

Description

The CC-AFG20 is a 20 MHz waveform generator module that has a control interface via the CalBench control centre. It is a versatile test tool that provides users with multi-instrument capabilities for a wide range of applications.

The module integrates an advanced USB unit with a modern software user interface that provides various features and functionality for applications. When used in the CalBench the software is pre-loaded on the control centre module. The software simplifies test setups and configurations, making it ideal for onbench product and device evaluation and diagnostics.

Waveform Generation

The arbitrary waveform generator can be used to generate custom waveforms with up to 65,536 points at sample rates of up to 1.25 MSa/s. For maximum flexibility to generate truly arbitrary waveforms, it's easy to load waveforms from a file or input them as piece-wise mathematical functions with up to 32 segments. Use burst mode to trigger waveform generation from input channels with start or n cycle modes, or output waveforms with more than 250,000 cycles of dead time between pulses in pulsed mode.

The waveform generator enables you to generate two independent waveforms with a sampling rate of 125 MSa/s, and a maximum frequency of 20 MHz with an output voltage range up to 10 Vpp. Select between sine, square, ramp, pulsed, noise, or DC waveform shapes. Modulate the phase, frequency, or amplitude, or generate triggered bursts or sweeps from an internal or external source.

A Multi-Instrument Module

In addition to waveform generation, the CC-AFG20 incorporates several instruments that provide users with increased functionality and capabilities. These include a 30 MHz 2-channel oscilloscope, spectrum analyser, and in-built data logger with 8 GB of internal storage.

Features

- Multi-instrument module with waveform generation
- Operated via CalBench control centre application
- Frequency range: 1 mHz to 20 MHz (1 μ Hz resolution)
- 6 built-in waveforms: sine, square, ramp, pulse, noise, DC
- FM, AM, PM, and PWM modulation with internal waveform
- Pulse generation from 1 mHz to 5 MHz
- Oscilloscope: 2 channel, 30 MHz, sampling rate to 125 MSa/s
- Built-in spectrum analyser and data logger
- Suitable for electronic test and R&M applications
- Compact 50 mm wide module

Software Interface Features

- View multiple measurements simultaneously
- Easily log data, screenshots, and system state
- Rapidly prototype custom test sequences
- Recall past states of your USB Modular to replicate results
- Download/export data to the CalBench control centre PC



Arbitrary Waveform Generator

Description

The Arbitrary Waveform Generator can generate custom waveforms with up to 65,536 points at sample rates of up to 125 MSa/s. Waveforms can be loaded from a file or input as a piece-wise mathematical function with up to 32 segments, enabling you to generate truly arbitrary waveforms. In burst mode, waveform generation can be triggered from input channels with Start or N Cycle modes. In pulsed mode, waveforms can be output with more than 262,144 cycles of dead time between pulses.



- Select a pre-set waveform, load custom waveforms from a file, or describe your waveform mathematically using the in-built equation editor
- Configure pulsed arbitrary waveforms with up to 262,144 cycles of dead time between pulses
- Synchronize the phase of both output channels
- Generate arbitrary waveforms with up to 65,536 points

Common

Overview

Channels	2
Bandwidth (-3 dB)	> 20 MHz
Sampling rate	125 M per channel
Source impedance	200 Ω
Waveforms	Sine, Gaussian, Exponential Fall, Exponential Rise, Sinc, Cardiac, Equation, Custom (from file)

Amplitude

Output voltage range	10 Vpp into 1 MΩ
Resolution	100 µV _{pp}

DC offset

Voltage range	±4.999 V into 1 MΩ
Resolution	100 µV

Phase offset

Range	0° to 360°
Resolution	0.000 001°

Waveform

Custom

Maximum output rate	15.625 MSa/s	65536 points	
	31.25 MSa/s	32768 points	
	62.5 MSa/s	16384 points	
	125 MSa/s	8192 points	
Text file type	Comma- or newl	Comma- or newline-delimited text	
File import options	Clipboard, Files	Clipboard, Files	
Interpolation	None, Linear		



Waveform Generator

Description

Waveform Generator enables you to generate two independent waveforms with a sampling rate of 125 MSa/s, and a maximum frequency of 20 MHz with an output voltage range up to 10 Vpp. Select between sine, square, ramp, pulsed, noise, or DC waveform shapes. Modulate the phase, frequency, or amplitude, or generate triggered bursts or sweeps from an internal or external source.



- Generate 2 independent waveforms from DC to 20 MHz
- 6 built-in waveforms: sine, square, ramp, pulse, noise, and DC
- FM, AM, PM, and PWM modulation with internal waveform (cross-channel modulation) or external input
- Versatile trigger options: from input, or the other output channel

Common characteristics

Overview

Channels	2
Bandwidth (-3 dB)	20 MHz
Sampling rate	125 MSa/s per channel
Output impedance	200 Ω
Waveforms	Sine, Square, Ramp, Pulse, Noise, DC

Amplitude

Range	2 mV $_{\text{pp}}$ to 10 V $_{\text{pp}}$ into 1 M Ω
Resolution	100 µV

DC offset

Range	±4.999 V into 1 M Ω
Resolution	100 µV

Phase offset

Range	0° to 360°
Resolution	0.000 001°
Accuracy	± 0.000 001% of 360° range
Phase drift	0.000 5 deg/sec

Waveform characteristics

Sine	
Frequency range	1 mHz to 20 MHz
Frequency resolution	1 µHz
Total harmonic distortion	< 0.5% (1.9 MHz, 5 harmonics)
SFDR	> 50 dBc

Square	
Frequency range	1 mHz to 5 MHz
Frequency resolution	1μHz
Edge time	16 ns into 1 M Ω
Overshoot	< 1% into 1 M Ω

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Frequency range	1 mHz to 5 MHz	
Frequency resolution	1 µHz	
Symmetry ²¹	8% to 92% at 5 MHz	
	0.8% to 99.2% at 500 kHz	
	0.01% to 99.99% at 5 kHz	

Pulse

Frequency range	1 mHz to 5 MHz	
Frequency resolution	1 µHz	
Period range	1000 s to 200 ns	
Pulse width	16 ns to (period - edge time)	
Edge time	16 ns to pulse width	
Edge time resolution	1 ns	
Overshoot	< 1%	

Modulation

Amplitude

Carrier waveforms	Sine, Square, Ramp, Pulse, Noise	
Source	Ch1: Input 1, Input 2, Output 2, Internal Ch2: Input 1, Input 2, Output 1, Internal	
Internal modulation	Sine	
Frequency	1 mHz to 5 MHz	
Amplitude modulation resolution	±0.1 %/V	
Depth	0% to 100%	

Frequency	
Carrier waveforms	Sine, Square, Ramp, Pulse
Source	Ch1: Input 1, Input 2, Output 2, Internal
	Ch2: Input 1, Input 2, Output 1, Internal
Internal modulation	Sine
Frequency	1 mHz to 5 MHz
Frequency modulation resolution	±1 mHz/V
Deviation	DC to 20 MHz
(carrier + deviation)	

²¹ Symmetry is limited by the minimum rise time of 2 ns and number of harmonics required to maintain a linearity of more than 99%.



Phase		
Carrier waveforms	Sine, Square, Ramp, Pulse	
Source	Ch1: Input 1, Input 2, Output 2, Internal Ch2: Input 1, Input 2, Output 1, Internal	
Internal modulation	Sine	
Frequency	±1 mHz to 5 MHz	
Phase modulation resolution	0.001 °/V	
Phase shift	0.0° to 360.0°	

Pulse Width

Carrier waveforms	Pulse	
Source	Ch1: Input 1, Input 2, Output 2, Internal Ch2: Input 1, Input 2, Output 1, Internal	
Internal modulation	Sine	
Frequency	1 mHz to 5 MHz	
Pulse width modulation resolution	±1 ns/V	
Deviation	0 to pulse width (limited by pulse width period)	

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Modes of Operation	Start ²² , N-Cycle, Gated	
N-Cycle range	1 to 1,000,000	
Trigger Sources	Ch1: Input 1, Input 2, Output 2, Internal Ch2: Input 1, Input 2, Output 1, Internal	
Trigger Level	10 V _{pp} or 50 V _{pp}	

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Sweep Frequency Start/End	Sine: 1 mHz to 20 MHz Square, Ramp, Pulse: 1 mHz to 5 MHz	
Sweep Time	1 ms to 1 ks	
Trigger Sources	Ch1: Input 1, Input 2, Output 2, Internal Ch2: Input 1, Input 2, Output 1, Internal	
Trigger Level	±5 V or ±25 V	

²² Start burst mode cannot be internally triggered.



Data Logger

Description

The Data Logger enables you to log data up to 1 MSa/s directly to its internal memory. The versatile front ends allow the user to select between AC / DC couplings, and 10 V_{pp} or 50 V_{pp} input ranges based on the experiment. It also provides user-configurable sampling rate along with duration and delay start options. Data saved to the internal memory can be uploaded to cloud or computers for analysis once the measurement is complete.



- 8 GB of internal storage
- Log voltage data on two independent channels directly to the device
- Built-in two-channel 20 MHz waveform generator²
- Easily download log files to your computer for analysis. Built-in conversion tool to convert the binary data to .csv, .mat, HDF5, or NumPy format
- Schedule your log to start on a delay of up to 10 days

² See Waveform Generator for specifications on integrated waveform generators

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Logging

Acquisition

File formats	Binary: records data using a proprietary LI format for high-speed data logging. Can be converted to .csv, .txt, .mat, .npy, and HDF5.	
Export modes	Dropbox, email, and iCloud, My Files (iOS 11 / Windows 10 or later)	
Maximum sampling rate	1 MSa/s with 1 channel enabled 500 kSa/s with 2 channels enabled	
Minimum sampling rate	10 Sa/s	
Maximum logging duration	10,000 hours	
Delayed log start time	Up to 240 hours	
Acquisition mode	Normal: Direct digitization at the acquisition rate Precision mode: Downsampling from maximum sampling rate by averaging Peak detect: Similar to Precision mode, except the highest and lower samples are logged	

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Description

The Oscilloscope features two input channels with sampling rates up to 125 MSa/s and 30 MHz analog bandwidth. Both channels support user-selectable AC / DC couplings, and 10 V_{pp} or 50 V_{pp} input ranges. The built-in two-channel waveform generator is capable of producing waveforms with a maximum bandwidth of 20 MHz.



- Two analog inputs with 125 MSa/s sampling rate and 30 MHz bandwidth.
- Intuitive user interface on Windows or Mac.
- Onboard signal analysis measurements.
- Math channel with support for arbitrary functions.
- Integrated, high-speed, 2-channel waveform generator with maximum frequency up to 20 MHz.

Vertical characteristics

Voltage

Channels	2	
Input coupling	AC / DC	
Input impedance	1 ΜΩ	
Input bandwidth (-3 dB)	> 30 MHz	
Input voltage range	10 V _{pp} or 50 V _{pp}	
Input voltage noise	160 nV/ $ m /Hz$ above 220 kHz at 10 V $_{ m pp}$ input range	
Vertical resolution ¹⁴	12 bits at 125 MSa/s (ADC resolution)	
	13 bits at 31.25 MSa/s	
	22 bits at 250 Sa/s	
Channel-to-channel isolation	> 40 dB	

Horizontal characteristics

Time

Time mode	Normal, Roll	
Horizontal range	5 ns/div to 20 s/div	
Delay range	Pre-trigger:	16 kSamples
	Post-trigger:	2 ³⁰ samples

Acquisition

Acquisition mode	Normal, Precision, Peak Detect, Deep Memory ¹⁵	
Maximum sampling rate	125 MSa/s	
Memory depth	4.2 MSa per channel (Deep memory mode)	
Averaging (linear)	Off, 2 to 100 waveforms	
Interpolation	Linear, SinX/X, Gaussian	

¹⁴ Higher number of bits above the physical ADC specification is only available in precision mode. ¹⁵ See the User Manual for more information on how Acquisition modes are implemented.

Trigger

Trigger

Trigger modes	Auto:	Triggers automatically after timeout (1 second if previously triggered, 0.05 seconds otherwise)
	Normal:	Triggers only on trigger event
	Single:	Triggers once on a trigger event
Trigger sources	Input 1, Inp	ut 2, Output 1, Output 2
Nth event	Trigger on	the 1 st to 65,535 th event
Holdoff	up to 10 se	econds
Trigger types	Edge: Risir Pulse: Posi • 10	ng edge, falling edge, both edges itive / negative polarity .0 seconds > pulse width > 32.0 nanoseconds

Trigger sensitivity			
Sensitivity modes	Auto:	Automatically configures trigger sensitivity based on horizontal and vertical scales Select <i>Noise Reject</i> or high-frequency <i>HF Reject</i> options	
	Manual:	Manually configure trigger sensitivity	
Manual modes	Relative, A	Absolute	
Hysteresis	Relative: (Absolute:	Relative: 0.01 div to 5.00 div Absolute: 100 μV to 1.00 V	

Measurements

Measurements		
Time measurements	Frequency, phase, period, duty cycle, positive pulse width, negative pulse width, rise time, fall time, rise rate, fall rate	
Amplitude measurements	Peak-to-peak, amplitude, maximum, minimum, mean, cycle mean, RMS, cycle RMS, standard deviation, high-level, low-level, overshoot, undershoot, fringe vis.	
Math	Add, subtract, multiply, divide, XY mode, integrate, differentiate, FFT, min hold, max hold, arbitrary equation mode (using equation editor)	
Cursors		
Maximum voltage cursors	5	
Maximum time cursors	5	
Voltage cursor options	Manual, track mean, track maximum, track minimum, maximum hold, minimum hold	
User defined reference	A single cursor can be set as a reference for differential measurements using all other active cursors	

Saving data

Exporting data	
File formats	Binary: records data using a proprietary LI format for high-speed data logging. Can be converted to .csv, .txt, .mat, .npy, and HDF5.
Export modes	Dropbox, email, iCloud, and My Files (iOS 11 / Windows 10 or later)

Export types

Traces	Save 1024 points of data from each visible input pin in the current time span
Screenshot	Save the app window as a PNG or JPG
Settings	Save the current instruments settings to a text file
Measurements	Save all active measurements as comma-separated values
High-res data	Save up to 4.2 Mpts per active channel ¹⁶



Spectrum Analyzer

Description

Spectrum Analyzer allows you to observe input signals in the frequency domain between DC and 30 MHz. The frequency down-conversion / FFT hybrid approach provides significant improvement in dynamic range and spectral resolution compared to an FFT-based spectral analysis. View two channels of data simultaneously with a resolution bandwidth as low as 470 mHz over a minimum span of 100 Hz. The Spectrum Analyzer also features two integrated waveform generators capable of producing sine waves at up to 20 MHz.



- Generate two sine waves up to 20 MHz using the built-in analog outputs¹⁹ •
- Quickly measure key metrics by dragging measurement cursors onto features of interest using the • graphical interface
- View spectral data in units of Volts or dBm as either power or power spectral density •
- Export data and instruments settings quickly with email and My Files integration²⁰ •

¹⁹ See Waveform Generator for waveform specifications. Only sine wave can be generated when using the Spectrum Analyzer.

²⁰ See Oscilloscope for data export options.

Frequency

Frequency

Range	DC to 30 MHz
Span	100 Hz to 30 MHz

Resolution bandwidth (RBW)

Modes	Auto	Automatically sets the RBW based on the current span and window function	
	Manual	Allows the user to manually set the RBW within the limits tolerated by the span and window function	
	Min	Sets the RBW at the minimum possible value for the current span and window function The minimum RBW is 470 mHz	
Windows	Rectangula Nuttall, Gau	Rectangular, Bartlett, Hamming, Hann, Blackman-Harris, Flat top, Nuttall, Gaussian, Kaiser	

Amplitude

Voltage

Channels	2
Input coupling	AC / DC
Input impedance	1 ΜΩ
Input range	10 Vpp or 50 Vpp
Input bandwidth (-3 dB)	> 30 MHz into 1 MΩ

Display

Scales	Volts, dBm
Display modes	Power, Power Spectral Density (PSD)
Video bandwidth (VBW)	230 mHz to 310 kHz depending on span
Averages	1 to 100
Math Channel modes	Add, Multiply, Min hold, Max hold
Measurements	Peak level, Peak frequency, Noise level, Peak SNR, Occupied BW