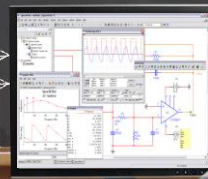
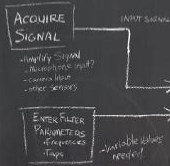


Enhancing Education With National Instruments



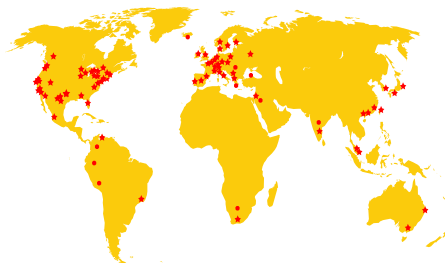
Alex Floor
Academic Sales Engineer Northern Region Europe
National Instruments Electronics

ni.com



National Instruments in Academia

- Adopted in 5,000+ Universities in over 110 Countries
- Used in all engineering and science disciplines
- 1,000+ U.S. schools use LabVIEW



KATHOLIEKE UNIVERSITEIT
LEUVEN

DE **HAAGSE**
HOGESCHOOL



vrije Universiteit amsterdam

HOGESCHOOL **GENT**
VRIJE VAN DE ASSOCIATE UNIVERSITEIT GENT

ROC **FRIESE POORT**

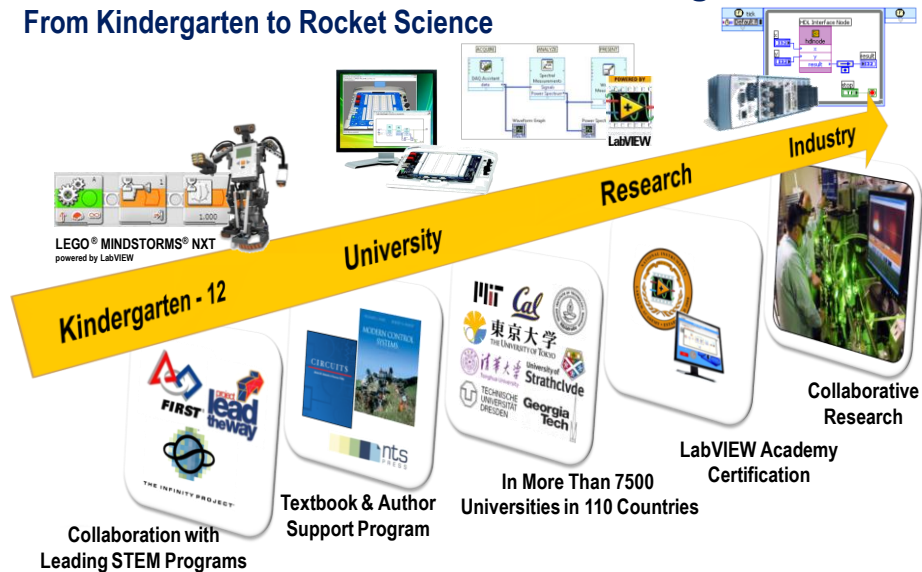
avans
hogeschool

ni.com



National Instruments Academic Program

From Kindergarten to Rocket Science

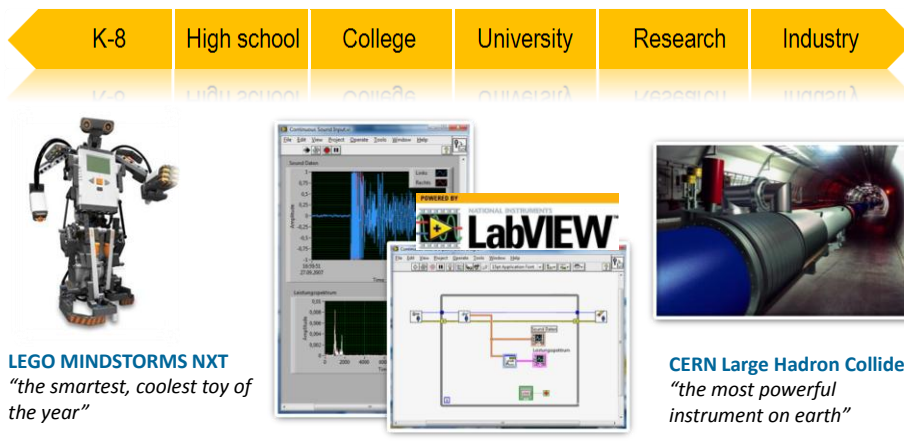


ni.com



3

Graphical System Design

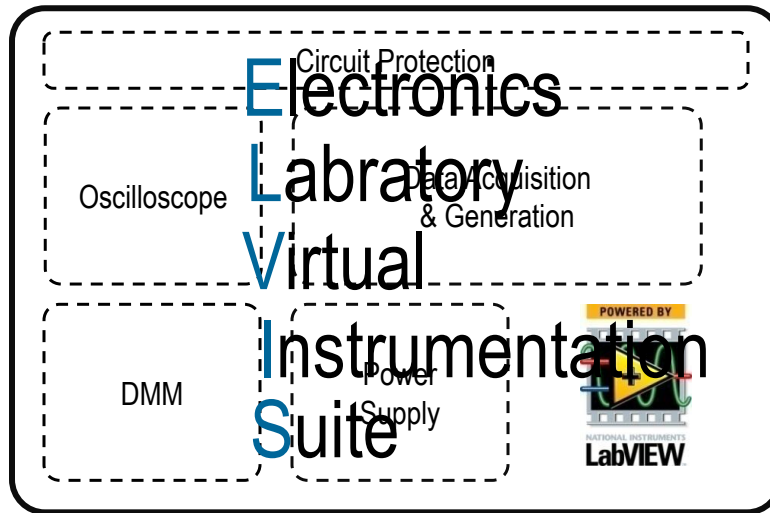


ni.com



4

What is NI ELVIS? | At the core...12 Instruments



ni.com

5



Introduction | A Little NI ELVIS History...

- Concept from California State University, San Bernardino
- Paul Dixon, Professor of Physics
 - Pioneer of virtual instrumentation in classroom
 - LabVIEW and DAQ board provided 90% solution
 - Needed connector more appropriate for student use – breadboard is ideal
 - Wanted to include lab instrument capability, example programmable power supply



ni.com

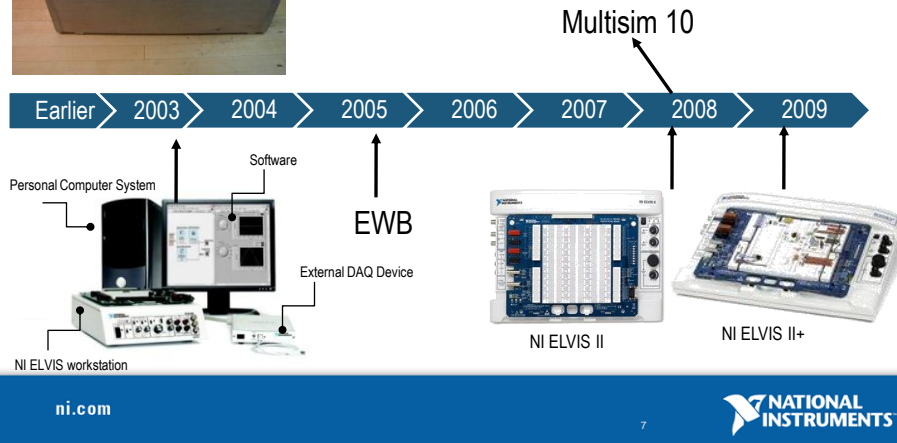
6



Introduction | From concept to reality








- LabVIEW / DAQ based system
- Removable prototyping board
- Integrated instrument capability



"The NI ELVIS platform has solved many lab problems. It gives the students all tools needed to design and test electronic circuits on a systematic basis. By having all tools readily at hand, the focus of the courses can be directed towards the content."

Frank Sierens, Docent Hogeschool Gent

<p>Controls and Mechatronics</p>  <p>QUANSER INNOVATE. EDUCATE.</p>	<p>Telecommunications</p>  <p>EMONA time</p>
<p>NATIONAL INSTRUMENTS NI ELVIS Platform</p> 	
<p>NATIONAL INSTRUMENTS XILINX</p>  <p>Digital Electronics</p>	<p>freescalar semiconductor</p>  <p>Embedded Design</p>
<p>ni.com</p> <p>15</p> <p>NATIONAL INSTRUMENTS</p>	

NI ELVIS | Circuits



NATIONAL INSTRUMENTS

National Instruments
Electronics Education Platform

- NI ELVIS
- NI Multisim
- NI LabVIEW

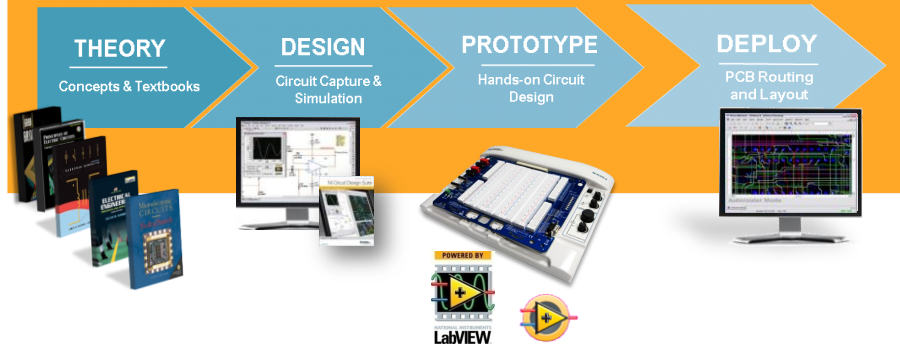


ni.com

NATIONAL INSTRUMENTS

NI Electronics Education Platform

Electronics Education Platform



ni.com

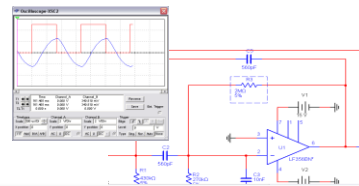
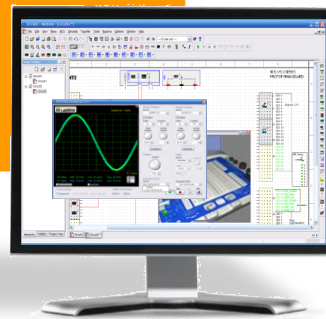
17



NI Multisim

NI Multisim
Teaching environment to foster student learning

- Engage students with interactive components and change-on-the-fly simulations
- Gain intuition through dynamic visualization using simulation-driven instruments
- Bridge gap between theory and real-world measurement



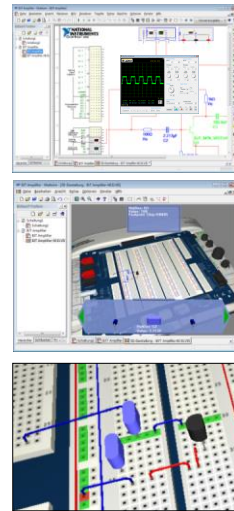
ni.com

18



Multisim Teaching Environment

- NI Multisim
 - SPICE-based simulation
 - Analog, digital, mixed
 - Interactive parts
 - Virtual instruments
 - Circuit faults and restrictions
- Integration with NI ELVIS II/II+
 - 3D virtual breadboard
 - NI ELVIS instruments
 - Input/output of real-world signals



ni.com

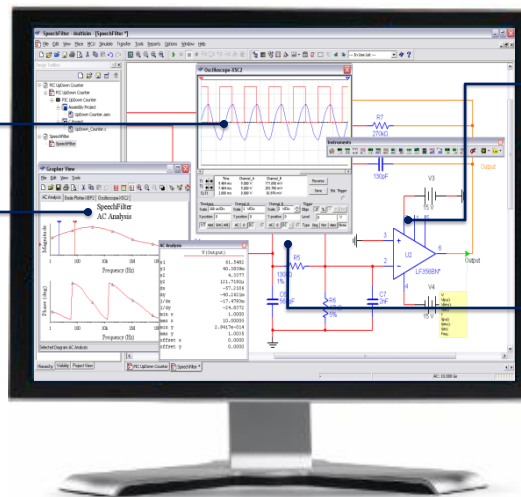
19



Core NI Multisim Educational Features

22 Virtual Instruments
behaving like
real-world
counterparts

Advanced Analyses to
investigate circuit
characteristics



15,000+ Components
to reinforce theory

Teach troubleshooting
with circuit
restrictions and
hidden faults

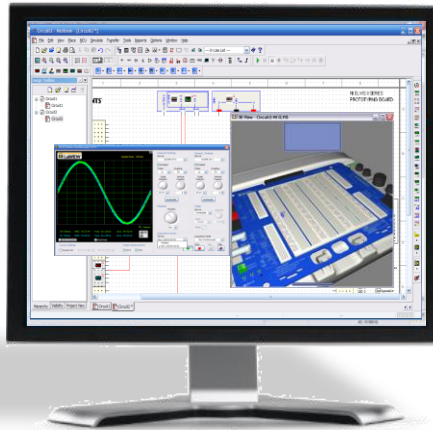
ni.com

20



NI ELVIS Instruments Inside Multisim

NI ELVIS Instruments –
Access them from the
toolbar in addition to other
Multisim instruments



NI ELVIS Schematic –
Click NI ELVIS II icons on
the schematic to access
NI ELVIS instruments

3D NI ELVIS – Updated
3D model and
components that allow
students to prototype in a
safe environment

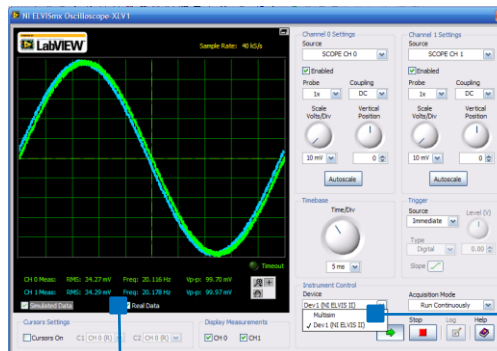
ni.com

21



Theory and Measurement

Compare simulated data and measured signal on the same
instrument



Access NI ELVIS
hardware With one
click switch between
simulated signals and
acquiring signals from
your NI ELVIS II
hardware

NI ELVIS II Instruments Compare simulated
Multisim data with measured signals from NI ELVIS
II within Multisim

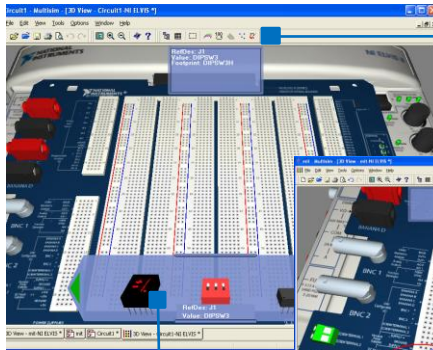
ni.com

22



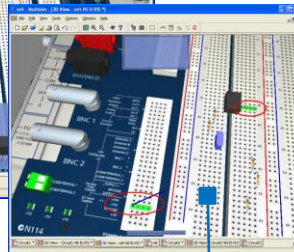
3D NI ELVIS Environment

3D NI ELVIS Environment
Fully interactive environment allows users to rotate, zoom in and out and pan view



Design Rules and Connectivity Check. Verify circuit on breadboard with the schematic

3D Components
Fully interactive allowing users to rotate, zoom in and out and pan view



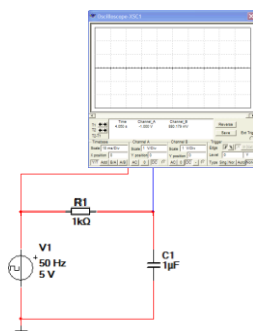
Teaching aid. Legitimate "target" pin turn green...illustrating where to make signal connection.

ni.com

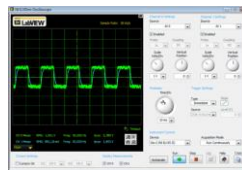
23



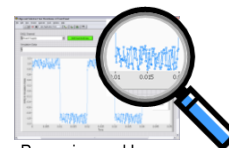
Teaching Circuits



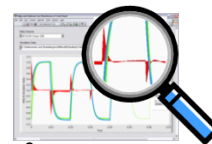
Step 1: Capture, Simulate and improve a design in NI Multisim



Step 2: Build circuit and measure Real-world signals with NI ELVIS



Recognize and Learn



Compare

Step 3: Compare *Simulated* vs. *Real* Measurement Data

ni.com

25



Teaching | Measurements



- Analog Protoboard connector
- Digital Protoboard connector
- more than 50 sensors
 - Hand Dynamometer
 - Heart Rate Monitor
 - pH sensor
 - and more...
- Program with NI LabVIEW

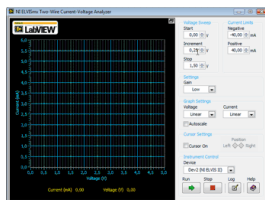


ni.com

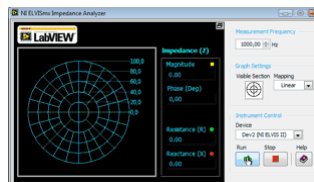
29



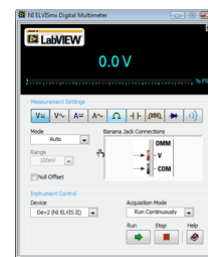
Teaching | Measurements & Instrumentation



IV Characteristic of a diode



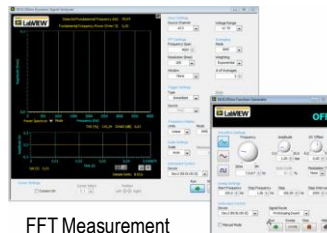
Impedance Analyzer



Resistance Measurement



Digital Reading



FFT Measurement

ni.com

30





NI ELECTRONICS EDUCATION PLATFORM DEMO

ni.com

31



NI ELVIS | Digital Electronics FPGA



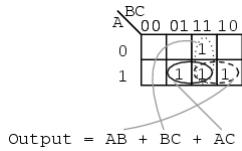
National Instruments
Digital Electronics FPGA



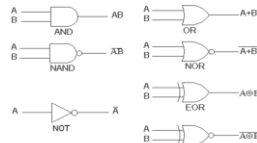
ni.com



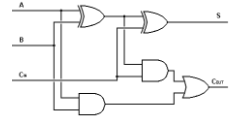
Teaching Digital Electronics | Challenge



Boolean Algebra



Logic Gates



Digital Logic Design

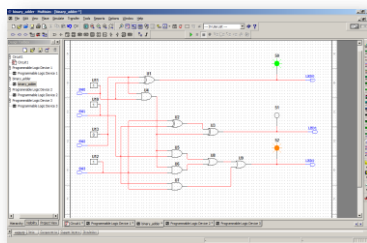
VHDL

```
-- Use: This file defines the top-level of the des
-- Use with File:
library ieee;
use ieee.std_logic_1164.ALL;
use ieee.numeric_std.ALL;

library work;
use work.test_vhdl_pkg.ALL;

entity binary_adder is
  port (
    LED0 : out std_logic;
    LED1 : out std_logic;
    LED2 : out std_logic;
    SW0 : in std_logic;
    SW1 : in std_logic;
    SW2 : in std_logic;
    SW3 : in std_logic;
    sys_clk_pin : in std_logic
  );
end binary_adder;
```

Programmable Logic Design



Programmable Logic Design from Schematic

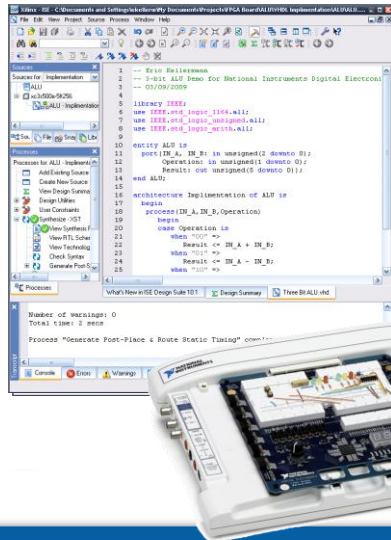
- Generate raw VHDL from a schematic drawn in Multisim
- 100+ basic components
- VHDL code can be use to target programmable logic devices

```
-- Use: This file defines the top-level of the des
-- Use with File:
library ieee;
use ieee.std_logic_1164.ALL;
use ieee.numeric_std.ALL;

library work;
use work.test_vhdl_pkg.ALL;

entity binary_adder is
  port (
    LED0 : out std_logic;
    LED1 : out std_logic;
    LED2 : out std_logic;
    SW0 : in std_logic;
    SW1 : in std_logic;
    SW2 : in std_logic;
    SW3 : in std_logic;
    sys_clk_pin : in std_logic
  );
end binary_adder;
```


Programmable Logic Design



Integration to NI Digital Electronics FPGA Board

- Exported VHDL code from Multisim to target NI Digital Electronics FPGA Board
- No need to recapture logic in different software package
- Integration eases student transition from theory, design, to hardware



ni.com

36



NI Digital Electronics FPGA Board



Digital electronics and design board with field-programmable gate array (FPGA)

- Hands-on learning through implementation
- Student interaction with onboard displays, switches and buttons
- Programmable with LabVIEW and Xilinx ISE tools



ni.com

37



NI ELVIS | Controls & Mechatronics Plants



QNET-011 Rotary Inverted Pendulum

QNET-012 HVAC Trainer

QNET-010 DC Motor Control Trainer

QUANSER INNOVATE. EDUCATE.

NATIONAL INSTRUMENTS LabVIEW

NEW! QNET-013 VTOL 1DOF Helicopter Plant

NEW! QNET-014 Mechatronics Sensors 1 Board

ni.com

NATIONAL INSTRUMENTS

NEW in Controls



QNET-013 VTOL Actuator

Flight Control: Vertical Take Off and Landing

- Model Aerospace dynamics, kinematics and control

QNET-014 Mechatronic Sensor 1

- How and when to use sensors
- Characteristics of each sensor
- Sensors on the board include:
 - Encoder
 - Potentiometer
 - Flexgage
 - Sonar
 - Infrared
 - Pressure
 - Piezo

All plants include:

- VIs specific to plant
- Courseware



ni.com

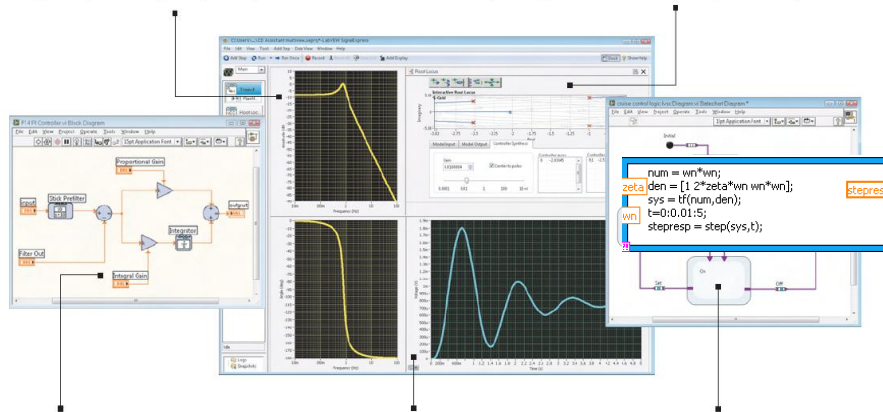
39



LabVIEW Control Design & Simulation Module

Graphical System Design
Design and optimize complex, dynamic system models

Interactive Algorithm Engineering
Quickly tune algorithms or interactively change simulation parameters



Open Design Platform
Integrate your models created in third-party packages such as The MathWorks, Inc. Simulink® software

Intuitive User Interface
Interactively use dials, gauges, 3D visualizations, and more to better illustrate numerical results

Multiple Models of Computation
Combine graphical programming, textual math, and statecharts or reuse existing algorithms quickly and efficiently

ni.com

40



NI ELVIS | Biomedical Engineering

NEW! QNET-014
Myoelectric Trainer



NEW! Vernier Biosensor Kit

ni.com



Myoelectric Prosthetics

Concepts

- Myoelectric prosthetics
- Bioinstrumentation
- Clinical diagnostic tool: identifying neuromuscular diseases
- Assisted control in aircrafts
- Unvoiced speech recognition



Hardware:

- Electromyograph with opto-isolated electrode and a grounding strap
- runs on two AA batteries
- Pulse-width controlled metal gear servo
- monitor electromyogram signal at different stages in circuit
- Curriculum included

ni.com

47



Biomedical Sensors Kit

Biomedical Concepts

- Air Flow and Lung Volume
- Blood Pressure
- Electrocardiogram
- Human Respiration
- Muscle Activity and Fatigue
- Temperature

VERNIER: Biosensors

- Spirometer
- Blood Pressure
- Surface Temperature
- O2 Gas Sensor
- EKG Sensor
- Hand Grip Heart Rate
- Monitor
- Hand Dynamometer



ni.com

48



NI ELVIS | Green Engineering

Emona FOTEx ETT-203



EMONA
times

NATIONAL INSTRUMENTS
LabVIEW



Vernier Green Sensor Kit

ni.com

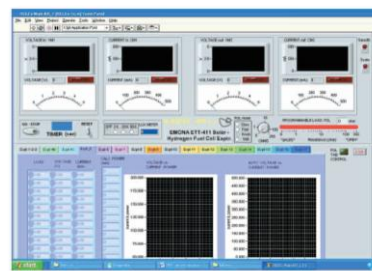
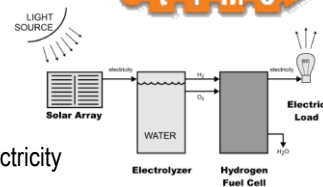
NATIONAL
INSTRUMENTS

Measurements & Sustainable Energy

EMONA
times

EMONA HELEX: Solar-Hydrogen Electricity

- SECTION A - SOLAR ENERGY: light to electricity
- SECTION B - ELECTROLYSIS: water to gases
- SECTION C - HYDROGEN FUEL CELLS: gases to electricity

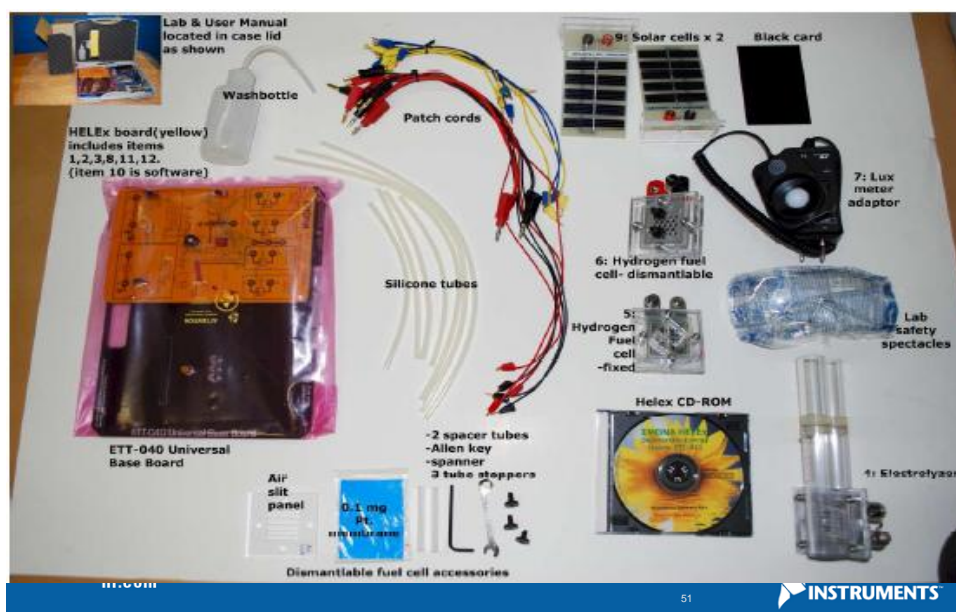


ni.com

50

NATIONAL
INSTRUMENTS

Components & Accessories



Measurements & Sustainable Energy



EMONA HELEX: Solar-Hydrogen Electricity

A - SOLAR ENERGY: light to electricity

- The visible spectrum and photometry
- Measuring solar energy, intensity & angle of incidence
- Maximum Power Point & Fill Factor measurements
- Photovoltaic cell internal characteristics measurement
- Multiple solar cell configurations & performance

B - ELECTROLYSIS: water to gases

- Electrolysis in action
- Electrolyzer decomposition voltage & load matching
- Avogadro's number & Faraday efficiency measurements

C - HYDROGEN FUEL CELLS: gases to electricity

- Introducing the Hydrogen Fuel Cell: reversing the electrolytic process
- Faraday's 1st Law using fuel cells and consumption measurement
- System efficiency and fuel cell characteristic curves
- Dismantlable fuel cells: impact of oxidant supply & catalyst
- Modeling a fuel cell power plant
- Mathematically modeling a fuel cell using **LabVIEW & Multisim**
- Stacking multiple fuel cells in series & parallel

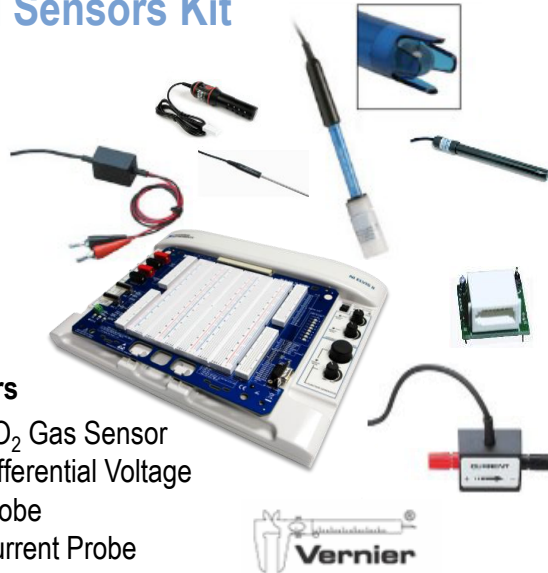
Green Engineering Sensors Kit

Green Concepts

- Water and air quality
- Respiration of organisms
- CO₂ Emissions
- Conductivity of ions
- Power quality
- Energy storage

VERNIER: Green Sensors

- | | |
|-------------------------------------|------------------------------|
| ▪ pH Sensor | ▪ CO ₂ Gas Sensor |
| ▪ Stainless Steel Temperature Probe | ▪ Differential Voltage Probe |
| ▪ Conductivity Probe | ▪ Current Probe |



ni.com

53



NI ELVIS | Telecommunications & Fiber Optics



Emona FOTEx ETT-203



Emona DATEx ETT-202



ni.com



NEW FOTEx | Fiber Optics



Fiber Optical Trainer

- Block Diagram based modeling
- LabVIEW Soft Front Panels
- Courseware

Example Labs

- Optical Signal Transmission
- Optical Signal Splitting and Combining
- Bidirectional Optical Fiber Link
- Wavelength Division Multiplex (WDM)
- Optical Losses

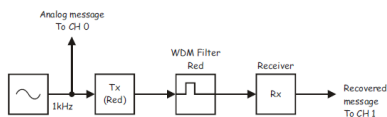


ni.com

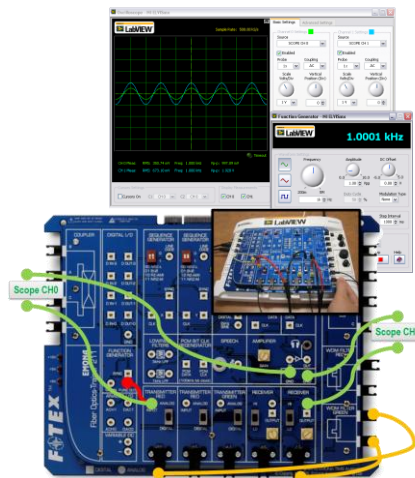
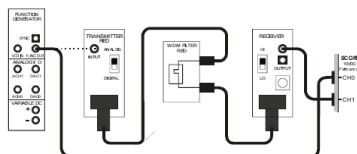
55



Teaching | Fiber Optics



Step 1: Block diagram approach to optical signal filtering, splitting and combining



Step 2: Connecting FOTEx Modules and NI ELVIS Instruments

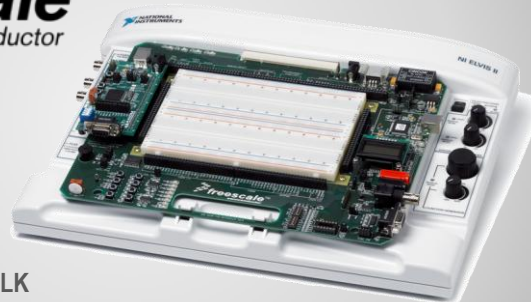
ni.com

56



- [illegible]

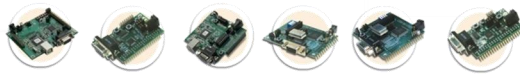
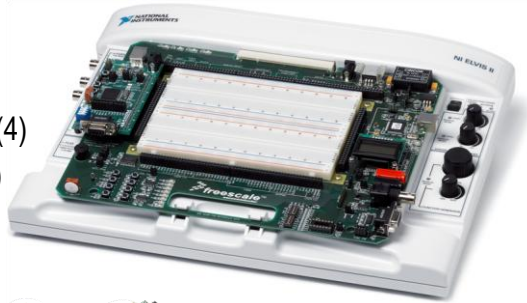
- ni.com



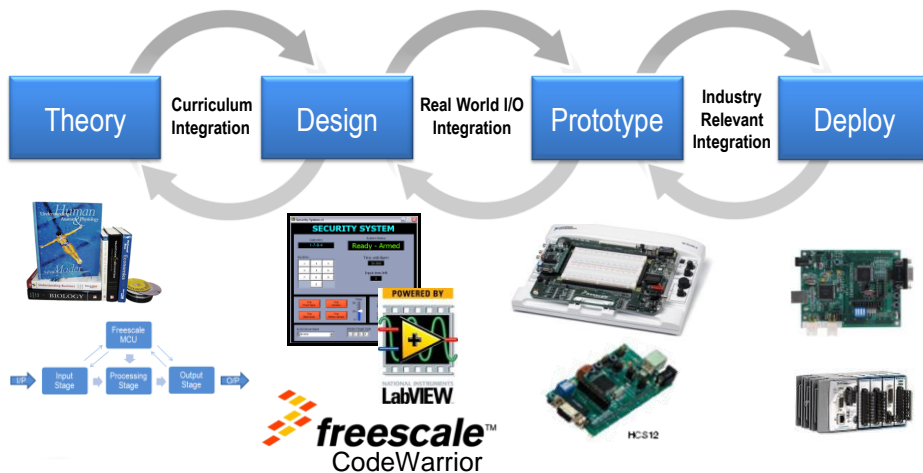
Freescale HCS12 SLK



- Integrated HCS12(x)/HCS08 USB pod
- Applicable Modules
 - HCS08 (1)
 - HCS12/HCS12x/DSP (4)
 - Coldfire processors (2)
 - RF Transceiver (1)



Teaching | Embedded





AFTER THE BREAK (14.30) HANDS-ON SESSION WITH NI ELVIS & MULTISIM

ni.com

66



NI ELVIS Platform for Hands-On Learning



- 12 Integrated Instruments
- Programmable with LabVIEW
- USB-Plug & Play
- Small form factor
- Expandable with plug-in modules



Circuits



Digital Electronics



Controls



Telecommunication



Embedded

ni.com



Online Resources



NI ELVIS II Guided Tour



Courseware



Download Resource Kits



Webcast



Textbook Resources



Case Studies & White Papers

ni.com

68

