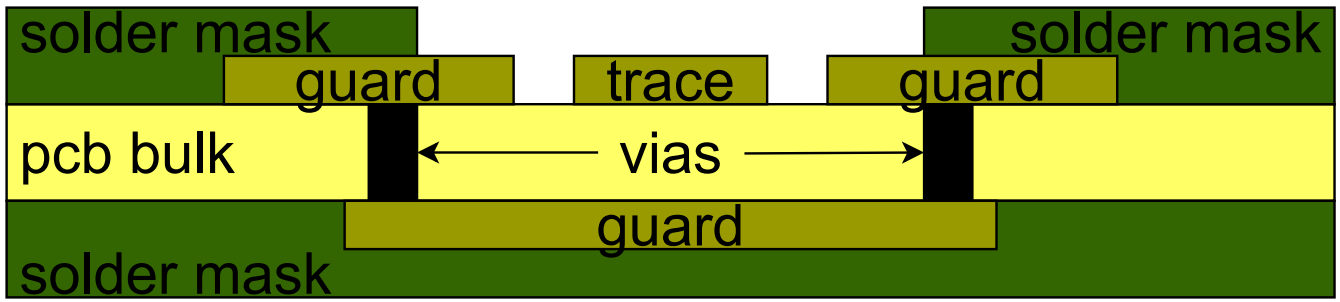
Appendix

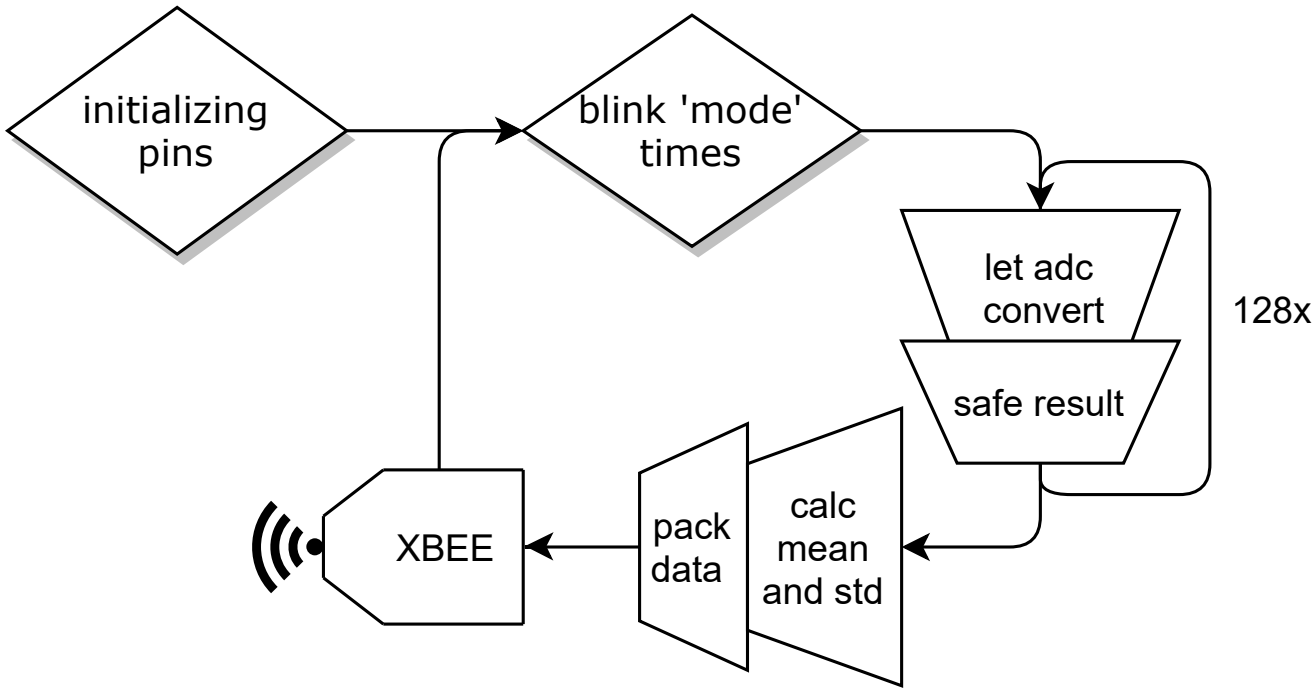
Florian Rössing

June 9, 2020

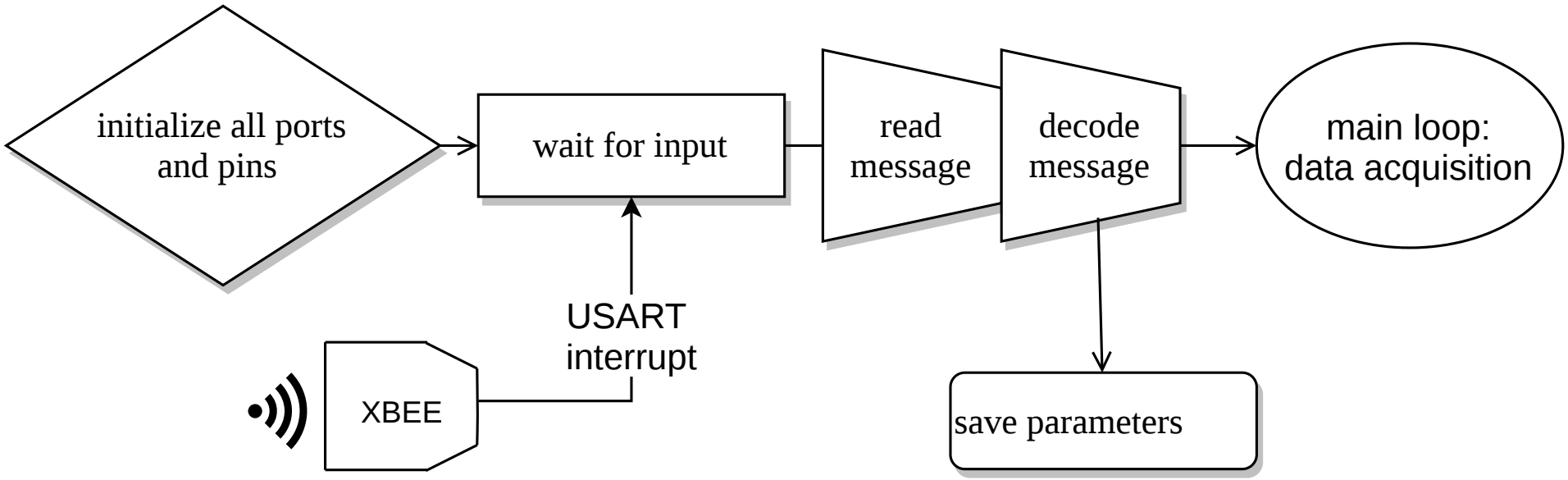
Guarding


solder mask
guard
trace
guard
solder mask
pcb bulk
vias
guard
solder mask

Firmware Workflow I

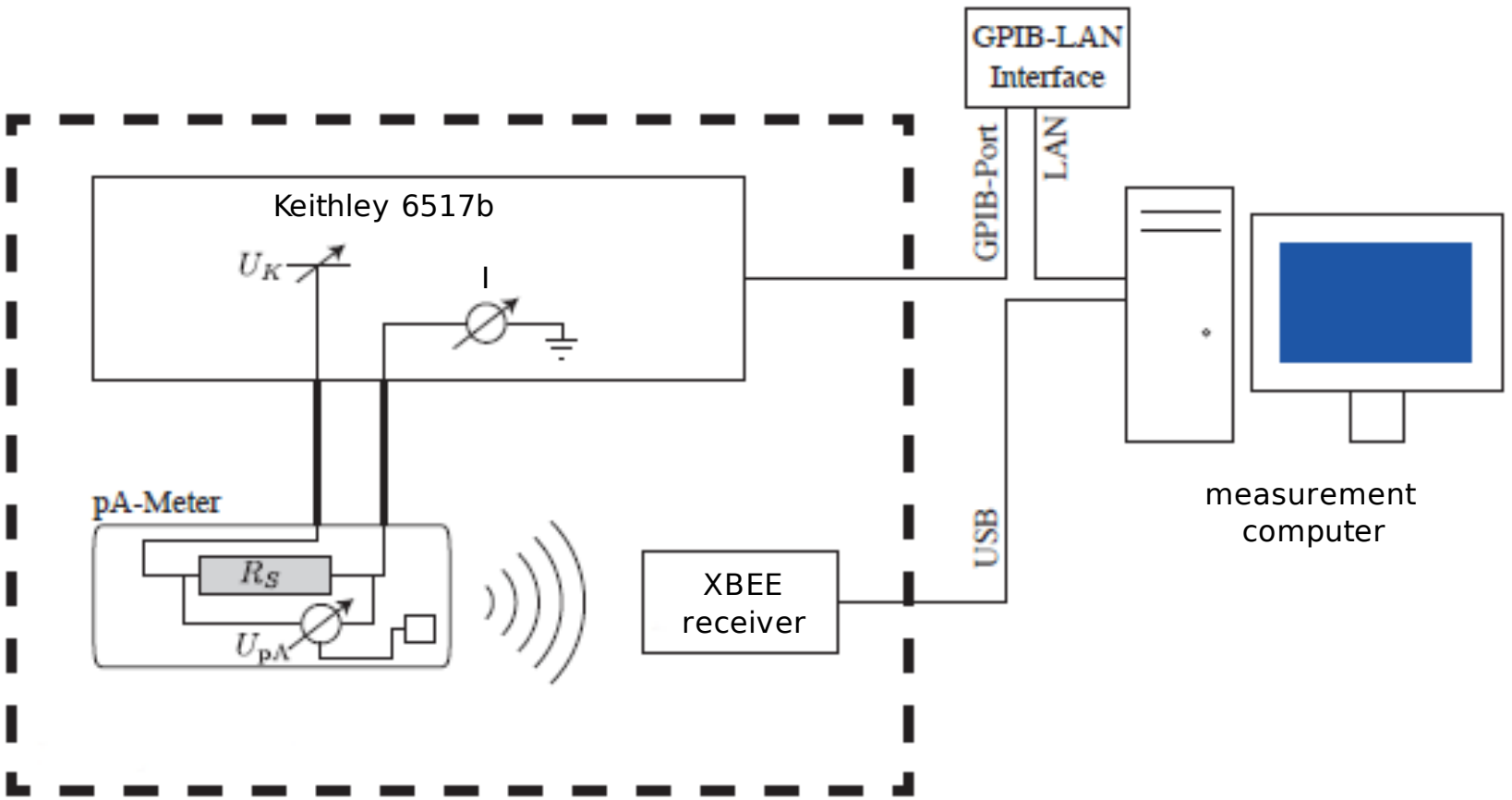


Firmware Workflow II

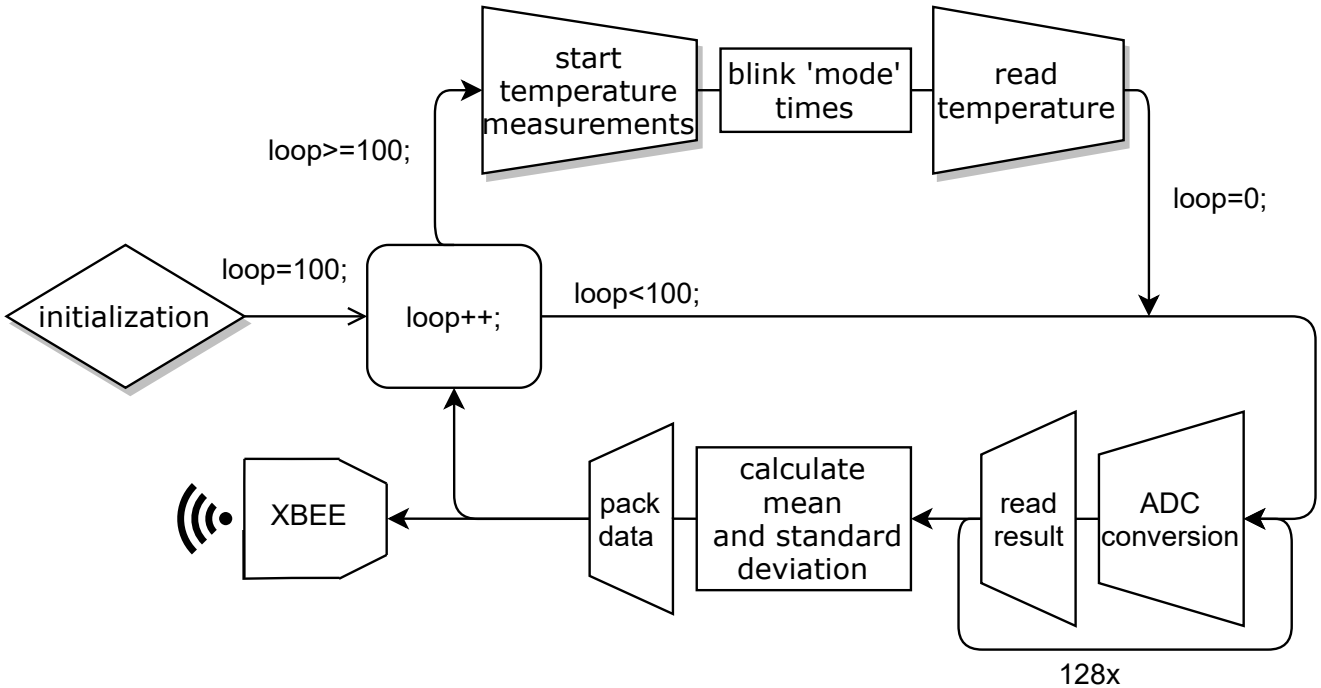


Parameter	
DestAddress	Address of the receiver station
dataFormat	Select between ADC raw values or their mean
delay	Adds a delay to adjust the readout rate

Calibration Setup



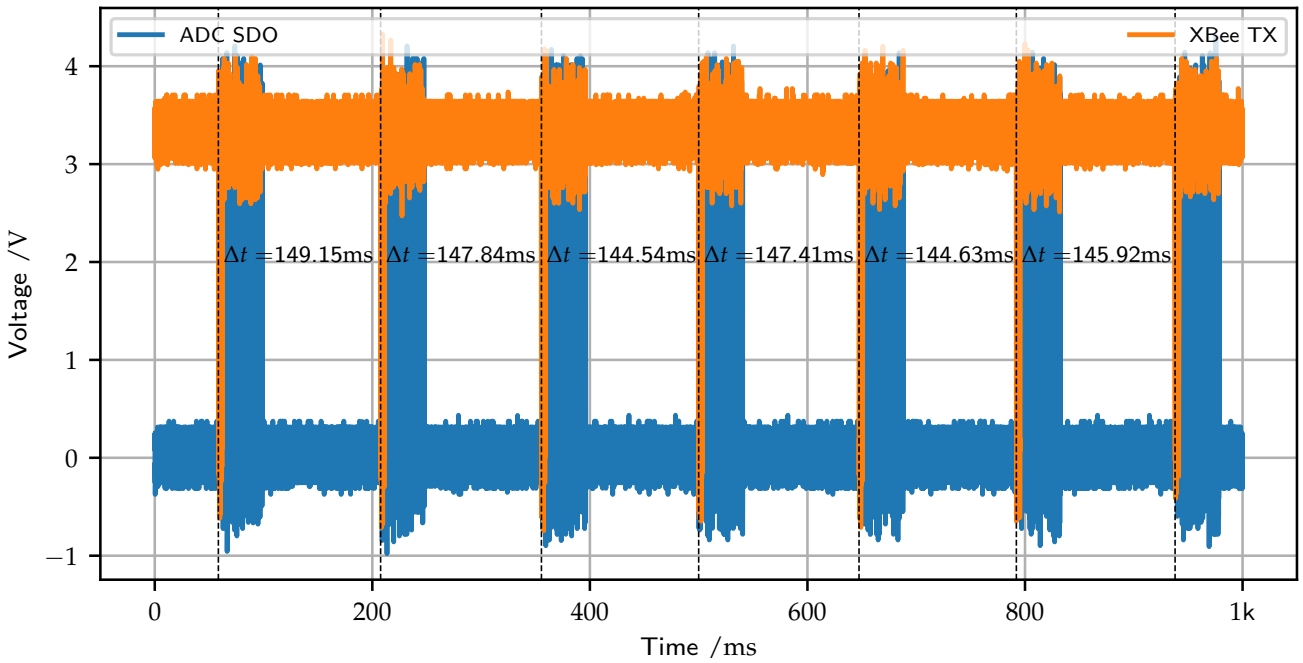
Firmware Workflow New



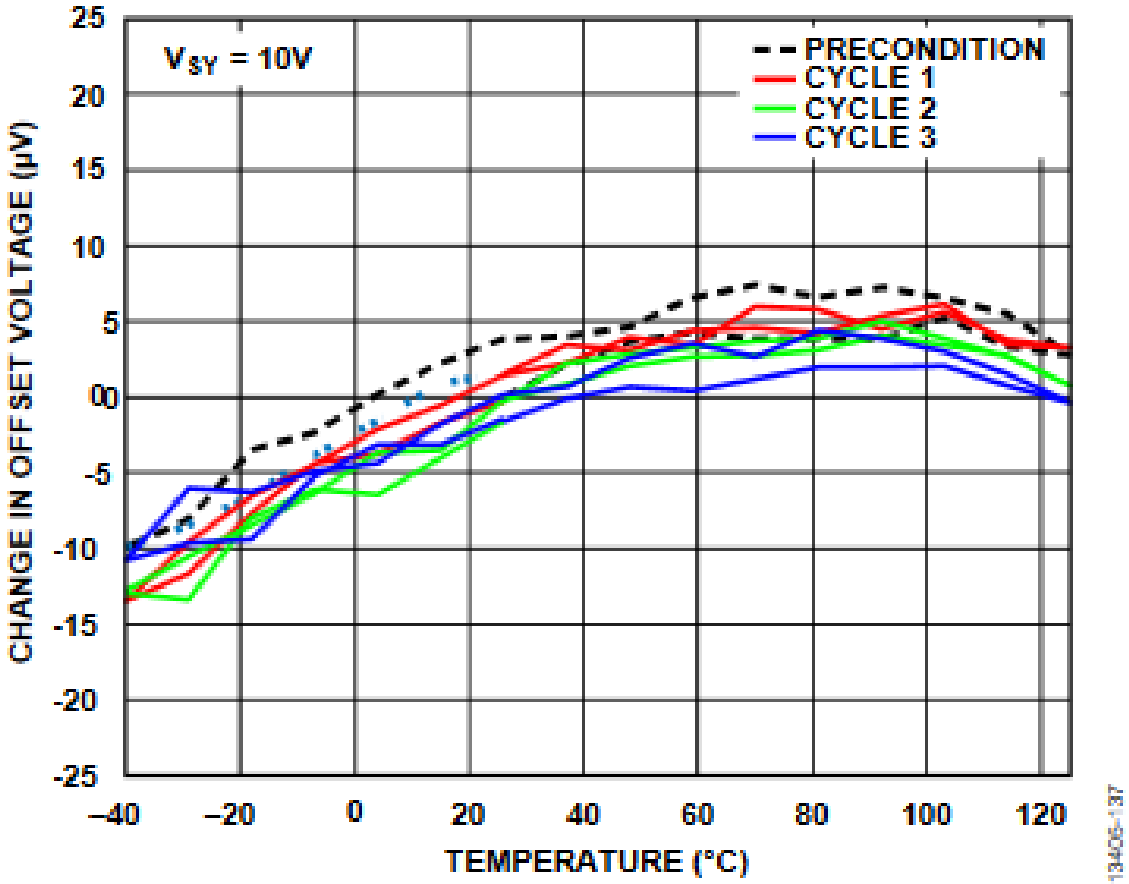
Temperature

Component	Parameter	Fluctuation in the range of 15 to 30 °C
ADA4530 [1]	Offset voltage	$\pm 5\,\mu V$
	Input bias current	$\pm 0.1\,fA$
LTC2327 [2]	Non-Linearity	$\leq 1\,LSB$
	Full-Scale Error	$\pm 2\,LSB$
	Offset Error	$\ll 1LSB$
Feedback resistor	Temperature Drift	0.3 %

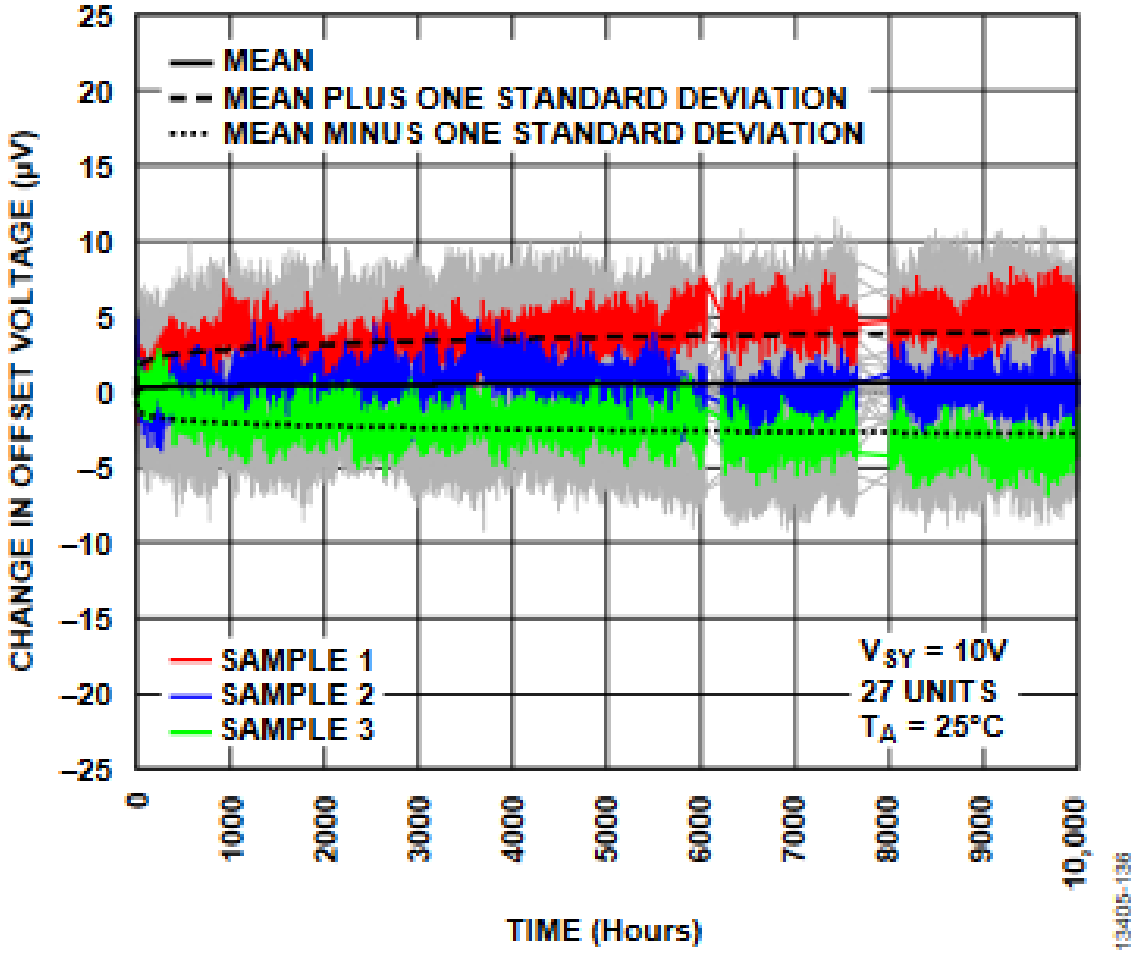
Prototype Duty-cycle



ADA4530 I


V_{SY} = 10V
PRECONDITION
CYCLE 1
CYCLE 2
CYCLE 3
CHANGE IN OFFSET VOLTAGE (µV)
25
20
15
10
5
00
-5
-10
-15
-20
-25
–40
–20
0
20
40
60
80
100
120
TEMPERATURE (°C)
13405-137

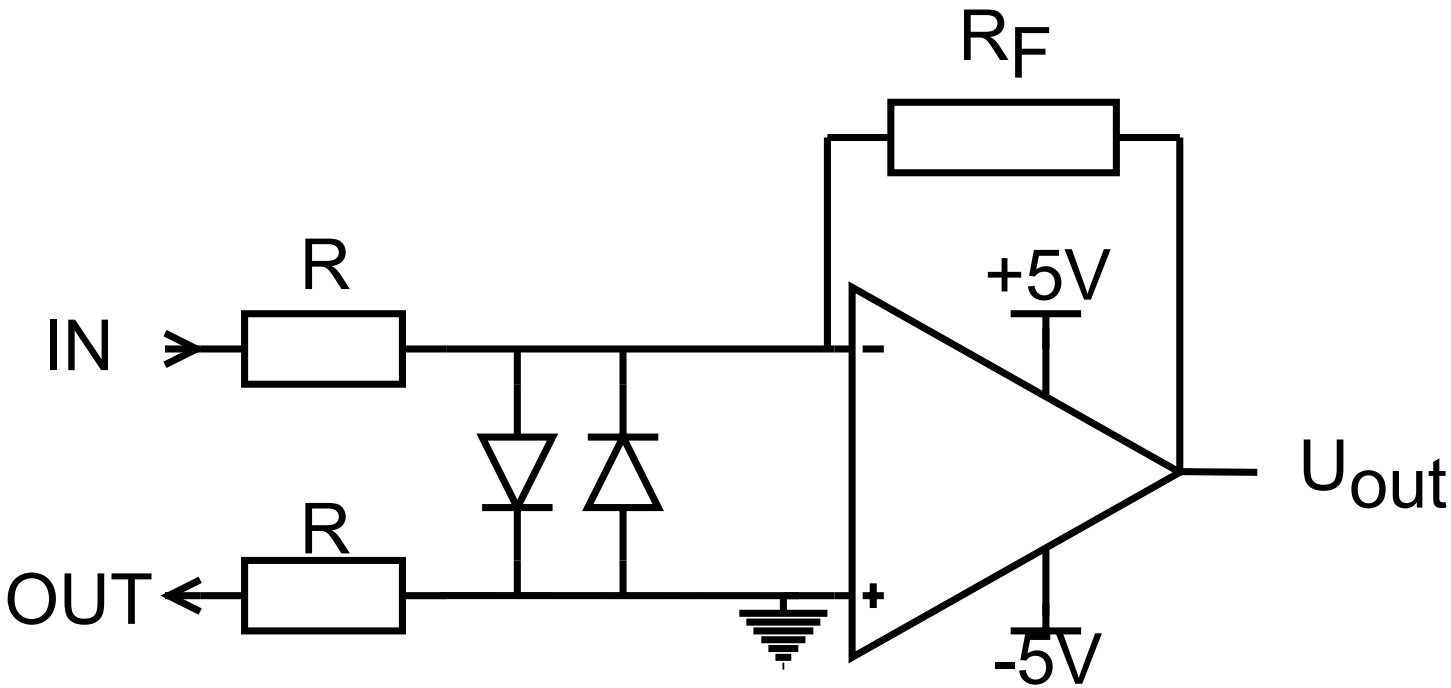
ADA4530 II


MEAN
MEAN PLUS ONE STANDARD DEVIATION
MEAN MINUS ONE STANDARD DEVIATION
SAMPLE 1
SAMPLE 2
SAMPLE 3
V_{SY} = 10V
27 UNITS
T_A = 25°C
CHANGE IN OFFSET VOLTAGE (µV)
TIME (Hours)
25
20
15
10
5
0
–5
–10
–15
–20
–25
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
13405-136

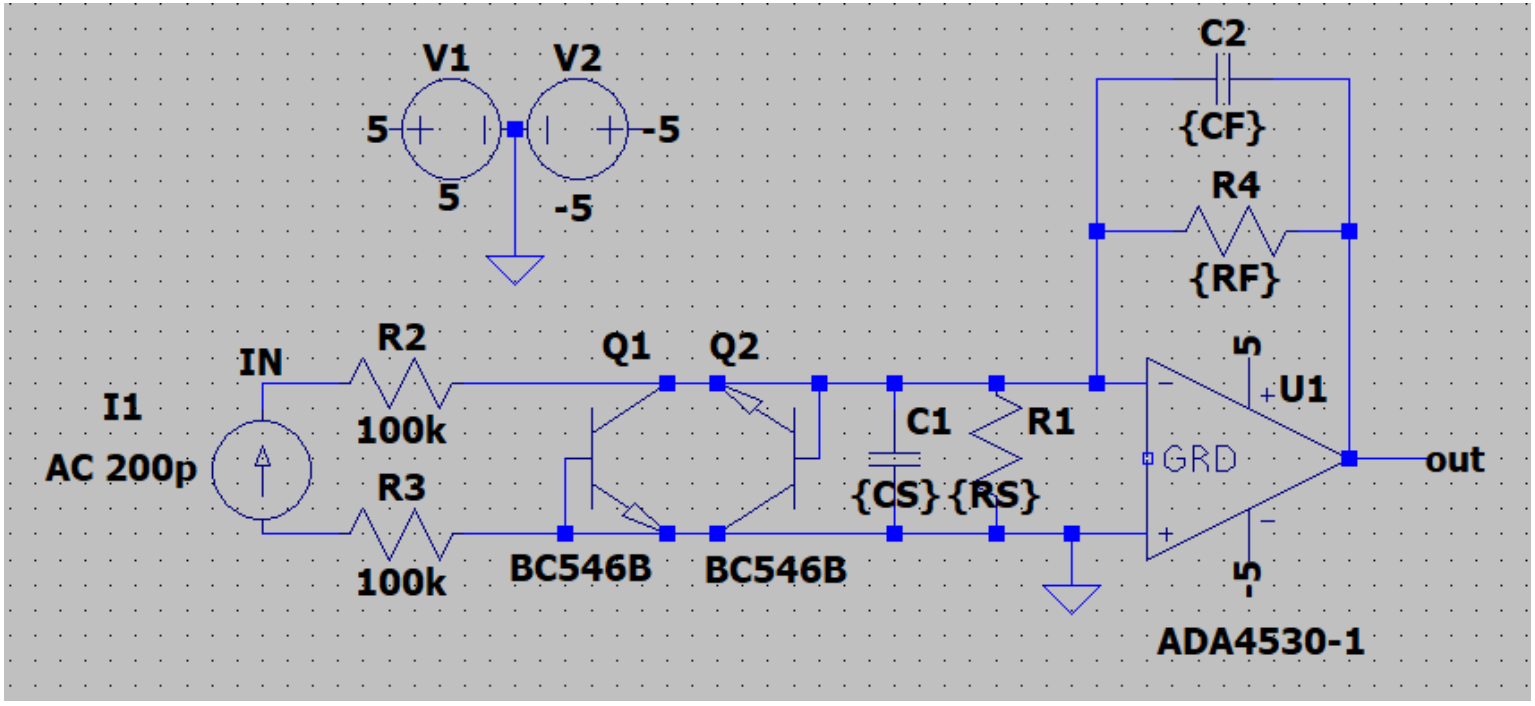
Cleaning

1. Ultrasonic cleaning in isopropyl alcohol for 30 min
2. flushing the board with isopropyl
3. use a brush scrub the solder joints
4. blow dry using compressed air
5. solder relays in place
6. repeat step 2, 3 & 4
7. bake the board at 80 °C for 3 h

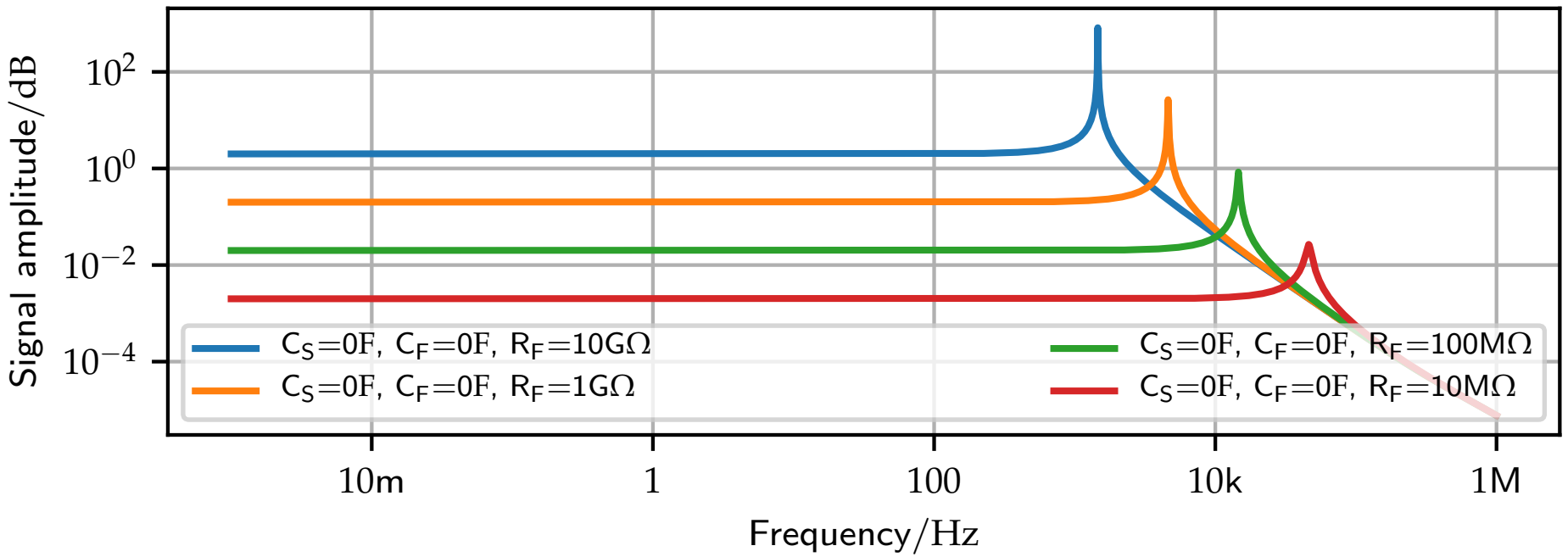
TIA OVP



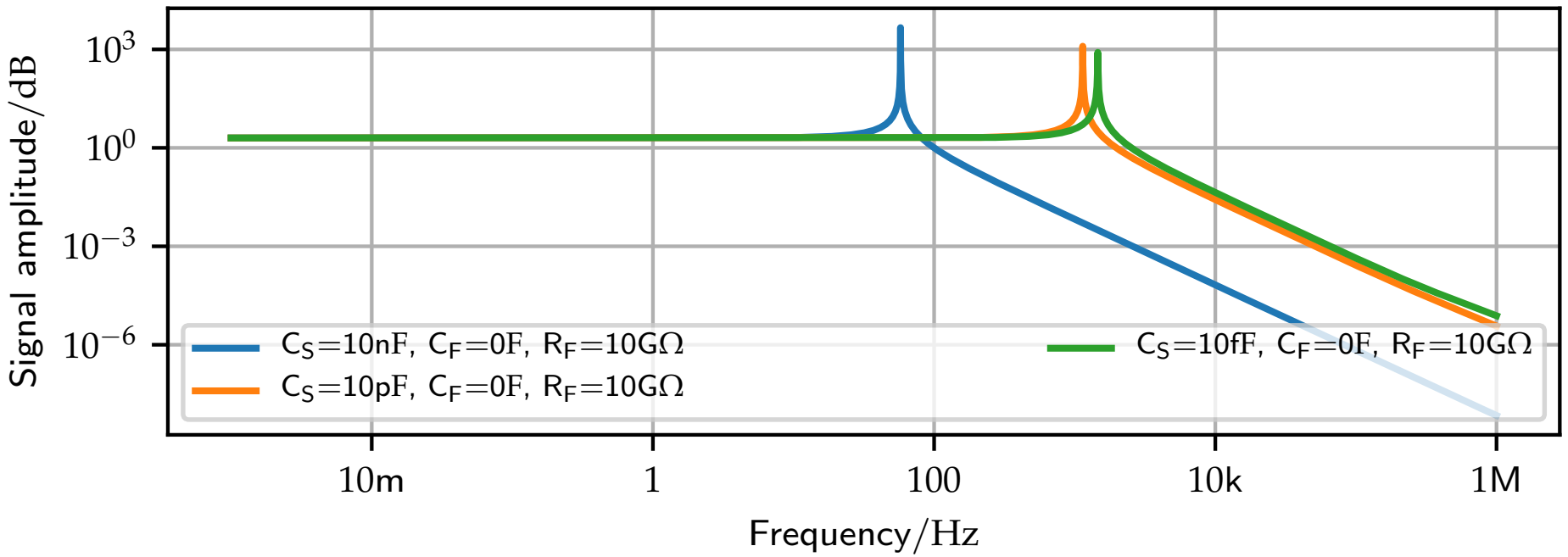
TIA Model


V1
V2
5
-5
5
-5
C2
{CF}
R4
{RF}
IN
R2
100k
Q1
Q2
I1
AC 200p
R3
100k
BC546B
BC546B
C1
R1
{CS}
{RS}
5
U1
GRD
out
-5
ADA4530-1

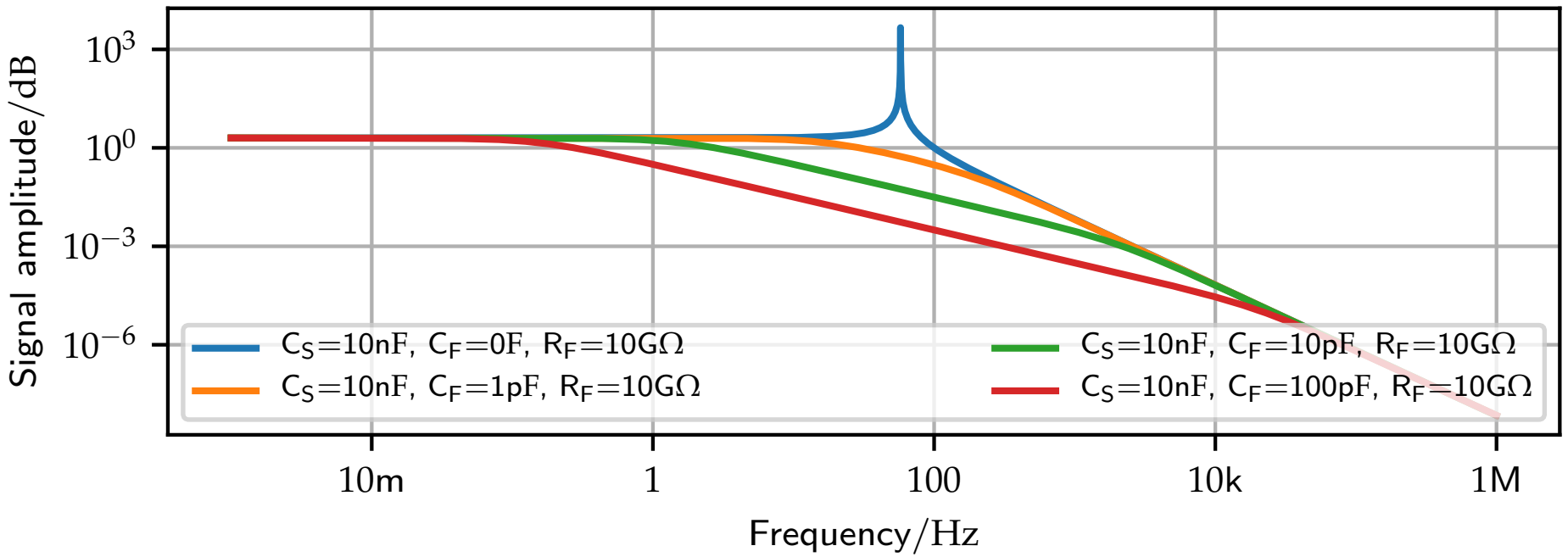
AC Simulation



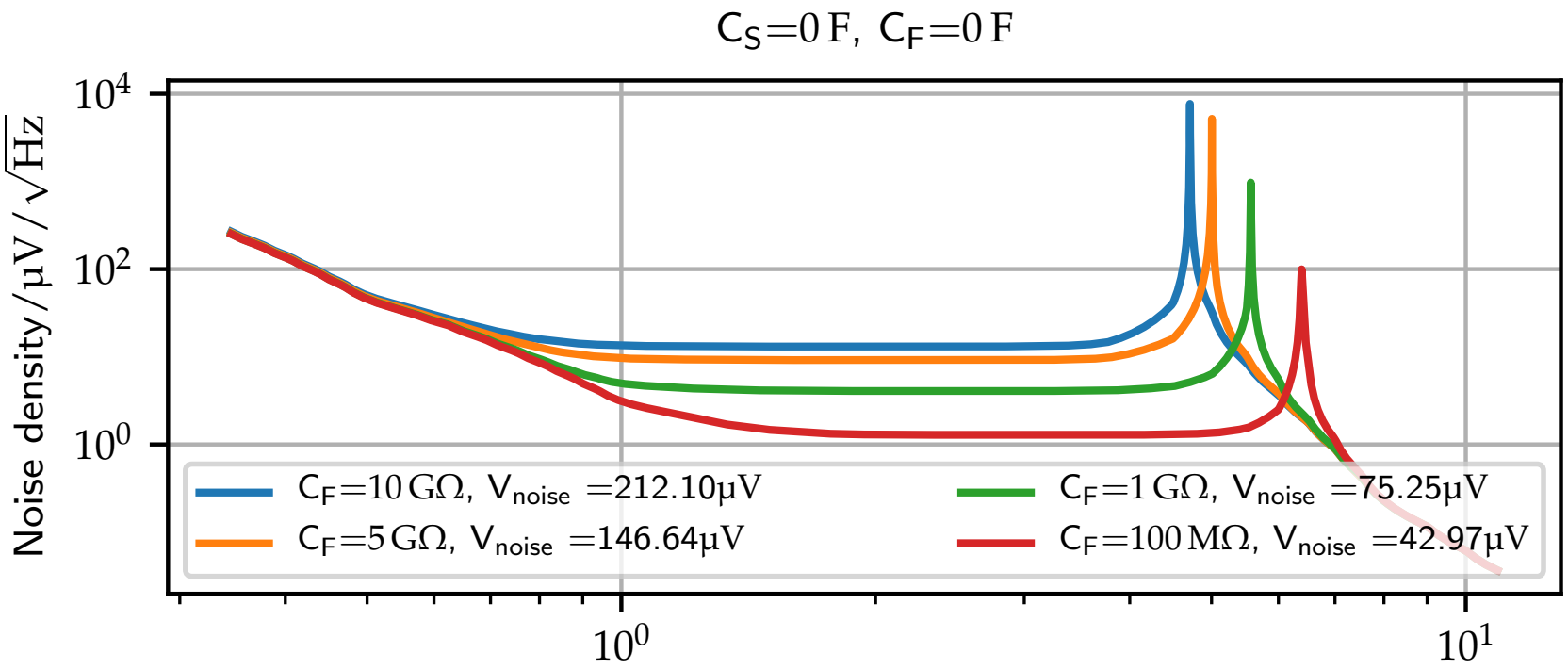
AC Simulation



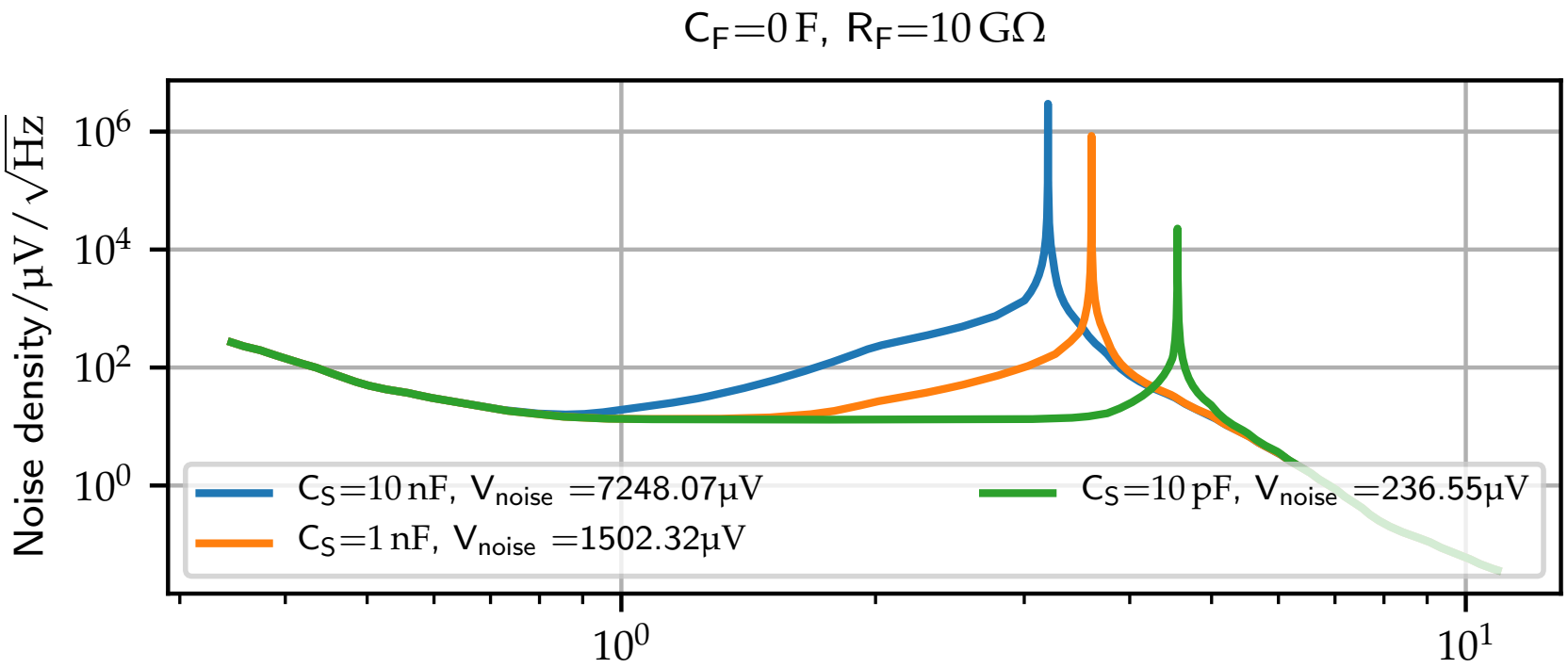
AC Simulation



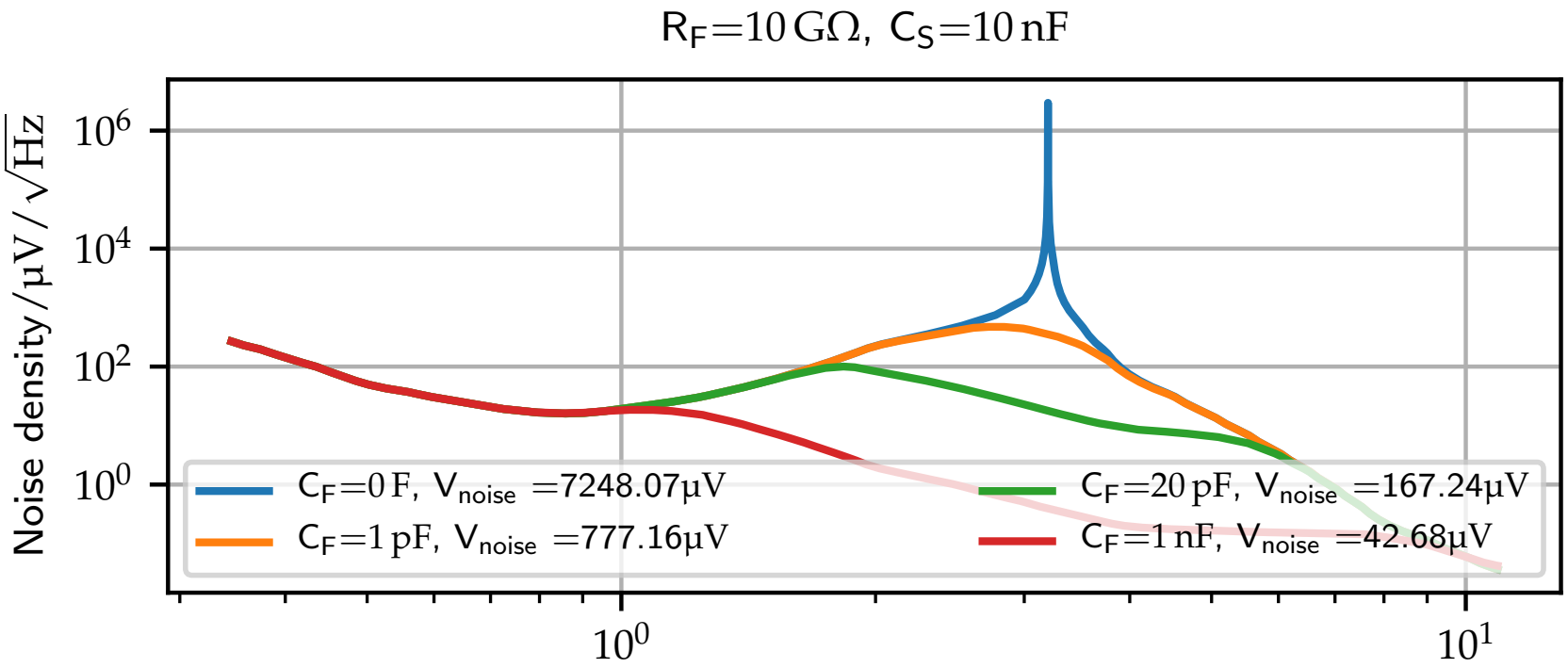
Noise Simulation



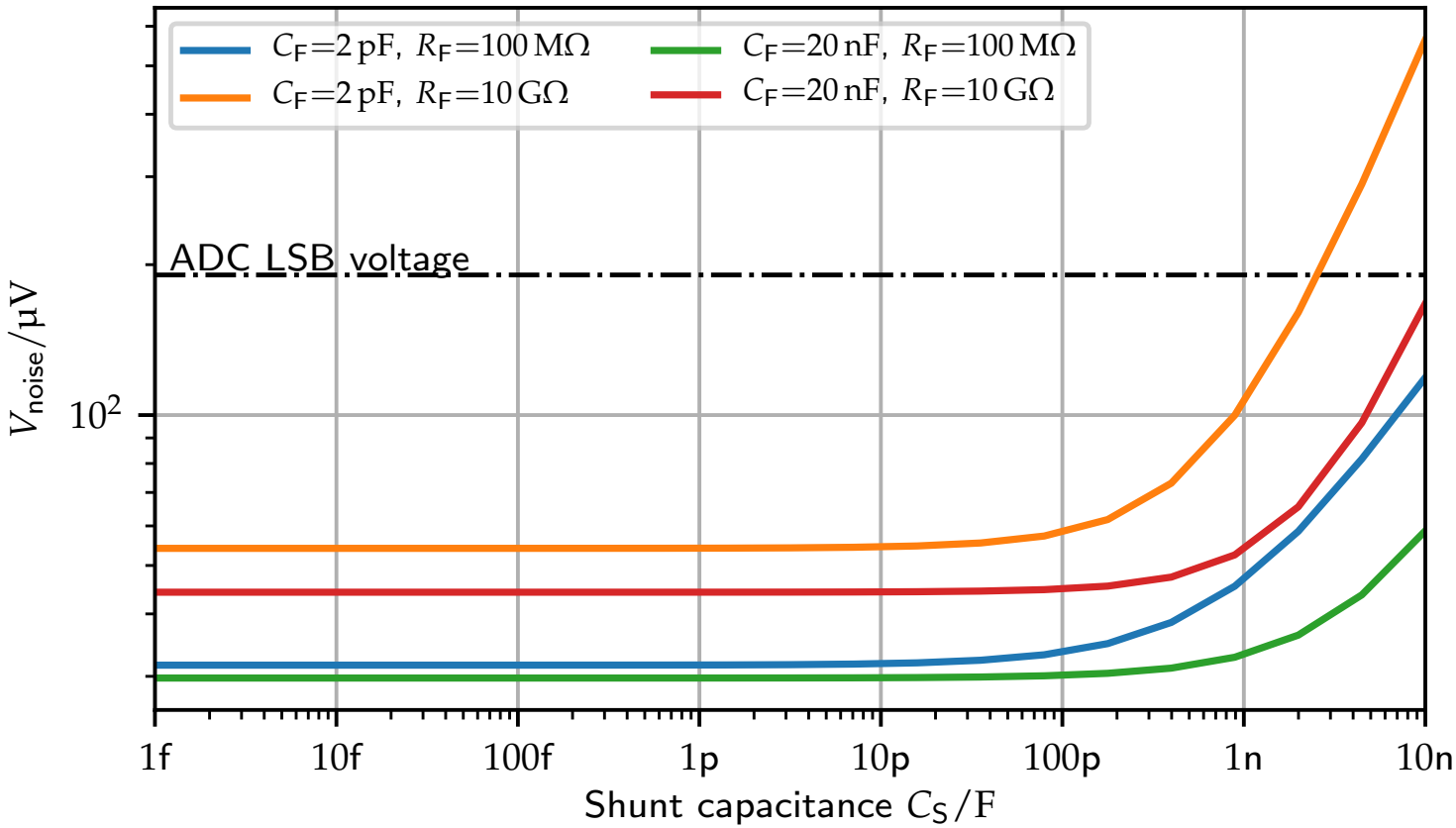
Noise Simulation



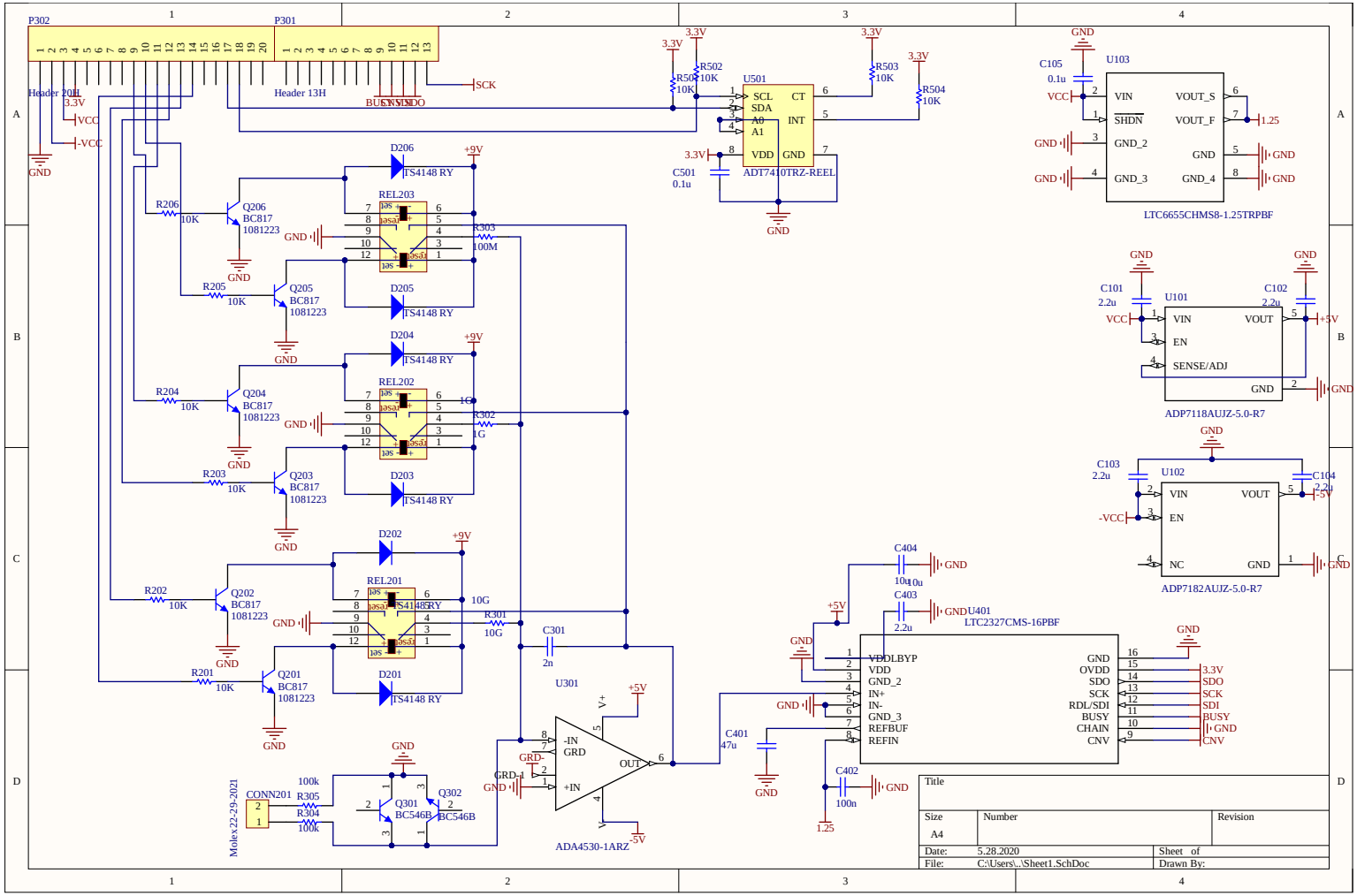
Noise Simulation



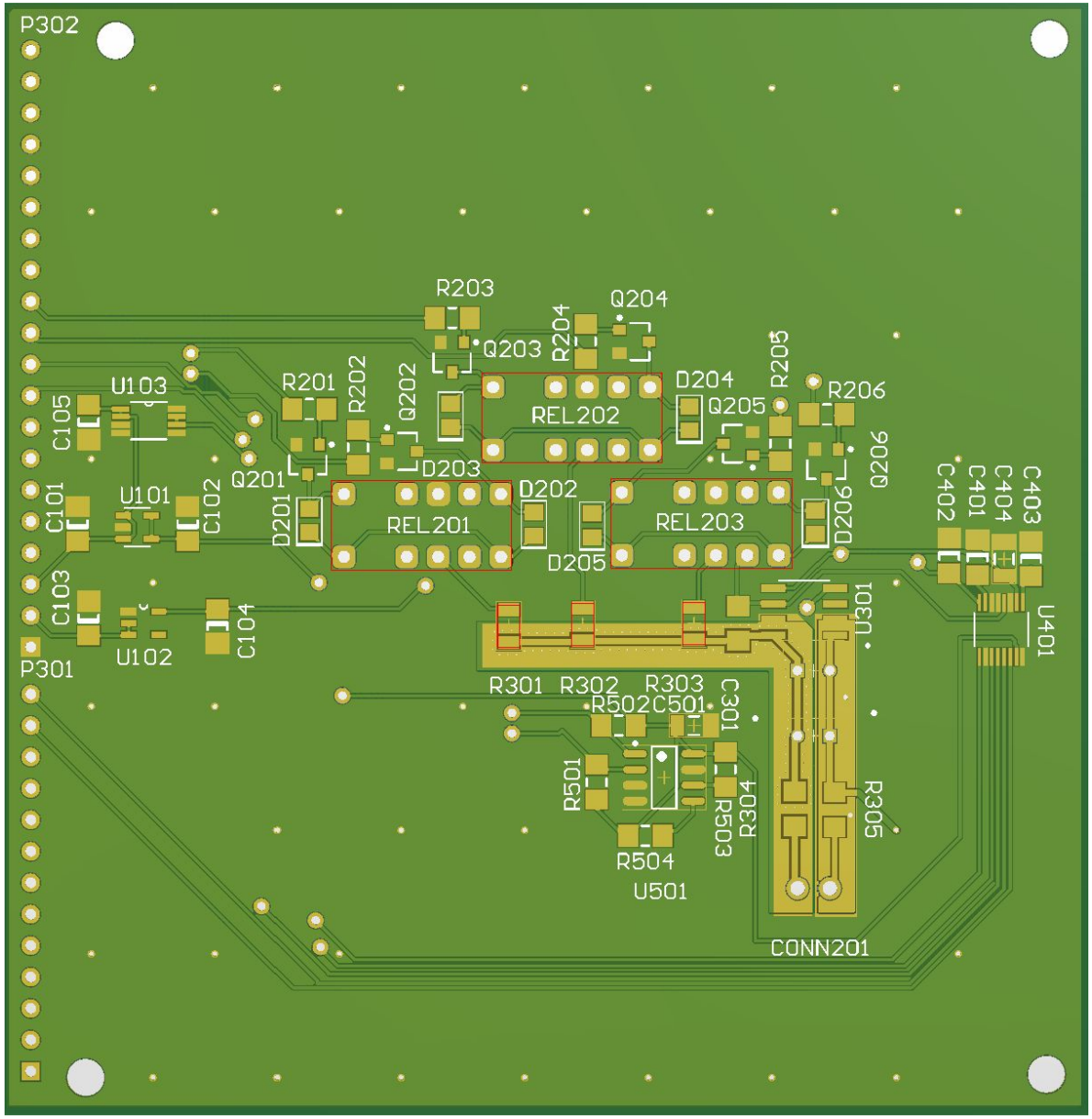
Noise


C_F=2 pF, R_F=100 MΩ
C_F=2 pF, R_F=10 GΩ
C_F=20 nF, R_F=100 MΩ
C_F=20 nF, R_F=10 GΩ
ADC LSB voltage
V_{noise}/µV
10^2
1f
10f
100f
1p
10p
100p
1n
10n
Shunt capacitance C_S/F

Prototype Front-End



Prototype Front-End



Bibliography


ADA4530 - Femtoampere Input Bias CurrentElectrometer Amplifier, b edition, 2017.


LTC2327-16 datasheet, b edition, 2017.