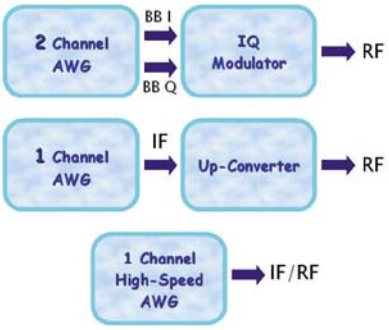
Modular 1.0

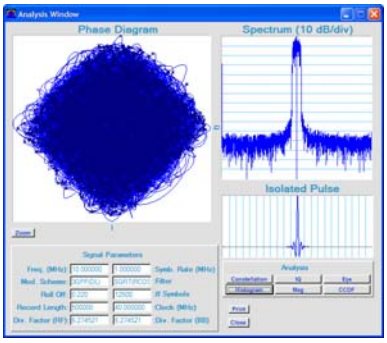
Now there's a Modular way to meet all your wireless signal generation needs

- Base-band (I-Q) and IF/RF signal generation
- Multiple carrier capability with independent definition of modulation parameters for each carrier
- High quality modulation supported by up to 16 bit DACs
- Automatic handling of wrap-around related artifacts for continuous play-back
- Channel coded signals support for applications in CDMA, W-CDMA, and DVB environments
- User defined baseband filtering, modulation scheme, symbol list, modulation envelopes, and payload data
- Linear and non-linear impairment addition
- Built-in analysis including phase, constellation and eye diagrams, signal density and histogram displays, and CCDF power analysis
- ASCII export formats for spreadsheet and scientific calculation software packages
- Supports the entire Tabor Wonder Wave Series range
- Runs under Windows 98/Me/XP/2000/ NT
- Supports GPIB, Ethernet and USB Interfaces

Tabor's Modular provides wireless design and manufacturing engineers with access to the most flexible signal generation tool in the market - the Arbitrary Waveform Generator (AWG). Tabor's Wonder Wave Series of AWGs answer virtually all test stimulus needs at baseband or IF/RF levels, whether required signals are analog or digital. Additionally, unlike traditional generators with their performance limitations, Tabor's Wonder Wave Series allow any signal, simple or composed, clean or noisy, ideal or impaired, to be downloaded and played back.



To make the most of Tabor's AWG, test engineers need the signal creation and edition tools that perform without exposure to complex signals and instrumentation. Wireless communication, with its ongoing evolution, emerging standards, increasing bandwidth and complexity requirements is an area where traditional generators must often be replaced or upgraded to keep pace with application needs. Arbitrary Waveform Generators, on the other hand, are limited only by their resolution, sampling speed, record length and intrinsic linearity. With devices reaching or exceeding 16-bit resolution, 1 GS/s and 75dB SFDR, multi-carrier, channel coded, high quality signals can be generated easily.



MODULAR provides the wireless engineer with the ideal tool to easily define, analyze and transfer such signals to the target AWG.

In fact, MODULAR provides all the essentials to use any AWG in a specific signal environment:

- Baseband: 2 or more channel AWGs support I and Q baseband signal generation. These signals can be used directly or as an input for an external I-Q modulator.
- IF: Intermediate frequency signals can be used directly or as an input to an external up-converter.
- RF: Modern AWGs with sampling frequencies beyond 1 GS/s allow direct generation of multiple carriers right at the required carrier frequency.

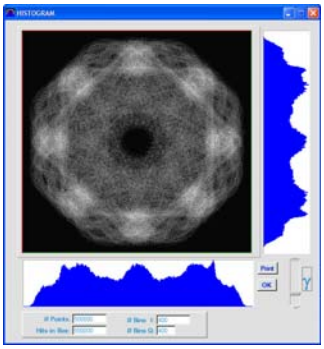
Mixed signal environments are not a problem as AWGs support digital generation easing the integration of DSP based software-radio architectures.

Modular 1.0

Now there's a Modular way to meet all your wireless signal generation needs

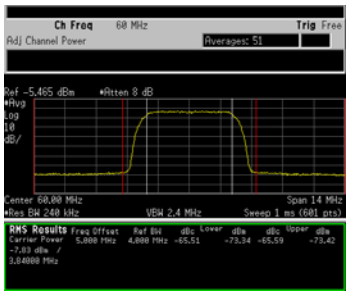
Signal quality that meets your expectations

Measurements of the distortion introduced by any DUT are dependent on the stimulus signal applied to them. Using MODULAR, engineers control the quality necessary to meet the expectations required by each application. Users can make trade-offs between compilation speed and ACLR, between time-domain (EVM) and frequency domain (ACLR), or simply make the most of the available hardware.



Continuous signal generation requires seamless signal repetition. Modern AWGs provide seamless looping and sequencing but error--free signal generation requires continuity at all levels: sample, carrier, symbol, baseband filtering, and, in some cases, channel coding. MODULAR meets all these requirements by automatically adjusting the carrier and modulation parameters and performing continuous signal convolution to eliminate any wrap-around effects in all the component signals.

The result is a clean signal without any degradation in any frequency, time, or modulation domain parameter, no matter how many carriers or modulation schemes (analog, QAM, FSK/MSK) involved. Furthermore, MODULAR supports seamless sequencing of dissimilar (different payload) signal fragments, enabling generation of pseudo-random signal sequences with real traffic spectral density behavior allowing performance of nearly impossible measurements such as residual carrier.

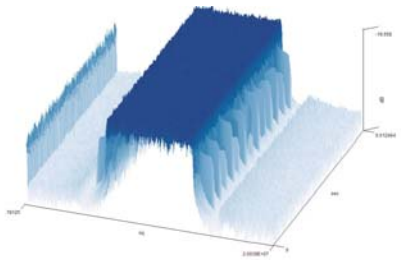


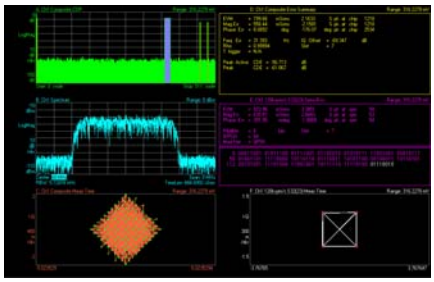
High quality signals with multiple channels/carriers require an additional feature - uncorrelated payloads. MODULAR allows complete definition of pseudo-random binary sequences (PRBS) for payloads, controlling both the generation polynomial and the seed values in a carrier-by-carrier basis. Additionally, carrier phase can be defined by the user or at random. This feature sharply reduces the PAPR (Peak to Average Power Ratio), hence improving linearity, dynamic range and SNR.

End-to-end modulation scheme support

MODULAR incorporates a complete range of modulation schemes supports including:

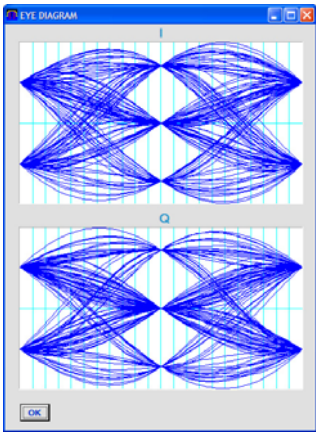
- BPSK, QPSK, O-QPSK, π/4-DQPSK, 8PSK, O-8PSK (EDGE)
- QAM-16, QAM-32, QAM-64, QAM-128, QAM-256, QAM-512, QAM-1024
- 8-VSB, 16-VSB
- 2-FSK, 4-FSK, 8-FSK, 16-FSK, 32-FSK, MSK (including GMSK)
- Sinusoidal Analog: AM, FM, PM
- User-defined modulations schemes, data, baseband filters, and data





Channel coding and channelization are important features for 2G, 2.5G and 3G mobile telephony, wireless LAN and digital TV testing. MODULAR offers channel-coded signals for the following environments:

- DVB-C: QAM-64, QAM-256. Scrambling, interleaving, Reed-Solomon and differential coding supported.
- CDMA IS95 (CDMAOne) Downlink: Spreading, channelization (Walsh codes), complex scrambling supported.
- WCDMA IMT2000 (UMTS) Downlink: Spreading factor, complex scrambling codes, channelization (OVSF codes), CCPCH-SCH multiplexing.
- IEEE-802.11b: DSS spreading, Barker sequences, CCK modulation.



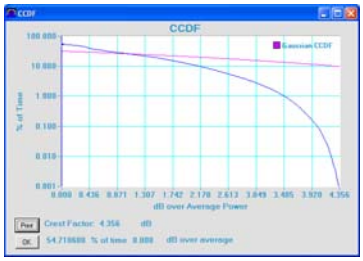
Modular 1.0

Now there's a Modular way to meet all your wireless signal generation needs

Analyze and Compare

To be precise, MODULAR lets you analyze and compare mathematical, predictable nature of signals generated by AWGs makes them ideal for degradation analysis. MODULAR incorporates an array of analysis tools and features that can be used as references that can be compared with results generated by measurement instruments such as oscilloscopes, spectrum analyzers, or vectorial analyzers. These are some of the analysis functions available:

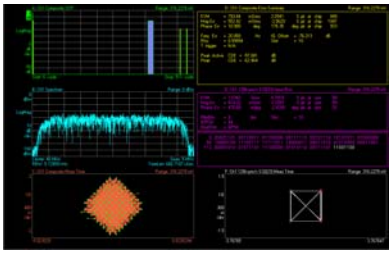
- Spectrum display: Spectral analysis allows validation of the signals in the frequency domain.
- Phase/Constellation diagrams.
- Signal Density/Histogram display: It creates a gray-scale display including histogram analysis in both the I and Q axis.
- Eye Diagram for both I and Q components.
- I and Q vs time displays.
- CCDF



Additionally, MODULAR can export signals in a variety of formats readable by spreadsheet applications such as Excel, or scientific/mathematical packages such as Matlab for further analysis, manipulation, and/or documentation.

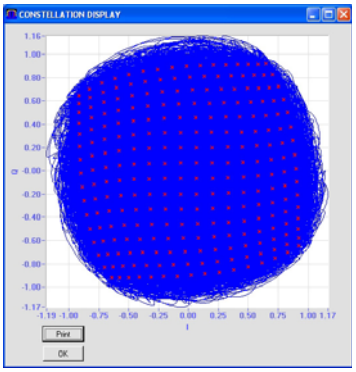
Open environment with virtually endless possibilities

MODULAR is an open environment. Users can choose from built-in signal parameters or define their own. Signals characteristics such as baseband filtering and payload data can be imported from externally defined files. Users can even create their own modulation schemes by editing their constellation diagrams and symbol mapping. Non-supported modulation schemes can be also accommodated through the external I-Q symbol/envelope feature.



Margin testing requires more than ideal signals. Impairments, noise and interfering signals must be added in order to obtain the required results. MODULAR, with its built-in impairment tool, featuring carrier feed-through and quadrature error and imbalance and multi-carrier capability, makes it possible to do all this with just a single unit.

Non-linear impairments such as amplifier distortion (AM/AM, AM/PM distortion) are also supported. Non-linear support also helps implementing and experimenting pre-distortion correction for high-power amplifiers. Multipath emulation is as easy as filling a form with the description of the different paths by entering the delay/amplitude/phase for each delay. Testing equalizers and rake receivers has never been so easy.



Modular 1.0

Now there's a Modular way to meet all your wireless signal generation needs

Applications
For expert technical assistance with your specific needs and objectives, contact your local sales representative or our in-house applications engineers.

Complimentary free of charge solution
Every instrument comes equipped with a dedicated copy of the ArbConnection software. However, if your copy is lost or outdated, Tabor Electronics makes it possible to log-on to its Download Center and get the latest version "in a click".

Product Demonstrations
For you convenience, if you want to evaluate the software before you purchase the instrument, you may download a demo version of the ArbConnection to use as a real-time hands-on demonstration.

Modular 1.0

Now there's a Modular way to meet all your wireless signal generation needs

Technical Specifications

Modulation Scheme Support

QAM:	QAM16, QAM32, QAM64,QAM128, QAM256, QAM512, QAM1024 with hierarchical modulation support.
PSK:	BPSK, QPSK, OQPSK, $\pi/4$-QPSK, 8PSK, O-8PSK (EDGE).
ASK:	Binary ASK with settable modulation index.
FSK:	2-FSK, 4-FSK, 8-FSK, 16-FSK, 32-FSK, MSK.
Analog:	Analog AM, FM, PM. Sinusoidal modulation. Settable modulation index / frequency or phase peak deviation.
VSB:	8-VSB, 16-VSB.
OFDM:	User definable OFDM characteristics including number of carriers, carrier spacing and pilot set-up.
Other:	Low-jitter clock generation.
User Defined:	Symbol Map, Symbol List, I/Q time-domain.

Modulation Parameters

Base Band:	Raised Cosine, Root Raised Cosine, Gaussian (Dirac Input), Gaussian (Pulse Input), Rectangular, Triangular, EDGE, Half-sine, Butterworth, User Defined.
Time Domain:	None, Triangular, Hamming, Hanning, Blackman, Blackman-Harris, Exact Blackman, Kaiser, Tapered Cosine, Flat Top.
Filter Parameters:	α, BT
Convolution Length:	Minimum 3 Symbols, Maximum 201 Symbols, independently defined for each carrier.
FSK Modulation:	Peak Frequency Deviation.

Signal Impairments

Linear Impairments:	Quadrature Error, Quadrature Imbalance, Carrier Feed-through.
Non-Linear Impairments:	AM/AM, AM/PM for base band (IQ) and amplifier non-linear behavior simulation. Hard and soft clipping simulation.
General:	Impairments are defined independently for each carrier.

Power Ramping

Power Ramping Shapes:	Linear, Cosine.
Profiling:	Power profiles are defined in a carrier-by-carrier basis based in a user-defined transition table.
Periodicity:	Single or cyclic.

Multi-Path

Type:	Up to 10 different paths independently set for each carrier.
Control Parameters:	Delay (positive or negative) and phase.
Delay Range:	± (Convolution length)/2.
Phase Range:	± 180°.

Channel Coding

DVB-C:	Internally defined TS (“all zeros”+ sync byte), sync byte inversion, Reed-Solomon, scrambling, interleaving, and differential coding.
IS95 (CDMAOne) Downlink:	Channelization/Spreading (Walsh Codes), scrambling.
IMT2000 (UMTS) Downlink:	3GPP R5 support with channelization/Spreading (OVSF Codes), complex scrambling, C-CCPCH/SCH synthesis and time multiplexing, P-SCH and S-SCH relative power control, compressed mode and HSDPA (QAM16)support.
IEEE-802.11b:	Spreading: Barker codes and CCK based modulations.

Payload Data

Data Source:	Internal “all zeros”, Internal “all ones”, Internal PRBS, User-editable pattern, User defined.
Internal PRBS:	Any generation polynomial and seed up to 31 bits long.
User-Defined Pattern:	Any bit sequence up to 256 bits long. Sequence states may be '1', '0' or 'x' (internal PRBS).
Data Coding:	None, Gray, Differential, Gray Differential.

Symbol Map Edition

Maximum Symbol Number:	Up to 1024 symbols may be defined.
Symbol Definition:	I/Q or Magnitude/Phase pairs.
Predefined Maps:	QPSK, 16QAM-1024QAM, Symbol in a circle.
Additional Settings:	Time-domain Q samples may be delayed by half a symbol time (offset modulations). Constellations may be rotated symbol to symbol by a user defined angle.
Edition Tools:	Offset addition, Phase Rotation, Scaling.
Analysis Tools:	Edited map graphic preview (constellation display).

Multi-Carrier Assistant

Maximum Number of Carriers:	512
Functionality:	Any number of carriers with similar characteristics can be defined at once.
Carrier Frequency Parameters:	Base and spacing frequencies.
Carrier phase control:	Fixed or random (low correlation).
PRBS control:	PRBS polynomial is common but seed value may be sequenced to avoid data sequence related correlation problems resulting in high Crest Factor values.

Waveform Compilation Control

Record Length:	Record Length may be defined in samples, symbols or DVB-C/IS-95/UMTS frames.
Sampling Rate:	Sampling rate is automatically set based on the maximum carrier frequency or symbol rate and a user-defined oversampling factor.
Amplitude Control:	Amplitude is automatically adjusted to use the complete AWG dynamic range or it can be manually set to any value.
Wrap-around Control:	None or automatic. Automatic carrier phase consistency.

Analysis Tools

Spectrum:	FFT (8192 samples) of the combined signal. Quantization noise based in actual performance of the target instrument' DAC.
Phase Diagram:	Selected or combined (for CDMA) signal. Symbols position shown in low intensity mode.
Constellation Diagram:	Selected or combined (for CDMA) signal. Phased diagram shown in low intensity mode.
CCDF:	For selected or combined signal. Cursor linked to the curve.
Histogram Display:	Phase diagram gray scale display with control showing up to 500,000 samples. I and Q histograms for user defined areas.
I, Q:	Time domain I,Q displays.
Eye Diagram:	I and Q eye diagrams showing 2 bit intervals.
Magnitude:	Power vs Time display.

Data Communication and Export

Instruments supported:	WW506x, WW107x, WW257xA, WW2074, WW128xA.
Instrument formats:	Direct and Native file transfers.
Communication interfaces:	GPIB (IEEE-488), Ethernet 10/100 Mb/s (TCP/IP), USB.
Export File Format:	ASCII delimited (comma, LF, CR/LF, TAB).

Computer Requirements

Operating System:	Windows 9X/Me/XP/2000/NT/Vista.
Memory:	256 MBytes minimum, 512 MByte or more recommended.
Hard Disk:	20 Mbyte. Waveform files, if created in the local hard drive, may require more hard disk space.
Display:	800x600 and 256 colors minimum, 1024x768 and 16bit color or better recommended.
Interfaces:	Ethernet, USB and GPIB support.