



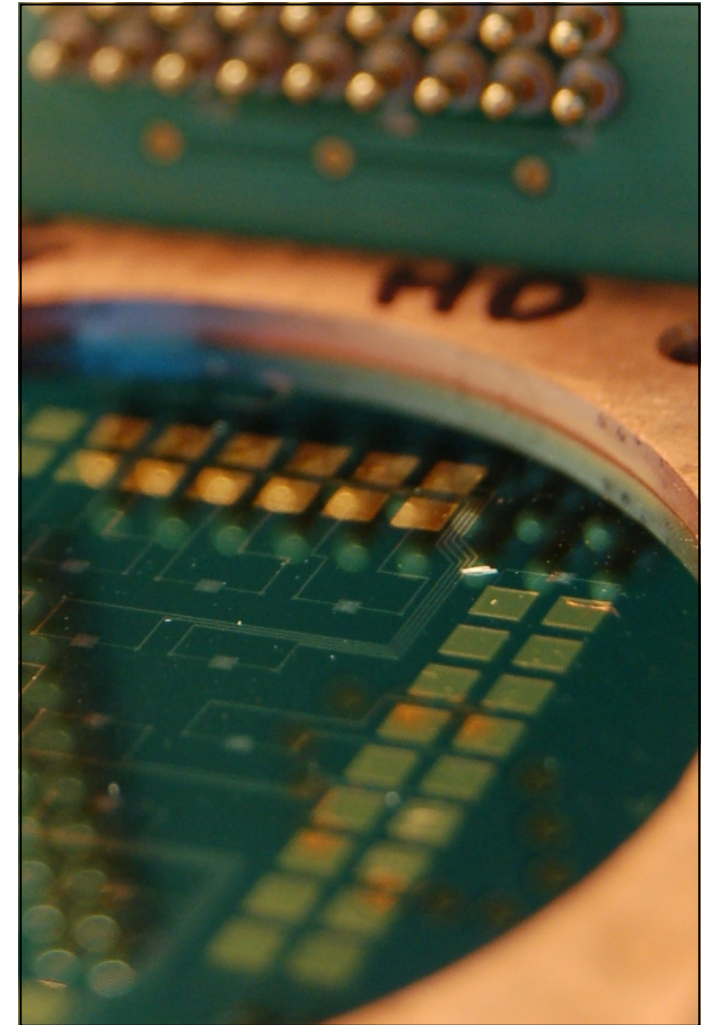
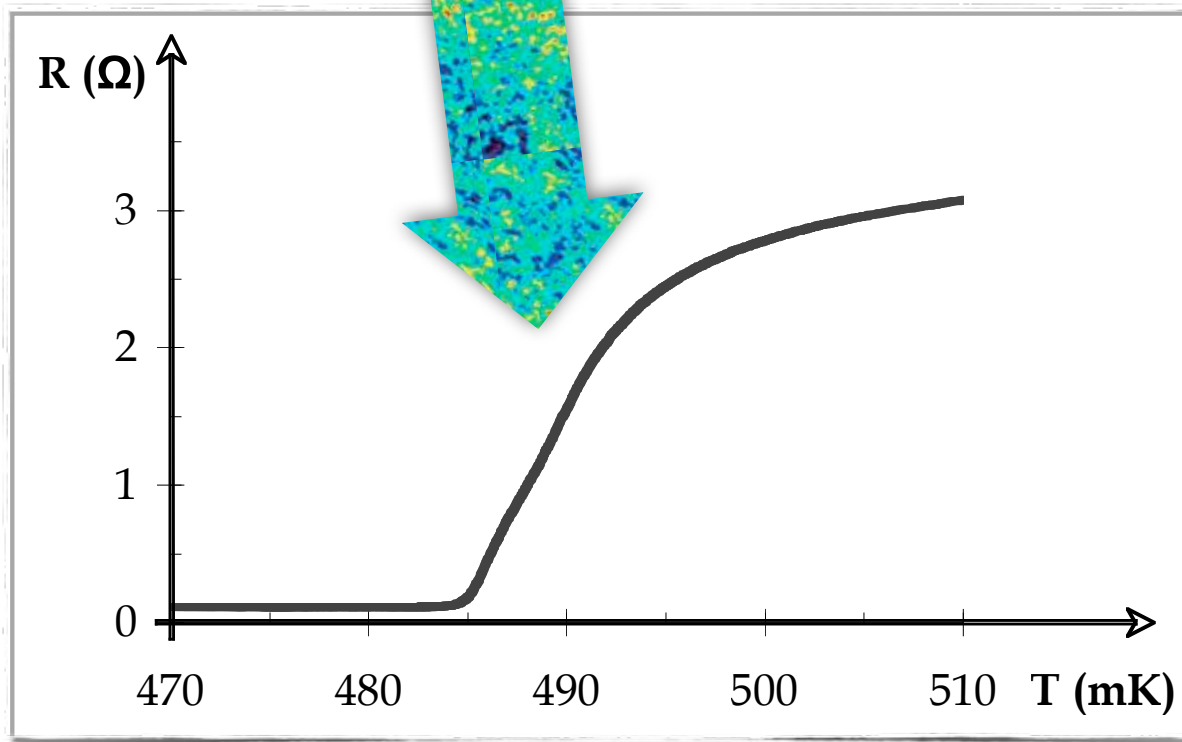
# SQUID Multiplexing Control

D. Prêle, F. Voisin

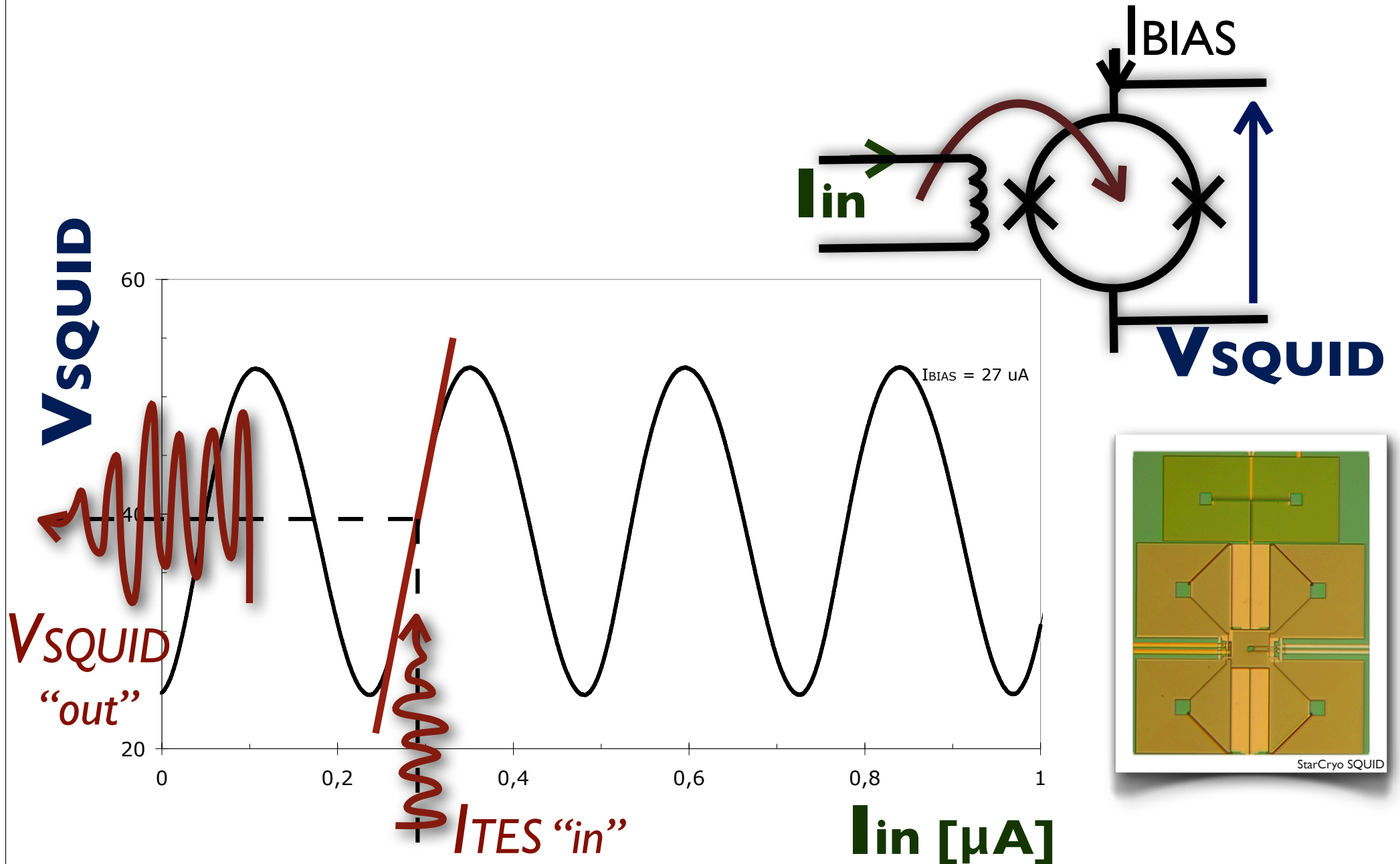
*Ecole Micro-électronique - La Londe - Oct. 09*

# Sensor : TES (superconducting bolometer)

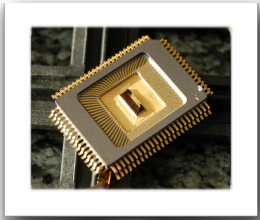
**CMB**



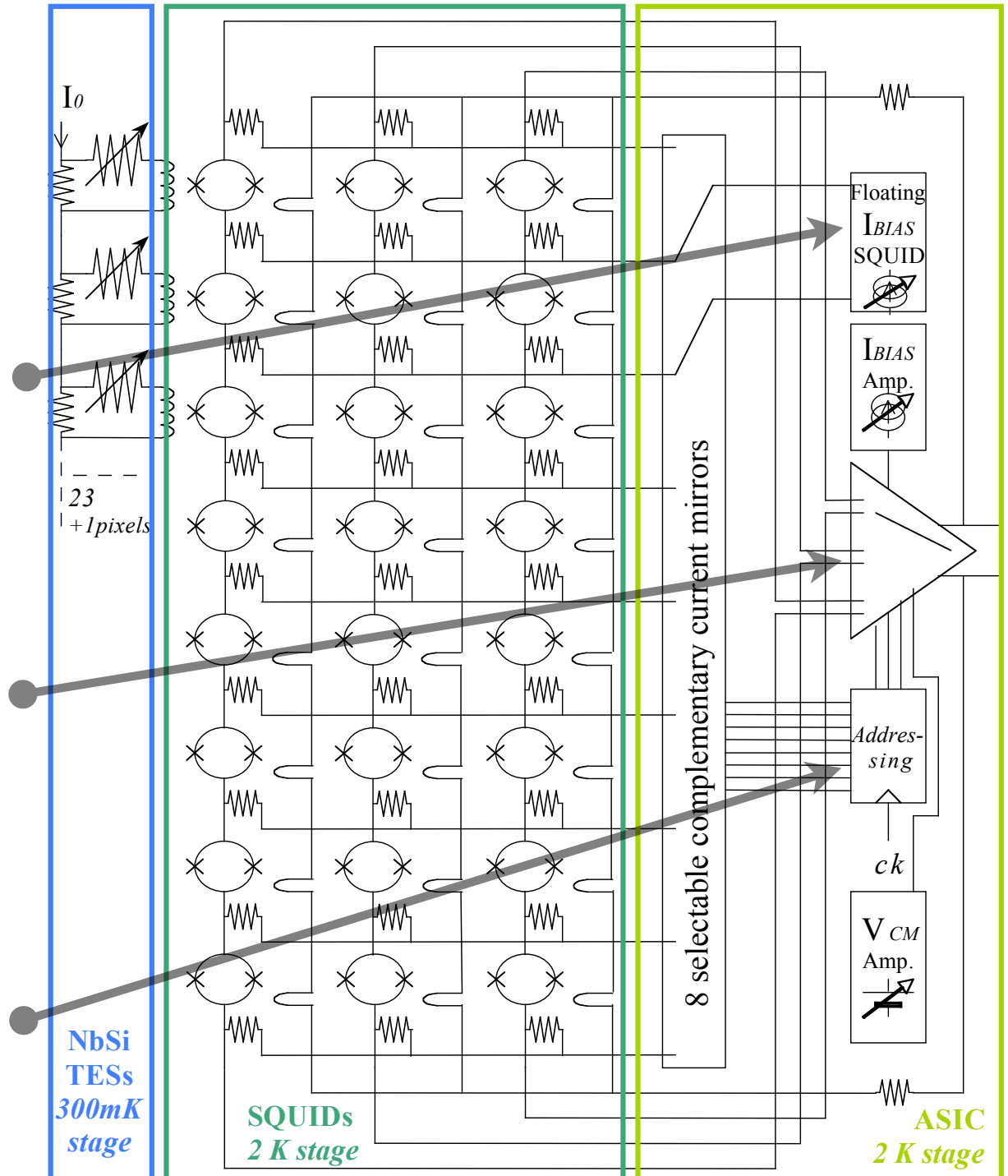
# First readout : SQUID



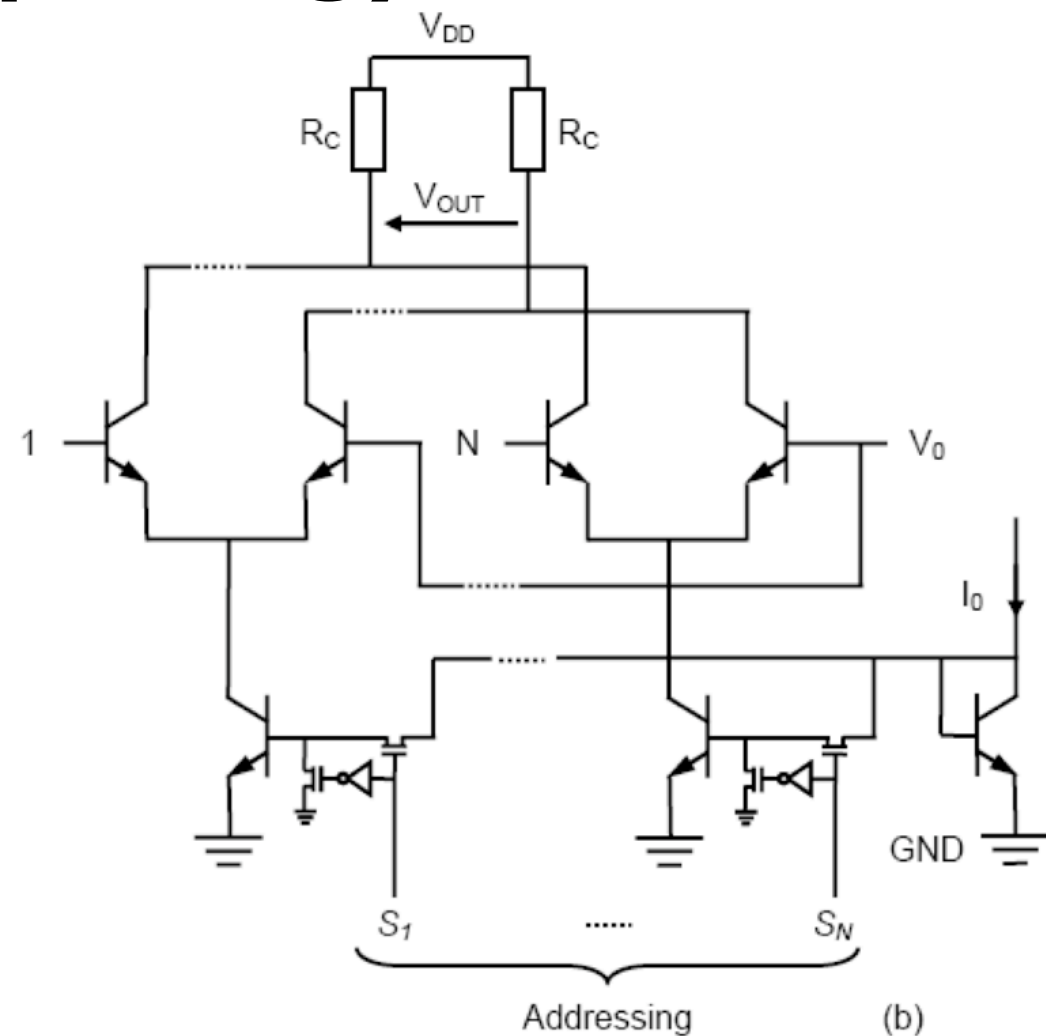
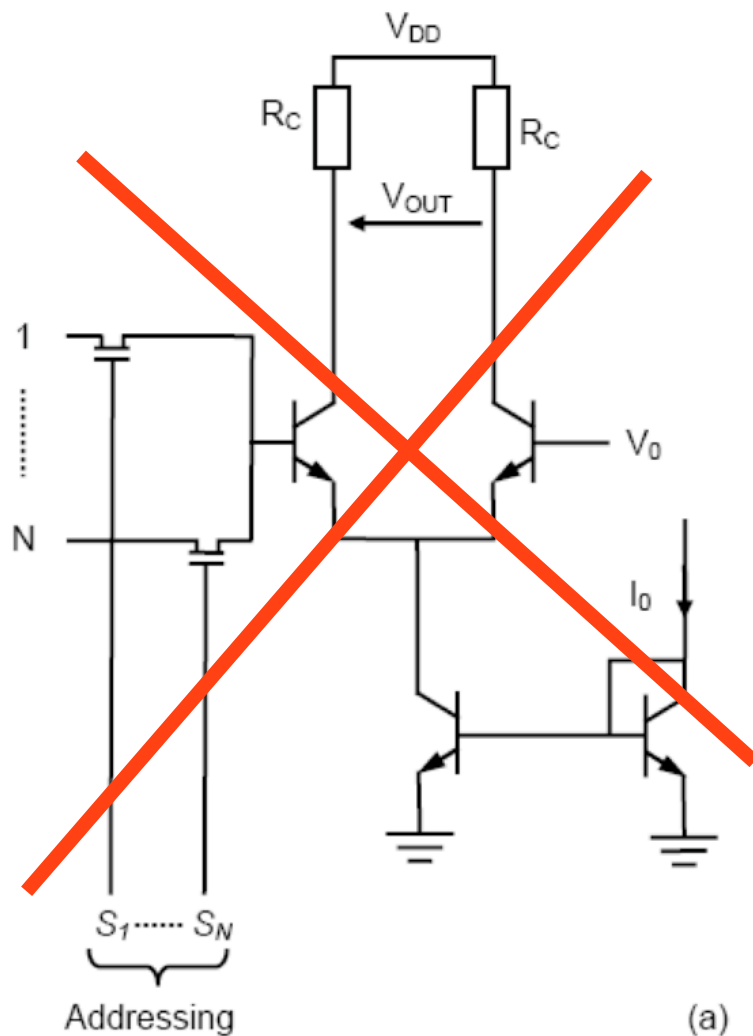
# Cryogenic SiGe IC



- Digitally adjustable current source with **8 selectable current mirrors**
- High voltage gain **LNA with multiplexed inputs** to readout 3 columns of SQUIDs
- Digital circuit to **address** sequentially each pixel

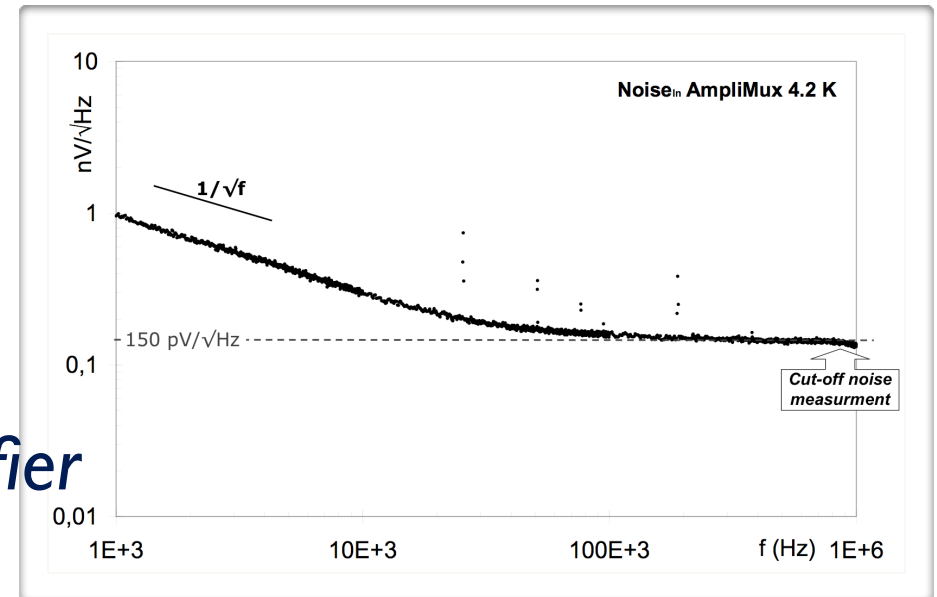
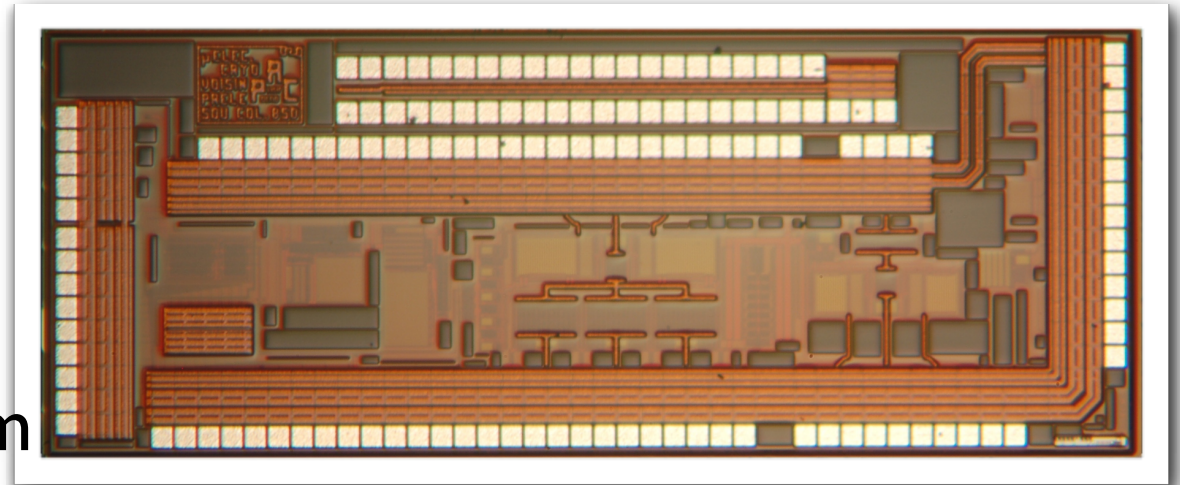


# Multiplexing amplifier topology

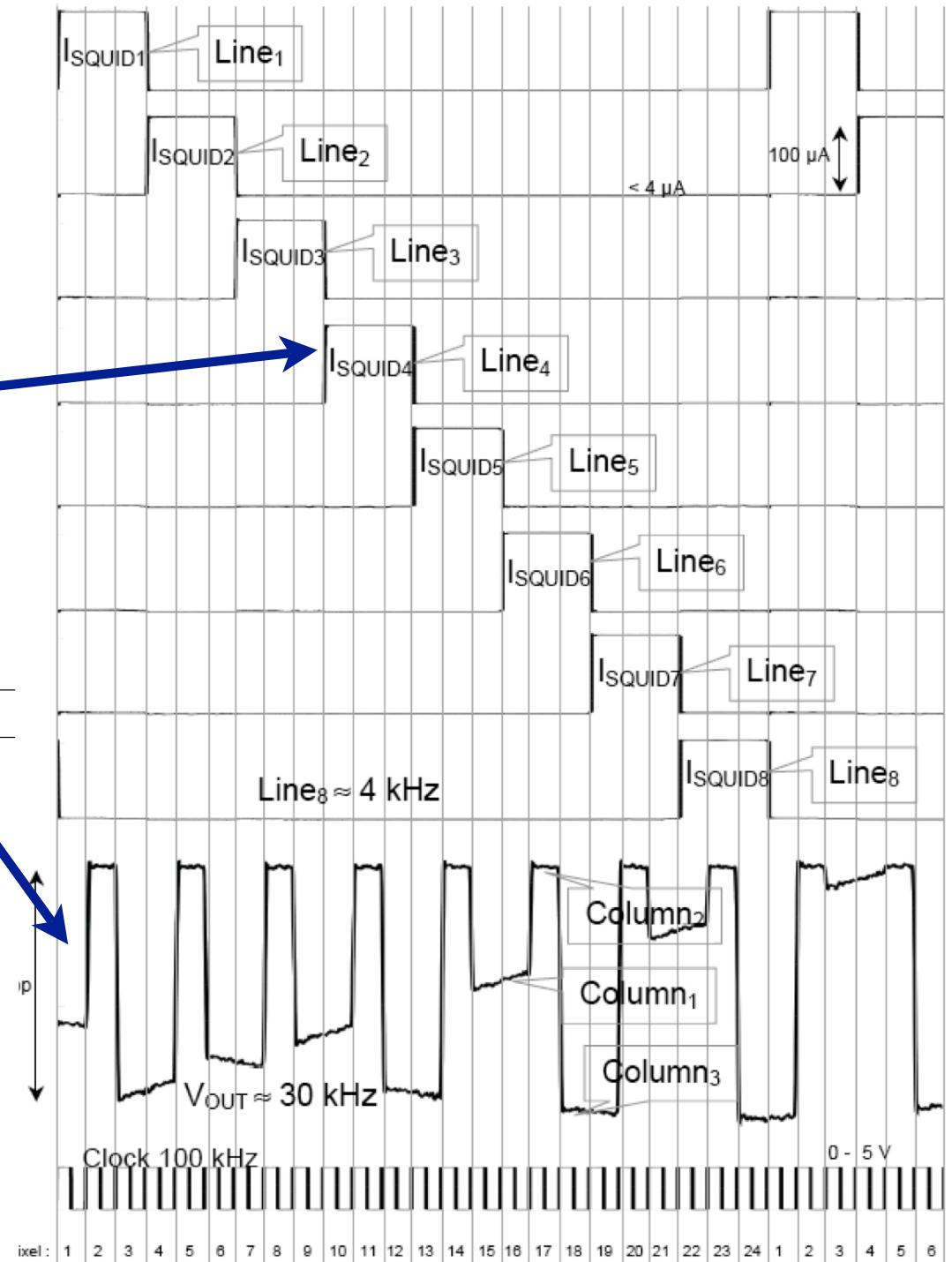
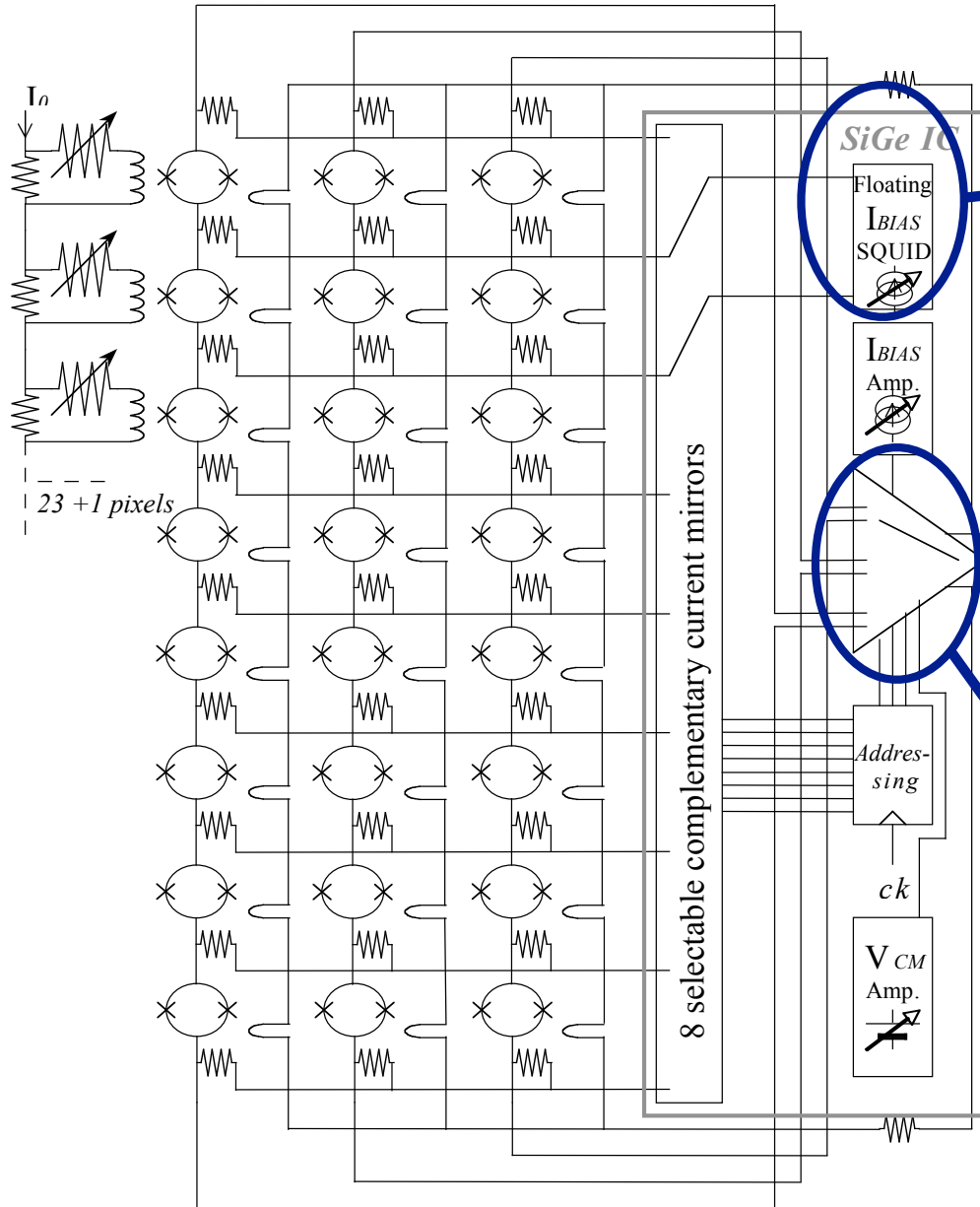


# SiGe 0.35 AMS

- T operation range :  
*measured down to 2 K*
- Dimension : 2 mm x 5 mm
- Input noise : 150 pV/ $\sqrt{\text{Hz}}$
- Multiplexing frequency : 10 MHz
- Power consumption : 15 mW  
*10 mW for the multiplexed LNA*  
*5 mW for a second optional amplifier*  
*100  $\mu\text{W}$  for SQUID biasing*  
*Few  $\mu\text{W}$  for digital addressing*



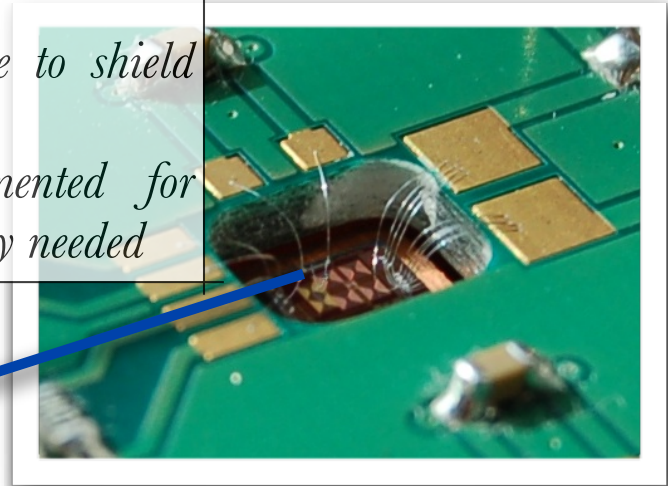
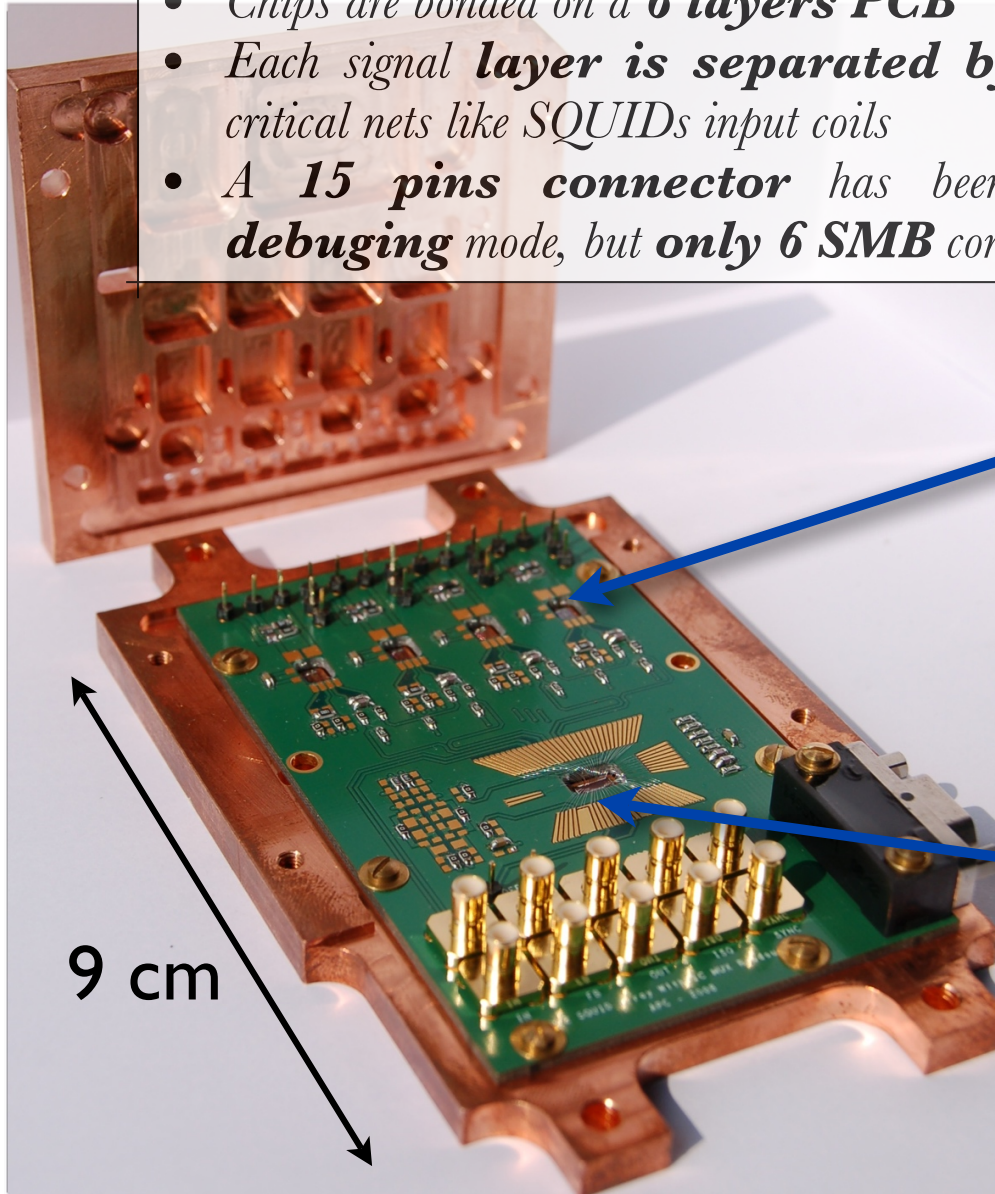
# Cryogenic operation of the SiGe IC



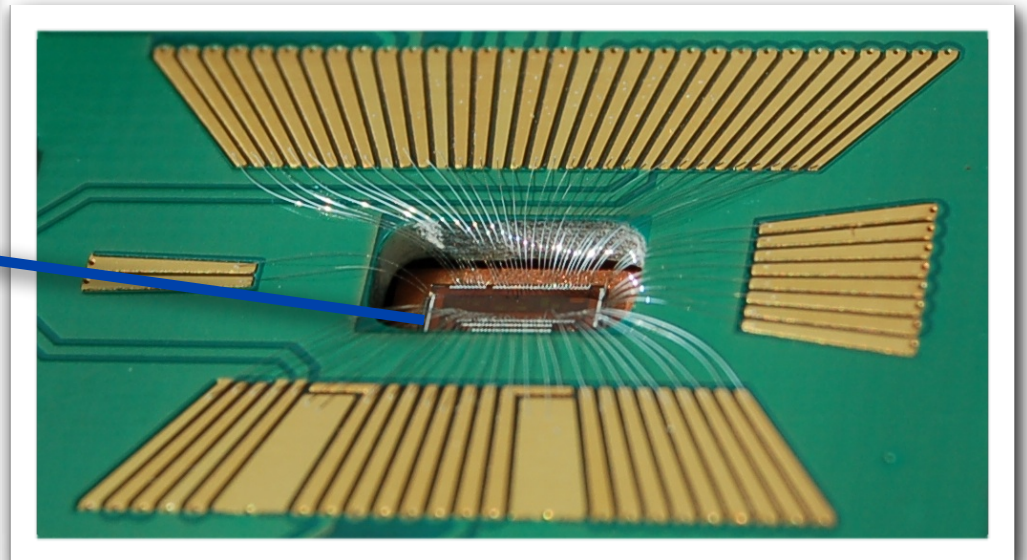
# SiGe/SQUID Hybrid



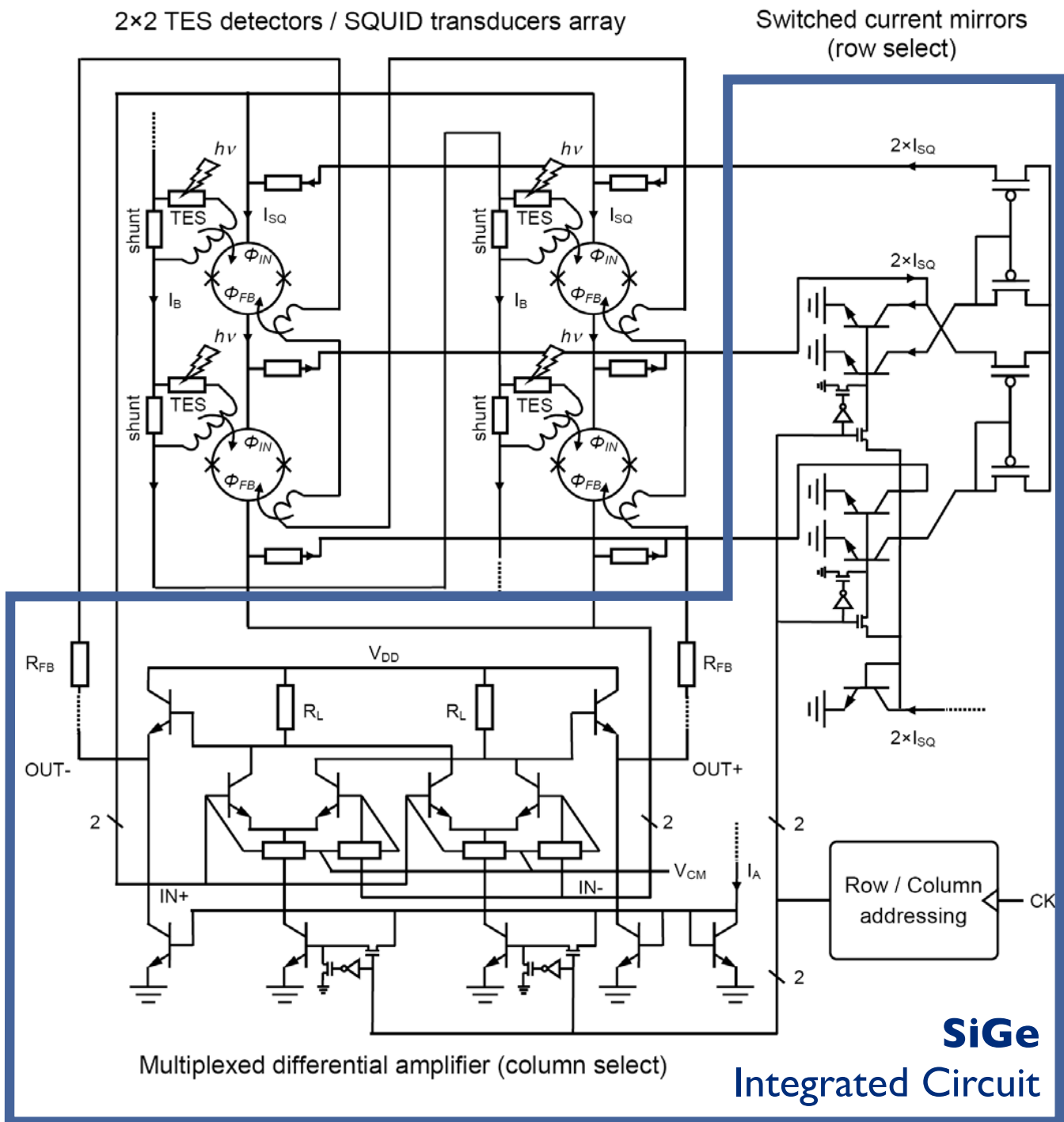
- Chips are bonded on a **6 layers PCB**
- Each signal **layer is separated by GND plane** to shield critical nets like SQUIDs input coils
- A **15 pins connector** has been also implemented for **debugging mode**, but **only 6 SMB** connectors are really needed



4 x SQ680 STARCryo



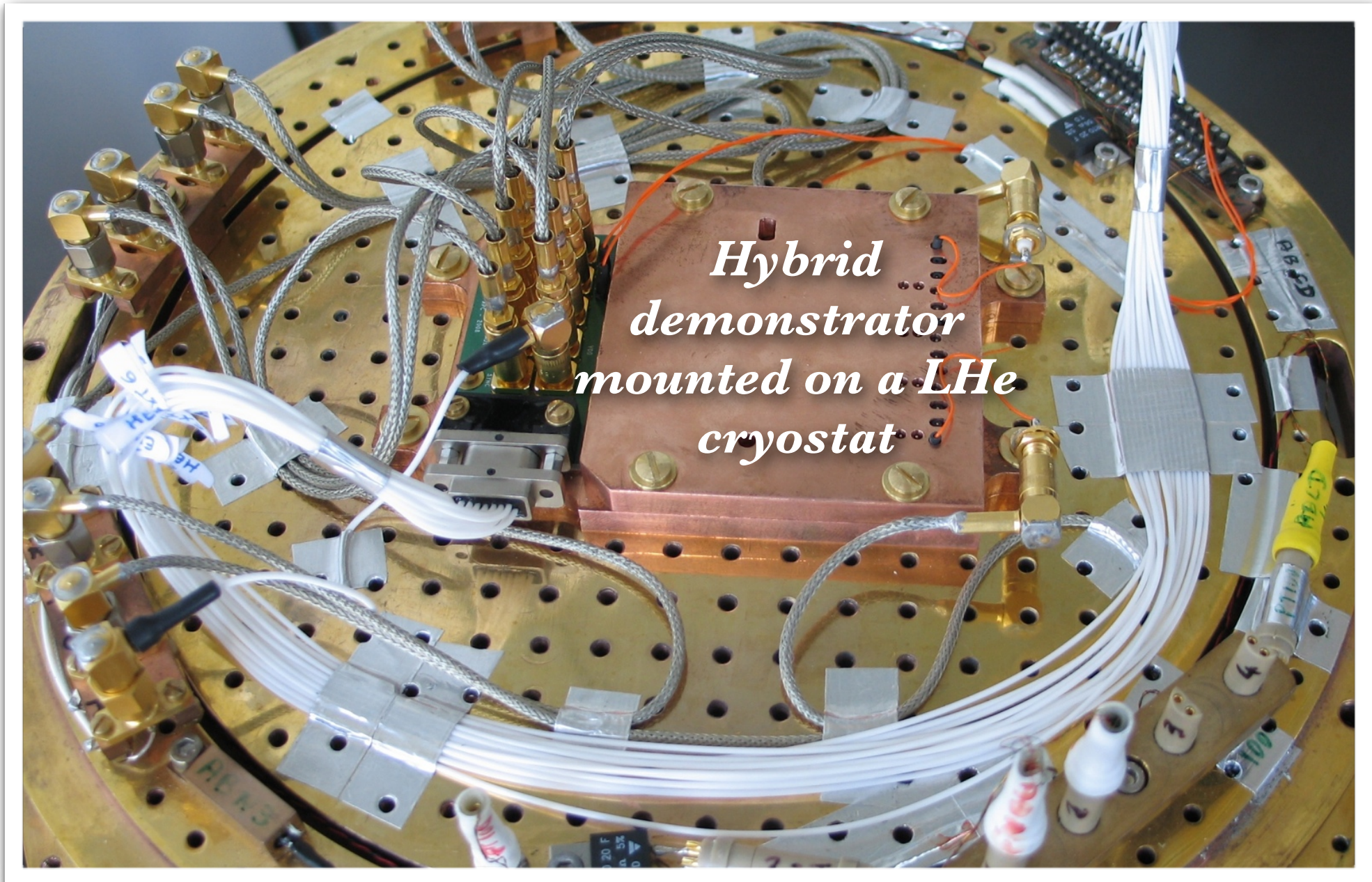




# SiGe/SQUID Hybrid Demonstrator

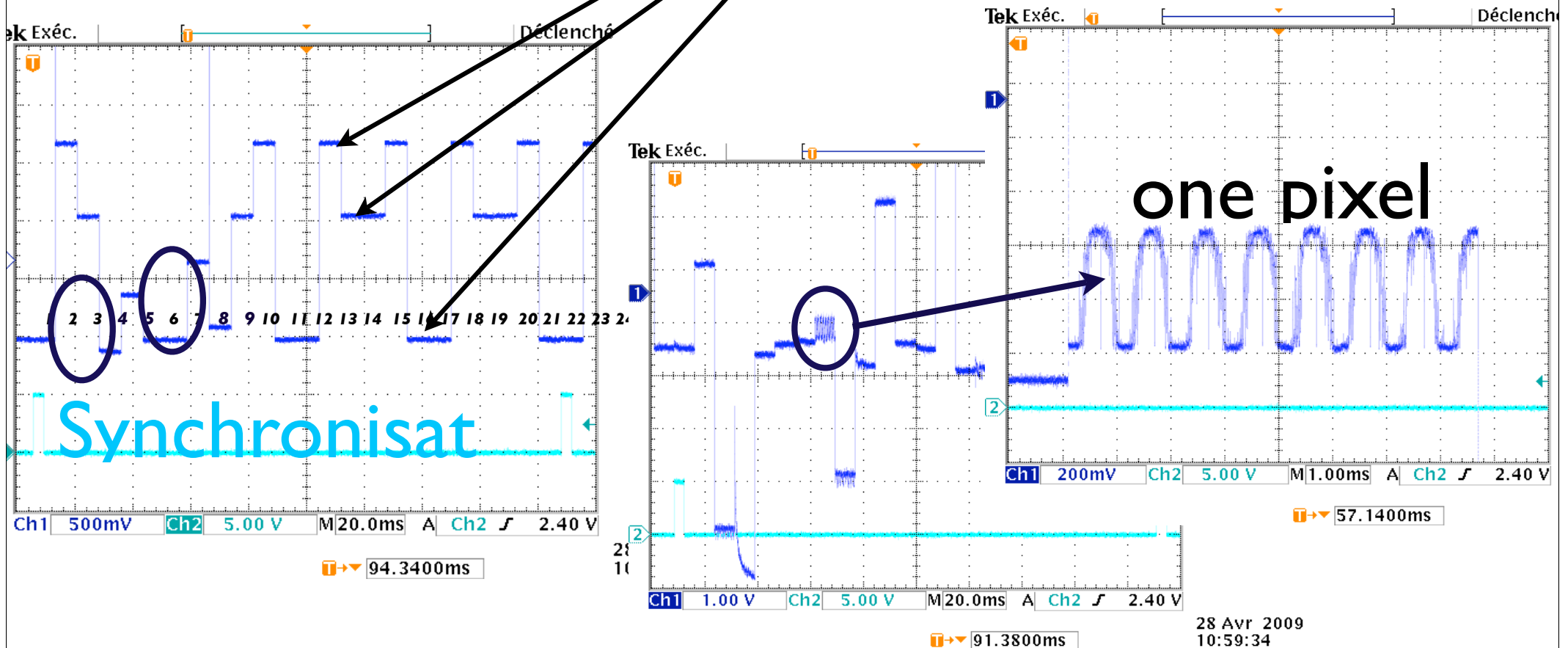
*scheme*

# Under cryogenic measurements

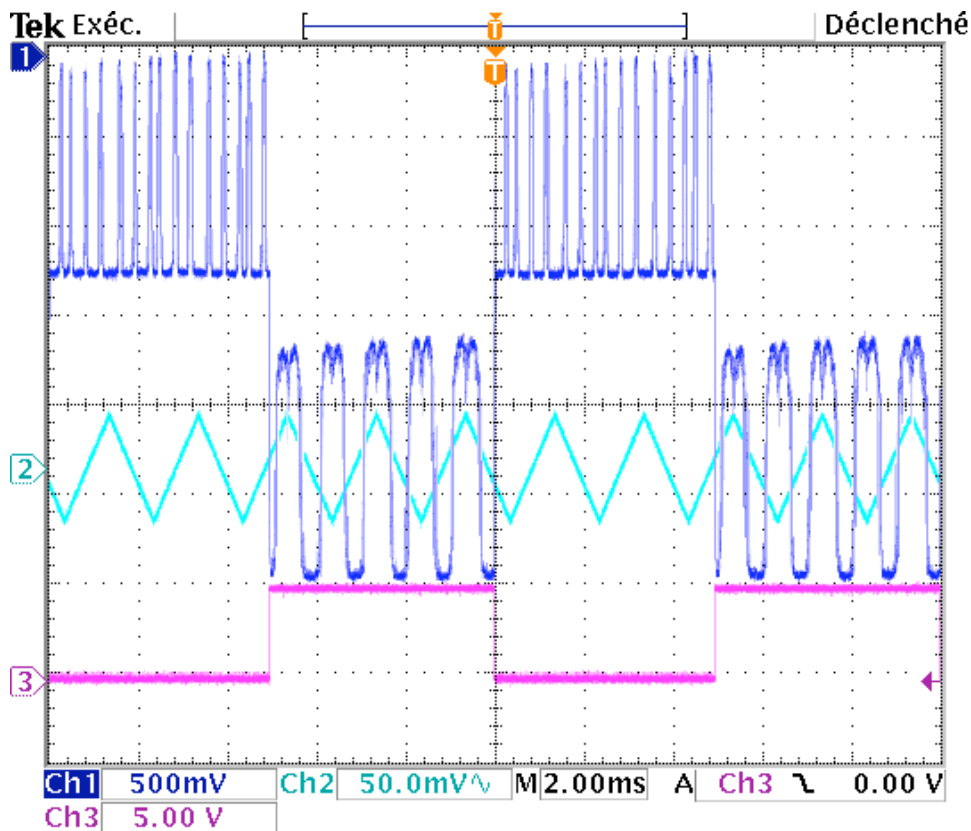


# Multiplexing : 24 pixels

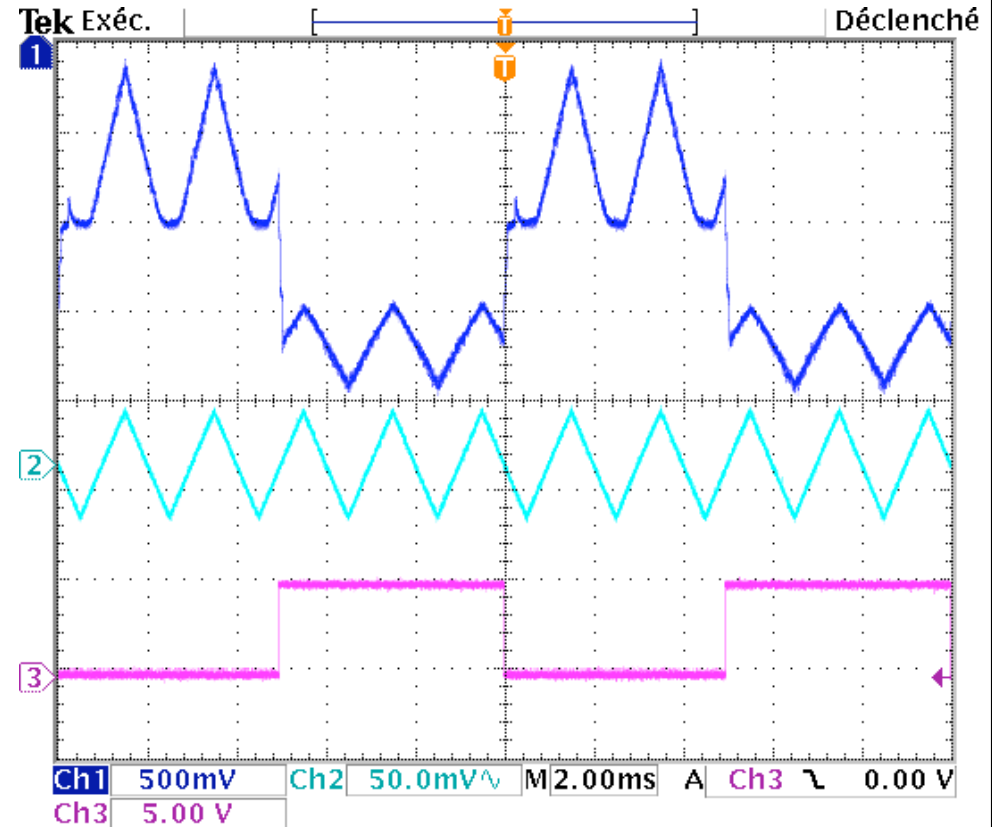
*Steps are due to the DC offset of the tree multiplexed inputs of the SiGe LNA*



# Multiplexing : in open loop and with feedback (FLL)



Without FLL



With FLL

# Architecture thermo-meca. pour matrice TES NbSi 23 pixels

