P79 Low Distortion Signal Generation for ADC Linearity Test

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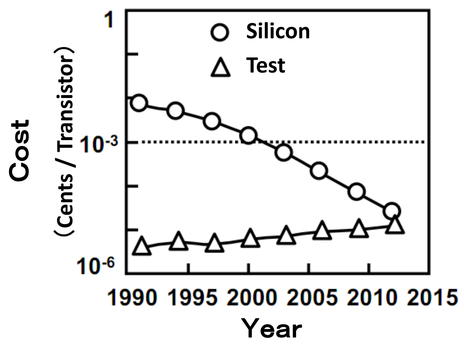
Introduction

Industrial Background

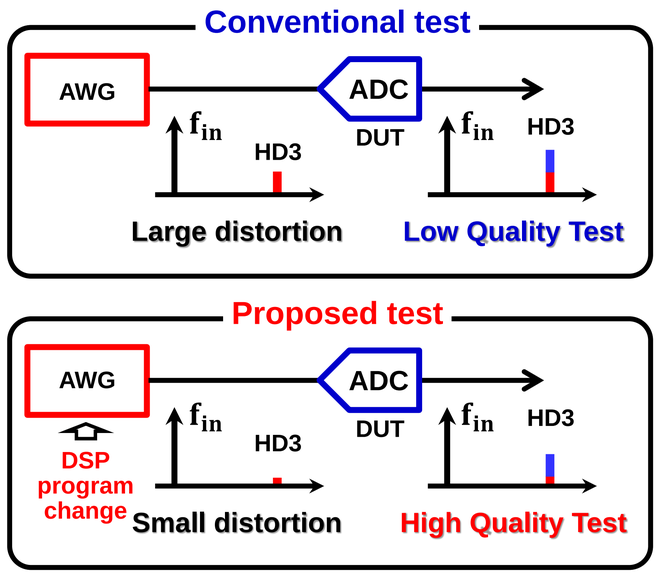
- Need for ADC **low-cost** test
- Need for ADC **high-quality** test



Silicon Cost : Reduce
Test Cost : Increase

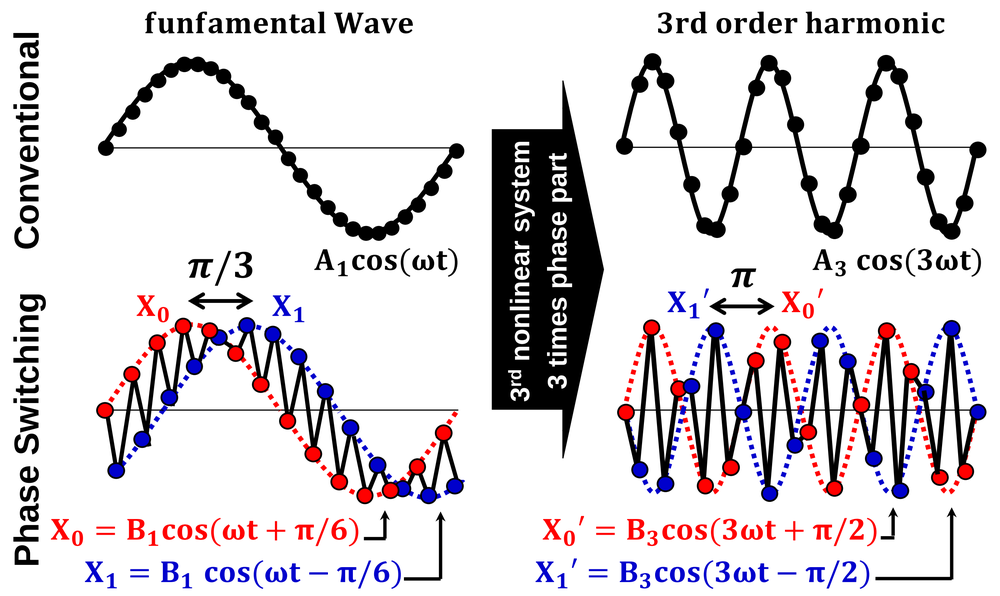
Research Goal

High Quality ADC test with a low cost AWG



Proposed test can realize high quality test with the conventional AWG

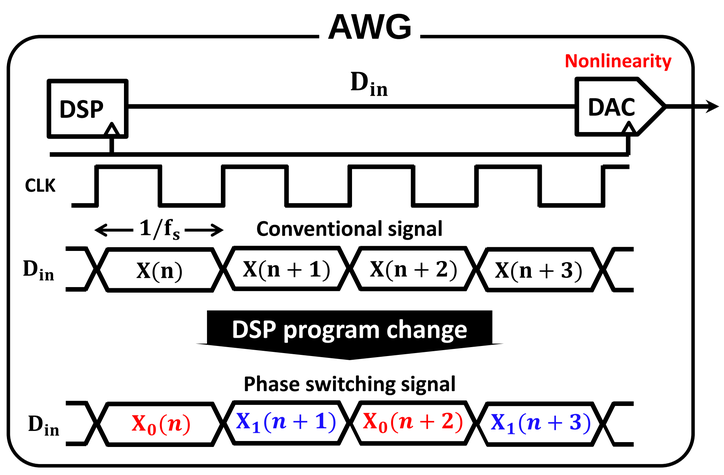
Principle of distortion signal cancellation



AWG : Arbitrary Waveform Generator

Low distortion sine wave generation

Test signal generation with an AWG



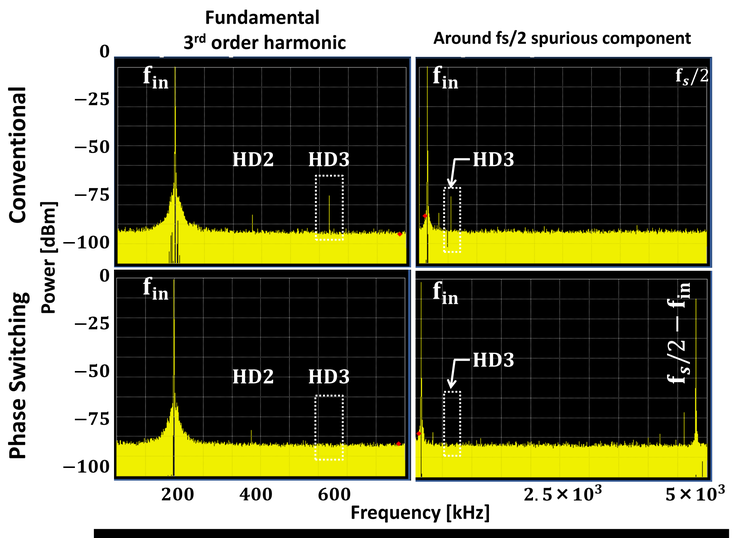
Conventional signal $X(n) = A\cos(2\pi f_{in} n T_s)$

Phase Switching signal
$X_0(n) = B\cos(2\pi f_{in} n T_s + \pi/6)$
$X_1(n) = B\cos(2\pi f_{in} n T_s - \pi/6)$

Here, $B = 1.15A$

Output Signal

Conventional and Phase switching signals



Comparing conventional and phase switching

3rd order harmonic disappear

Comparison of conventional and phase switching signals

	Undesired Signal	Undesired signal reduction by a filter
Conventional	$3f_{in}$ Around Fundamental	Hard
Phase Switching	$f_s/2 - f_{in}$ Around $f_s/2$ spurious	Easy

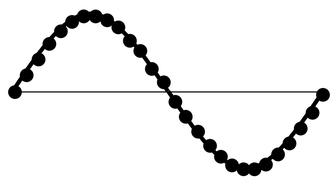
ADC dynamic performance measurement

AWG

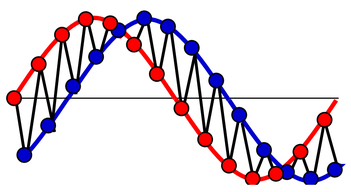
Agilent 33220A

for signal generation

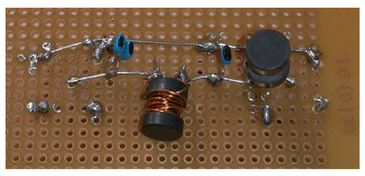
Conventional test signal



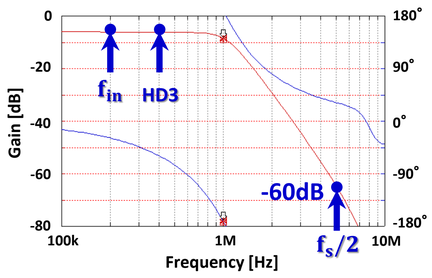
Phase Switching test signal



LPF



Frequency Response

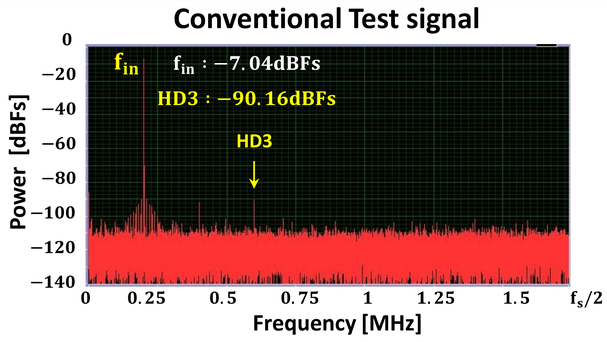


ADC Device Under Test

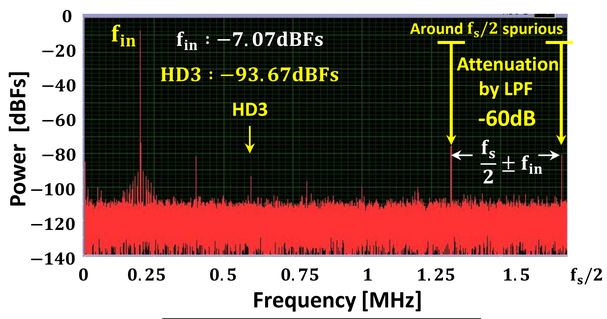
for attenuating around fs/2 spurious

Measurement result

Conventional Test signal



Phase Switching test signal

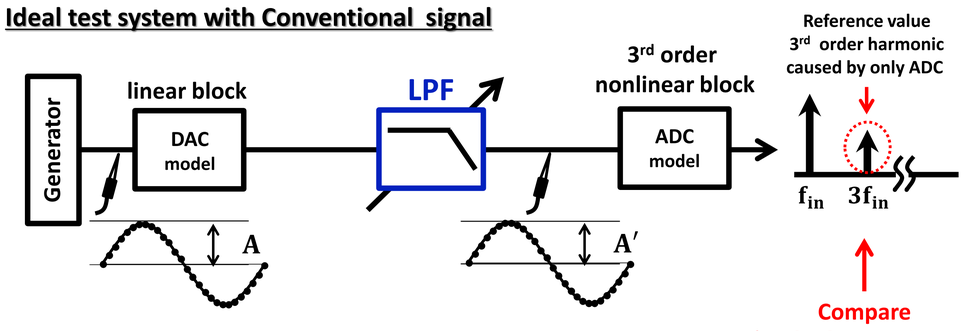


HD3 Power

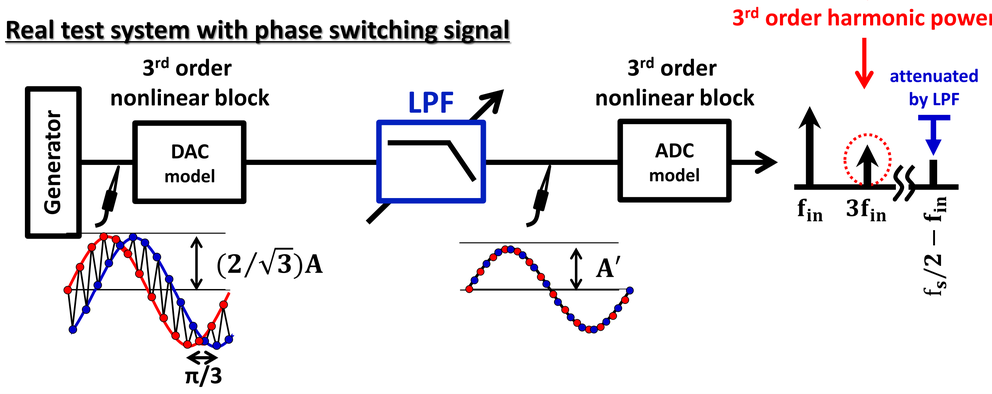
conventional	Phase Switching
-90.2dB	-93.7dB
Including DAC + ADC HD3	mainly Including ADC HD3
Low quality test	High quality test

around fs/2 spurious attenuation

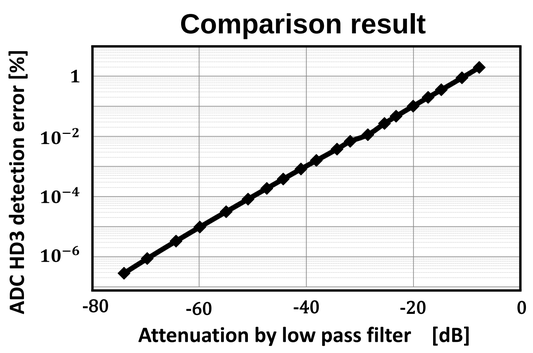
Ideal test system with Conventional signal



Real test system with phase switching signal



Comparison result



$f_s/2 - f_{in}$ attenuation	HD3 detection error
- 20dB	0.1 %
- 30dB	0.01 %

Conclusion

- ADC linearity test with AWG
- Phase switching signal & simple LPF realize high quality ADC test
- Only AWG program change