AEROFLEX

A passion for performance.

Intuitive, fast, digital

modulation waveform

creation tool

IQCreator ™

making waves...

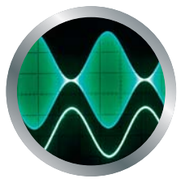
Waveform Creation and Simulation

Designed for use with Aeroflex's digital RF signal genertors, including the 3410 and PXI-based 3000 Series, ***IQCreator***™ enables you to create waveforms that emulate digitally modulated RF and analog baseband I and Q transmission formats.

IQCreator™ is an easy to use, Windows™-based software application that enables a user to set up a modulation scheme and then create an ARB (Arbitrary Waveform Generator) file. Graphical displays of the waveform FFT, vector and constellation diagrams, etc. can be viewed and exported for use in other Windows™ applications. The ARB file may be saved or downloaded into the ARB (option required). User-defined configurations can also be saved. Consequently, it is possible to load previously saved setups to regenerate the ARB files quickly and easily.

For a free download of the latest version of ***IQCreator***™ please visit:

www.aeroflex.com/IQCreator



Modulation Formats

IQCreator™ is under constant development as communications systems and modulation standards evolve.

To keep up with the ever changing standards the software is available as a free download from the Aeroflex web site where it is constantly updated with the latest modulation schemes. The current version can produce files for the following formats that are then down-loaded into the 3410 and 3020 Series ARBs where the signal can be generated. Always check to make sure you have the latest version as more modulation formats and features are constantly being added to the list.

Generic Modulation

- PSK, FSK, MSK, QAM modulation types
- User defined PSK and QAM mapping
- Tones
- Nyquist, Root Nyquist, Low Pass, Gaussian and user defined filters
- PRBS, fixed pattern and user-defined data sources
- Generic frame editor
- 4 markers
- Multi-carrier

TDMA Digital Standards

- GSM 900, 1800, 1900
- EDGE
- Combined GSM/EDGE
- TETRA
- DECT
- VDL-Modes 2, 3, 4
- Generic frame editor
- RF burst or IQ profile
- Automatic burst control (marker)
- Multi-carrier

Modulation Impairments

- I/Q skew
- I/Q carrier leak
- I/Q gain imbalance
- Gaussian noise (AWGN)

WiMAN

- 802.16 (2005) OFDMA
- 802.16 (2004) OFDM

WLAN

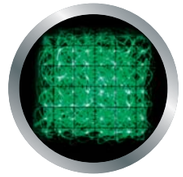
- 802.11a
- 802.11b
- 802.11g
- Multi-carrier

CDMA Digital Standards

- CDMAone (IS-95)
- CDMA2000 (release C)
- 1 xEVDO
- 3GPP FDD (release 6)
- HSDPA
- 3GPP TDD-LCR
- TD-SCDMA (TSM) (v3.0.0)
- Clipping
- Multi-carrier

Graphics

- FFT
- Vector
- Constellation
- CCDF
- Code domain power
- I/Q v time
- I/Q wrap v time
- Amplitude v time
- Phase v time
- Frequency v time
- Zoom mode
- 2 markers
- Save or print



Don’t wait for your wave. Make it.

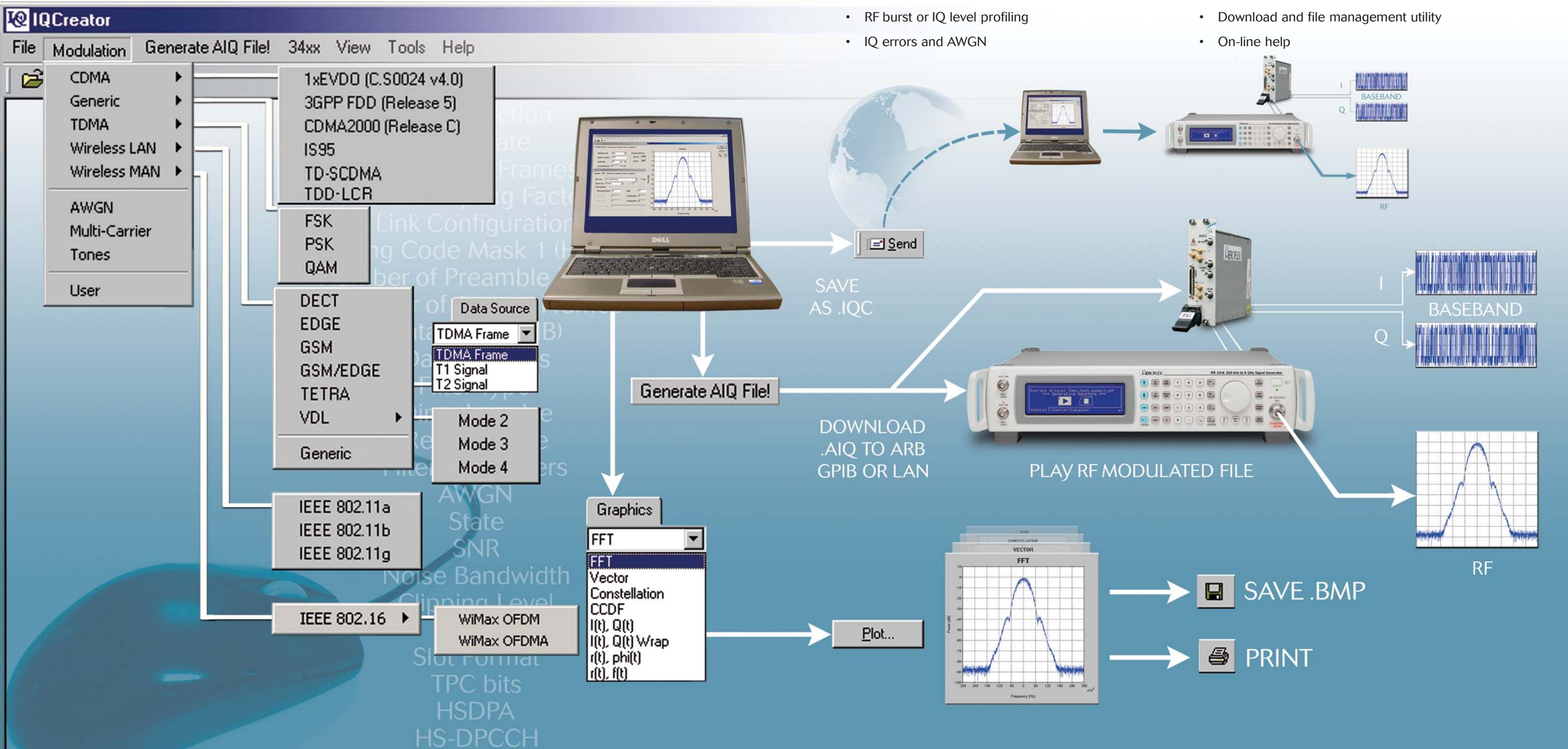
Basic Features

Features and Capabilities

IQCreator™ is designed for the next generation of complex digitally modulated signals. The software allows easy file creation using Windows™-based library templates for generic or specific modulation schemes such as GSM, WCDMA or WLAN802.11. ***IQCreator***™ is suitable for the generation of single carrier generic or framed signals as well as multi-carrier and multi-tone signals. It also allows users to package and download their own I/Q data files generated in third party software tools such as MATLAB®.

- Generic PSK, FSK, QAM or framed CDMA, TDMA, WLAN, WiMAN modulation types
- Tones or multi-carrier
- Nyquist, Root Nyquist, Low Pass, Gaussian and user defined filters
- PRBS, fixed pattern and user-defined data sources
- 4 markers with automatic burst control
- RF burst or IQ level profiling
- IQ errors and AWGN

- Spectrum, CCDF, vector, constellation, code domain power
- IQ vs time
- Amplitude vs time
- Phase vs time
- Frequency vs time
- Download and file management utility
- On-line help



Features
Waveform Adjustments

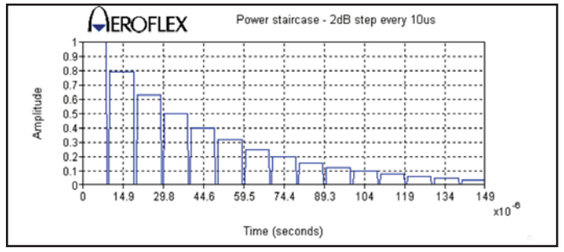
Before a user-defined waveform can be generated by the ARB, it has to be formatted and downloaded to the instrument. ***IQCreator***™ includes a utility that converts and packages a file into a form that can be downloaded into the 3410 Series or 3000 Series PXI module ARB.

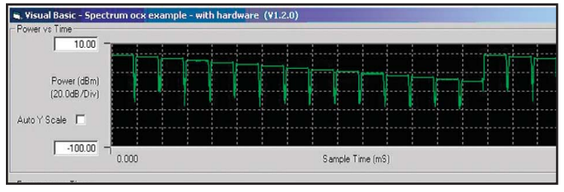
User IQ data must be saved either in one file with the data stored as I1Q1I2Q2…InQn samples, with I as the first sample or in two separate files, one consisting of the I data and the other consisting of the Q data. In both cases, the IQ data is automatically scaled so that the peak value is at full scale on the ARB to provide optimized dynamic range.

The file format must be one of the following:

1. 14-bit, 16-bit or 32-bit signed or unsigned integer binary files in Little Endian format
2. 32-bit IEEE floating point notation
3. ASCII format with floating-point numbers delimited by commas, spaces or tabs, line feeds or carriage returns

When you package your own IQ data you also have the option of providing a marker settings file in ASCII text format.





Example of IQ profiling - power staircase in a GSM frame (simulation and measurement)

Markers and Level Profiling

Markers are used to mark important events within the file, for example, the location of a burst or the start of a TDMA slot or frame.

IQCreator™ allows the user to define these events using up to four markers. One of them can be used internally to control the output power bursts and all four are available as external outputs from the ARB for triggering purposes. There are two types of burst: RF bursting and IQ profiling.

RF Bursting

With this type of bursting the burst marker is used to trigger a hardware burst modulator that adjusts the RF gain of the signal generator.

IQ Profiling

With this type of bursting the profile is implemented by profiling the IQ data. This allows you to define multiple levels in adjacent slots.

The rise/fall, profile shape and location of the burst can be defined in the software but may be modified later on from the instrument front panel (3410 series only).

IQ Profiling for PULSE Generation

IQCreator™ profiling capability enables flexible generation of pulse patterns for RF or baseband radar, avionics and EMC simulation. The software provides the interfaces to create pulse patterns or import custom signals from MATLAB®, VisualBasic or other external waveform sources. Profiling allows the user to define the pulse location, profile shape (Cosine, Gaussian, high speed) and rise/fall times (down to 1µs with shape, min of typically 20 ns with no shape) as well as intra-pulse modulation (FSK, PSK) and pulse by pulse level definition.

Complex signal environments can also be simulated by combining different pulse patterns with other interfering signals (CW, modulated, AWGN).

The internal pulse dynamic range is limited by the IQ modulator residual carrier (typ >55 dB on the 3410 Series) but can be improved by using the 3410 option 006 high performance pulse modulator (typ. >80 dB on/off ratio) in external loopback mode.

Modulation Impairments

IQCreator™ allows the user to distort the waveforms by adding IQ errors or interference. Thus the user can take real impairments into account when simulating baseband or RF modulated signals.

IQ Errors

Four parameters can be entered to simulate errors: skew or quadrature error, gain imbalance and carrier leakage (I&Q).

Calibrated AWGN Source

With its AWGN (Additive White Gaussian Noise) capability, ***IQCreator***™ enables the generation of repeatable noise sequences with a programmable bandwidth of up to 20 MHz. The software provides two modes of operation: Interference mode (the noise signal is added to the baseband modulated signal) and noise only mode (only generates a noise signal).

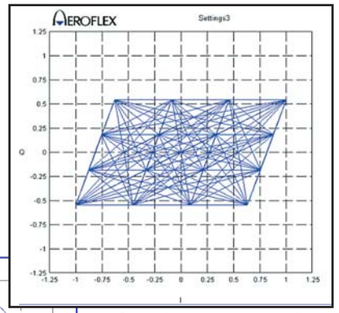
In interference mode, AWGN can be super-imposed onto any modulation format with programmable carrier to noise ratio (SNR) and noise bandwidth. The simulated cumulative signal can easily be displayed in the graphic menu for visual inspection. Typical applications are receiver sensitivity tests or dynamic range measurements as a function of SNR.

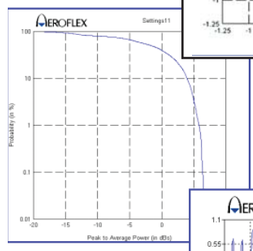
In Noise only mode, variable length AWGN signals can be generated with a user defined bandwidth of up to 20 MHz. Bursted noise combined with signals (noise and modulated carrier) can also be generated to simulate a complex test environment.

Graphical Displays

IQCreator™ allows a number of parameters of the selected waveform to be calculated and graphically displayed. Graphics functions include auto-scale, zoom mode, 2 markers, save to .bmp for use in other Windows™ applications and print.

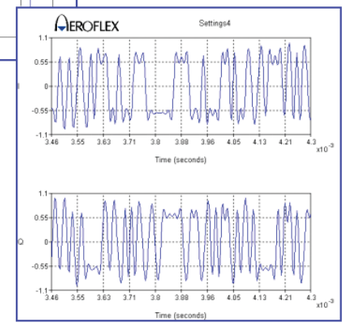
IQ skew and gain imbalance

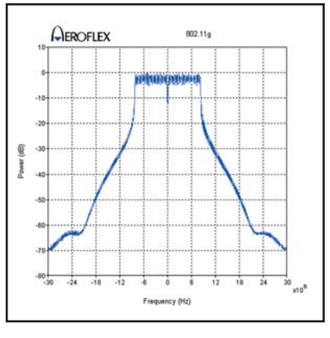




CCDF of 3GPP test signal

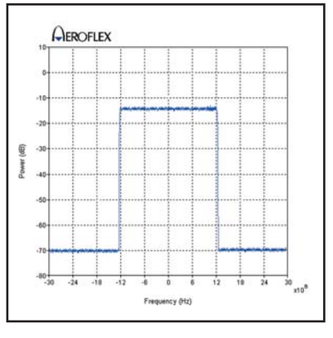
I&Q baseband signals displayed at the wrapping period of the ARB file





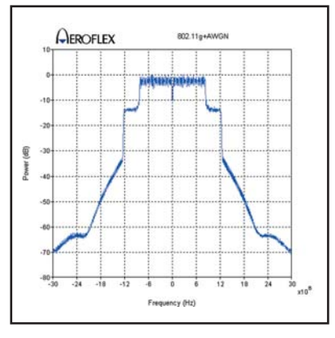
802.11g signal

+



AWGN

=



802.11g signal with AWGN

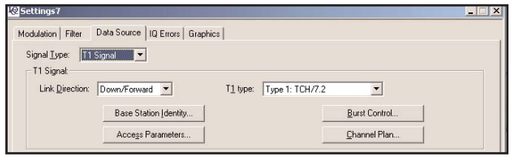
Digital Standards

TDMA

IQCreator™ allows various TDMA systems to be simulated in accordance with the corresponding radio-communication standards. Default configurations of modulation and filtering can easily be modified and stored. The user can also select the format and the type of data (PRBS, pattern, zeros, ones, user data from file) for each slot in the frame. For some standards even more comprehensive functions are available, like GSM/EDGE signals with combined slots in a single frame, or T1 protocol data in a TETRA frame.

Pre-configured templates are available for:

- GSM 900, 1800, 1900
- EDGE
- Combined GSM/EDGE
- TETRA TDMA T1, T2
- DECT
- VDL-Modes 2, 3, 4



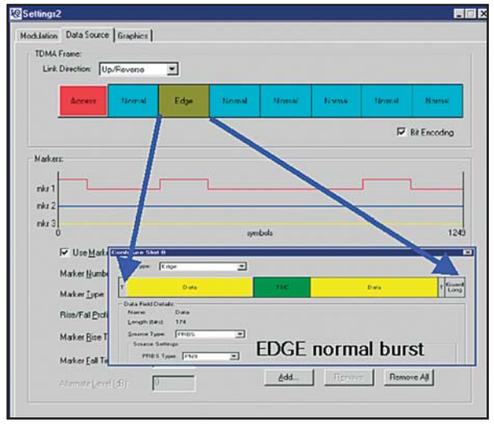
TETRA T1 protocol menu

Data Editor

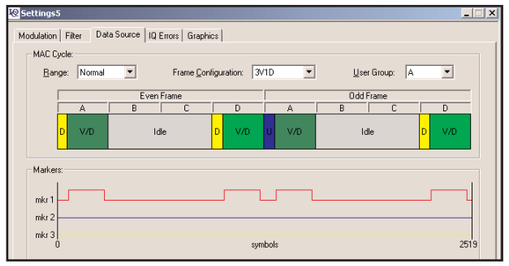
In addition to the comprehensive TDMA standards, ***IQCreator***™ enables you to produce a waveform that simulates any TDMA signal with the Generic Frame Editor. With the data editor the user can define all data fields and combine them into bursts and frames. Each field can be configured with name, position, length and data source as well as markers to define the burst control.

Automatic Burst Control and Trigger Facilities

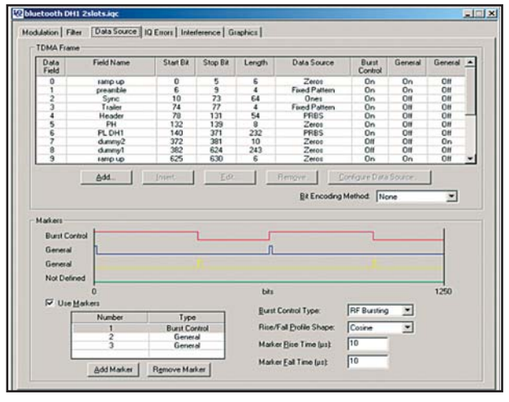
Automatic burst control provides the ability to automatically configure the markers for the “on” and “off” timeslots. Enhanced trigger facilities are also available to configure single or repeated frame structures.



GSM/EDGE frame with different slots and validated burst control



VDL Mode 3, 3V1D frame with full markers

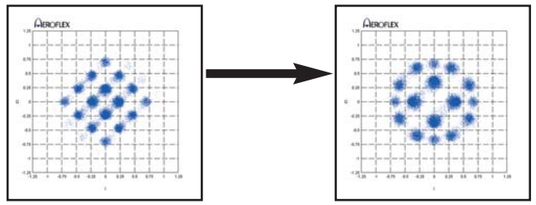


Example of generic frame editor defining Bluetooth data fields, burst control and trigger markers

W/CDMA

IQCreator™ allows various WCDMA and CDMA systems to be simulated in accordance to the corresponding radio-communication standards. Preconfigured templates are available for cdma2000, CDMAone (IS-95), 1 XEVDO, 3GPP FDD, 3GPP TDD-LCR and TD-SCDMA (TSM). Default configurations of UP and DOWN links are implemented. All data, control and sync channels defined by the relevant standard can be edited and modified from their default settings, as well as orthogonal codes, data sources (PRBS, pattern, random, zeros, ones, user file) and the power of the individual code channels.

IQCreator™ also supports clipping on the CDMA standards to simulate effects on high crest factor signals. A clipping level between 1% and 100% can be set and applied before or after the channel filter.



Effect of 50% clipping on WCDMA

3GPP-FDD

In the 3GPP uplink, ***IQCreator***™ supports two physical channels; the Dedicated Physical Channel (DPCH) and the Physical Random Access Channel (PRACH). With the DPCH it is possible to include the HS-DPCCH which carries HSDPA (High Speed Downlink Packet Access) feedback signalling.

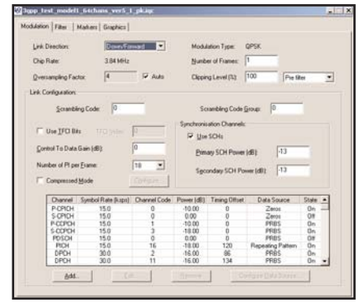
In the 3GPP downlink, the default data channel is a Dedicated Physical Channel (DPCH). In addition to the DPCH channel you can also add an HS-SCCH channel or a HS-PDSCH channel for HSDPA and an OCNS channel (Orthogonal Noise Source).

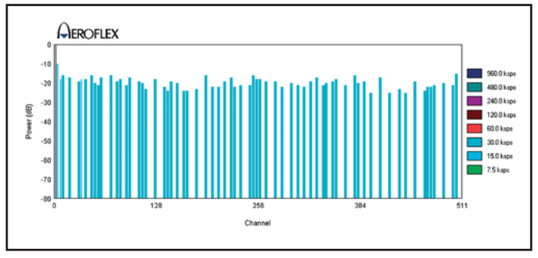
Inter-frequency handovers are needed to pass data from one radio frequency in one cell to another radio frequency in another cell, especially for inter-operability between 3G and 2G systems. This is achieved by using 3GPP compressed mode. ***IQCreator***™ allows different methods to compress the data on the link.

Test Models: In order to quickly generate 3GPP standard signals, ***IQCreator***™ can load predefined Test Models (1 to 5) or usual test configurations for user equipment or components using 3GPP compressed mode. ***IQCreator***™ allows the different methods to compress the data to be defined depending on the link.

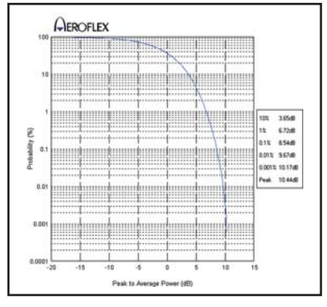
CDMA Graphics

IQCreator™ provides various graphic modes to visually check the calculated characteristics of the signal. Particularly important in CDMA standards are CCDF (Complementary Cumulative Distribution function) including Crest factor and Code Domain Power. In this mode the graph shows the parameters of each code (color, width and size) and whether any code conflict occurs.





IQCreator™ *template and code domain power graphic of 3GPP model 1 64 channel test signal*



CCDF graphic of 3GPP test signal

Digital Standards

WLAN

IQCreator™ comprehensive waveform creation software also covers wireless LAN standards IEEE 802.11a/b/g.

For 802.11b the 4 data rates (1, 2, 5.5 and 11 Mbps) are available together with their corresponding modulation format (DBPSK, DQPSK, CCK and PBCC). For 802.11a ***IQCreator***™ supports the 8 data rates from (6, 9, 12, 18, 24, 36, 48 and 54 Mbps) and their modulations (BPSK, QPSK, 16 QAM and 64 QAM).

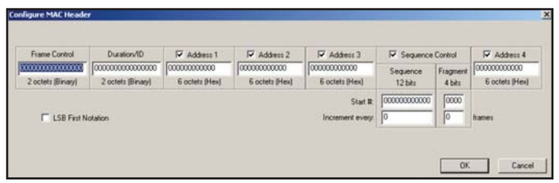
The 802.11g standard is a combination of the OFDM based 802.11a standard operating at 5.4 GHz and the CCK based 802.11b standard operating at 2.4 GHz. The 802.11g standard provides the data rates and modulation modes of both a and b as well as enhanced rate PBCC modulations (up to 33 Mbps - see table below). ***IQCreator***™ can be used to simulate all of these variants.

802.11a	
Modulation	OFDM
Data Rates	6 TO 54 Mbps
Carrier Frequency	5.4 GHz

802.11b	
Modulation	D8PSK/DQPSK CCK/PBCC
Data Rates	6 TO 54 Mbps
Carrier Frequency	5.4 GHz

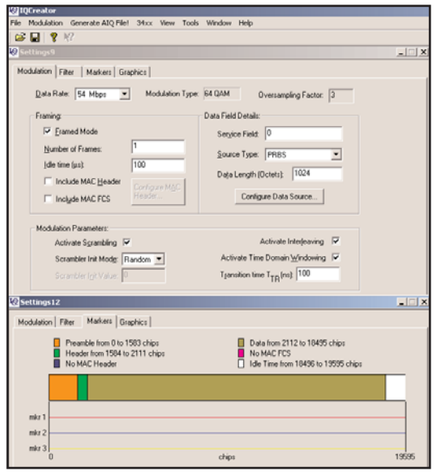
802.11g	a part	b part	new part	
Modulation	OFDM	D8PSK/DQPSK CCK/PBCC	PBCC	D8PSK/DQPSK Header OFDM payload
Data rates	6 to 54 Mbps	1 to 11 Mbps	22 and 33 Mbps	1 to 54 Mbps (payload)
Carrier Frequency	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz

The configurable data source (PRBS, pattern, user file) can be transferred in unframed or framed modes. In the latter, Preamble, MAC Header, MACFCS and Idle Period can be programmed. Markers can be set synchronous to the frame and FFT and CCDF graphics can be checked.

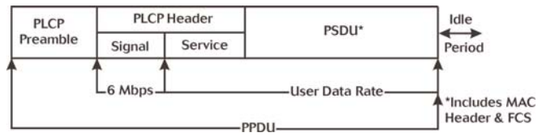


MAC header configuration window

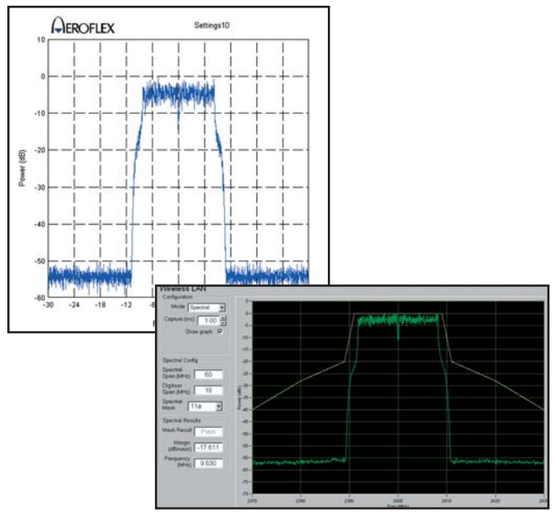
IQCreator™ therefore provides an ideal tool to verify 802.11 WLAN demodulation and sensitivity performance of receivers or characteristics of components.



802.11 WLAN default templates



802.11a physical layer frame



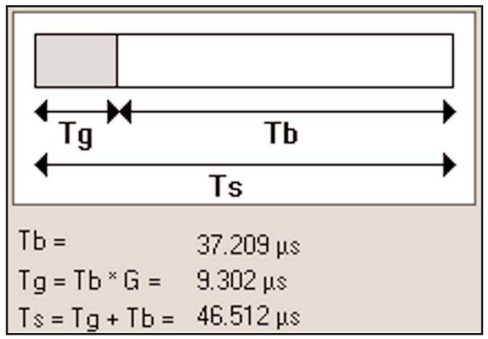
FFT graphic and RF spectrum of 802.11g signal (measured at 2.4 GHz with spectrum mask)

WMAN

IQCreator™ enables creation of the complex waveforms associated with WMAN (Wireless Metropolitan Area Network). Supporting both the IEEE 802.16 (2004) OFDM and IEEE 802.16 (2005) OFDMA standards, ***IQCreator***™ is capable of generating simulated waveforms for both FDD and TDD transmission formats. WMAN technology provides high capacity links in both uplink and downlink, in addition multiple bandwidths, adaptive modulation and FEC are used to further increase system capacity and reliability.

802.16 OFDM

IQCreator™ supports the 256 carrier OFDM modulation scheme for bandwidths from 28 to 1.25 MHz. From the modulation screen, selection of bandwidth and G, the ratio of cyclic prefix time to useful time, establishes the symbol time TS.

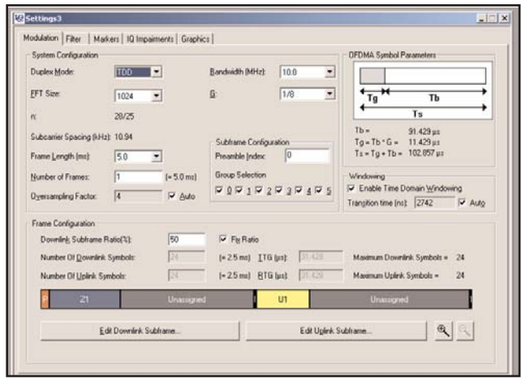


OFDM symbol time structure

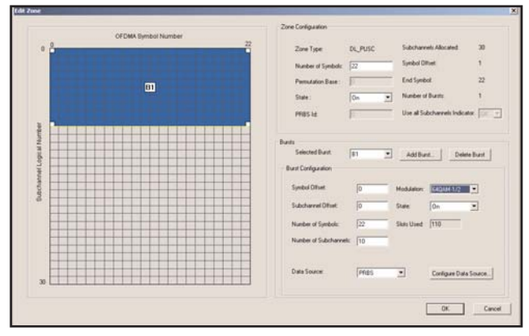
Selection of frame length between 2.5 to 20 ms then determines the number of symbols to be transmitted in the subframe. The ***IQCreator***™ easy to use user interface guides the user through the building of the complex waveforms used in the system.

802.16 OFDMA

The OFDMA version of the 802.16 standard introduces features to make the system applicable to mobile users. The ***IQCreator***™ interface allows the user to choose the major parameters required to construct an uplink and downlink frame. Using the edit tools, the user can further configure the OFDMA subframe by expanding to an add zone dialog box which allows the user to select the various zone parameters and the various attributes of the burst within the zone.



OFDMA modulation tab



Edit/Add zone dialog

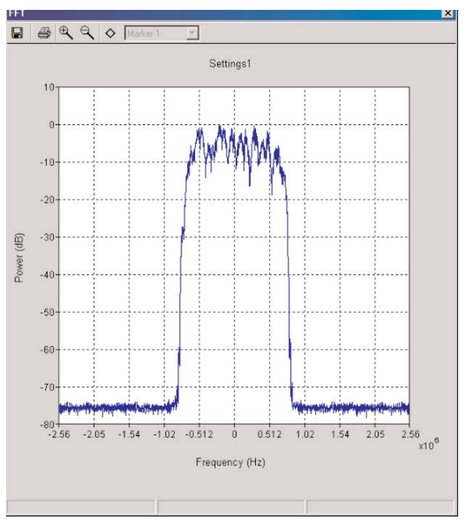
IQCreator™ provides the capability to generate 802.16 waveforms for use in system and subsystem testing, while still maintaining an intuitive graphical interface to guide the user through the system complexities.

3GPP TDD-LCR and TD-SCDMA

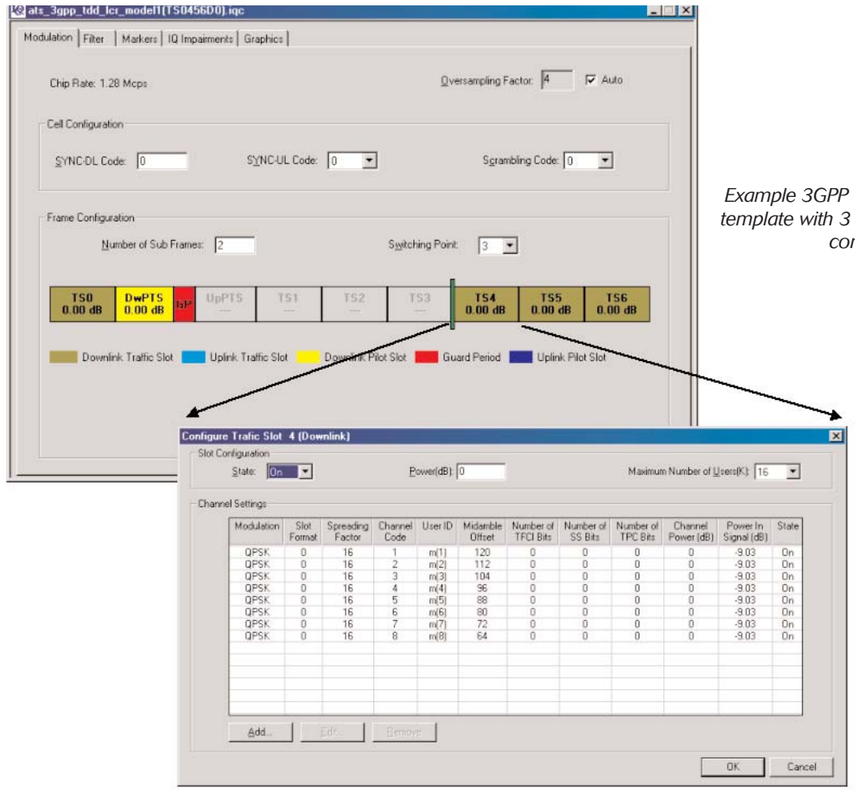
3GPP TDD-LCR and TD-SCDMA

Up to 1000 frames can be created in one waveform. The TDD-LCR sub-frame consists of 7 traffic time slots, a DwPts (Downlink Pilot time slot), a guard period and a UpPts (Uplink Pilot time slot). The first traffic time slot transmitted (Ts0) must carry downlink data. The second time slot transmitted must carry uplink data. The data carried in Ts2 to Ts6 is determined by the position of the switching point: the timeslots before the switching point carry uplink data and the timeslots after the switching point carry downlink data. Each timeslot can be configured with up to 16 channels. 3GPP TDD-LCR allows each channel to be modulated with QPSK or 8PSK and provides the ability to control the downlink and uplink pilot slot powers and sync codes.

Example test model waveforms are included to enable 3GPP TDD-LCR uplink, downlink or other timeslot combinations waveforms to be quickly generated.



FFT graphic of 3GPP TDD-LCR signal



Example 3GPP TDD-LCR test model template with 3 downlink traffic slots configured

Downlink slot configuration table

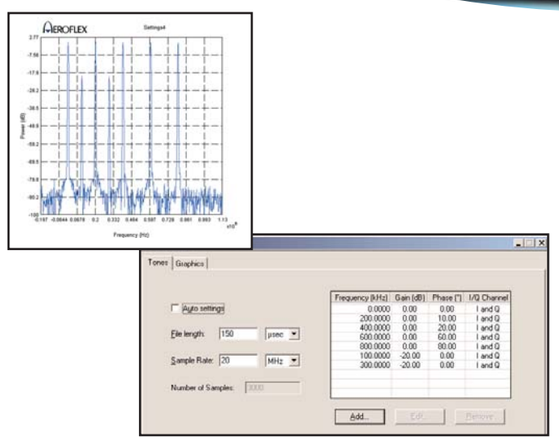
Multi-Tone/Carrier

Multi-Tone CW Signals

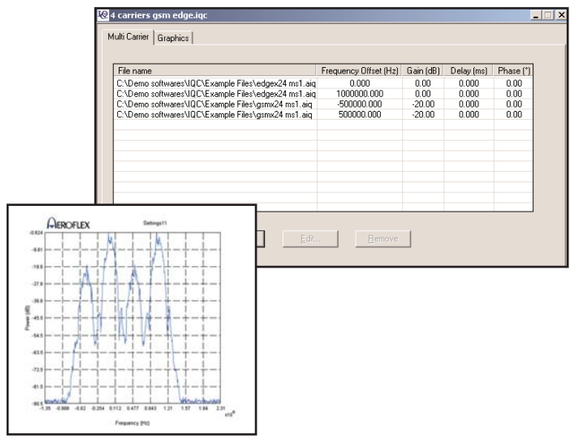
The Tones window of ***IQCreator***™ has tabs allowing you to create up to 20 CW tones. The waveform spectrum can be displayed and then saved. Frequency offset, level and phase can be set independently for each tone, as can the total file sampling rate and file length. Random mode is also offered to automatically generate a random phase between -180 and +180 degrees. Selecting this option for each tone in the table will typically result in a waveform with a lower crest factor.

Multi-Carrier Signals

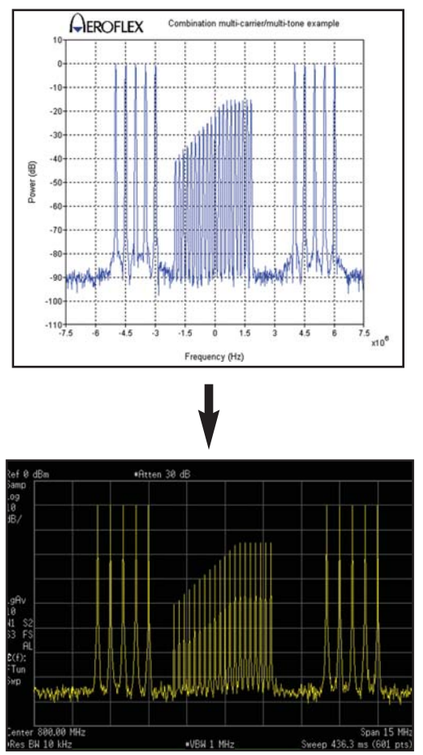
The multi-carrier modulation facility enables you to produce a waveform that contains multiple carriers (AIQ files), each with modulation, turning a single-source generator into a multi-source device. The modulation on each carrier can either be the same (to emulate a band of occupied channels) or different (representing interfering signals from a different transmission scheme). You are able to set the level, phase and time delay of each carrier independently, as well as the frequency offset. Random delay and phase options are available to randomize the time delay and/or phase of all the files selected.



7 CW tones menu and FFT display



Graphic and template for GSM/EDGE intermodulation test signal

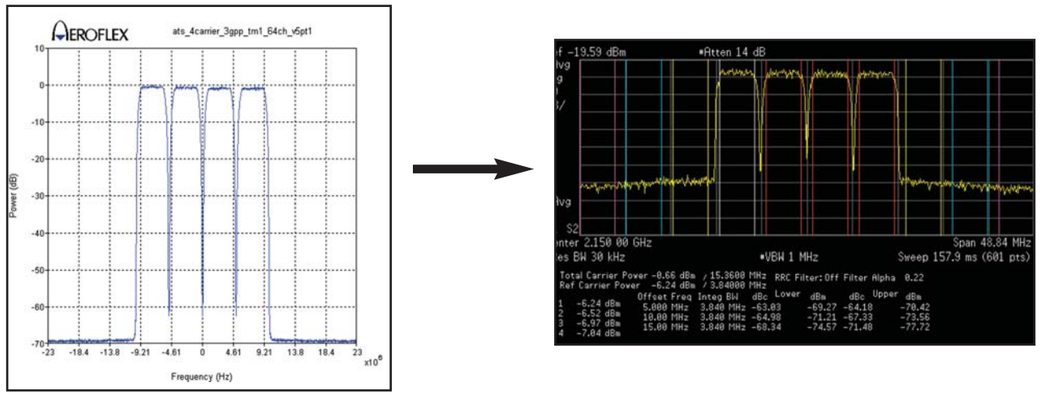


Example of combination multi-carrier/multi-tone

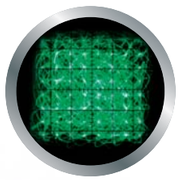
Multi-Tone/Carrier

Multi-Carrier Power Amplifier (MCPA) Test

Base station MCPA testing requires the use of high performance multi-carrier signals with minimum levels of ACLR. The multi-carrier capability of ***IQCreator***™ together with the high linearity of the 3410 Series of digital signal generator provides a very attractive test tool, particularly for 3GPP applications.



Multi-carrier 3GPP graphic



3410 Series Digital RF Signal Generators

IQCreator™ is designed for use with Aeroflex's digital RF signal generators, including the 3410 and PXI-based 3000 Series.

The 3410 Series are agile signal generators that combine a wide frequency cover and high performance vector modulation in a small package, making it ideal for testing wireless communication systems and components.

- Wide frequency coverage:
  - -- 250 kHz to 2 GHz (3412)
  - -- 250 kHz to 3 GHz (3413)
  - -- 250 kHz to 4 GHz (3414)
  - -- 250 kHz to 6 GHz (3416)
- Fast RF frequency and level settling for high speed testing
- High performance vector modulation for improved component test
- Optional dual channel arbitrary waveform generator (ARB)
- Low adjacent channel power for receiver selectivity and amplifier linearity testing
- Fast GPIB response to maximize ATE system performance
- Optional list mode for ultra-fast frequency and level hopping capability
- Wide bandwidth FM and AM modulation capability
- Optional high speed pulse modulation capability
- Compact, lightweight package
- Simple-to-use touch panel interface

Signal Generators

RF Modular Instruments (PXI)

The Aeroflex 3000 Series of RF modular instruments expand PXI's speed and modularity into the realm of wireless testing. The range includes a broad choice of PXI chassis and modular instruments for wide band width RF signal generation, RF signal analysis and RF signal conditioning for signals up to 6 GHz supported by software applications for waveform generation and vector signal analysis of complex communications systems.

3020 Series PXI RF Signal Generators

The 3020 Series are compact 3U high precision PXI modular RF signal generators with an integrated dual-channel arbitrary waveform generator. Their functionality and performance are ideally matched to the needs of RF test systems for design verification and manufacturing up to 6 GHz. They provide RF output power control ranging from –120 dBm to +6 dBm with modulation bandwidths up to 90 MHz.

Models: 3020, 3020A, 3025 and NEW 3025C

- High speed frequency switching
- Low phase noise
- Level range –120 dBm up to +6 dBm
- Level accuracy ±0.3 dB
- Built in dual-channel arbitrary waveform generator
- Digital interface for IQ streaming
- Optional analog IQ inputs and outputs

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AEROFLEX
A passion for performance.

Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven and customer-focused.

Part No. 46891/521
Issue 5
12/07