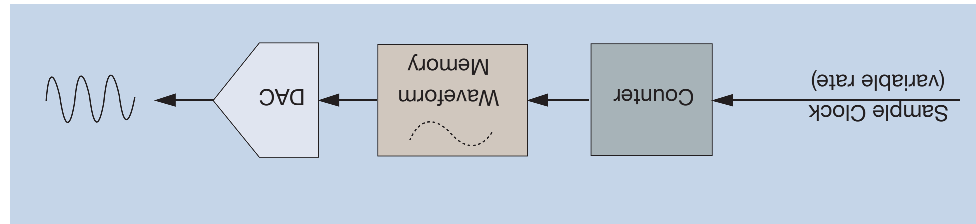
Pocket Guide to

Signal Sources

Waveform Generation Principles

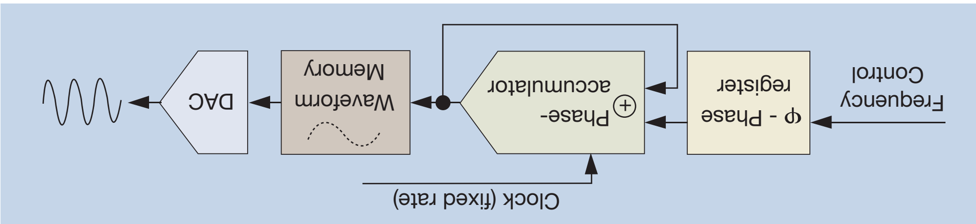
There are two different methods to generate arbitrary waveforms:

True Arbitrary Waveform Generator (True Arb)

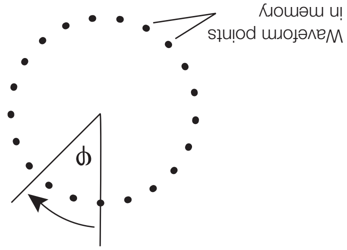


- The synthesizer generates the signal by recalling waveform points from memory
- With each clock cycle, the next point in memory is recalled
- Frequency tuning is achieved by varying the clock rate

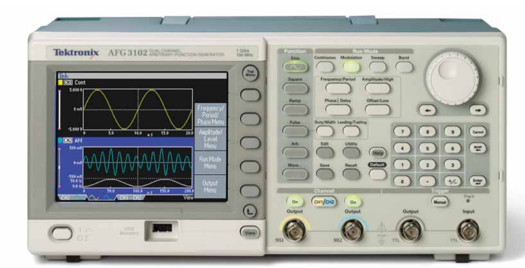
Direct Digital Synthesis (DDS)



- Imagine all points of the waveform in memory spread at equal angles around a full circle. The output signal is generated by recalling points from memory.
- A phase accumulator determines the next point to be recalled by incrementing the phase by a fixed angle φ with each clock cycle. The clock rate is constant.
- Frequency tuning is achieved by varying the phase increment φ. Large increments lead to high frequencies, as the phase accumulator completes the circle faster. At high rates, waveform points are skipped. At low rates, identical points are output several times.



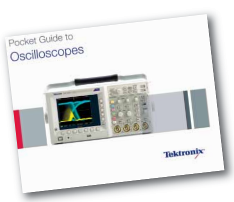
AFG3000 Arbitrary/Function Generator Series



With 12 standard waveforms, arbitrary waveform capability, and signal impairment options, the AFG3000 Series supports a wide range of application needs with one instrument. Best-in-class performance ensures signals are accurately reproduced. A large display and 25 shortcut keys make the AFG3000 Series both easy to learn and easy to use.

- 10 MHz to 240 MHz models
- One or two channels
- Sample rates up to 2 GS/s
- Amplitudes up to 20 V_{pk-pk} (into 50 Ω load)

For more information visit:
www.tektronix.com/afg3000



Download the Pocket Guide to Oscilloscopes and more educational materials at
www.tektronix.com/fundamentals

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Signal Source Classification

Signal Source
Generates signals used as a stimulus for measurements.

Function Generator
Outputs standard waveforms, such as a sine wave or a rectangle wave.

Arbitrary Waveform Generator
Generates waveforms defined by the user.

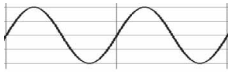
Logic Source
Outputs digital patterns such as pulses or patterns.

- Pulse Generator
  Drives stream of square waves or pulses from small number of outputs.
- Pattern Generator (or Data Generator)
  Generates digital pattern of many channels.

Mixed Signal Sources
Type of signal source that outputs analog waveforms and digital patterns.

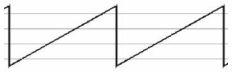
Basic Waveforms

Sine Wave
A curved wave shape defined by the mathematical sine function.

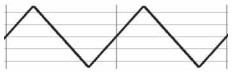


Square Wave
A wave shape consisting of repeating square pulses.

Sawtooth Wave
A waveform that ramps up slowly, then falls off quickly.



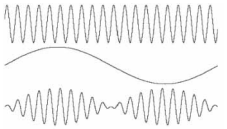
Triangle Waves
A waveform with symmetrical rise and fall times.



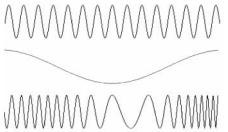
Pulse Wave
A waveform with a fast rising edge, a period of time at a constant amplitude, and a fast falling edge.

Signal Modulation

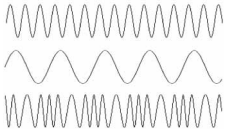
Amplitude Modulation (AM)
A type of analog modulation in which amplitude variations embed lower-frequency information into a carrier signal of higher frequency.



Frequency Modulation (FM)
A type of analog modulation in which frequency variations embed lower-frequency information into a carrier signal of higher frequency.

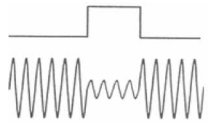


Phase Modulation (PM)
A type of analog modulation in which phase variations embed lower-frequency information into a carrier signal of higher frequency.

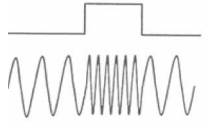


Signal Shift Keying

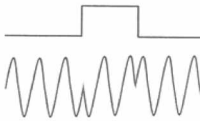
Amplitude Shift Keying (ASK)
A type of digital modulation in which the digital modulating signal causes the output frequency to switch between two amplitudes.



Frequency Shift Keying (FSK)
A type of digital modulation in which the carrier switches between two frequencies.



Phase Shift Keying (PSK)
A type of digital modulation in which the carrier switches between two phase settings.

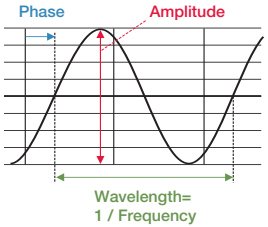


Waveform Characteristics

Amplitude
A measure of the voltage "strength" of a waveform. Amplitude is constantly changing in an AC signal.

Frequency
The number of times a full waveform cycle repeats in one second, measured in Hertz [Hz]. Frequency equals 1 divided by period or wavelength.

Phase
Time placement of a cycle relative to a reference waveform or point in time.

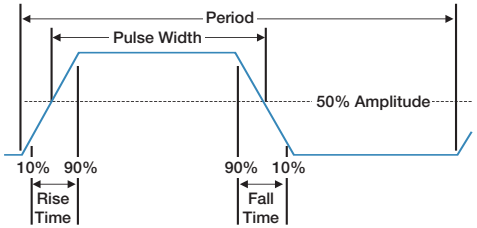


Pulse Characteristics

Rise Time
Amount of time required for a pulse edge to transition from low to high level.

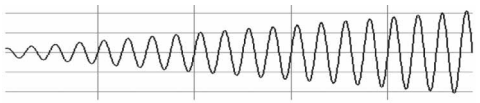
Fall Time
Amount of time required for a pulse edge to transition from high to low level.

Pulse Width
Amount of time the pulse takes to go from low to high and back to low again, measured at 50% of full voltage.

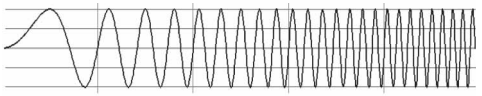


Swept Waveforms

Amplitude Sweep
A waveform that increases in amplitude over some period of time.



Frequency Sweep
A waveform that increases in frequency over some period of time.



Arbitrary Waveforms

Arbitrary Waveform
A waveform defined by the user rather than by the intrinsic nature of the signal generator.

Sample Rate
The maximum clock or sample rate at which the signal source can operate.

Memory Depth
The number of data points used to record a waveform, which determines the maximum amount of waveform data (equivalent to time).

Bandwidth
The frequency range of the signal source; usually defined as the frequency at which a sinusoidal signal is attenuated by 3 dB.

Vertical (Amplitude) Resolution
The smallest voltage increment that can be programmed in a signal source; the binary word width, in bits, of the instrument's digital to analog converter, which defines amplitude accuracy and distortion of the waveform.

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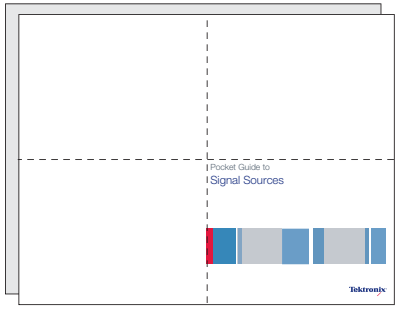
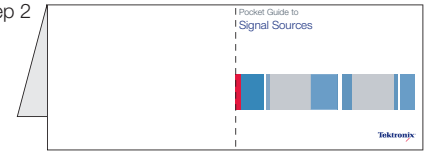
step 1



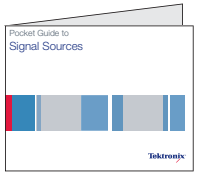
1. Print the four-panel guide on both sides of a single sheet of paper

step 2



2. Fold the guide in half with a horizontal fold

step 3



3. Fold the guide in half with a vertical fold