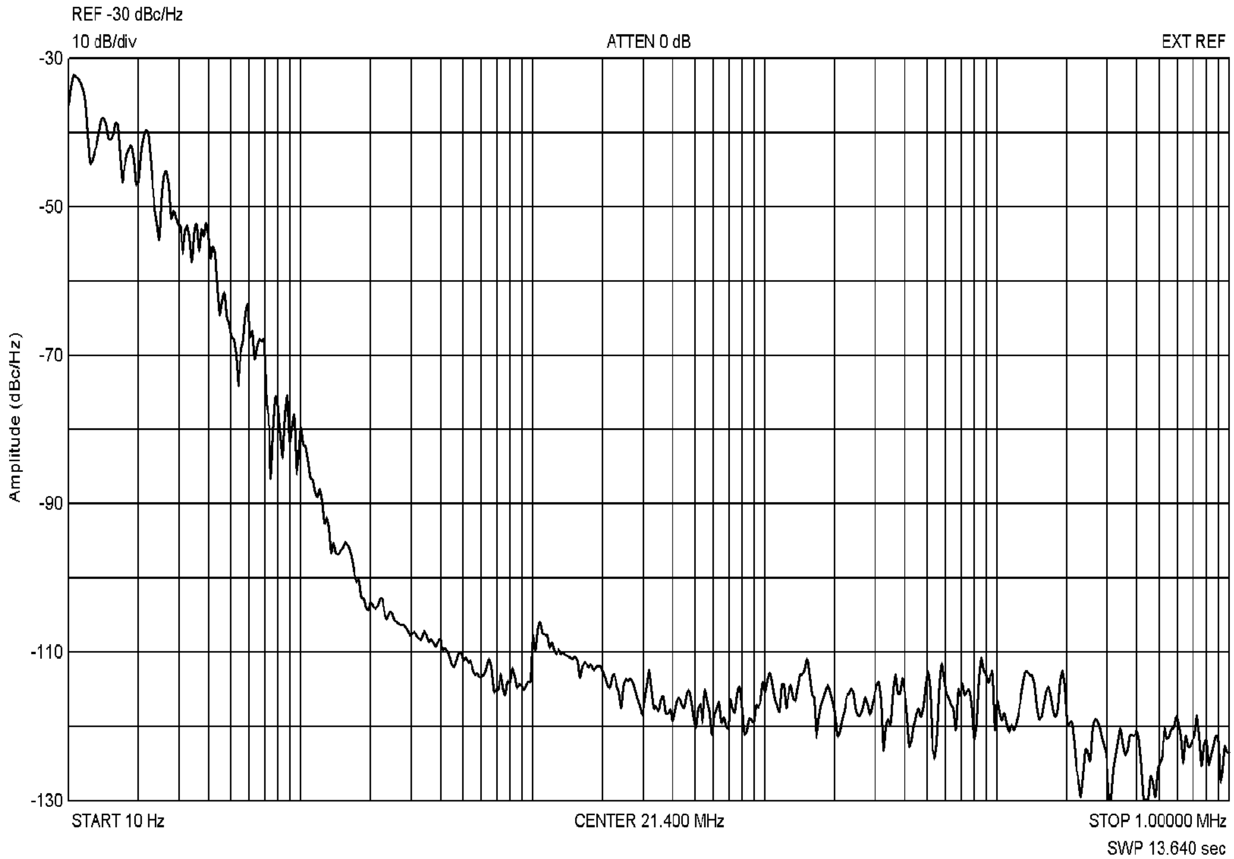
Siglent SAG1021 Review



SAG1021_Sine_21.4MHz_PN

At 21.4MHz, a phase noise of -100dBc is reached at about 180Hz carrier distance. Also -110dBc @ 420Hz.

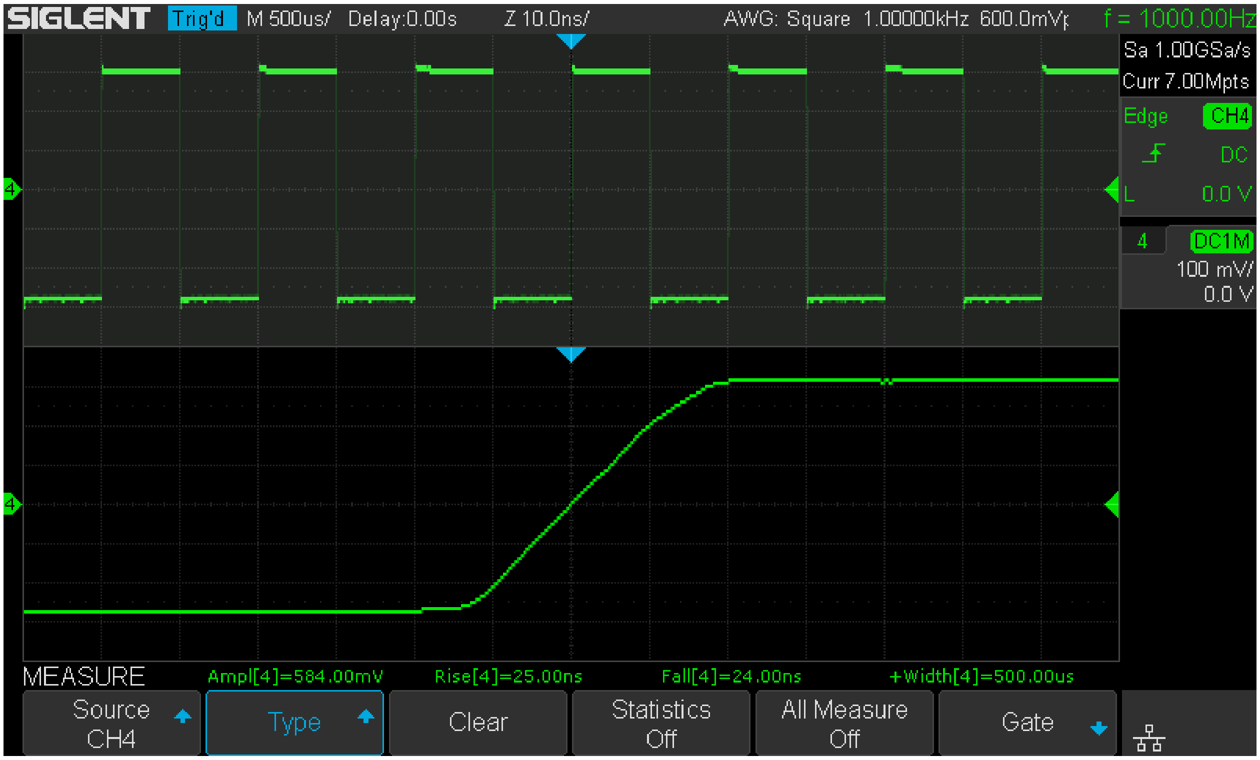
Square

Square wave has an additional parameter *Duty* that allows setting the duty cycle from 1 to 99% with 1% resolution.

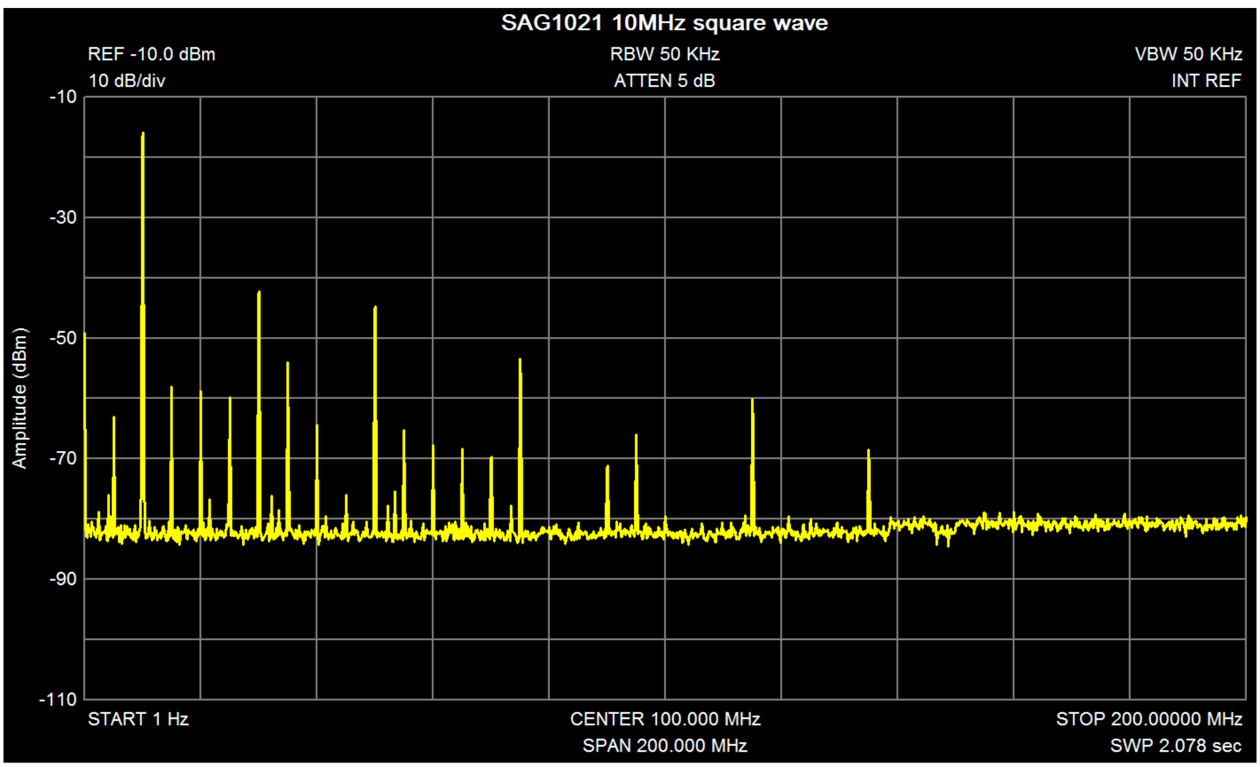
From a square wave, we'd expect fast transitions with little overshoot and a flat top and bottom. As can be seen from the screenshot below, the 25ns transitions are anything but fast, yet the waveform appears very clean otherwise.

The first screenshot shows the zoomed riding edge and there it appears absolutely clean. But then again, with a rise time as slow as 25ns, we certainly wouldn't expect anything different. In any case this is an ideal signal for LF probe compensation and certainly more versatile than the calibrator output on the scope.

The second screenshot shows the spectrum of the square wave at it maximum frequency of 10MHz. We see lots of spurious signals, but only up to the 5th harmonic of the square wave, which is no surprise given the sample rate of 125MSa/s.



SAG1021_Square_600mV_1kHz

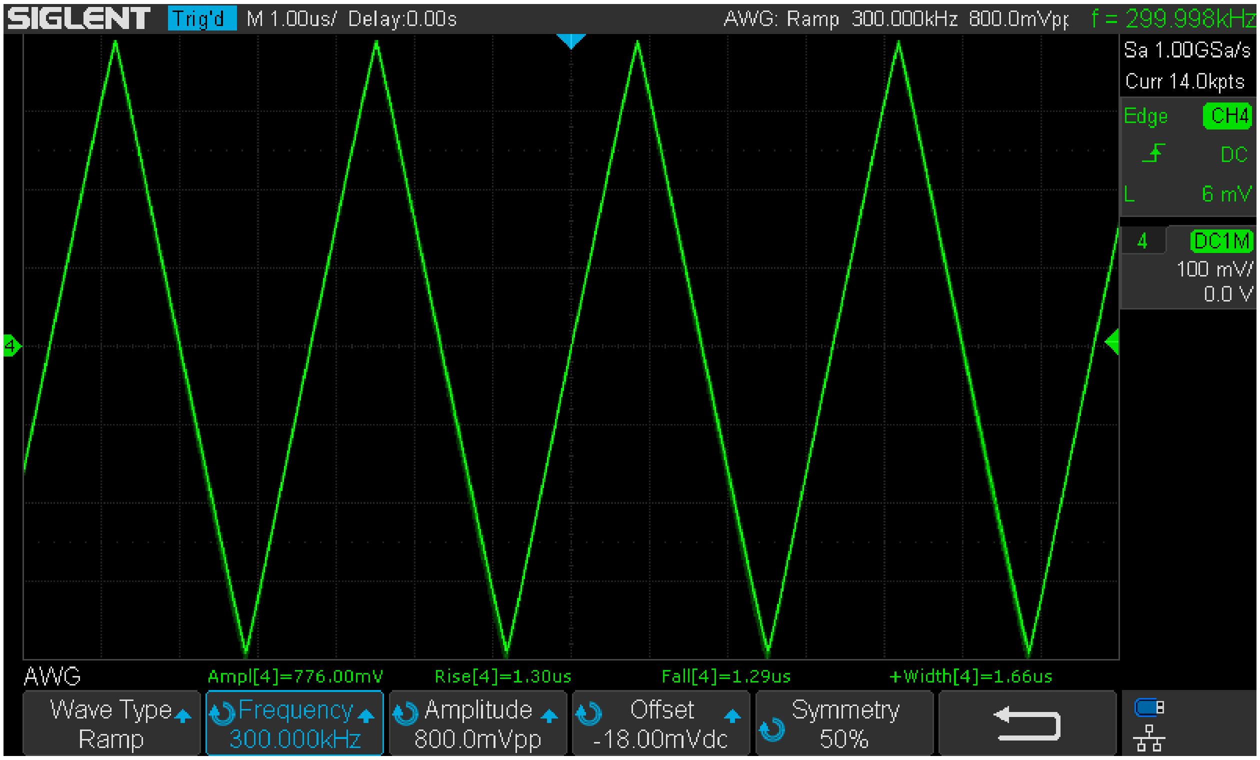


SAG1021_Square_3Vpp_10MHz_Spectrum

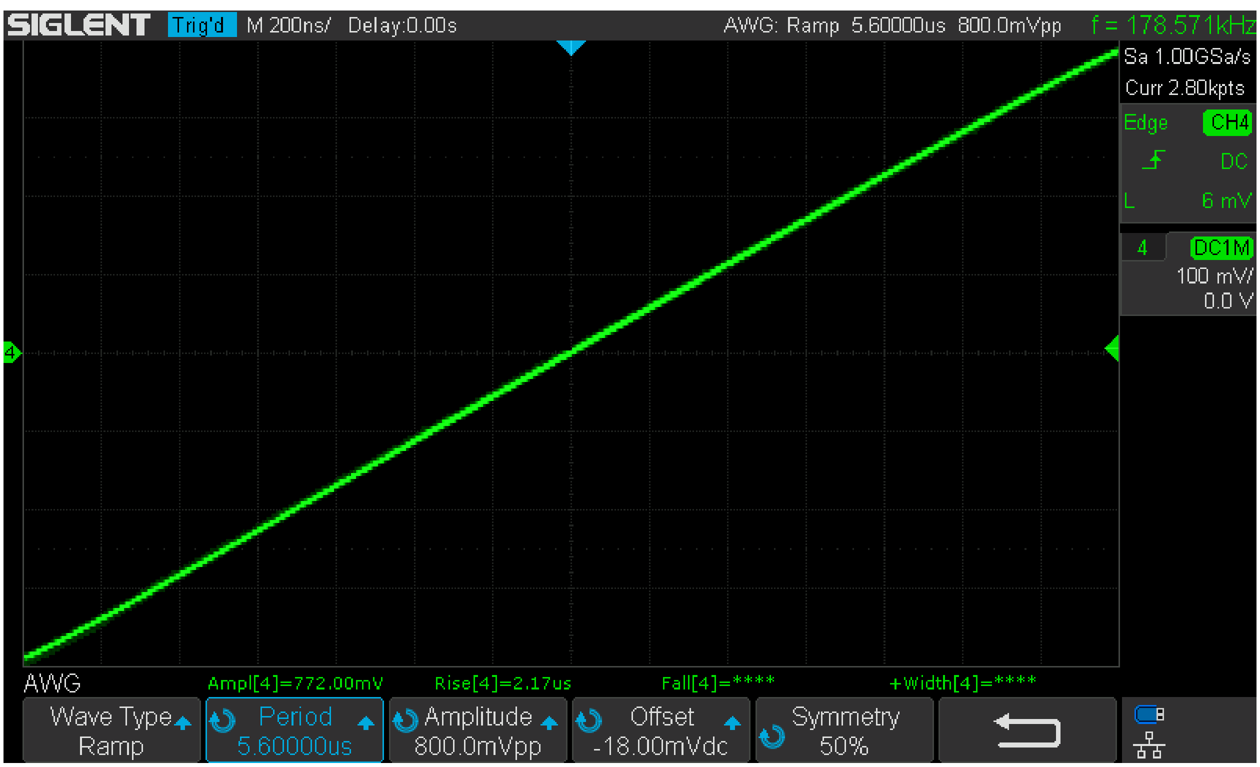
Ramp

Ramp has an additional parameter *Symmetry* that allows setting the symmetry from 0 to 100% with 1% resolution.

The single most important property of a ramp is its linearity, which is increasingly difficult to achieve at higher frequencies. The following screenshots show examples at or near the maximum frequency of 300kHz.



SAG1021_Ramp_800mV_300kHz

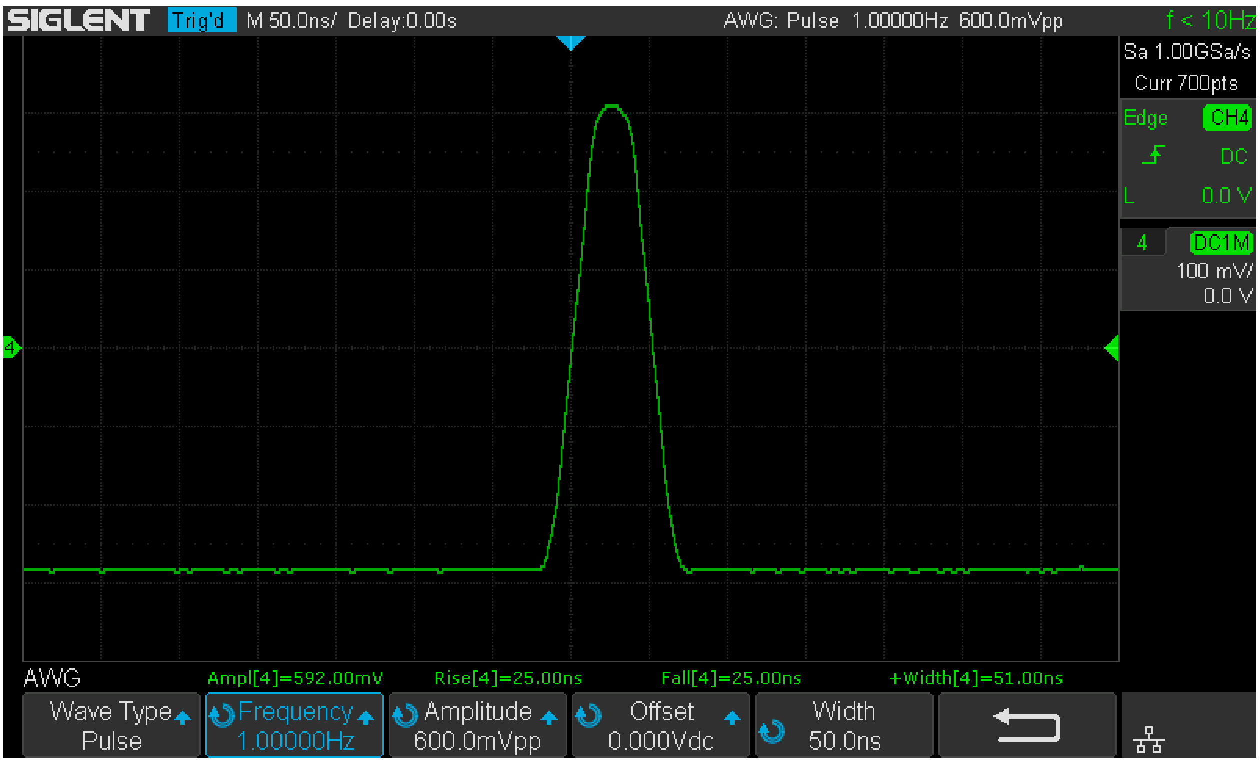


SAG1021_Ramp_linearity

Pulse

Pulse has an additional parameter *Width* that allows setting the positive pulse width from 50ns to 10s with 3 digits resolution. Of course the pulse width cannot exceed the pulse period.

The pulse waveform has the nice feature of width adjustment totally independent of the repetition rate (with the obvious constraint that it cannot exceed the pulse period). This is not at all common for AWGs and would hint on Siglent using their “Easy Pulse” technology in the SAG1021. The features are still very basic or non-existent. No variable transition times – well, okay, who would want to set them even slower than 25ns? – also no choice for the pulse polarity. Pulses are always positive, but we can set the max. pulse width in order to get negative 50ns pulses, but this has to be repeated every time the repetition rate (frequency) of the pulses is changed. The minimum pulse width of 50ns is in accordance with the transition times. Just like the square wave, pulses appear very clean.



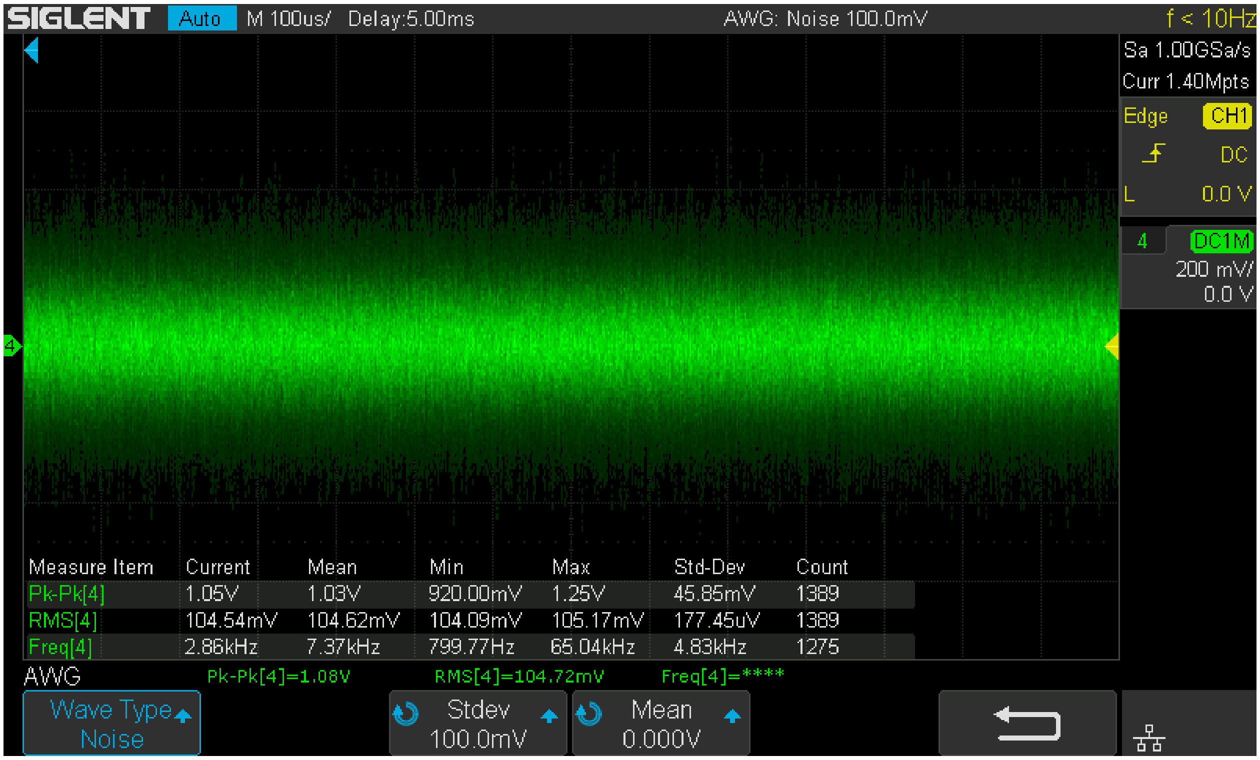
SAG1021_Pulse_600mV_50ns

Noise

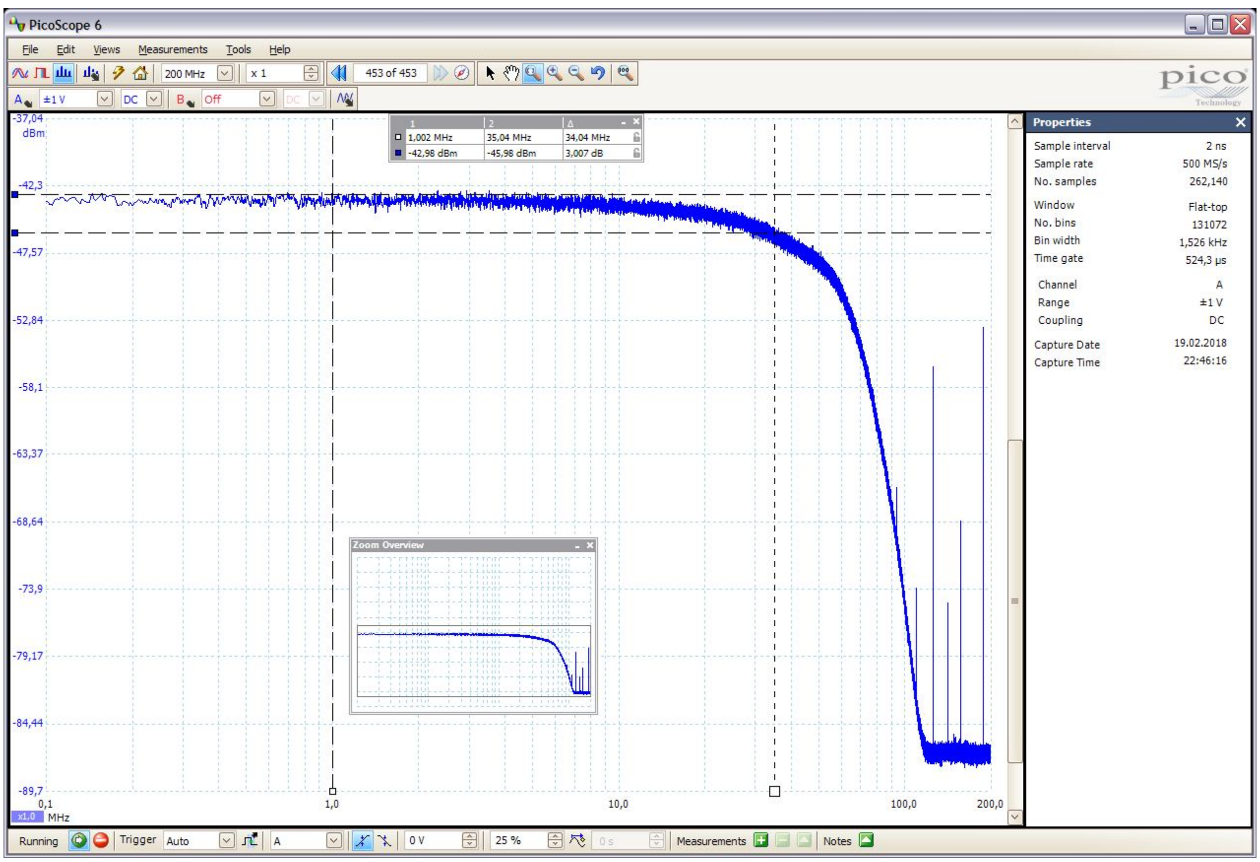
This has just a setting Stdev for setting the RMS amplitude and *Mean* for the DC offset.

White noise should provide a flat spectrum so it can be used a signal source for frequency response measurements with a spectrum analyzer (or the FFT in a DSO). The first screenshot shows what it looks like in the time domain – well, it looks like noise, no surprises there.

The 2nd screenshot below shows the noise spectrum up to 200MHz (log axis!) for 150mV standard deviation. Up to some 10MHz the spectrum is flat within -1dB and the -3dB corner frequency is at about 35MHz, followed by a fairly steep roll-off. Just ignore the spurious signals visible above 90MHz, they are not related to the SAG1021 in any way.



SDS1104X-E_SAG1021_Noise_100mV



SAG1021_Noise_150mV_FFT_200MHz

DC

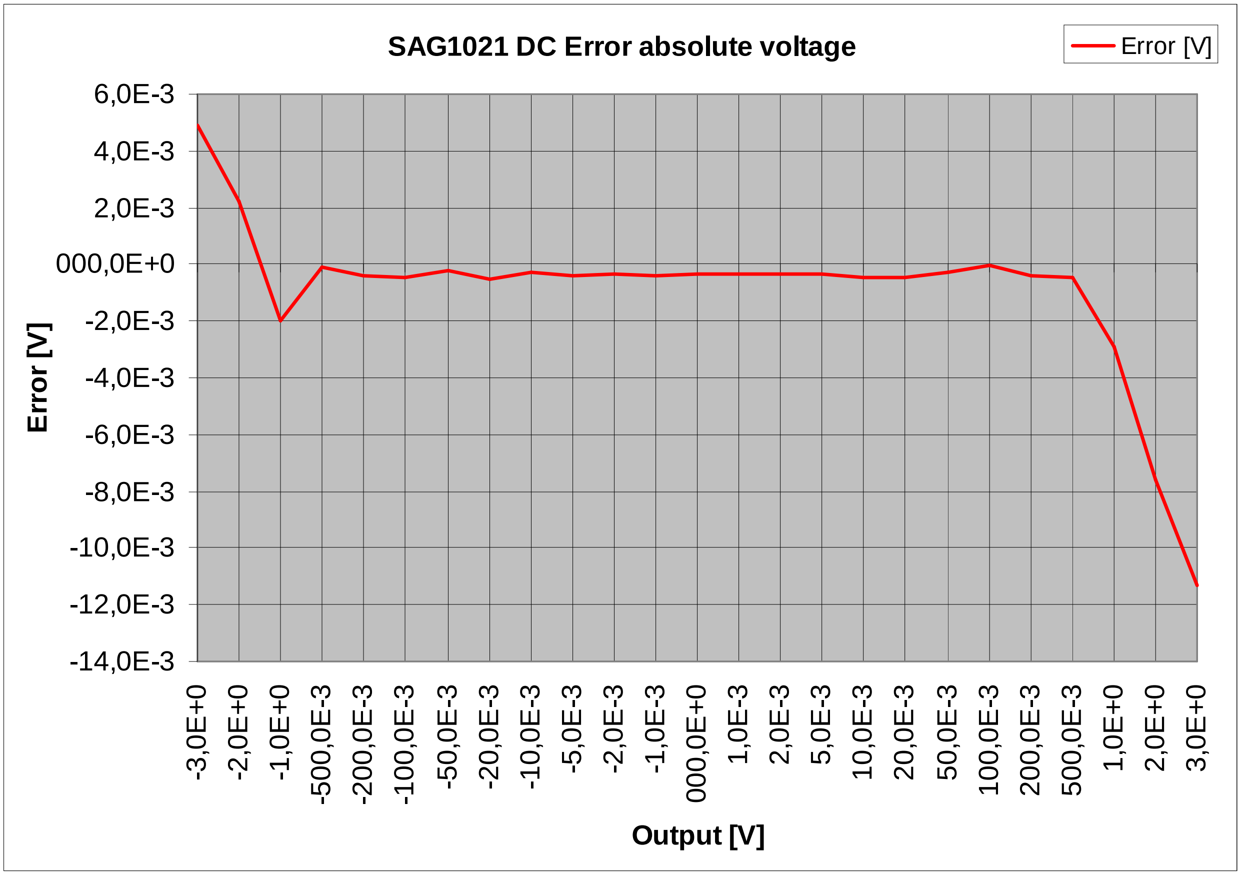
A function generator can be used as a DC signal source and is a much better alternative to a bench power supply for testing DC-amplifiers, bias points and thresholds in various circuits. It cannot deliver destructive power, has no significant output capacitance, hence any voltage change is instant and it should be more precisely controllable from the outset. Even more importantly, the DC voltage should be fairly free from interferences. The only thing to keep in mind is the output impedance of 50Ω, but this is rarely ever a problem for applications like the ones listed above.

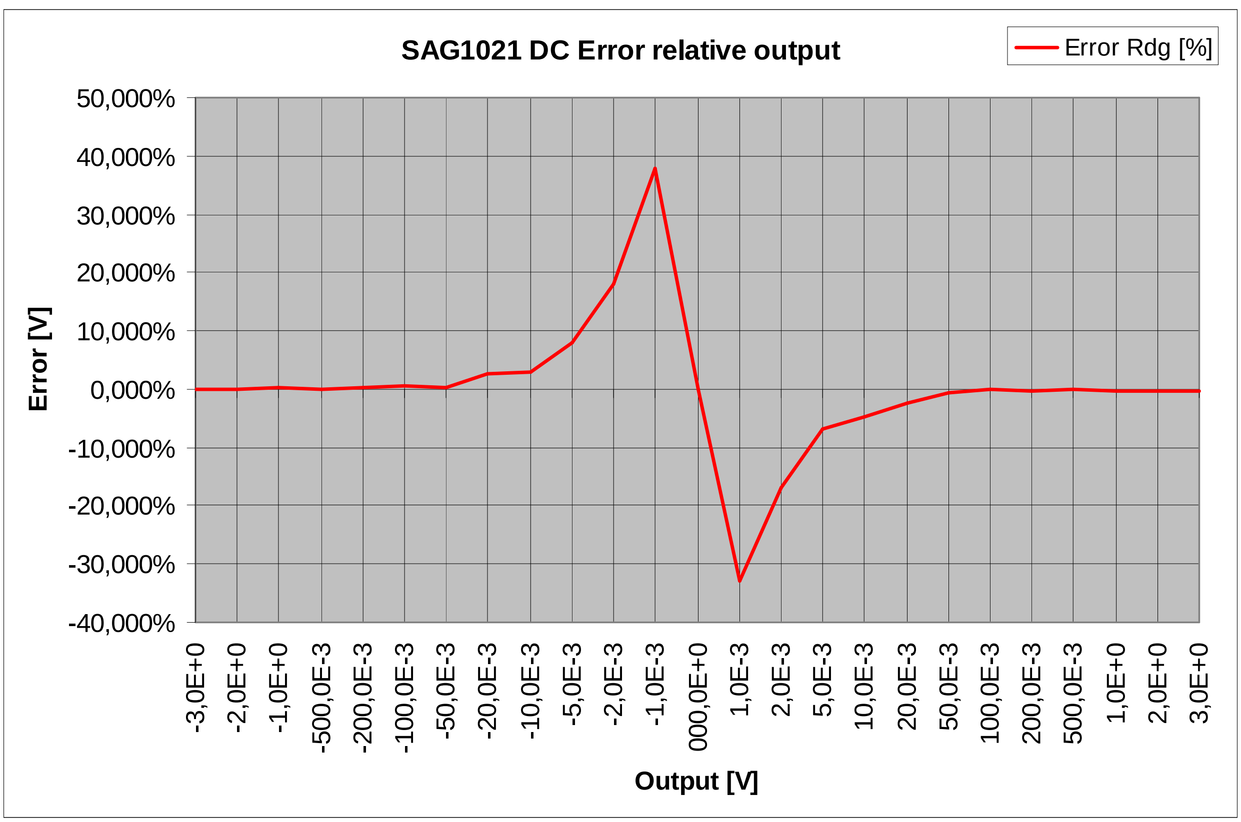
Siglent specifies 1% ±3mV accuracy and I did a measurement series in order to confirm that. The results are in the table below:

SAG1021 DC			FS [V]	3,00
Offset [V]	**Output [V]**	**Error [V]**	**Error Rdg [%]**	**Spec. Error [V]**
-3,0E+0	-2,995E+0	4,9E-3	-0,163%	33,00E-3
-2,0E+0	-1,998E+0	2,2E-3	-0,110%	23,00E-3
-1,0E+0	-1,002E+0	-2,0E-3	0,200%	13,00E-3
-500,0E-3	-500,090E-3	-90,0E-6	0,018%	8,00E-3
-200,0E-3	-200,390E-3	-390,0E-6	0,195%	5,00E-3
-100,0E-3	-100,480E-3	-480,0E-6	0,480%	4,00E-3
-50,0E-3	-50,200E-3	-200,0E-6	0,400%	3,50E-3
-20,0E-3	-20,520E-3	-520,0E-6	2,600%	3,20E-3
-10,0E-3	-10,300E-3	-300,0E-6	3,000%	3,10E-3
-5,0E-3	-5,400E-3	-400,0E-6	8,000%	3,05E-3
-2,0E-3	-2,360E-3	-360,0E-6	18,000%	3,02E-3
-1,0E-3	-1,380E-3	-380,0E-6	38,000%	3,01E-3
000,0E+0	-340,000E-6	-340,0E-6	-0,011%	3,00E-3
1,0E-3	672,000E-6	-328,0E-6	-32,800%	3,01E-3
2,0E-3	1,663E-3	-337,0E-6	-16,850%	3,02E-3
5,0E-3	4,660E-3	-340,0E-6	-6,800%	3,05E-3
10,0E-3	9,520E-3	-480,0E-6	-4,800%	3,10E-3
20,0E-3	19,530E-3	-470,0E-6	-2,350%	3,20E-3
50,0E-3	49,690E-3	-310,0E-6	-0,620%	3,50E-3
100,0E-3	99,944E-3	-56,0E-6	-0,056%	4,00E-3
200,0E-3	199,600E-3	-400,0E-6	-0,200%	5,00E-3
500,0E-3	499,530E-3	-470,0E-6	-0,094%	8,00E-3
1,0E+0	997,100E-3	-2,9E-3	-0,290%	13,00E-3
2,0E+0	1,992E+0	-7,6E-3	-0,380%	23,00E-3
3,0E+0	2,989E+0	-11,3E-3	-0,377%	33,00E-3
Spez. abs. V + % rdg		**3,0E-3**	**1,000%**	

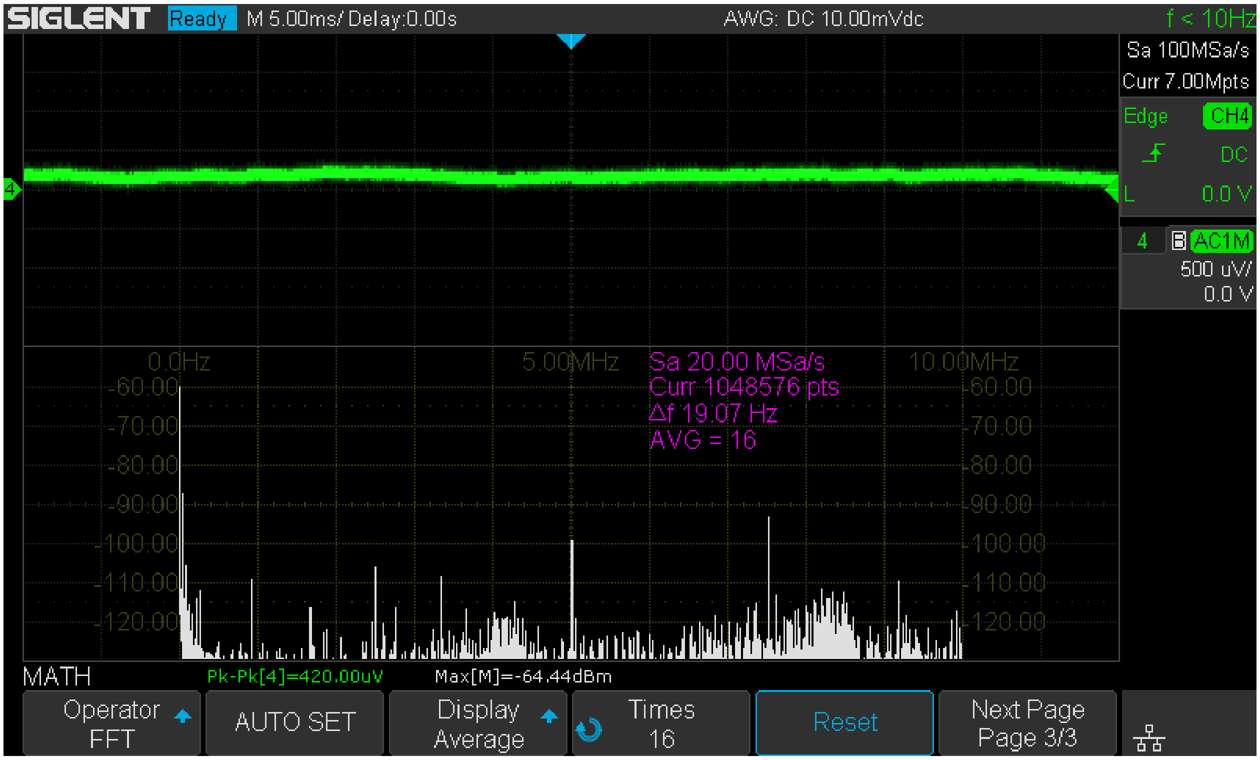
As can be seen, all output voltages in the range of ±3V are well within spec. The green results mean less than ¼ of the specified error.

The graphs below show the absolute and relative error (including offset) with regard to the set voltage.


SAG1021 DC Error absolute voltage
Error [V]
6,0E-3
4,0E-3
2,0E-3
000,0E+0
-2,0E-3
-4,0E-3
-6,0E-3
-8,0E-3
-10,0E-3
-12,0E-3
-14,0E-3
Error [V]
-3,0E+0
-2,0E+0
-1,0E+0
-500,0E-3
-200,0E-3
-100,0E-3
-50,0E-3
-20,0E-3
-10,0E-3
-5,0E-3
-2,0E-3
-1,0E-3
000,0E+0
1,0E-3
2,0E-3
5,0E-3
10,0E-3
20,0E-3
50,0E-3
100,0E-3
200,0E-3
500,0E-3
1,0E+0
2,0E+0
3,0E+0
Output [V]


SAG1021 DC Error relative output
Error Rdg [%]
50,000%
40,000%
30,000%
20,000%
10,000%
0,000%
-10,000%
-20,000%
-30,000%
-40,000%
Error [V]
-3,0E+0
-2,0E+0
-1,0E+0
-500,0E-3
-200,0E-3
-100,0E-3
-50,0E-3
-20,0E-3
-10,0E-3
-5,0E-3
-2,0E-3
-1,0E-3
000,0E+0
1,0E-3
2,0E-3
5,0E-3
10,0E-3
20,0E-3
50,0E-3
100,0E-3
200,0E-3
500,0E-3
1,0E+0
2,0E+0
3,0E+0
Output [V]

The DC "signal" shouldn't actually be a signal, but just a plain DC voltage without any AC components. To check this, I took the opportunity to use the excellent FFT of the SDS1104X-E in order to detect any interference signals. The full DC output voltage was connected to the AC-coupled DSO input channel 4 and the spectrum from 0 to 10MHz computed:



SAG1021_DC_10mV_FFT

As can be seen from the screenshot above, even at maximum sensitivity of 500µV/div, the Y-t trace shows nothing but white noise. Even the FFT with a 19Hz frequency step could not detect any signal stronger than -92dBm (5.62µV_{RMS}), which could just as well be an interference from the scope rather than the function generator.

Arbitrary Waveforms

The SAG1021 can handle arbitrary waveforms up to 16kpts at a sample rate of 125MSa/s and a maximum repetition rate up to 5MHz. A set of predefined arbitrary waveforms is stored internally and user defined waveforms are supported as well.

Internal

There are 45 predefined waveforms presented in a single dialog box as shown in the screenshot below.