## Sharing and Updating Lab Information

The courseware management solution solves a variety of issues when dealing with the distribution of lab material to students and to electronic labs that support multiple classes. Since the lab content is loaded onto the TBS1000B-EDU electronically it can alleviate the need for paper lab manuals. If a lab needs updating to support recent lectures or equipment changes it can be done quickly using the PC Courseware Editor Tool. Changes are made to the lab and then the updated lab can be quickly redistributed to the oscilloscopes via a USB drive. This saves cost, time and effort and with electronic distribution there is no longer a need to reprint out-of-date lab manuals.

The courseware is also structured so that multiple labs can be organized into a grouping called a “Course”. A “Course” can correspond to a specific class or lab series. Up to eight courses can be loaded onto a TBS1000B-EDU scope and each course can contain up to 30 or more labs. This means for an electronic laboratory that supports multiple classes, lab material could potentially be loaded onto an oscilloscope at the beginning of a term and wouldn’t require updating until the next term begins. Although there is still the option of uploading new information onto the instruments mid-term if updates are required.



Figure 7. Data collection includes the feature of assigning results to specific steps of the lab experiment.

## Data Collection & Report Generation

Documenting lab exercises and creating lab reports is a significant challenge for both students and educators. If printed lab manuals are used, often lab results are just response boxes filled with numbers which may not necessarily reflect the student's true understanding of the material. If drawings are required, students may resort to duplicating waveforms by hand which can take an unnecessarily long time and may not truly represent what the student obtained as a result. With digital oscilloscopes, screen captures are also an option but then students are required to paste those images into a document. Often, with multiple documents submitted by multiple students the lab reports will have different formats making the grading process more difficult.

The TBS1000B-EDU includes various tools that streamline the reporting process. When performing labs using the courseware system, students can easily switch between the courseware application and the oscilloscope application using a "Data Collection" option on the instrument. Using the step-by-step instructions, students can set-up the scope to see the desired waveform and then save the results using screen

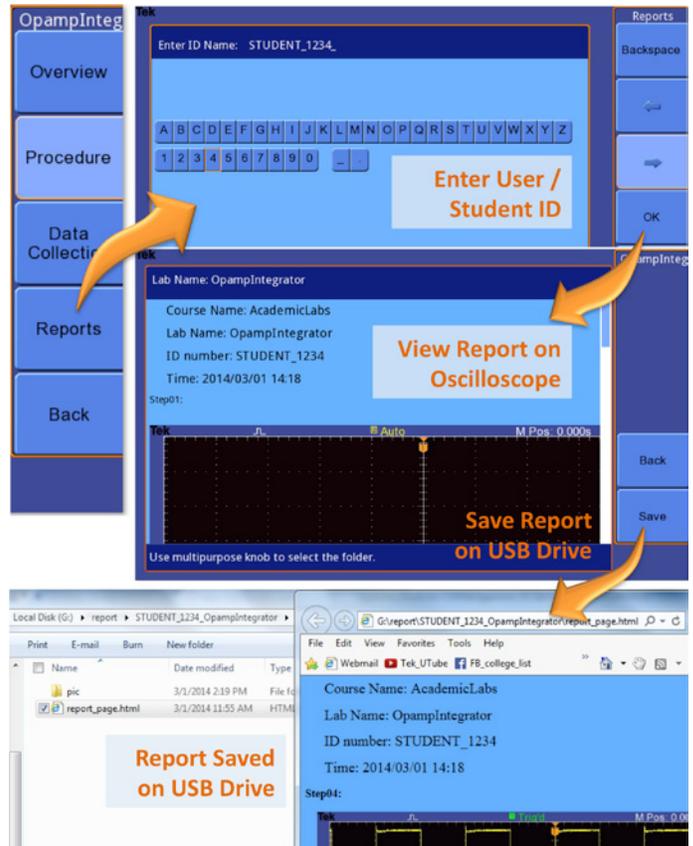


Figure 8. Generate an HTML lab report from the data collected.

captures. For tracking, the scope provides the option of associating the captured information with a specific step in the procedure. When the lab is complete, the student can then automatically create a lab report comprised of all of the screen captures taken during the lab. The oscilloscope generates an HTML file and a folder that contains the screen capture images. The report includes the lab name, the student's ID, the date and screen images annotated with the step number assigned when the image was captured. To turn in the report the student can save the files to a USB drive and upload them onto a server or .zip the file and folder together and then submit it by e-mail. The reports are generated in a standard format which makes it easier to review and can provide a clearer indication on how well the student understands the material.

**Courseware Resources for Educators**

Enabling teaching with the TBS1000B-EDU

With your purchase of the TBS1000B-EDU instrument – the world's first dedicated teaching oscilloscope – you've taken the first step in creating an environment that makes it easier to develop and distribute lab material to your students. Use this site for assistance and ideas to uncover new ways of enhancing the teaching and learning experience.

Feel free to download posted labs for inspiration and provide comments on content you've used. When you're ready, you can share your own labs with our global "courseware" community.

**Log in or register to access these courseware resources:**

- Courseware files contributed by your peers
- Sample files created by Tektronix
- User manuals
- Updates for the PC Courseware Editor tool

**Search Courseware**

Language: English

Terms:

Go

**Find By Category**

- Scope Tutorials
- Edu-kit based Labs
- Academic Labs

**Developer Toolbox**

- Courseware Home
- Search Courseware
- Contributor
- PC Courseware Editor Tool
- User Manuals
- FAQ

**Courseware Submission Guidelines**

We encourage you to submit courseware that other educators can use in their classrooms, or submissions make the community stronger.

Submissions cannot be anonymous. We do require you to register and complete a short profile the people who view your lab. (Profiles may be updated at any time through the My Account link)

Read the full terms & conditions.

We appreciate your contribution.

**Submit Courseware**

**INSTRUCTIONS: EXPORT + UPLOAD**

1. Using the PC "Export" button create an .xlab
2. Create a zip
3. Click to begin
4. Log in or reg
5. Create a pro this web site.

**BROWSE COMMUNITY-CONTRIBUTED COURSEWARE**

Filter results by language

<Any> Apply

	Language	
<p><b>German: Schmitt Trigger circuit using OPAMP</b></p> <p>In electronics, a Schmitt trigger is a comparator circuit with hysteresis, implemented by applying positive feedback to the noninverting input of a comparator or differential amplifier. It is an active circuit which converts an analog input signal to a digital output signal. Oscilloscope is used to verify derivative operation.</p> <p>More Detail</p>	German	19 March 2014
<p><b>Spanish: Integrator circuit using OPAMP</b></p> <p>Opamp circuit that produces output as integral of input signal. Oscilloscope is used to verify derivative operation.</p> <p>More Detail</p>	Spanish	19 March 2014

**Courseware Search**

Search:

Category: <Any>

Keywords: <Any>

Language: <Any>

Author: <Any>

Apply

Figure 9. The Tektronix Courseware Resource Center is a global, online community that promotes sharing lab courseware information.

## Collaborating & Sharing Information Effectively

Sharing lab information is made much easier with the courseware management solution. Since labs are created using a standard format, content can be shared between peers on the same campus or with educators from around

the world. Tektronix created the Courseware Resource Center which is a web based community for educators to freely share lab courseware information with one another. At this site, educators can download relevant course material or upload material to share their own labs. The site also contains a comprehensive search engine that allows visitors to search for labs by key word, author, category, topic and/or language.

## Conclusion

The TBS1000B-EDU and the Courseware Management Solution provides important tools that address the challenges faced by educators, lab administrators and students involved with electronic laboratories. The TBS1000B-EDU, PC Courseware Editor Tool and the web based Courseware Resource Center create the first integrated courseware ecosystem that can help educators teach more efficiently.

- PC Courseware Editor Tool simplifies the creation of lab experiments by providing intuitive tools for adding text, images, tables and equations; making it easier for instructors to provide clear and detailed procedural instructions to students on performing lab experiments.
- Educators can leverage the global Courseware Resource Center that offers a collection of multilingual lab experiments prepared by educators from around the world. Information can be downloaded and customized to support individual needs.
- Lab-administrators can organize multiple labs that support multiple classes and upload the material onto a TBS1000B-EDU, potentially supporting an entire term of lab activity.
- Educator can easily collaborate as they develop lab materials because the PC Courseware Editor Tool standardizes the lab format making it easier to share content.

The Courseware Management Solution is equally beneficial to the students.

- Students can see lab information directly on the oscilloscope screen thereby making it easy to access the instructions and supporting documentation needed to complete lab experiments.
- Measurement data can be collected using screen captures and lab report are automatically created in a standard format saving time for both students and professors.



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**For Further Information**

Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tektronix.com](http://www.tektronix.com)



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