

Overview of Reference Drive Topologies

TIPL 4502

TI Precision Labs – ADCs

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Agenda

Reference Performance Specifications:

Initial Accuracy, Drift, Long Term Drift, and Noise

Overview of SAR REF Drive Topologies:

Standalone Reference vs. Buffered Reference

SAR ADCs with Internal Reference Buffer

SAR REF Input Overview: The Capacitive DAC (CDAC)

Build TINA REF Input Model for a SAR:

Discrete Charge Model

TI Device Specific Model

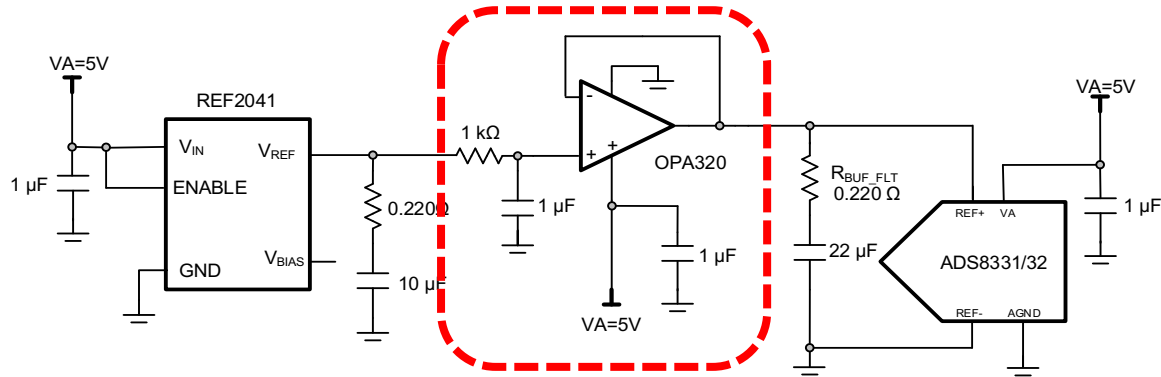
SAR REF Drive Circuit Design:

Reference Bypass Capacitor

Reference Buffer Stability and Compensation

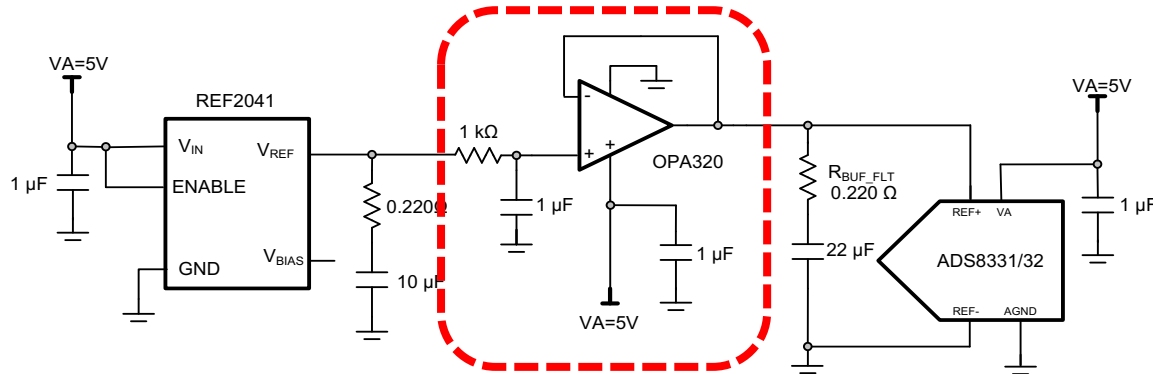
What is a reference buffer?

- Wide bandwidth
- Low output impedance across frequency
- Capable of sourcing and relatively large currents (e.g. $\pm 10\text{mA}$)
- Good DC specifications (i.e. offset, and Temperature Drift)
- May be integrated in the reference, or an external amplifier

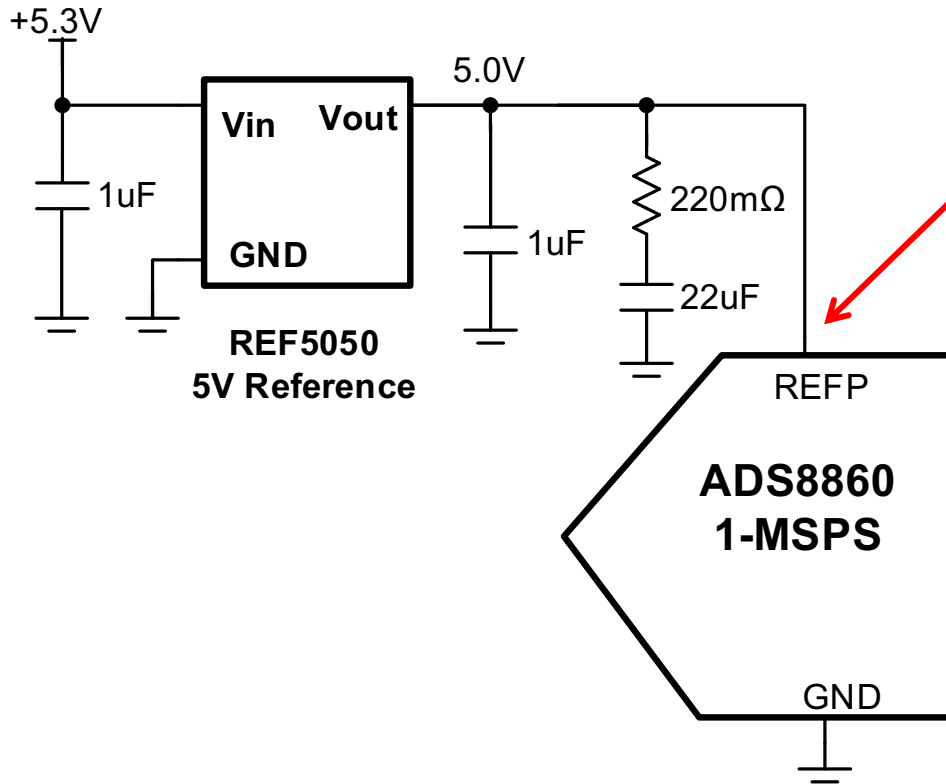


When is the reference buffer required?

- Reference buffer requirement depends on:
 - Output drive capability of reference.
 - SAR reference input current demand:
 - Function of sampling rate and resolution performance of ADC.
 - Higher resolution devices more challenging
- Check device datasheet guidelines for reference drive circuit.
 - Detailed analysis and simulation may be required to verify.

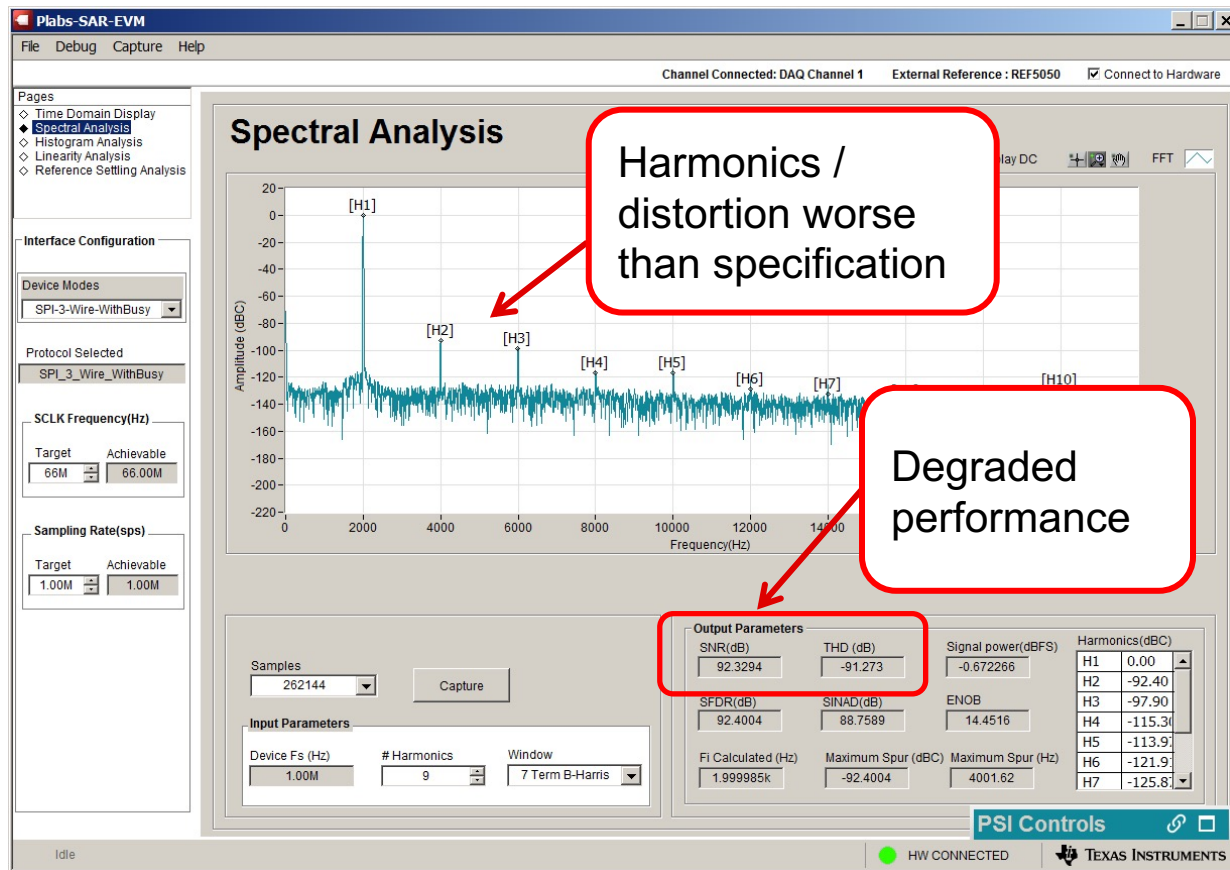


Performance limitations from unbuffered reference



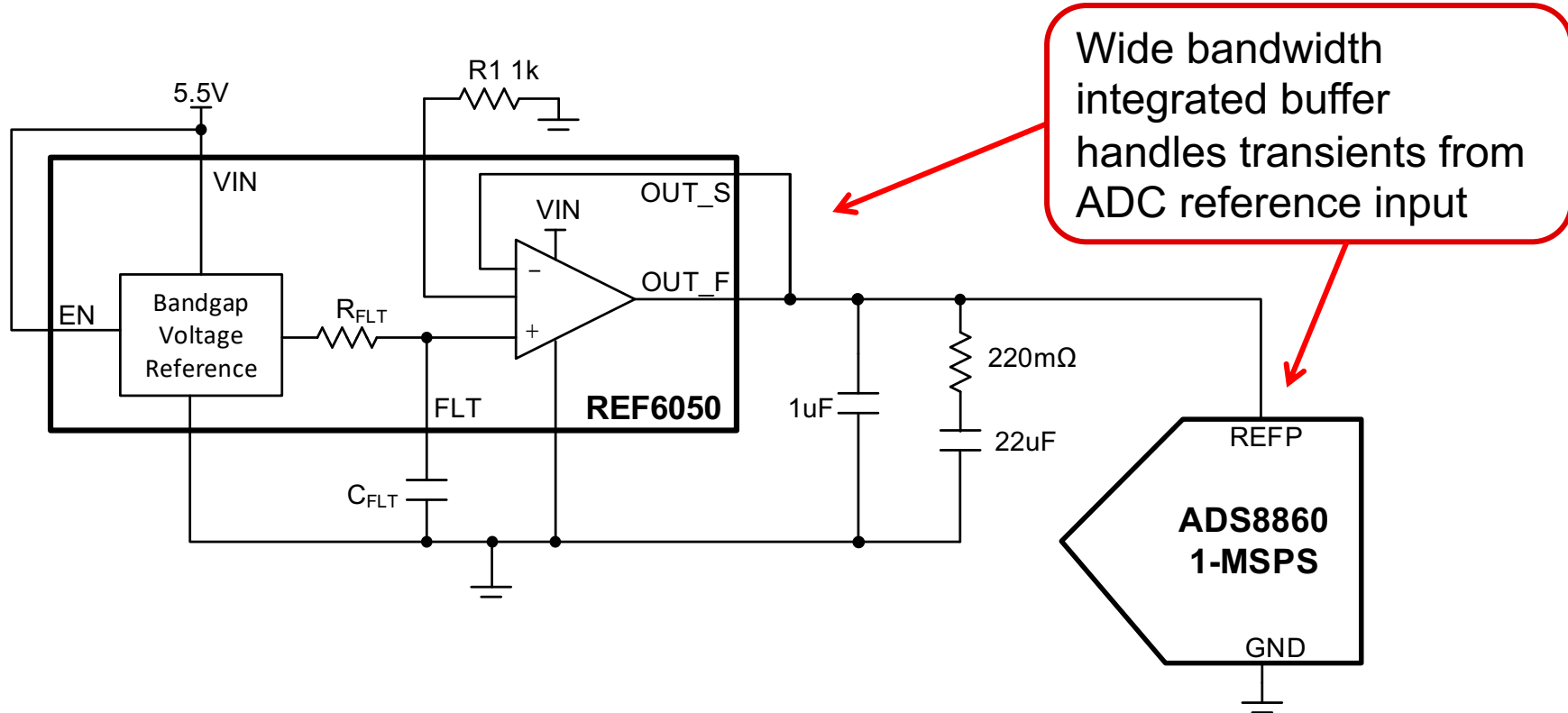
REF5050 output doesn't have sufficient bandwidth to respond to ADC reference input transients

Unbuffered Reference: ADS8860 + REF5050

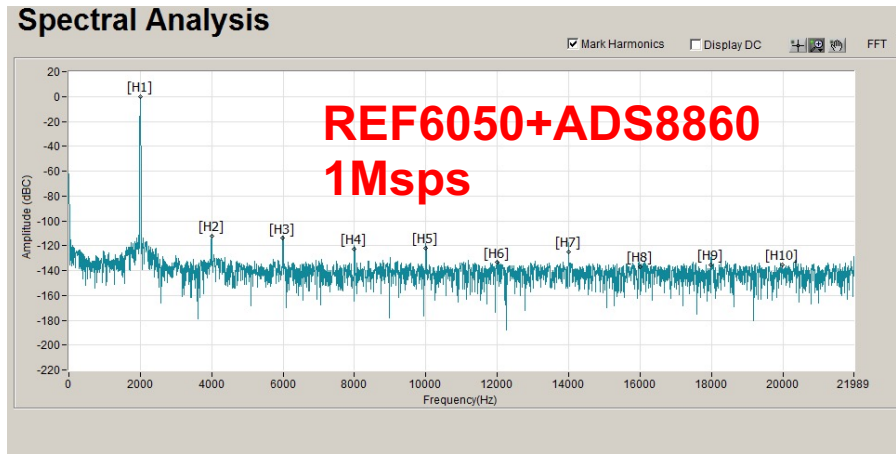
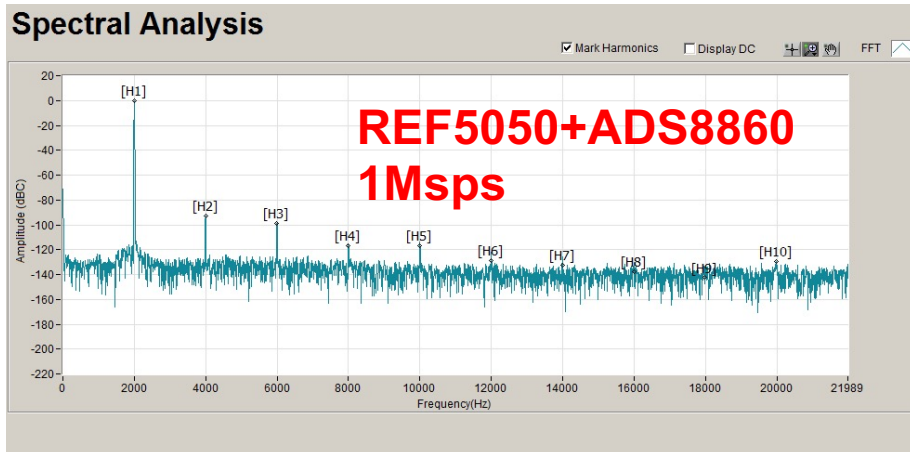


	SNR (dB)	THD (dB)
Specification	93	-108
REF5050	92.3	-91.3

Performance improvement using buffered reference



Buffered vs. Unbuffered.



Output Parameters

SNR (dB)	THD (dB)
92.3294	-91.273

Input Parameters

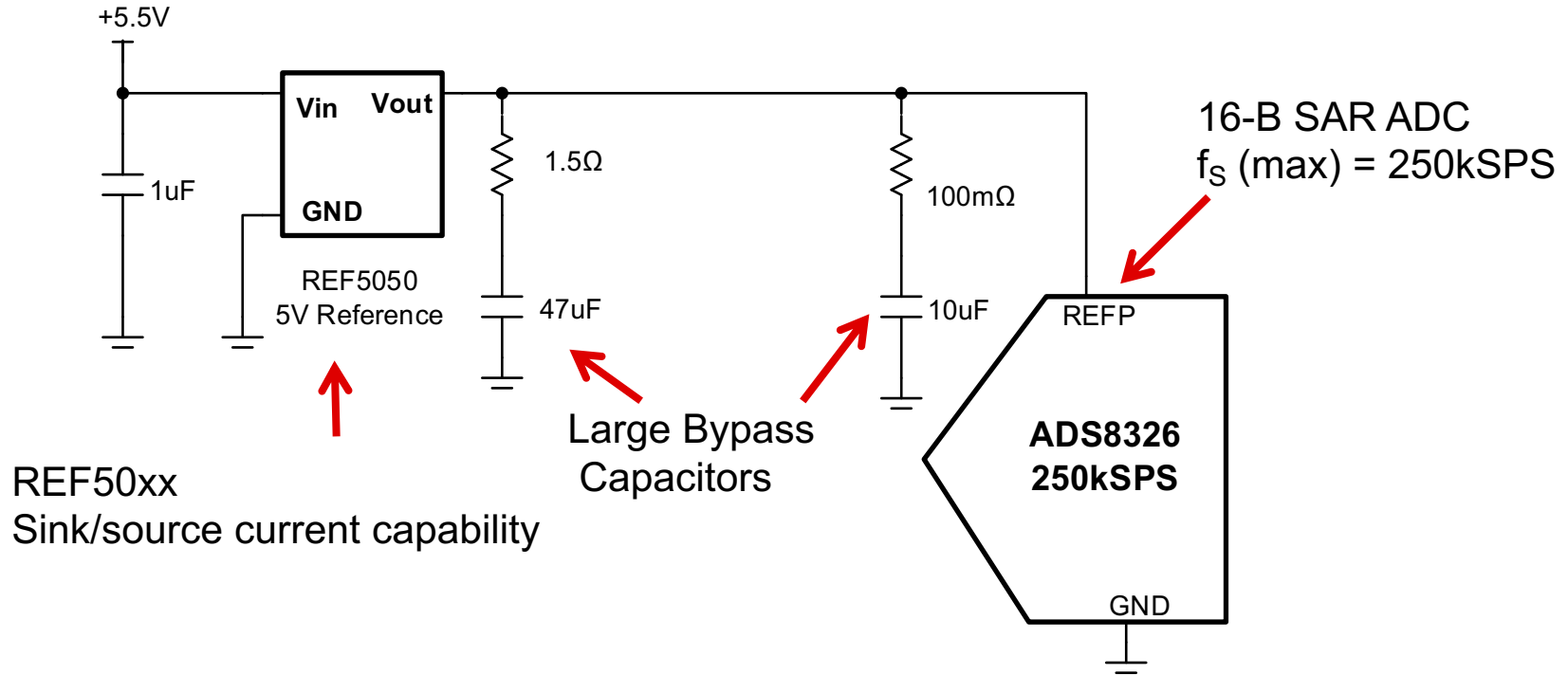
Device Fs (Hz): 1.00M, # Harmonics: 9, Window: 7 Term B-Harris

	SNR (dB)	THD (dB)
Specification	93	-108
REF5050	92.3	-91.3
REF6050	92.9	-107.6

Output Parameters

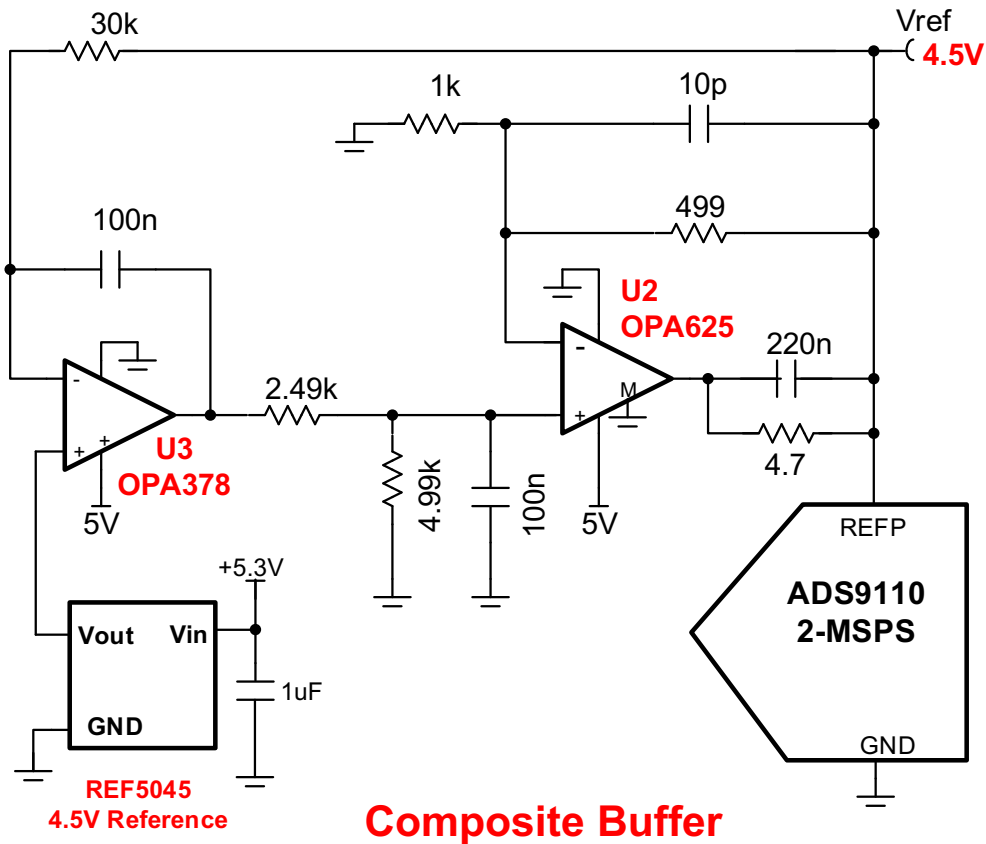
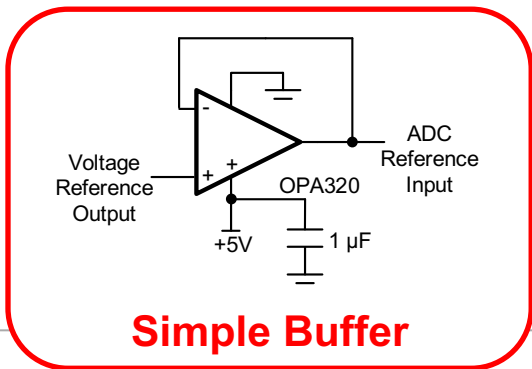
SNR (dB)	THD (dB)	Signal power (dBFS)	Harmonics (dBc)
92.985	-107.611	-0.580956	H1 0.00
SFDR (dB)	SINAD (dB)	ENOB	H2 -111.5
111.548	92.8378	15.1292	H3 -112.4
FI Calculated (Hz)	Maximum Spur (dBc)	Maximum Spur (Hz)	H4 -120.2
1.999985k	-111.548	4001.62	H5 -118.0
			H6 -132.1
			H7 -117.3

Buffered reference isn't always required

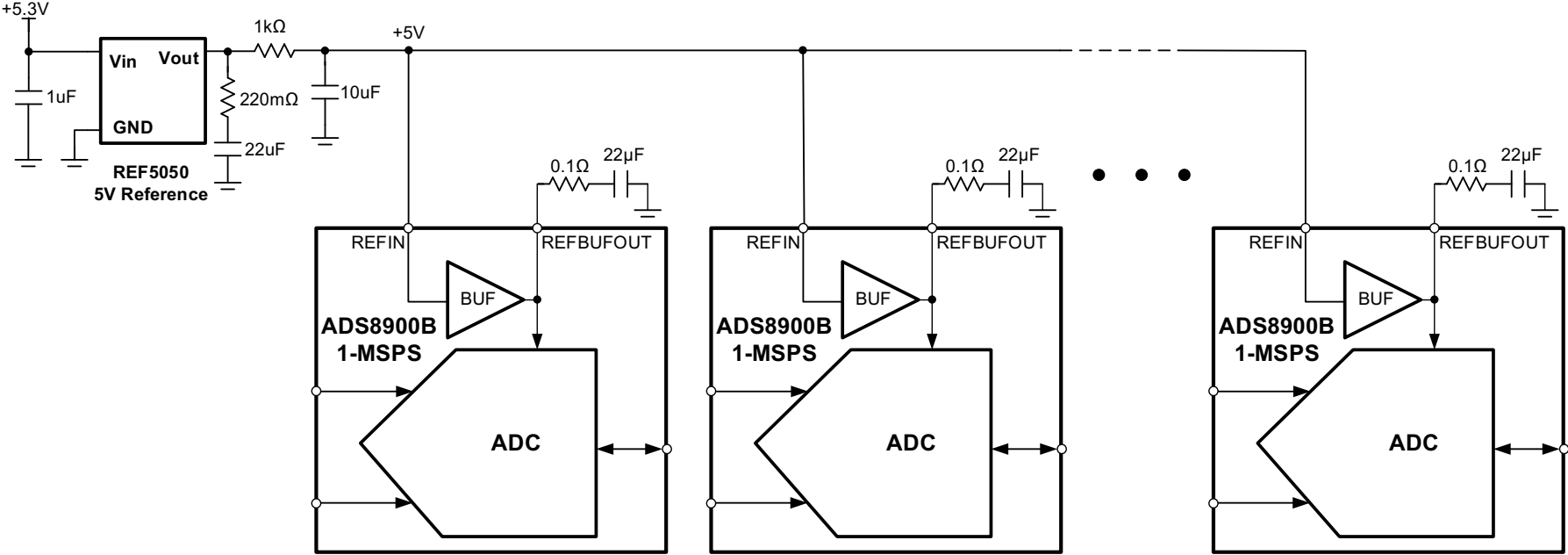


Composite Amplifier Topology

- OPA378 chopper op-amp as an input stage for excellent low drift and DC stability of buffer.
- High-Bandwidth output buffer (OPA625) provides a wide bandwidth and low-output impedance to drive the SAR REFP input



Device with internal reference buffer: ADS89xxB



**Thanks for your time!
Please try the quiz.**



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