

**How to present  
TIMS to Professors  
using  
TIMS Brochure**

**Quick reference Cheat Sheet**

Please visit

[www.emona-tims.com/distributor-training](http://www.emona-tims.com/distributor-training)

to watch the video

“ I would like to introduce you the  
TIMS Telecoms Engineering  
Modeling System ”



The advertisement features the 'tims' logo in a blue oval at the top left. Below it, the text 'Telecommunications Signals & Systems Lab Equipment' is displayed. A central image shows a person working with a rack-mounted device. To the left, a list of experiments is provided, and to the right, a list of university-level experiments is shown. The Emona Instruments logo and website are at the bottom.

**tims**  
Telecommunications  
Signals & Systems  
Lab Equipment

EXPERIMENTS COVERING  
THE PRINCIPLES BEHIND:

- LTE
- TETRA
- Wideband-CDMA
- HSDPA
- CDMA2000®
- EDGE
- cdmaOne (IS-95)
- GSM
- Wi-Fi
- WiMAX
- Cordless Telephone
- ZigBee™
- DECT
- Bluetooth®
- Near Field Communications
- UWB
- RFID
- Digital Radio DAB
- DVB-S
- Satellite Modems
- Satellite Links
- EBEM
- Deep Space Telemetry
- GPS
- OFDM (DVB-T, ADSL, WLAN)
- Software Defined Radio and much more . . .

University Level Experiments in

- Wireless Communications
- Signals & Systems
- DSP and SDR
- Fiber Optics
- Student Projects

**EMONA INSTRUMENTS**  
[www.emona-tims.com](http://www.emona-tims.com)

“TIMS is a Laboratory Teaching  
equipment for Telecommunications  
and Signals and Systems courses.”



This advertisement is identical to the one above, featuring the 'tims' logo in a red oval, a list of experiments, a central image of a person working with equipment, and the Emona Instruments logo and website at the bottom.

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“With TIMS, Students gain real understanding behind the principles of today’s and tomorrow’s Telecoms technologies.”

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“TIMS covers more than 200 experiments in fields such as:

- > Wireless Communications
- > Signals & Systems
- > Digital Signal Processing
- > Software Defined Radio
- > Fiber Optics
- > Student Projects”

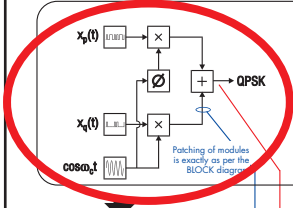
# COMMUNICATIONS SYSTEMS THEORY

**TIMS is a True Hardware Math Modeling System**  
 . . . . . more than just a "trainer"

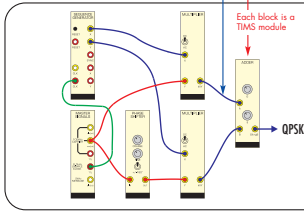
$$x_p(t) \cos \omega_c t + x_q(t) \sin \omega_c t = QPSK$$

where  $x_p(t)$  and  $x_q(t)$  are alternate elements of a digital sequence.

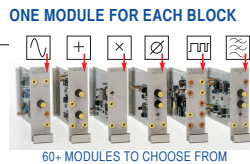
**START WITH MATH OR THEORY**  
 Telecommunications text books are a source of equations and theories. This is the starting point for a TIMS experiment.



**REPRESENT IT AS A BLOCK DIAGRAM**  
 In telecommunications, Math and Theory is always expressed in the universal language of BLOCK DIAGRAMS.  
 Telecommunications engineers make sense of math and theory through BLOCK DIAGRAMS.



**STUDENTS BUILD IT USING TIMS MODULES**  
 Students patch the BLOCK DIAGRAMS based on communications theory - then view and measure **real time signals**.



STUDENTS PATCH OUTPUTS TO INPUTS TO BUILD THE MODULATION SCHEME and HAND ADJUST EACH PARAMETER: gain, phase, frequency, coupling, alignment, synchronization....

*Students build each experiment, step-by-step*

“Telecoms theory and equations are always expressed as BLOCK DIAGRAMS in Text Books.”

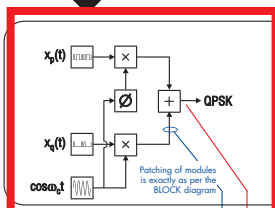
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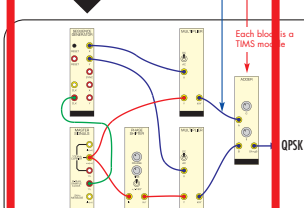
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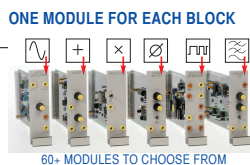
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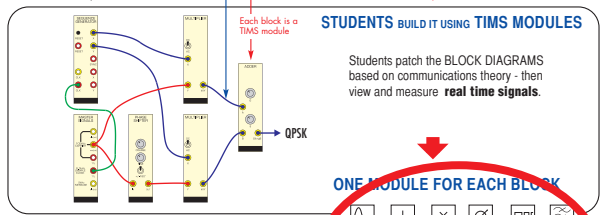
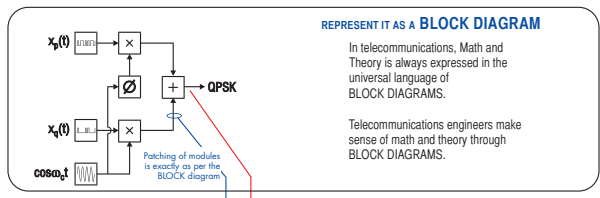
*Students build each experiment, step-by-step*

“TIMS Modeling system brings these Block Diagrams to life and students build experiments step by step.”

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 Telecommunications text books are a source of equations and theories. This is the starting point for a TIMS experiment.



**ONE MODULE FOR EACH BLOCK**  
 STUDENTS PATCH OUTPUTS TO INPUTS TO BUILD THE MODULATION SCHEME and HAND ADJUST EACH PARAMETER: gain, phase, frequency, coupling, alignment, synchronization....  
 60+ MODULES TO CHOOSE FROM

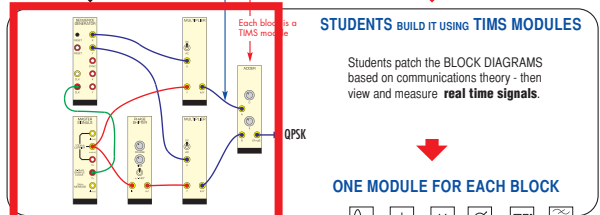
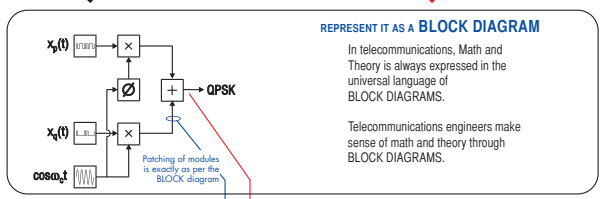
*Students build each experiment, step-by-step*  
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“There is a TIMS hardware module available for each block in the Block Diagram”

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“Students patch the TIMS modules together to build the experiments based on the Block Diagrams, for hands-on knowledge.”

# TIMS EXPERIMENTS AND THE TRANSMISSION MODEL

This diagram is a summary of the schemes which TIMS currently implements.

TRANSMITTED MESSAGE

ENCODING

MODULATION

CHANNEL

DEMODULATION

DECODING

RECEIVED MESSAGE

<p>Sinusoidal and speech messages</p> <p>Pseudo Random Sequence Generation &amp; Gold Codes</p> <p>Line codes: NRZ-L, NRZ-M, Uni-RZ, Bip-RZ (Manchester), DiCode, Duobinary</p> <p>PCM, companding</p> <p>Block codes</p> <p>Block interleaving</p> <p>Convolutional codes</p> <p>Trellis: TCM encoding</p> <p>SDH / SONET frames</p> <p>Student Projects with DSP, CPLD &amp; Circuits</p>	<p>AM / DSB / SSB / LSB</p> <p>ASK, FSK, GFSK</p> <p>BPSK, QPSK, 4/8/16-QAM, Adaptive Delta</p> <p>QAM, 4/8/16-QAM</p> <p>Delta, Adaptive Delta</p> <p>QPSK, GMSK, OQPSK</p> <p>OFDM</p> <p>UWB - Ultra Wideband</p> <p>Multiplexing: TDM, FDM, PDM</p> <p>Spread Spectrum: DSSS, CDMA, FHSS, Hybrid</p> <p>PAM, PWM, PPM</p> <p>Sampling and aliasing</p> <p>Armstrong's phase modulator</p> <p>WB-PP, MB-PM</p> <p>Student Projects with DSP, CPLD &amp; Circuits</p>	<p>+ Noise</p> <p>+ Distortion/non-linearity</p> <p>+ Band limiting</p> <p>+ SNR measurements</p> <p>+ Filter characteristics</p> <p>+ Fading Channel</p> <p>Baseband channel</p> <p>Fiber Optic channel: WDM along single fiber; Bidirectional comm's along a single fiber</p> <p>Wireless antenna</p> <p>TIMS free channel</p> <p>Ethernet link</p> <p>Student Projects with DSP, CPLD &amp; Circuits</p> <p>Nyquist theorem</p> <p>Shannon theorem</p>	<p>Corresponding decoder for each demodulator</p> <p>Envelope</p> <p>Product demodulation</p> <p>LPF &amp; reconstruction filters</p> <p>Phasing of local oscillator</p> <p>Carrier Acquisition: Costas Loop and PLL</p> <p>Matched Filters</p> <p>Integrate &amp; Dump</p> <p>Superheterodyne</p> <p>Fundamentals of Digital Radio - Under-sampling</p> <p>Student Projects with DSP, CPLD &amp; Circuits</p>	<p>Corresponding decoder for each encoder</p> <p>Eye Patterns &amp; decision thresholds</p> <p>Bit Error Rate vs SNR measurements</p> <p>Timing jitter</p> <p>Equalization for ISI</p> <p>Baseline Wander</p> <p>Pulse shaping - RRC, Linear Phase, Bessel</p> <p>Constellations</p> <p>Synchronization: bit clock and frame</p> <p>Bit Clock Regeneration</p> <p>Viterbi Algorithm</p> <p>Student Projects with DSP, CPLD &amp; Circuits</p> <p>System fault finding</p>
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“TIMS experiment capabilities are listed under each components of the Transmission Model.”

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“The Modulation Box shows that TIMS can cover from the simplest analog modulation (DSB - Double Side Band) through to the most advanced modulation, OFDM”

## TIMS-301 SYSTEM UNIT and BASIC MODULE SET

### TIMS-301/C BASIC SYSTEM

The starting point. Includes the System Unit (FIXED modules) and the most useful set of multi-useable plug-in modules (BASIC Module Set)

The TIMS-301 and TIMS-301C kit includes:

- The TIMS-301/C System Unit
- 13 plug-in modules of the BASIC Module SET (see BASIC module list below)
- User Manuals;
- Student Text experiment manuals;
- LabSheet experiment manuals;
- Modules Storage Box
- Standard accessories



#### TIMS-301 and TIMS-301C

TIMS-301C has an in-built PC-based, 2 channel scope and spectrum display (FFT) multi-instrument. Complete with PC software and cables. Requires an external PC (not included in TIMS-301C price).



TIMS-301C with built-in PC Instrumentation: LabVIEW™ and MATLAB™ compatible

#### TIMS-301 SYSTEM UNIT with FIXED Modules

The FIXED MODULES are the most commonly used modules.

The TIMS-301 and 301C both include:

- 12-Slot Rack for plug-in modules
- Master Oscillators
- Buffer Amplifiers
- Frequency and Event Counter
- Variable DC Voltage Output
- Oscilloscope Display Selectors
- TIMS Trunks Outputs
- Power Supply

The TIMS-301C also includes:

- PC-based virtual instrument - 2 channels plus trigger input, with wide bandwidth scope and spectrum analyzer displays, true RMS voltmeter and frequency counter.

#### TIMS-301 BASIC Module Set (PLUG-IN modules)

- TIMS-147 Adder
- TIMS-148 Audio Oscillator
- TIMS-149 Dual Analog Switch
- TIMS-150 Multiplier
- TIMS-151 Phase Shifter
- TIMS-152 Quadrature Phase Splitter
- TIMS-153 Pseudorandom Sequence Generator
- TIMS-154 Tuneable Low Pass Filter
- TIMS-155 Twin Pulse Generator
- TIMS-156 Utilities
- TIMS-157 Voltage Controlled Oscillator
- TIMS-158 60kHz Low Pass Filter
- TIMS-425 Quadrature Utilities

#### TIMS-301C EXPERIMENTS documented in the TIMS Experiment Manuals:

- Introduction to TIMS
- Modeling of math equations
- AM modulation (2 methods)
- Envelopes/envelope recovery
- DSSB mod and demod
- SSB mod - phasing method
- SSB demod - phasing method
- Product demodulation
- Phase lock loop
- FM modulation & demod
- Armstrong's Phase modulator
- PAM generation
- TDM generation
- FDM generation or recovery
- PDM generation or recovery
- PWM mod and recovery
- Eye diagrams
- Introduction to Pulse shaping
- Noise generation
- Sampling Theorem and reconstruction
- QAM generation or demod
- BPSK mod and demodulation
- QPSK mod or demodulation
- ASK mod and demodulation
- QASK mod or demodulation
- FSK modulation (2 methods)
- Carrier acquisition - PLL
- Complex analog messages
- Spread spectrum generation

“TIMS system is available as standard kits that include the main frame unit, a selection of TIMS Modules, and the experiment manuals.”

## TIMS IMPLEMENTS ALL OF THIS AND MORE

Select your curriculum from the experiment list below.

#### TIMS DOCUMENTED EXPERIMENTS:

- Adaptive Delta Modulation
- AM - Amplitude Modulation
- Amplifier Overload
- Armstrong's Phase Modulator
- ASK - Modulation & Demodulation
- Baseline Wander and Line Coding
- BER Instrumentation & measurement
- Bit Clock Regeneration
- Block Coding and Decoding
- Block Coding Gain
- Block Coding - error correcting
- BPSK - Introduction
- BPSK and BER
- Broadcasting - AM and FM
- Carrier Acquisition - PLL
- CDMA - 2 Channel
- CDMA - Introduction
- CDMA - Multichannel
- CDMA - Processing Gain
- CDMA at Carrier Frequencies
- Complex Analog Messages
- Convolutional Coding
- Costas Loop
- Delta Demodulation
- Delta Modulation
- Delta-sigma Modulation
- Digital Signal Recovery with the Decision Maker
- Digital Noise in Baseband and Baseband Channels
- DPSK and BER
- DPSK and Carrier Acquisition
- DSBSC - Generation & Demodulation
- DSSS - Spread Spectrum
- Envelopes and Envelope Detection
- Equalization for ISI
- Eye Patterns & BER
- Fading, Multi-path Channel
- FDM - Frequency Division Multiplex
- FHSS - Fast & Slow Hopping
- FHSS and Bit Error Rate Performance
- FHSS - Hybrid DSSS/FHSS System
- Fiber Optic Transmission, Splitting and Combining
- Fiber Optic - Bidirectional Transmission
- Fiber Optic - WDM Transmission
- FM - Demodulation by PLL
- FM - Demodulation by Zero Crossing Counting
- FM - Deviation Multiplication
- FM - Wideband - Generation by VCO
- FM - Synchronous Demodulation
- FM and Bessel Zeros
- Frequency Synthesis with the PLL
- QPSK - Generation & Envelope Demodulation
- BFSK - coherent signalling & BER
- BFSK - non-coherent signalling & BER
- Introduction to DSP
- GSK - Gaussian FSK
- ISB - Independent Sideband
- ISI: PAM & ASK in band-limited channel
- Line-Coding & Decoding
- Matched Filter Detection
- MSK, OQPSK,  $\pi/4$ -QPSK,  $\pi/4$ -DQPSK
- Modelling Equations
- Modem: Binary Data via Voiceband
- Modem: Multi-Level Data via Voiceband
- Modem: Data Rates & Voiceband
- Modems
- Multi-channel Digital Fiber Link
- Multi-level QAM & PSK
- Multi-path - Time-invariant fading channel characteristics
- Multi-path - ISI rejection in DSSS
- Noisy Channel
- Noise Generation - Binary Sequences
- OFDM Principles - Introduction
- OFDM, Cyclic Prefix & PAPR
- OFDM & Channel Equalisation with BER Measurement
- OFDM in band limited, multipath, time-invariant channel with BER measurements
- OFDM - IDT, Complex Exponent & Complex Quad Signals
- PAM & TDM
- Parseval's Theorem: Harmonic & Non-harmonic Signals
- PCM & Bit Clock Regeneration
- PCM Encoding & Decoding
- PCM TDM
- PCM-TDM T1 Implementation
- PDM - Phase Division Multiplex
- PLL - Phase Lock Loop
- Power Measurements
- PPM - Pulse Position Modulation
- PRBS Messages & Sequence Synchronization
- Product Demodulation
- Pulse Shaping - Introduction
- Pulse shaping for band-limited channels
- PWM - Pulse Width Modulation
- Random Variables & AWGN
- Radar signals:
  - Constant-frequency pulse
  - Linear-frequency modulated pulse
  - Coherent train of LFM pulses
  - Phase-coded pulse
  - Coherent train of identical unmodulated pulses
  - Stepped-frequency pulse
- QAM - Generation & Demodulation
- QAM and 4-PSK
- QASK - Modulation & Demodulation
- QPSK - Modulation & Demodulation
- QPSK - BER of Coherent QPSK in distortionless channel
- Sampling & Reconstruction
- Sampling with Sample-&Hold
- Signal Analysis: relationship between time and frequency domains
- Signal Constellations 4/8/16QAM and 4/8/16PSK
- SNR in AM Demodulated Signals
- SNR performance of SSB and DSSB
- SONET - TDM and Byte Interleave Mux
- SONET Data Frame
- SONET transmission via an optical link
- Spread Spectrum Principles
- Spread Spectrum:
  - Direct Sequence, Frequency Hop, Time Hop Hybrid FHDS, FHCDMA,
  - Speech in Telecommunications
  - SSB Generation and Demodulation
  - SSB Linear Amplifier Measurements
  - Superheterodyne
  - System fault finding
- TCM - Coding Gain
- TCM - Trellis Coding
- TDM
- Timing jitter in Band Limited Channels
- UWB - Pulse Shapes & Spectra
- UWB - with BER
- UWB - Multiband Modulation
- UWB - Multiple Access Orthogonal Pulse Modulation with MHP
- UWB - OOK, PPM, BPM & OPM
- Wave Analyzer - Spectrum Analysis
- Weaver's SSB Mod and Demodulator

#### SIGNALS & SYSTEMS EXPERIMENTS MANUALS:

- Special Signals - characteristics and applications
- Modeling Linear and Non-linear Systems
- Unraveling Convolution
- Integration, correlation & matched filters
- Exploring complex numbers and exponentials
- Comparing Responses in the Time and Frequency Domains
- A Fourier Series Analyzer
- Spectrum Analysis of Various Signal Types
- Poles and Zeros in the Laplace Domain
- Sampling and Aliasing
- Analog-Digital Conversion
- Discrete-Time Filters - Finite Impulse Response
- Poles and Zeros in the z plane: Discrete-time Filters
- Discrete-time Filters - Practical

#### STUDENT PROJECT CAPABILITIES:

- Building electronic circuits with the TIMS-820 Wire-wrapping Project Module
- Implementing functions in a CPLD with the TIMS-830 Programmable Digital Project Module
- Solderless breadboarding of electronic circuits with the TIMS-840 Circuit Experimenter
- Programming DSP implementation with the TIMS-DSP-6713 Module

NOTE: This list is constantly expanding as new modules are released and new experiments are written.

“TIMS can be completely customised to suit your curriculum, by selecting the experiments which match the course being taught”