ME1100

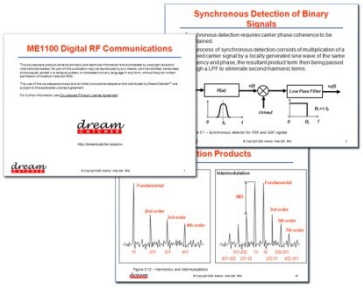
Digital RF Communications Courseware

dream CATCHER
~Complete Resources for Lecturers~

KEYSIGHT TECHNOLOGIES
Solutions Partner
Extending our solutions to meet your needs

Teaching slides

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



Training kit

- Digital RF communications kit
- IQ signal generation software
- Lab sheets & model answers
- Problem-based assignments
- Covers 24 hours of labs

Target university subject	Target year of study	Prerequisite(s)
Digital RF Communications	2nd or 3rd year undergraduate	Principles of Communications

The ME1100 serves as a ready-to-teach package in the area of digital RF communications. This is a lecturer resource consisting of teaching slides, training kits, lab sheets, and problem-based assignments.

Designed to impart knowledge in

- Digital communication fundamentals
- Digital modulation techniques
- Baseband and RF transceiver analysis
- Transceiver architectures
- Baseband generation software tools usage
- Measurement instruments usage

Benefits of the ME1100 courseware

- The digital RF communications kit is divided into two separate modules—a low-frequency module and a high-frequency module—that can be used individually. Students are given the flexibility to mix and match various circuits to build a typical transmitter.
- Lab sheets are specially designed to allow students to gain exposure on the use of industry-grade instruments and to demonstrate an end-to-end digital RF communication system.
- Various digital modulation schemes can be easily simulated using the IQ signal generation software and generated through function generators.
- The courseware allows students to easily perform signal demodulation, spectrum analysis, and baseband signal quality evaluation using the VSA software. It can also serve as a troubleshooting tool.
- You can start up a lab with basic instruments, and add RF instruments later to enhance your lab coverage.

Teaching Slides

More than 500 editable Microsoft PowerPoint teaching slides, covering 45 hours of teaching for one full semester are provided. The slides cover the following topics:

- Principles of Communications
- Amplitude Modulation
- Frequency Modulation
- Baseband Pulse Transmission and Digital Modulation Techniques
- Coherent/Non-Coherent Detection and Link Analysis
- Transmitter and Receiver Architectures
- Troubleshooting a Digital RF Communications Transceiver

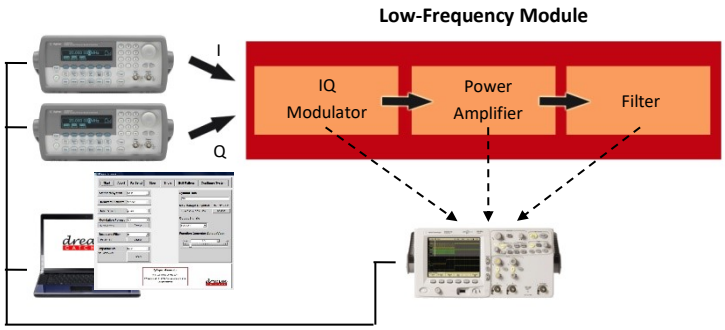
Training Kit

Digital RF communications kit

The digital RF communications kit consists of a 10 MHz low-frequency module and an 868 MHz high-frequency module. It requires two function generators to provide the IQ baseband signals.

The low-frequency module contains a 10 MHz IQ modulator used to generate an IQ modulated RF signal, which is then analyzed by the VSA software on the oscilloscope.

The high-frequency module requires an RF signal generator to modulate the baseband signals from the function generators to produce an IQ modulated RF signal, which is then analyzed by the spectrum analyzer.



IQ signal generation (IQG) software

The IQ Signal Generator software is an Keysight VEE (Visual Engineering Environment) program that controls the function generators via USB to generate various IQ baseband signals. It requires the Keysight VEE runtime (downloadable from Keysight website) engine to be installed on the PC.

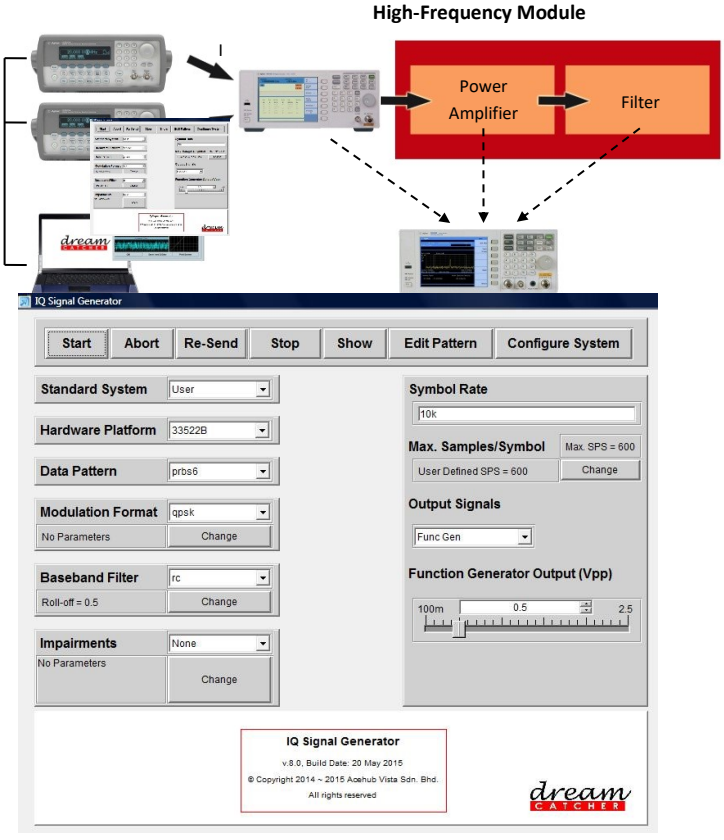
IQG setings:

Modulation schemes: BPSK, QPSK, OQPSK, 8PSK, 16QAM, 32QAM, 64QAM and MSK

Filter types: Raise Cosine, Root Raise Cosine, Gaussian, Chebyshev and Rectangular

Data formats: PRBS6, PRBS7, PRBS9, PRBS10 and PRBS11

Impairments: In-band noise, Wide-band noise, IQ imbalance, IQ offset, Quadrature error, IQ rotation, Interference tone, Quantization



Accessories

The following accessories are provided with the training kit.

Item	Quantity
BNC(m)-to-BNC(m) coaxial cable, 0.3 m	2
BNC(m)-to-BNC(m) coaxial cable, 1.0 m	2
SMA(m)-to-SMA(m) coaxial cable, 0.18 m	3
SMA(m)-to-SMA(m) coaxial cable, 1.0 m	2
SMA(m)-to-BNC(m) coaxial cable, 1.0 m	4
USB cable	3
Power adapter, 5 Vdc, 2 A	1

Note: A PC with Windows® XP, Windows® Vista, Windows® 7 or Windows® 10 is required to run the IQ Signal Generator software (included in the courseware CD).

Lab sheets

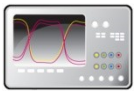
The training kit includes 8 lab sheets in editable Microsoft Word format. Each lab requires 3 hours to complete. Model answers are provided with all lab sheets. The required instruments for the labs are listed below.

Lab Sheet	Required Items	
	Option 1 Function Generator & Oscilloscope with VSA software	**Option 2** Function Generator, Oscilloscope with VSA software, Signal Generator, & Spectrum Analyzer
Maximum Output Power Verification	√	√
Occupied Bandwidth Measurement	√	√
Error Vector Magnitude Measurement with Noise & Interference	√	√
Spurious and Harmonic Signal Measurement	√	√
Adjacent Channel Power Ratio Measurement	√	√
Peak-to-Average Power Ratio and CCDF Measurement	√	√
Spectrum Analysis of CDMA Signals (at 10MHz)	√	√
Adjacent Channel Power Ratio Verification for GSM Signals (at 868MHz)		√
I/Q Imbalance and Offset Analysis	√	√

Problem-based assignments

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

- RF Transceiver Measurement and Analysis
- Digital Communication System Design
- IQ Modulator Performance Analysis



Instruments

The recommended instruments and software from Keysight Technologies, to be purchased separately, are listed below.

Instrument / Software[1]	Model
Function Generator	1 unit of 33512B Dual-channel Function Generator[4] [with option MEM]
Oscilloscope with VSA Software	Minimum 100 MHz Oscilloscope: DSOX3012A [3][4] 89601B Vector Signal Analysis Software [with option 200, AYA] Note: contact Keysight Sales for the educational discount for VSA, or visit https://www.keysight.com/main/editorial.jspx?cc=MY&lc=eng&ckey=2377461&id=2377461
RF Signal Generator	Minimum 1 GHz RF Signal Generator with Analog IQ input: N9310A [5], 9 kHz to 3 GHz [with option 001]
Spectrum Analyzer	Minimum 3 GHz RF Spectrum Analyzer: N9320B[6], 9 kHz to 3 GHz

[1] Refer to the Lab sheets section for the instrument selection.
[2] The DreamCatcher IQ Signal Generator software can only support these models of function generator.
[3] The 89601B VSA software can only support these models of oscilloscope.
[4] These instruments are also the recommended models for the ME1120, ME3000, ME3100 and ME3200.
[5] These instruments are also the recommended models for the ME1000, ME1020 and ME1300.
[6] These instruments are also the recommended models for the ME1000, ME1020, ME1200 and ME1400.

Training Kit Hardware Specifications

	Low-Frequency Module	High-Frequency Module
RF		
IQ modulator conversion loss	< 7.0 dB	
IQ modulator DC offset	< 0.09 mV	
Filter passband (3 dB)	5.4 MHz to 13.3 MHz	794 MHz to 1233 MHz
General		
Input voltage		4.5 V (min) 5.5 V (max)
Input current		22 mA (typical)
EMC designed to		IEC61326-1:2005 / EN61326-1:2006 CISPR11:2003/EN55011:2007 Group 1, Class A
Warranty		1 year

Ordering Information

Description	Package	Product Number
Teaching Slides	1 user license	ME1100–100
Training Kit (same HW kit as in ME1120)	1 set	ME1100–200
Training kit WITHOUT bundled HW kit	20 licenses (1 copy per lab station)	ME1100-210
Teaching Slides + Training Kit	1 user license + 1 set	ME1100–300
Basic Communications Module (refer to ME1100-900 datasheet for detail)	1 license of slide-set 20 licenses of lab sheets	ME1100-900
Instruments	where applicable	Purchase separately from Keysight or its distributor

Note: Pictures in this document are for illustration purposes only, and they may be different from the actual product.