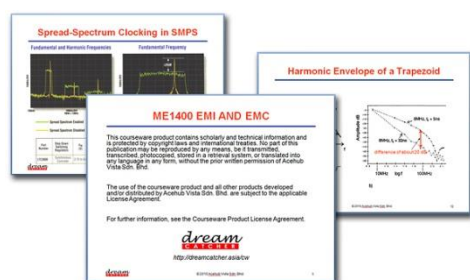


ME1400

EMI and EMC Courseware

Teaching slides

- Editable Microsoft® PowerPoint® slides
- Covers 45 hours of teaching



Training kit

- EMI/EMC hardware kit
- Lab sheets & model answers
- Problem-based assignments
- Covers 24 hours of labs



Target university subject	Target year of study	Prerequisite(s)
Electromagnetic Interference Electromagnetic Compatibility	3rd year or final year undergraduate	Electromagnetic Theory

The ME1400 is a ready-to-teach package in electromagnetic interference (EMI) and compatibility (EMC). It is a lecturer resource with teaching slides, training kits, lab sheets, and problem-based assignments.

Designed to impart knowledge in

- Sources of electromagnetic interference
- EMC fundamentals
- Good PCB design practices
- EMC regulations and standards
- Compliance testing and measurements
- Measurement instruments usage

Benefits of the ME1400 courseware

- The EMI/EMC hardware kit consists of two modules – an EMI source module and an EM coupling module, allowing students to understand the cause and effect of EMI in today's high-speed PCB board design.
- Students can analyze EMI from commonly found sources, such as a DC motor, high-frequency signals, and high-speed digital pulses generated by the EMI source module.
- Lab sheets are designed to enable students to perform various EMI/EMC measurements using industry-grade instruments. Each lab exercise highlights an EMI mechanism, factors affecting that mechanism, and mitigation/suppression methods.
- Examples of good PCB design practices are included in the teaching slides and lab sheets, enhancing students' practical skills in high-speed and high-frequency circuit design.



Teaching Slides

More than 400 editable Microsoft PowerPoint teaching slides are provided, covering 45 hours of teaching for one semester. The slides cover the following topics:

- Introduction to EMI/EMC
- Basic Theories
- EMC Control and Design
- PCB Layout Design Issues
- Filters, Cables, and Connectors
- Isolators, Transient, and Surge Protection
- Shielding
- Grounding and Bonding
- EMC Measurement Review
- EMI/EMC Troubleshooting Techniques and Methodologies
- System Integrity



Training Kit

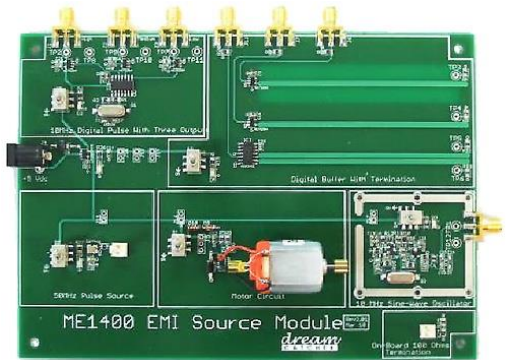
The EMI/EMC hardware kit demonstrates coupling between traces, radiation from traces, PCB signal integrity issues and mitigation, shielding effectiveness, and the transfer impedance concept.

Hardware kit

EMI Source Module

The EMI/EMC hardware kit consists of an EMI source module with the following features:

- 3-speed 10 MHz Digital pulse source (1 ns, 3 ns, 6 ns)
- 10 MHz Sine wave oscillator
- 50 MHz Square wave oscillator
- DC brushed motor circuits
- Digital buffer with termination



Transmission Line Module

The transmission line module contains various types of single and coupled transmission line for EMI measurements:

- Single microstrip ($Z_0 = 50 \Omega$)
- Coupled microstrip ($Z_0 = 50 \Omega$) 0.56 mm edge-to-edge spacing, coupled length = 100 mm
- Coupled microstrip ($Z_0 = 50 \Omega$) 1.2 mm edge-to-edge spacing, coupled length = 100 mm
- Coupled microstrip ($Z_0 = 50 \Omega$) 0.56 mm edge-to-edge spacing, coupled length = 50 mm
- Coaxial line for transfer impedance measurement
- Single co-planar line ($Z_0 = 50 \Omega$)
- Coupled co-planar line ($Z_0 = 50 \Omega$) Coupled Length = 100 mm



Accessories

The following accessories are provided with the training kit.

Item	Quantity
Power adapter, 5 Vdc, 2 A	1
Termination board	1
SMA(m)-to-SMA(m) jumper cable, 0.18 m	3
SMA(m)-to-SMA(m) coaxial cable, 1 m	2
Coaxial, twisted pair and straight cables	1 set
50 Ω terminator, SMA(m)	3
EMC probe (for H-fields)	1
Ferrite clamp	2

EMC Probe



Termination Board



Lab sheets

The training kit includes 8 lab sheets in editable Microsoft Word format. Each lab requires 3 hours to complete. Model answers are provided with all lab sheets. The required instruments for the labs are listed below.

Lab Sheet	Required Items	
	Option 1 Digital Oscilloscope & Spectrum Analyzer	Option 2 Vector Network Analyzer (or Spectrum Analyzer with Tracking Generator)
Probing Techniques	√	
Digital Pulse Spectra and Rise Time Measurement	√	
Controlling Crosstalk: Frequency-Domain Perspective		√
Controlling Crosstalk: Time-Domain Perspective	√	
Controlling Common Impedance Coupling	√	
Controlling Radiated Emission from Cable and PCB	√	
PCB Signal Integrity ^[1]	√ (partial)	√
Transfer Impedance Measurement	√	

[1] A section of this lab sheet requires the usage of a vector network analyzer

Problem-based assignments

The problem-based assignments below allow students to enhance their problem-solving skills.

- Investigation on Radiation from PCB and Shielding
- Study on Differential Signaling



Instruments

The recommended instruments to be purchased separately are listed below:

Instrument / Software	Model ^[1]
Oscilloscope ^[2]	Minimum 200 MHz Oscilloscope
Spectrum Analyzer ^[3]	Minimum 1 GHz Spectrum Analyzer
Vector Network Analyzer ^[4]	Minimum 1 GHz Vector Network Analyzer

[1] The courseware is designed to work with these instruments. Other models with equivalent performance may be used with alterations to the lab procedures.

[2] These instruments are also the recommended models for the ME1500, ME3000, ME3100, and ME3200.

[3] These instruments are also the recommended models for the ME1000, ME1020, ME1200, and ME1100.

[4] These instruments are also the recommended models for the ME1000, ME1020, ME1200, and ME1300.

Training Kit Hardware Specifications

	EMI Source Module	
	Amplitude	Frequency
Oscillators		
3-speed Digital Pulse	3.0 V _{pp} ± 0.5 V (into 50 Ω)	10 MHz ± 50ppm
Sine wave oscillator	550 mV _{pp} ± 50 mV (into 50 Ω)	10 MHz ± 50ppm
Square wave oscillator	3.5 V _{pp} ± 0.5 V (into 100 Ω)	50 MHz ± 50ppm
General		
Input voltage		Regulated 5 V DC
Input current		0.25 A ^[1] (typical)
EMC designed to		CISPR11:1990/EN55011:1991 IEC801-2:1984/EN50082-1:1992 IEC61010-1:1990+A1
Warranty		1 year

[1] Current value with the DC motor turned ON. When the DC motor is turned OFF, typical current consumption is less than 10 mA.

Ordering Information

Description	Package	Product Number
Teaching Slides	1 user license	ME1400-100
Training Kit	1 set	ME1400-200
Teaching Slides + Training Kit	1 user license + 1 set	ME1400-300
Instruments	where applicable	Purchase separately

Note: Pictures in this document are for illustration purposes only and may differ from the actual product.

Training courses related to subject matter are available on request. Visit dreamcatcher.asia for details.

<p>For more information or enquiries:</p> <p>Website: dreamcatcher.asia/cw E-mail: cw.sales@dreamcatcher.asia</p> <p>Acehub Vista Sdn Bhd (785702-P) <i>(the legal entity of the University Courseware business)</i></p> <p>70-03-79, D'Piazza Mall, Jalan Mahsuri 11900 Bayan Lepas, Penang Malaysia</p>	<p>© 2010-2011 Acehub Vista Sdn Bhd</p> <p>We reserve the right to change or alter the information in this material without prior notice. The information provided in this material is accurate as of the print date.</p> <p>Microsoft, Windows, and Office Programs are trademarks of Microsoft Corporation in the United States and/or other countries. All other copyrights and trademarks belong to their respective owners.</p> <p>Updated on 6th Aug 2023</p>
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