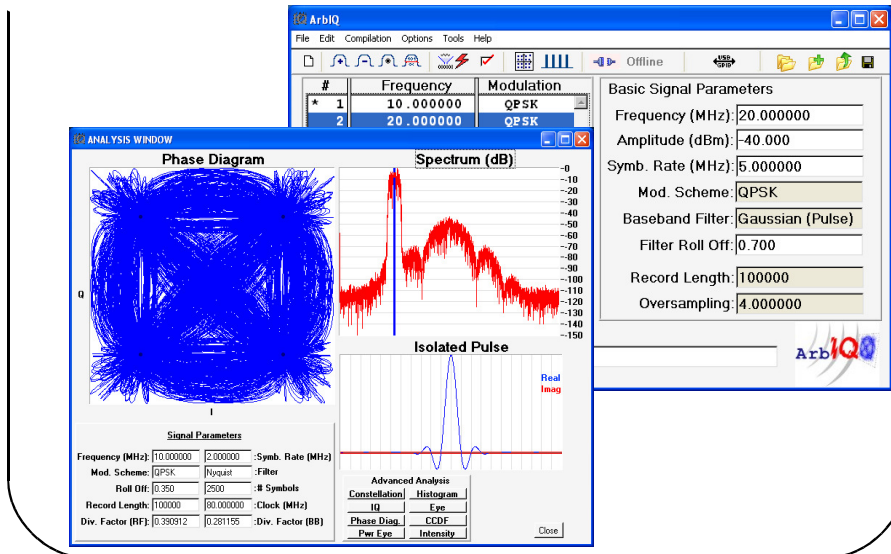


MODULATED SIGNAL CREATION SOFTWARE

► ArbIQ for Arbitrary Waveform Generators



► Features & Benefits

Base-band (I-Q) and IF/RF (DDS) signal generation.

Multiple carrier capability with independent definition of modulation parameters for each carrier.

High modulation quality supporting AWGs with more than 16 bit D/A converters.

Automatic handling of wrap-around related artifacts for continuous playback.

Fast compilation speed, ideal to handle ultra long record lengths with direct file creation in the target instrument.

Support of channel coded signals for applications in CDMA, W-CDMA, and DVB environments.

Support of user defined filtering, modulation scheme, symbols, 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.

Support of ASCII export formats for spreadsheet, scientific calculation software packages.

Supports a large variety of AWGs through multiple interfaces.

► Applications

Analog and digital RF stimulus generation for wireless design & manufacturing.

Complex digital modulation and wireless technology education.

Coherent optical communication.

Replacement of multiple RF generators in applications requiring generating multi-carrier signals.

Solve your complex modulated signal generation needs

The **ArbIQ** software package allows wireless design and manufacturing engineers to use the most flexible signal generation tool, the Arbitrary Waveform Generator (AWG), to solve almost all their wireless test stimulus needs at baseband or IF/RF levels, no matter if the required signals are analog or digital. AWGs do not suffer most of the limitations of traditional generators as any signal, simple or composed, clean or noisy, ideal or impaired, can be downloaded to and played back by them. In order to get the most of this tool, test engineers must have the right signal creation and edition tools, not exposing them to the cumbersome details of the complex signals and the instrumentation.

AWGs, in the other hand, are only limited by their resolution, sampling speed, record length and intrinsic linearity. With devices reaching or exceeding 16-bit resolution, 12 GS/s and 80+dB SFDR, multi-carrier, channel coded, high quality signals can be generated easily. **ArbIQ** provides the wireless engineer with the right tool to easily define, analyze, and transfer such signals to the target AWG.

ArbIQ offers all the capabilities needed to use any AWG right in your signal environment: Baseband, IF, and RF. Mixed signal environments are not a problem as **ArbIQ** supports PAT formats used by digital outputs in both AWG and Pattern Generators making easy the integration of DSP based software-radio architectures.

Continuous signal generation requires seamless signal repetition. Modern AWGs provide seamless looping and sequencing but spurious-free signal generation requires continuity at all levels: sample, carrier, symbol, baseband filtering, and, in some cases, channel coding. **ArbIQ** takes care of all these requirements by automatically adjusting the carrier and modulation parameters and performing continuous signal convolution to eliminate simultaneously any wrap-around effects in all the component signals. The result is a clean signal without any degradation at all in any frequency, time, or modulation domain parameter, no matter the number of carriers or the modulation schemes (analog, QAM, FSK/MSK) involved.

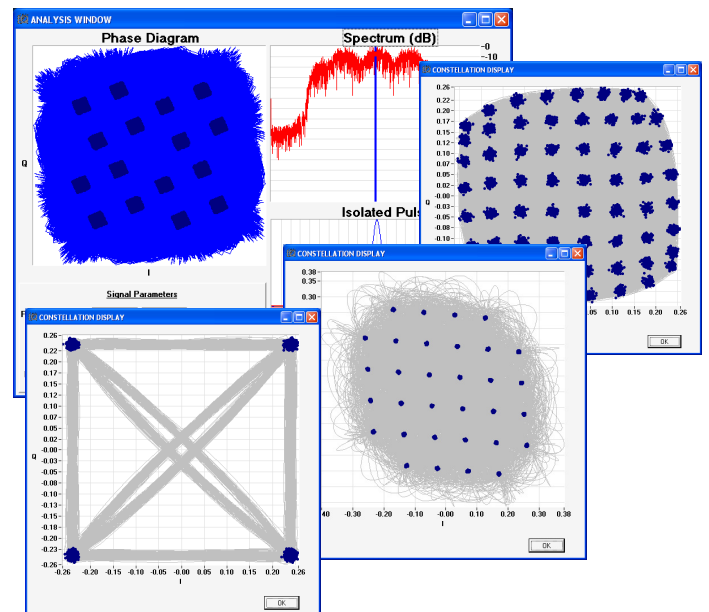
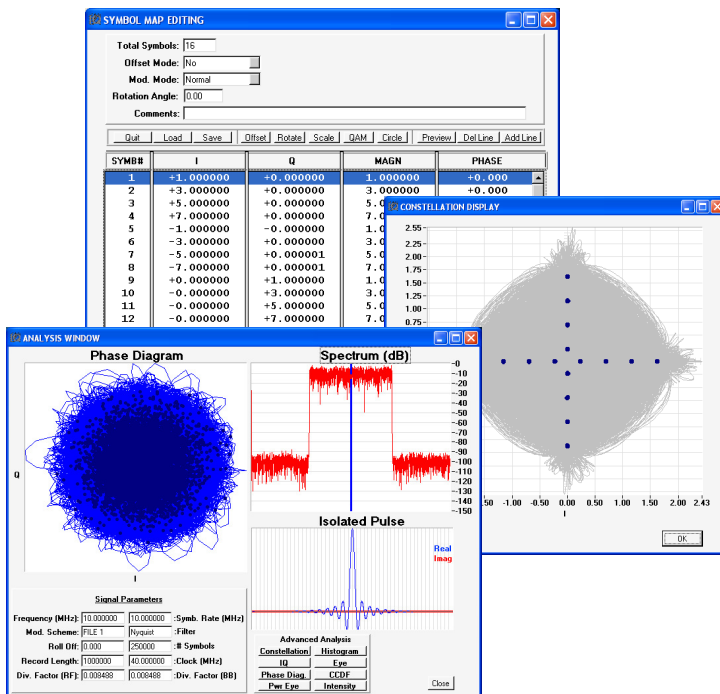
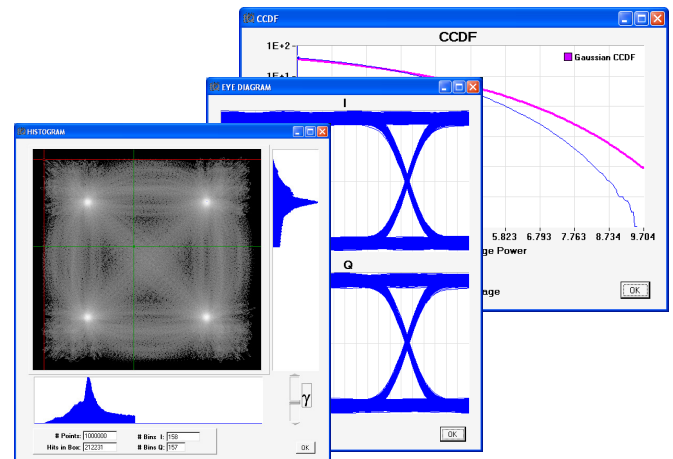


Comprehensive Modulation Support

A wide range of modulations are available for each individual carrier: QAM, FSK, MSK, QPSK, CDMA (UMTS and IS95), DVB-C, and analog (AM, PM, FM). Users can define all the modulation parameters independently including symbol rate, baseband filtering, roll-off factor and data source.

Signal Visualization and Analysis

Signals can be analyzed and validated before being sent to the target AWGs. Constellation/Phase diagrams, eye diagrams, CCDF graphs, grey scale and histogram information, I and Q versus time, are just some of the available analysis tools.



Real-World Impairments

Generating impaired signals is just as easy as doing it with perfect ones. Linear and non-linear (AM/AM, AM/PM) distortions, multipath, power profiling can be added to each carrier individually. Bandwidth limited noise with full crest factor control can be added as well.

Open Architecture

Users can use externally defined data, baseband filters, I and Q waveforms, and symbol lists. Additionally, an embedded tool allow users to define their own modulations by specifying the location of each symbol in the IQ plane and validating the resulting constellation.

CHARACTERISTICS

Modulation Scheme Support

Characteristics	Description
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	AM, FM, PM. Sinusoidal modulation. Settable modulation index / frequency or phase peak deviation.
VSB	8-VSB, 16-VSB
CDMA	IS95 (CDMAOne), 3GPP (UMTS) downlink including HSDPA
User-defined	User defined arbitrary constellation, externally defined symbols and IQ envelopes
Other	Bandwidth-limited Gaussian noise, Low-jitter clock generation

Modulation Parameters

Characteristics	Description
Base Band Filter	Raised Cosine, Root Raised Cosine, Gaussian (δ Dirac Input), Gaussian (Pulse Input), Rectangular, Triangular, EDGE, PRS (Partial Response), Half-sine, Butterworth, RZ, NRZ, User Defined
Time Domain Windowing	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

Characteristics	Description
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

Characteristics	Description
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

Characteristics	Description
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

Characteristics	Description
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

Characteristics	Description
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

Characteristics	Description
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 Support

Characteristics	Description
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

Characteristics	Description
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

Characteristics	Description
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 γ 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

Coherent Optical Signal Generation (opt. OPT)

Characteristics	Description
Specific Impairments	Chromatic Dispersion (CD), Polarization Mode Dispersion (PMD), I to Q delay/skew
Jones Matrix Emulation	Two and four channel support to emulate Dual Polarization Multiplexed systems.
Specific Analysis Tools	Power Eye, Delay Line Interferometer emulation

RADAR Signal Generation Option (opt. RDR)

Characteristics	Description
Specific Modulation Schemes	Linear Frequency Modulation, Bi-Phase Barker Codes, Polyphase Codes, Frank Codes, Chirp Generation
Pulse Control	Pulse time profile, pulse jitter, amplitude and frequency hopping support.
Pulse Shape	Trapezoidal, Raised Cosine, Custom
Beam Emulation	Sinc and Gaussian beams with variable width and rotation speed

Supported Instruments

Characteristics	Description
Tektronix	AFG3000 Series, AWG400/500/600 Series, AWG5000 Series, AWG7000 Series
Tabor	All WonderWave and WaveXciter Series
Agilent	33000 Series, 80180A, 81160A, 81150A, N824XA, M8190A
TTi	TG and TGA Series
LeCroy	ArbStudio Series
Active Technologies	AR-AWG GS, AT-AWG500/2000/4000, AT-1120/AT-1212
B&K Precision	407X Series, 408X Series
Rigol	DG1000/2000/3000/4000/5000 Series

Ordering Information

ArbIQ	Complex Modulation Waveform Synthesis Software
opt. WFM	Waveform export capability
opt. HS	Signal generation for arbs with Sampling Rates $\geq 2\text{GS/s}$
opt. RDR	Radar Signal Generation Toolbox (includes opt. HS)
opt. OPT	Coherent Optical Generation Toolbox (includes opt. HS)
opt. HSUP	Update to add opt HS to base ArbIQ
opt. OPTUP	Update to add full opt. OPT capabilities to base ArbIQ (includes opt. HSUP)
opt. HSOPTUP	Update to add full opt. OPT capabilities to ArbIQ with opt. HS
opt. WFMUP	Update to add opt WFM to any ArbIQ



C/ Provenca, 277
3rd floor, Suite IX
08037-Barcelona
SPAIN

Tel. (+34) 93 488 31 45

e-mail: info@arbitrary.es
www.arbitrary.es