HIGH DENSITY ECOG NEURAL STIMULATOR INTERFACE FOR CURRENT STEERING IN A CLOSED-LOOP BCI

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## Neural Stimulation for Closed-Loop BCI

- To reduce the common-mode artifact at the recording front-end in a closed-loop BCI with stimulation interface a new architecture is presented
- Current steering is proposed to have more focused stimulation at desired sites
- The stimulator is designed to deliver any arbitrary shape current pulse to determine a more efficient way of charge delivery to the neural tissue
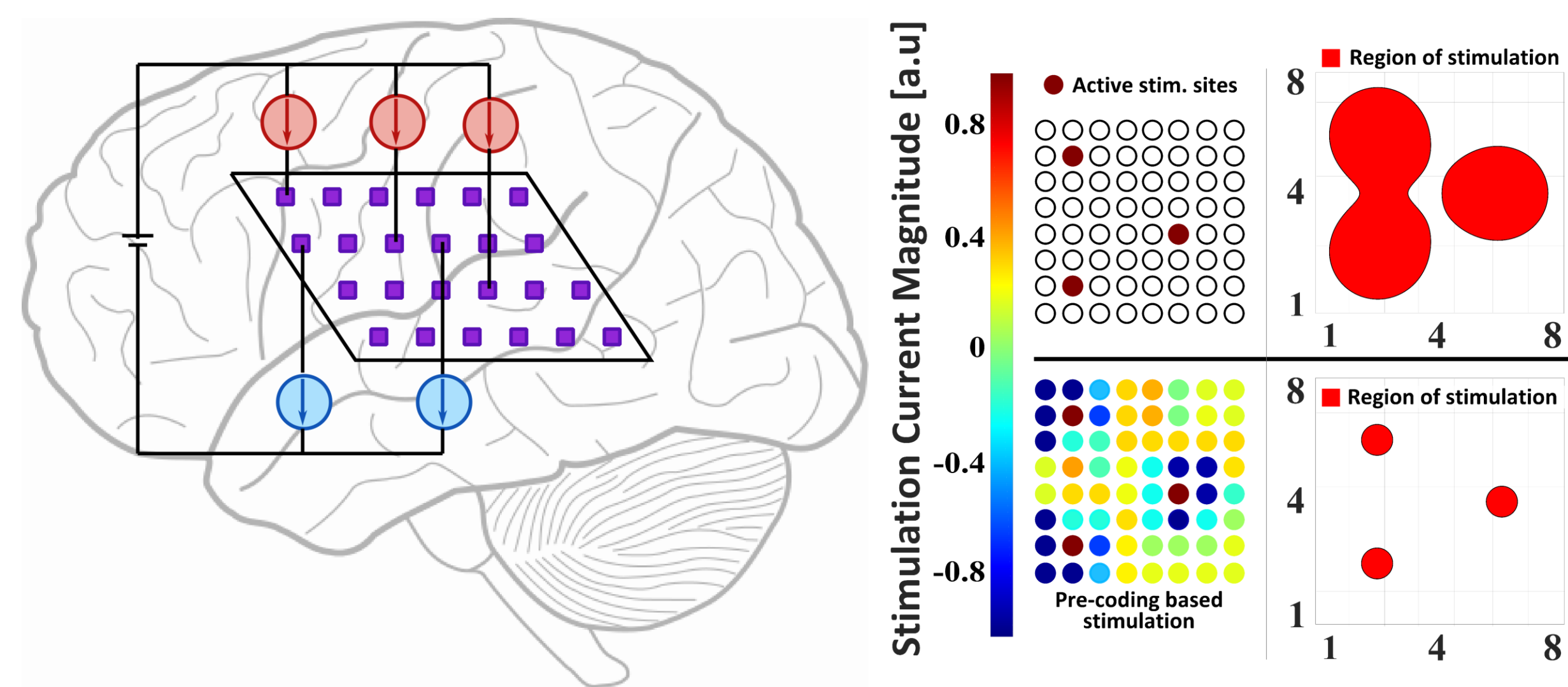

Stimulator Features
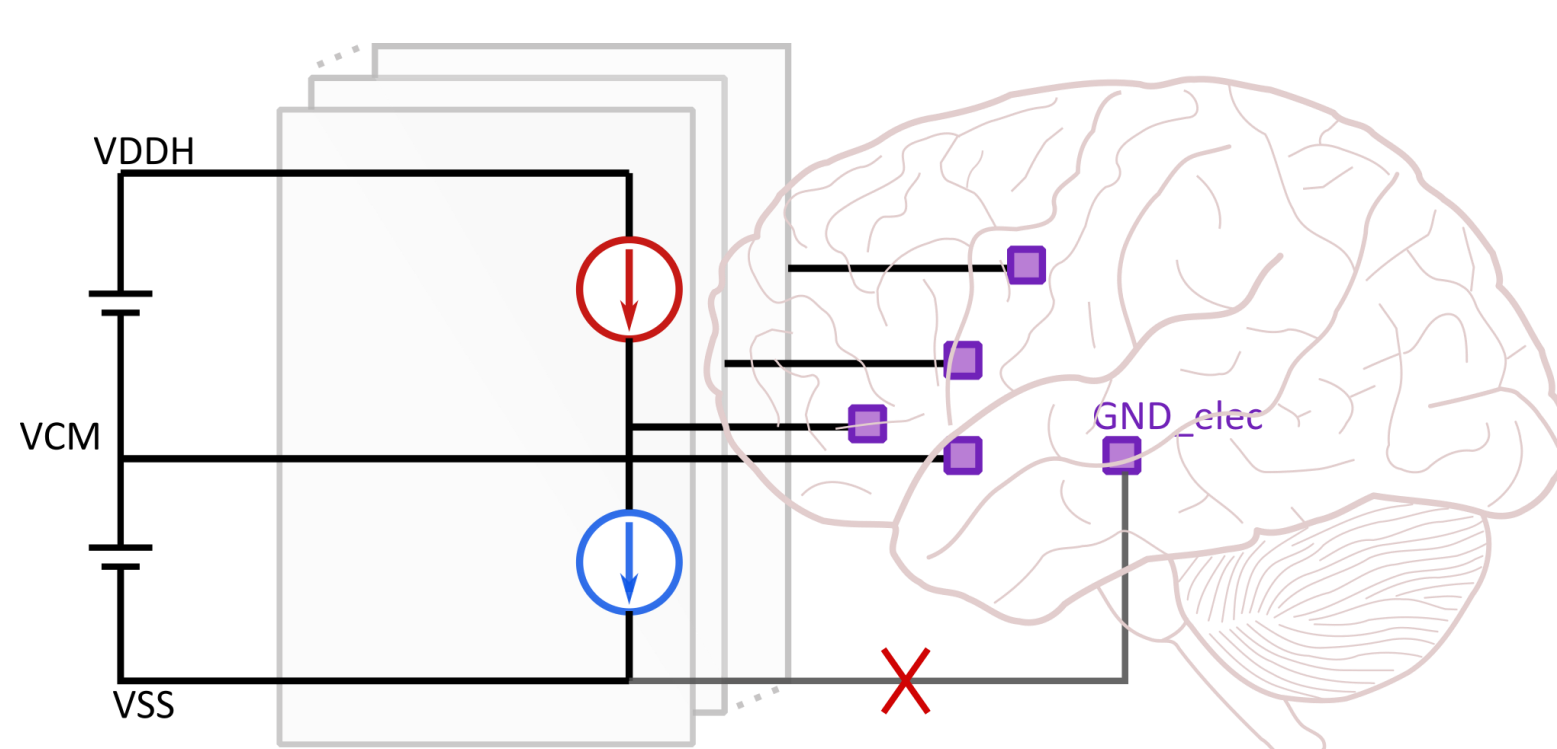
- Midpoint of the battery stack is connected to the brain for common-mode feedback
- Eliminates the need for a GND screw in the brain
- The chip supply floats with respect to the brain
- CM artifact is absent
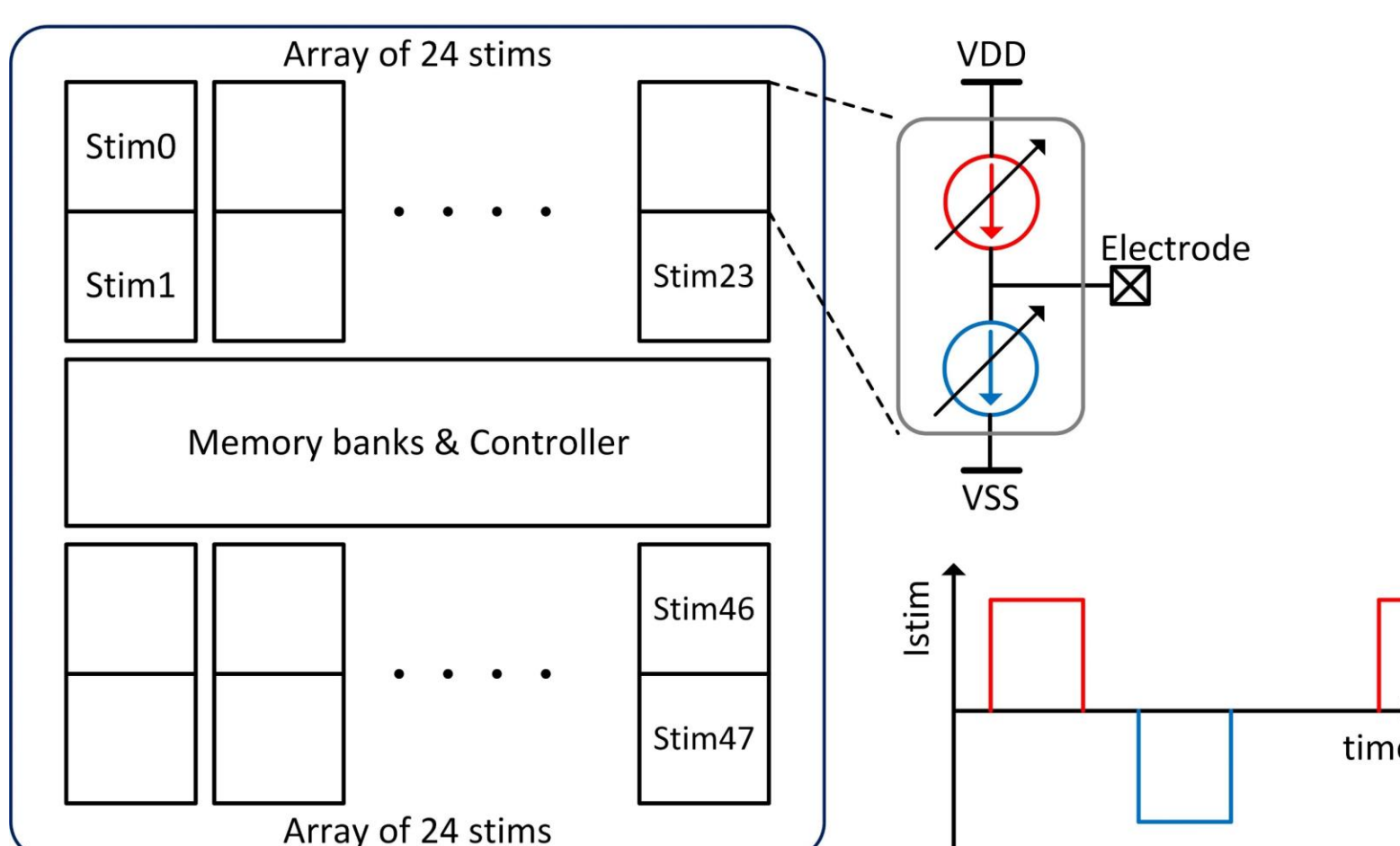
| # Channel	48
Compliance	26V
Stim current	2mA
Resolution	5-20μA
Output Resistance	>4MΩ

Current Driver Schematic

- Each current driver is capable of sourcing and sinking current through the high output impedance HV pMOS and nMOS mirror
- Output current is controlled by a 7-bit current DAC
- Dropout voltage of the output mirrors is designed to be 800mV
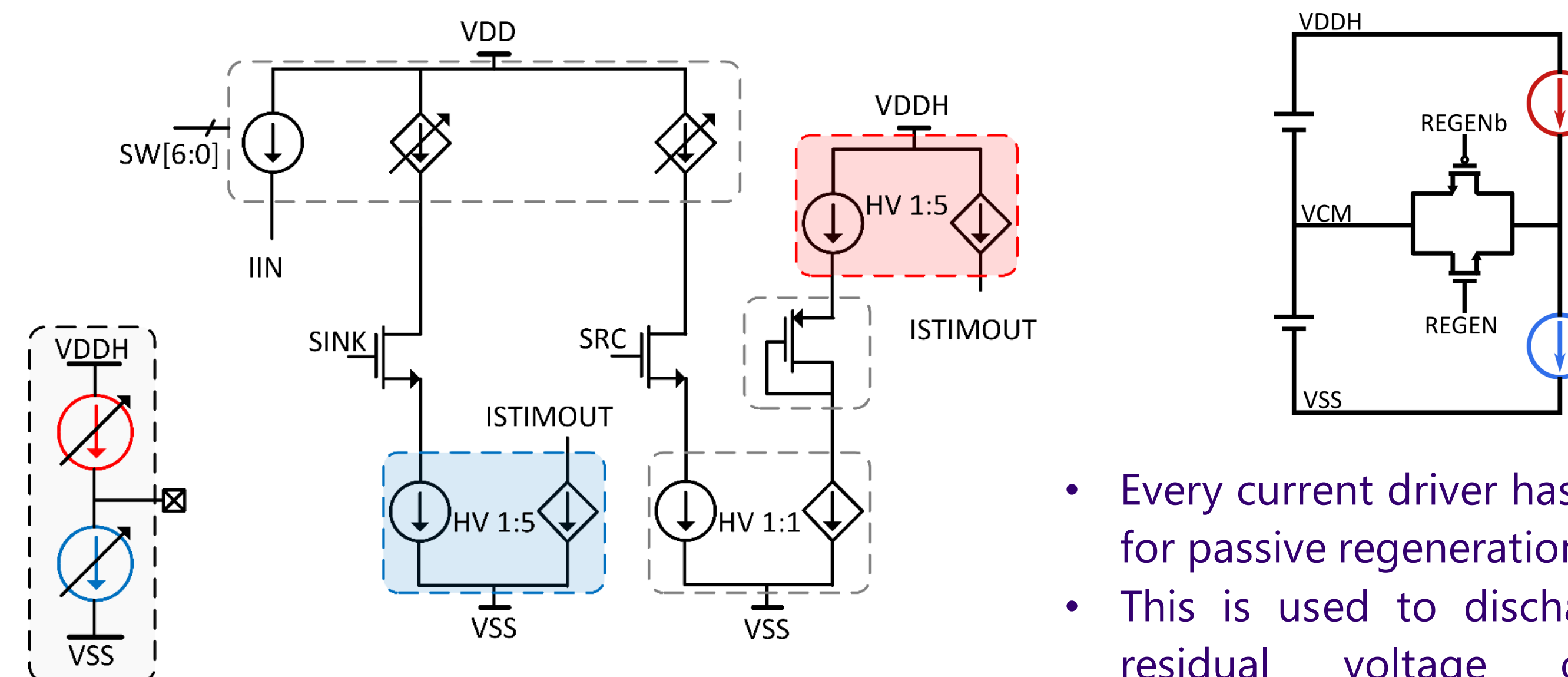
- Every current driver has a switch for passive regeneration
- This is used to discharge any residual voltage on the electrode

Mismatch Cancellation
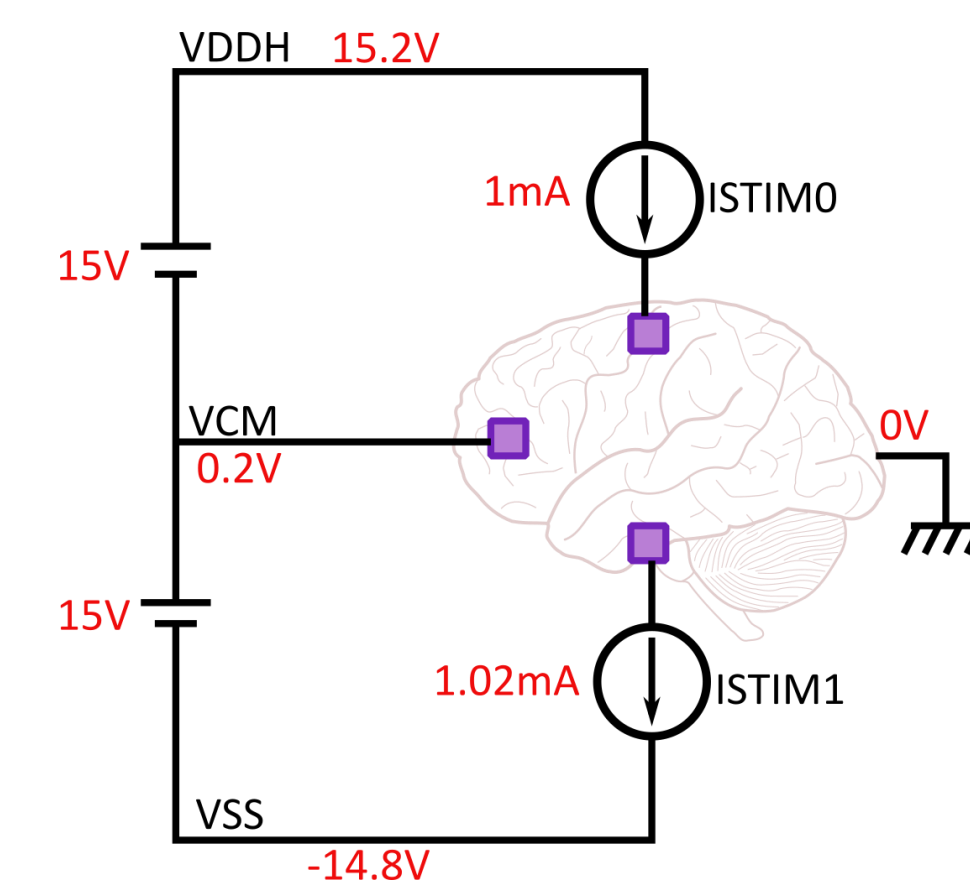
- Any mismatch current between the current sources and sinks flows through the low-impedance VCM-electrode
- Thus the VCM potential changes from the brain potential
- This will result in a CM artifact in an on-chip recording front-end
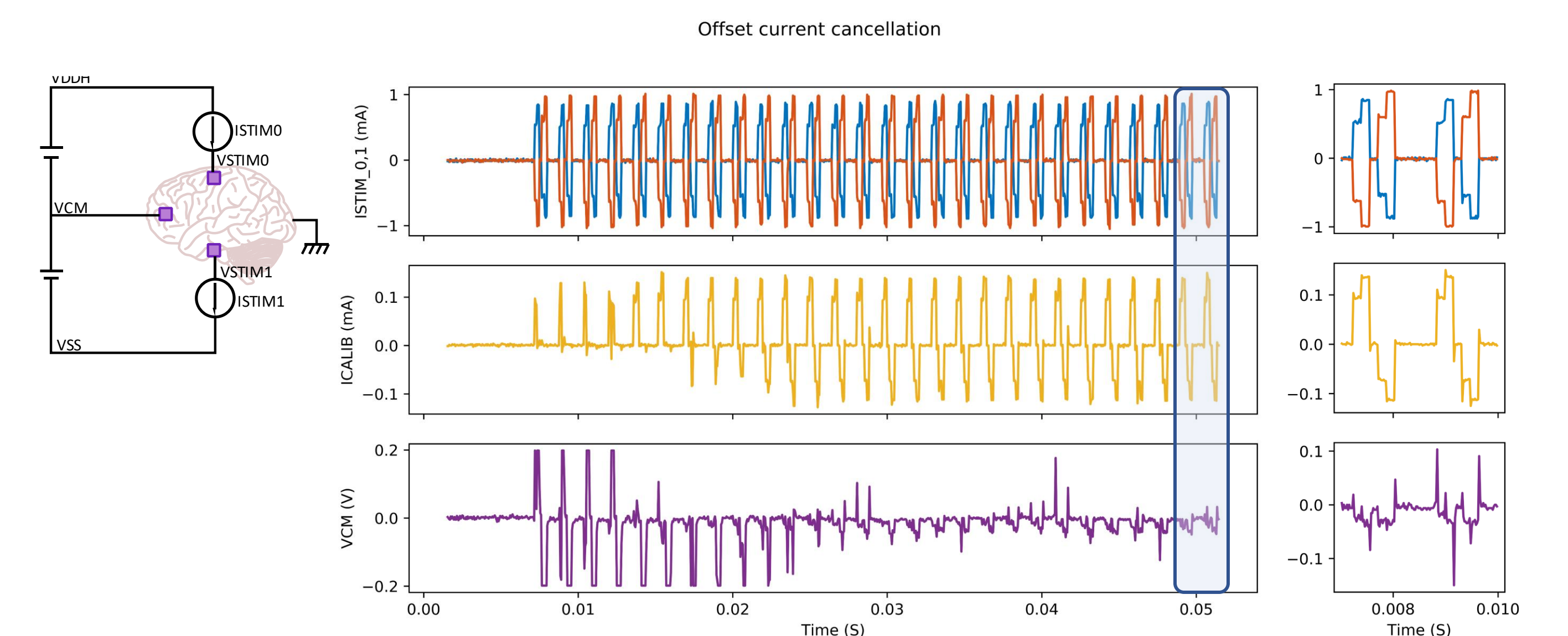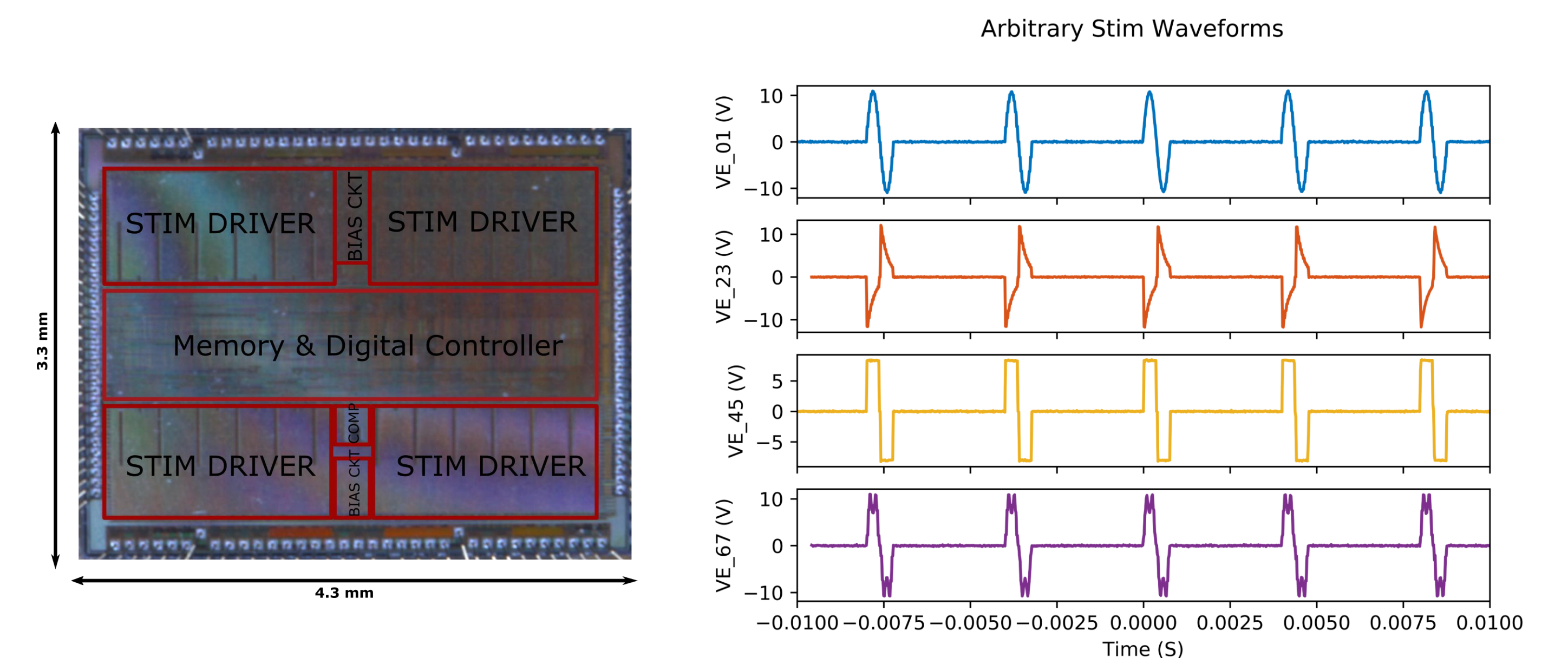
Required Calibrations
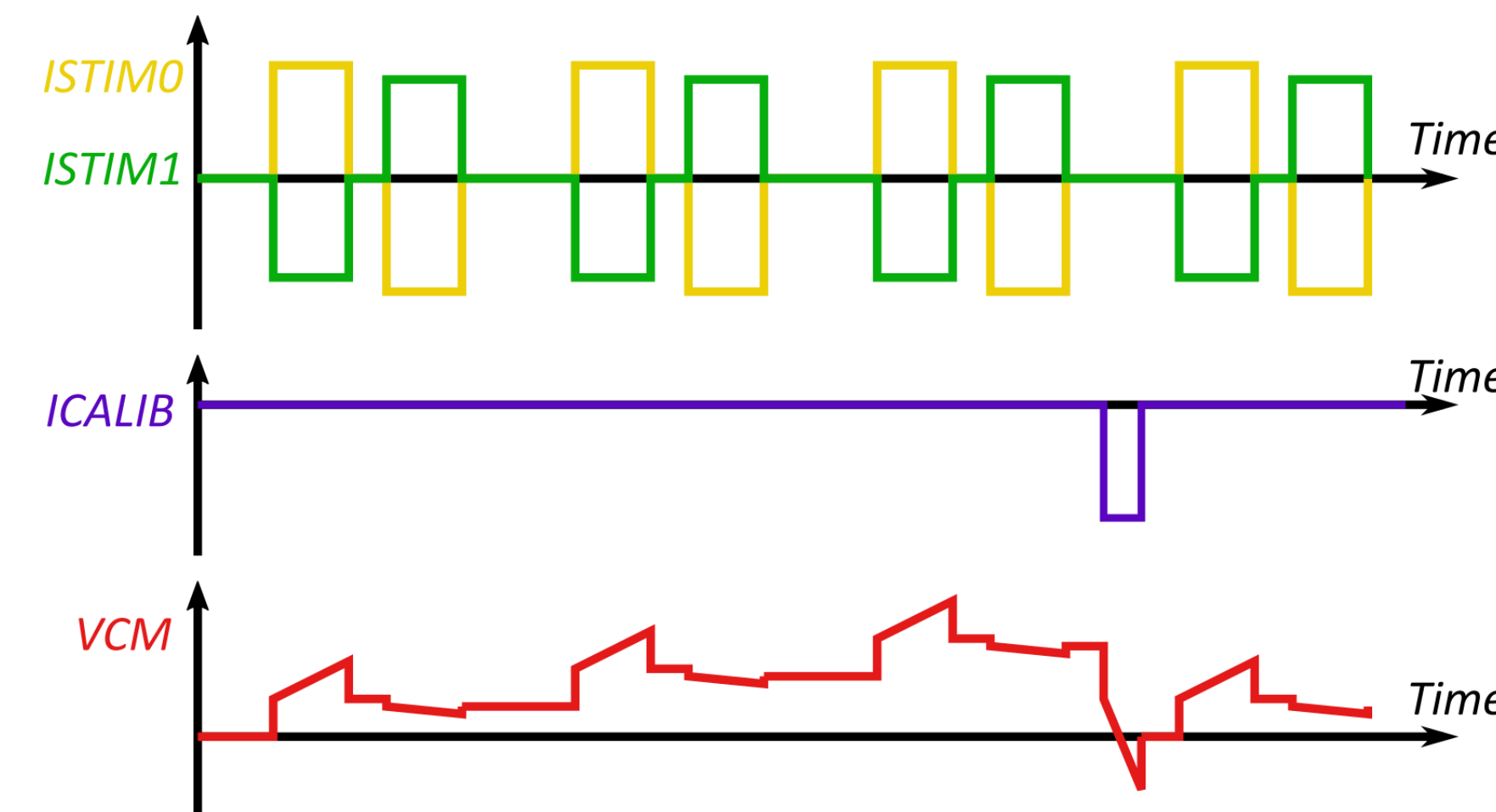
- Cancel the offset current for each timestamp
- Cancel any residual voltage on the VCM electrode by delivering an additional current pulse

Test Setup & Results

- Output channels are connected to emulated electrodes made with discrete R, C on the PCB
- The brain is emulated by a star-point
- Batteries are used as floating supply

- Offset is corrected within the LSB of the calibration current
- Radiated noise from the environment limits the ability to correct the offset

Future Work

- Improved PCB design for noise immunity
- Computational framework for current steering
- Integration with the recording front-end for closed-loop BCI