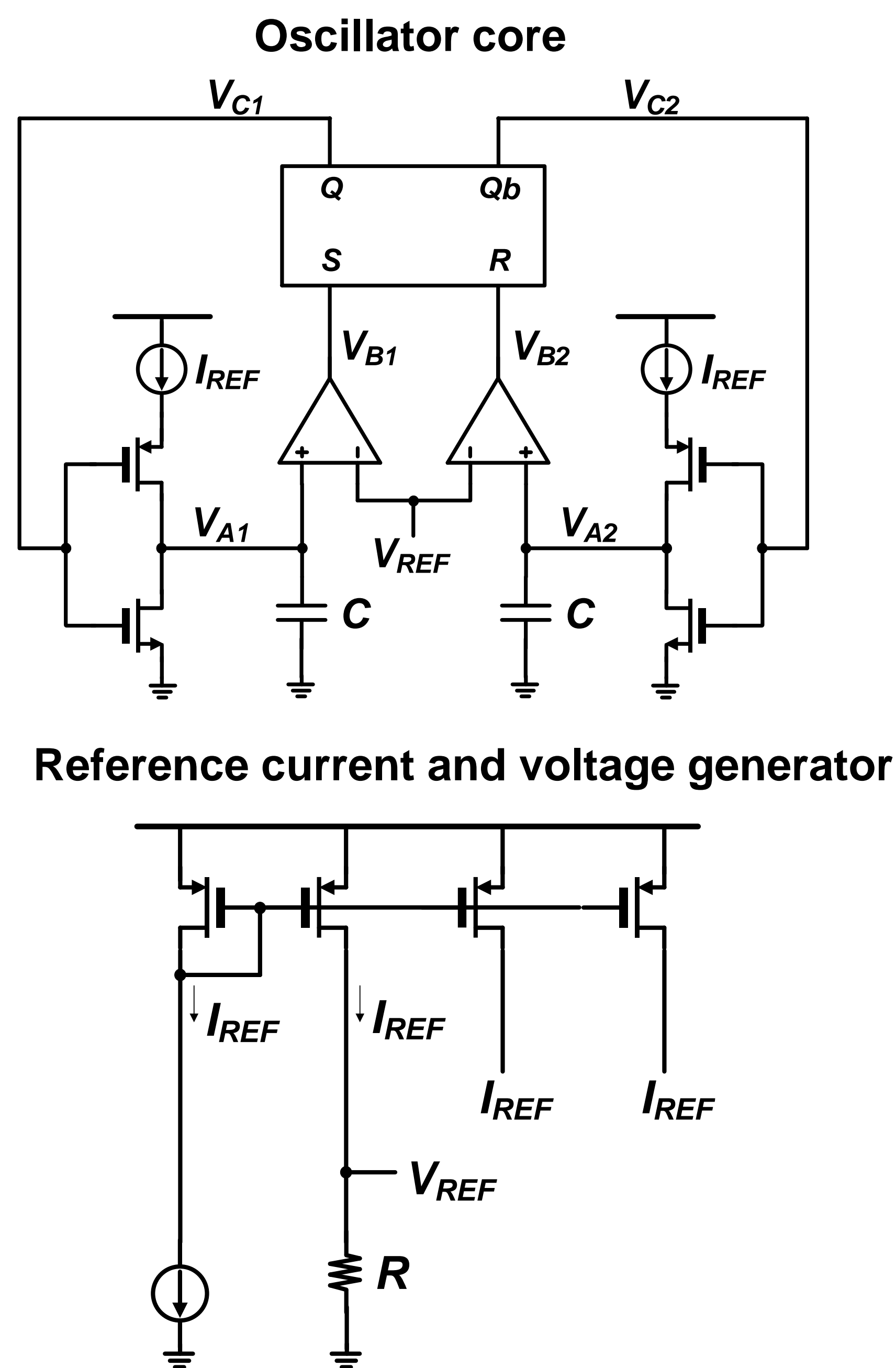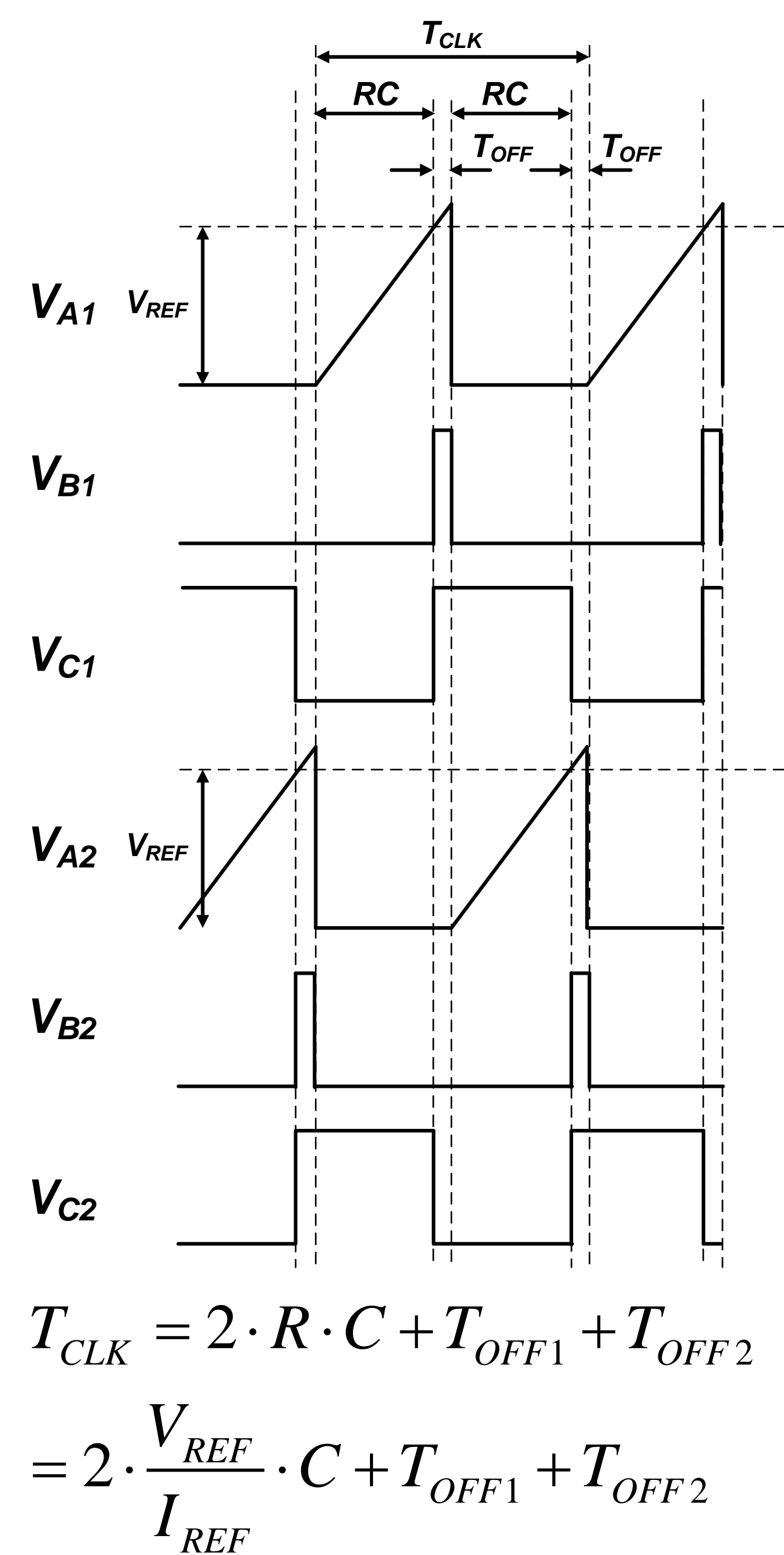# RC Relaxation Oscillator for Frequency Reference

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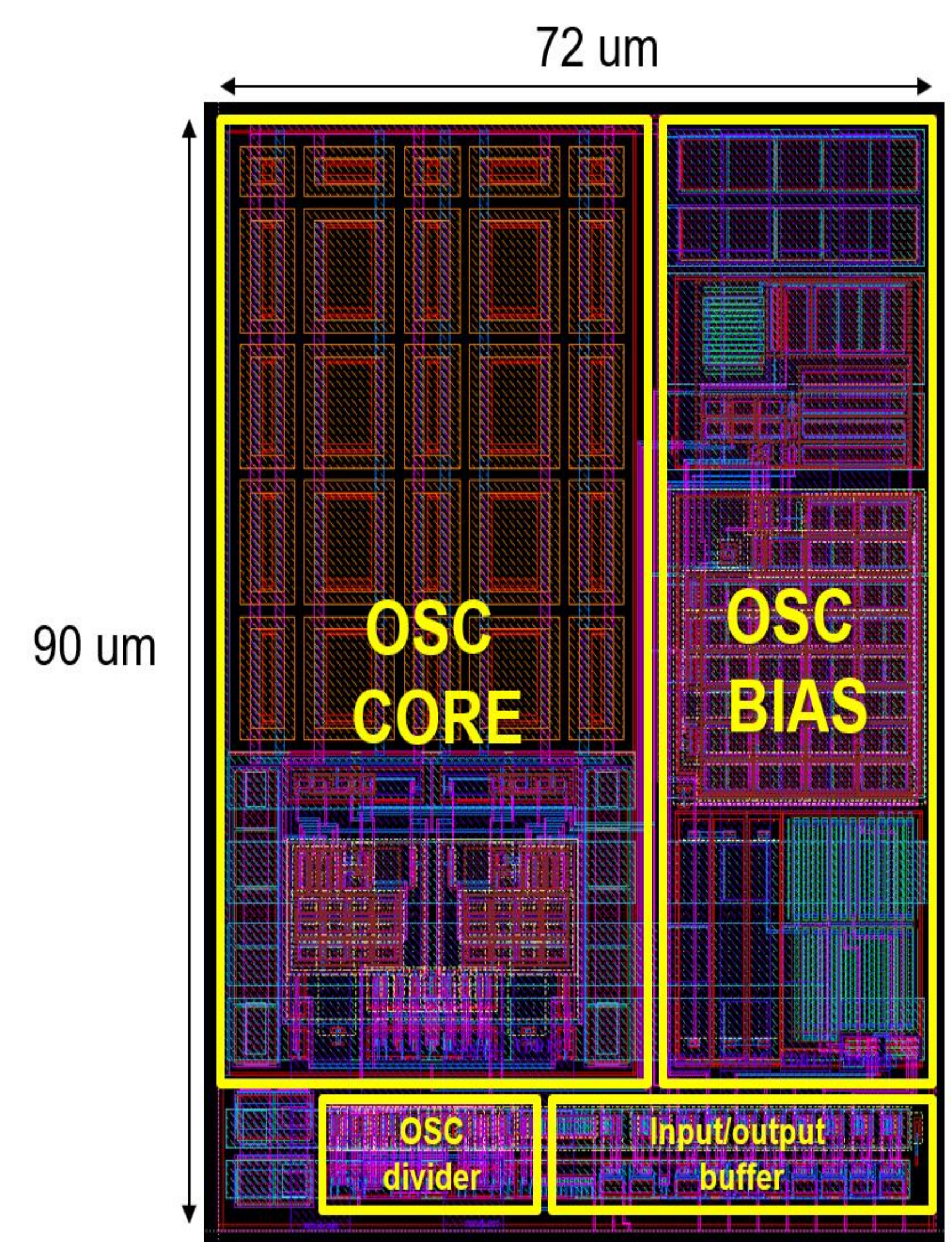
Structure of RC relaxation oscillator

Oscillator core

V_{C1} V_{C2}

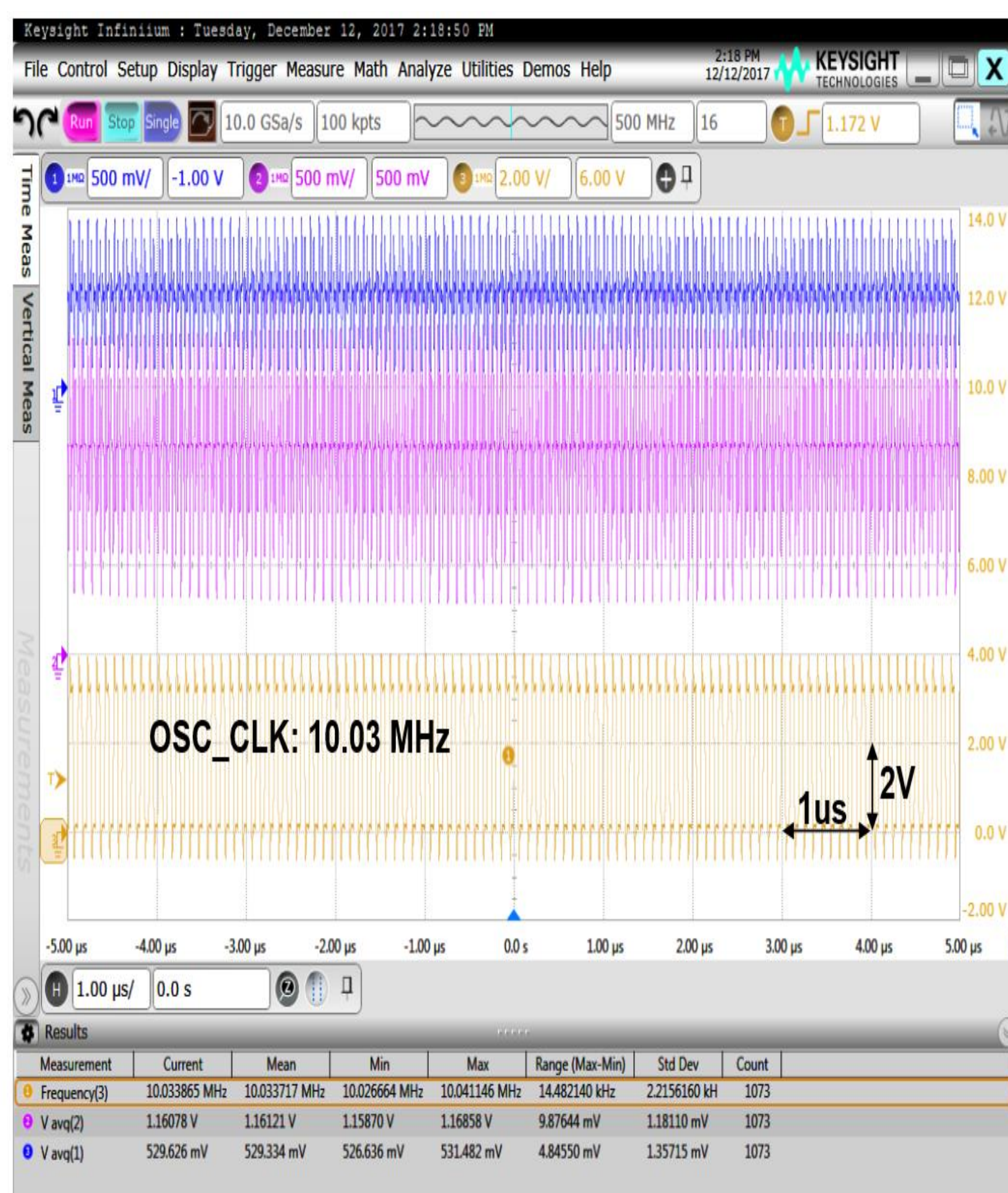Q Qb

S R

I_{REF} V_{B1} V_{B2} I_{REF}

V_{A1} V_{REF} V_{A2}

C C

Reference current and voltage generator

I_{REF} I_{REF} I_{REF} I_{REF}

V_{REF}

R

Timing diagram of RC relaxation oscillator

T_{CLK}

RC RC

T_{OFF} T_{OFF}

V_{A1} V_{REF}

V_{B1}

V_{C1}

V_{A2} V_{REF}

V_{B2}

V_{C2}

$$T_{CLK} = 2 \cdot R \cdot C + T_{OFF1} + T_{OFF2}$$
$$= 2 \cdot \frac{V_{REF}}{I_{REF}} \cdot C + T_{OFF1} + T_{OFF2}$$

Layout of RC relaxation oscillator

72 um

90 um

OSC CORE

OSC BIAS

OSC divider

Input/output buffer

Measurement result

Waveform of oscillator

OSC_CLK: 10.03 MHz

1us 2V

Oscillator frequency along with trimming code

OSC Frequency Trimming

— Measurement

Frequency (MHz)

Trimming code [5:0]

Frequency variation for supply voltage

Frequency vs. VDD

Frequency (MHz)

— Freq
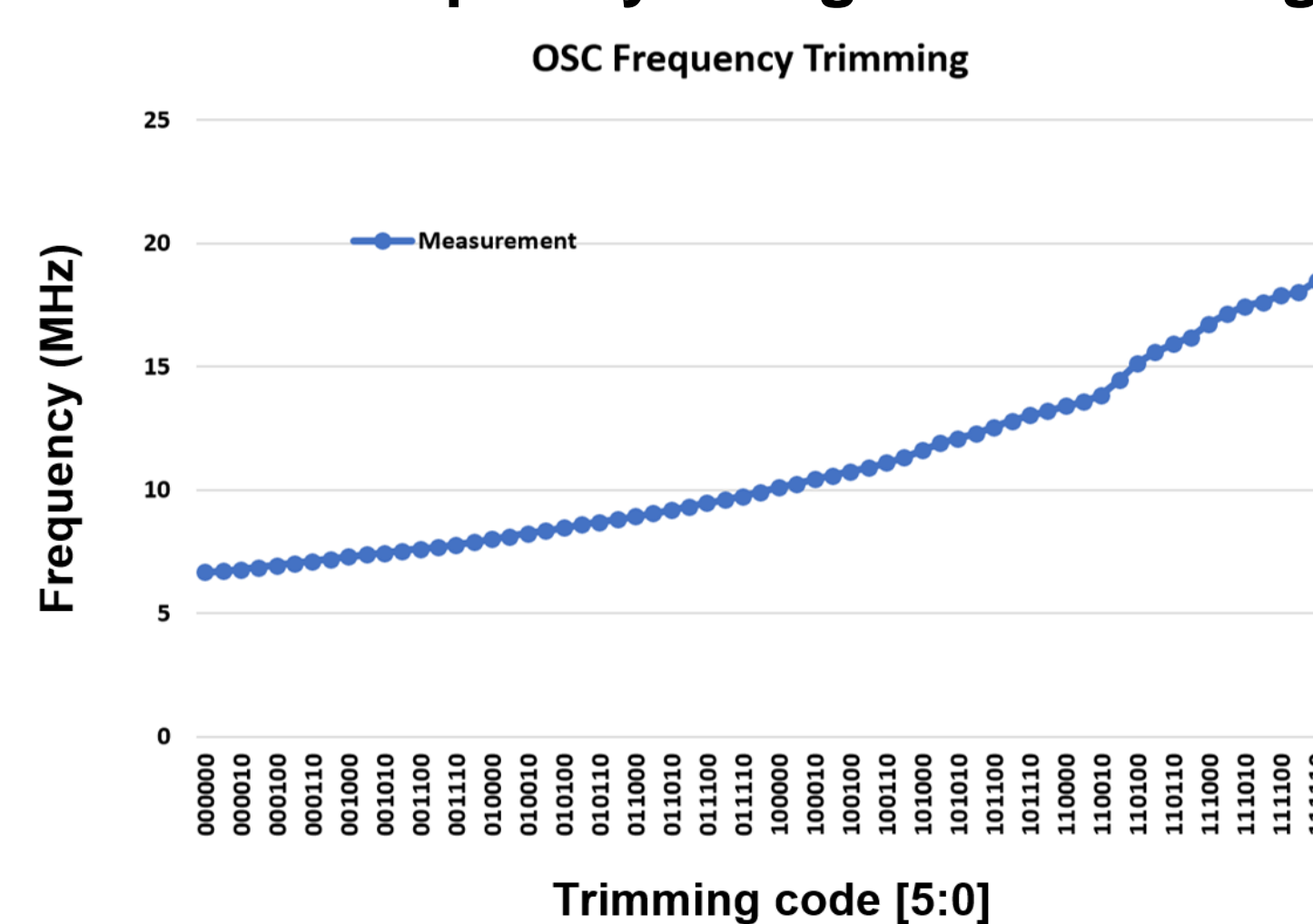
Supply voltage (V)

Oscillator frequency for process variation

Process variations

| 10.11 | 9.21 | 7.91 | 10.39 | 7.61 | 8.4 | 9.8 | 9.72 |
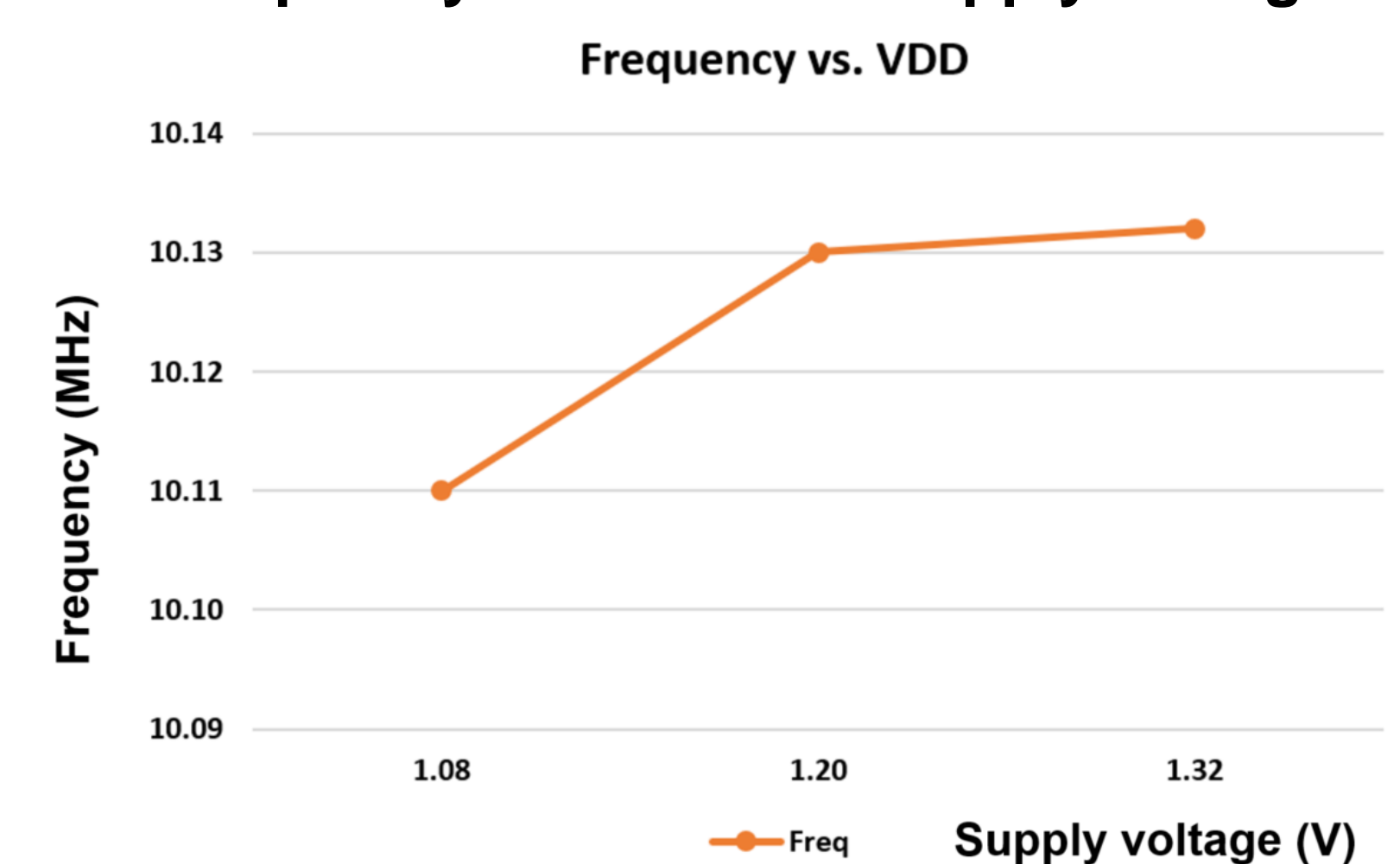
Frequency variation for temperature

Freq ±1%

Frequency (MHz) Frequency variation(%)

— Freq

Temperature (℃)
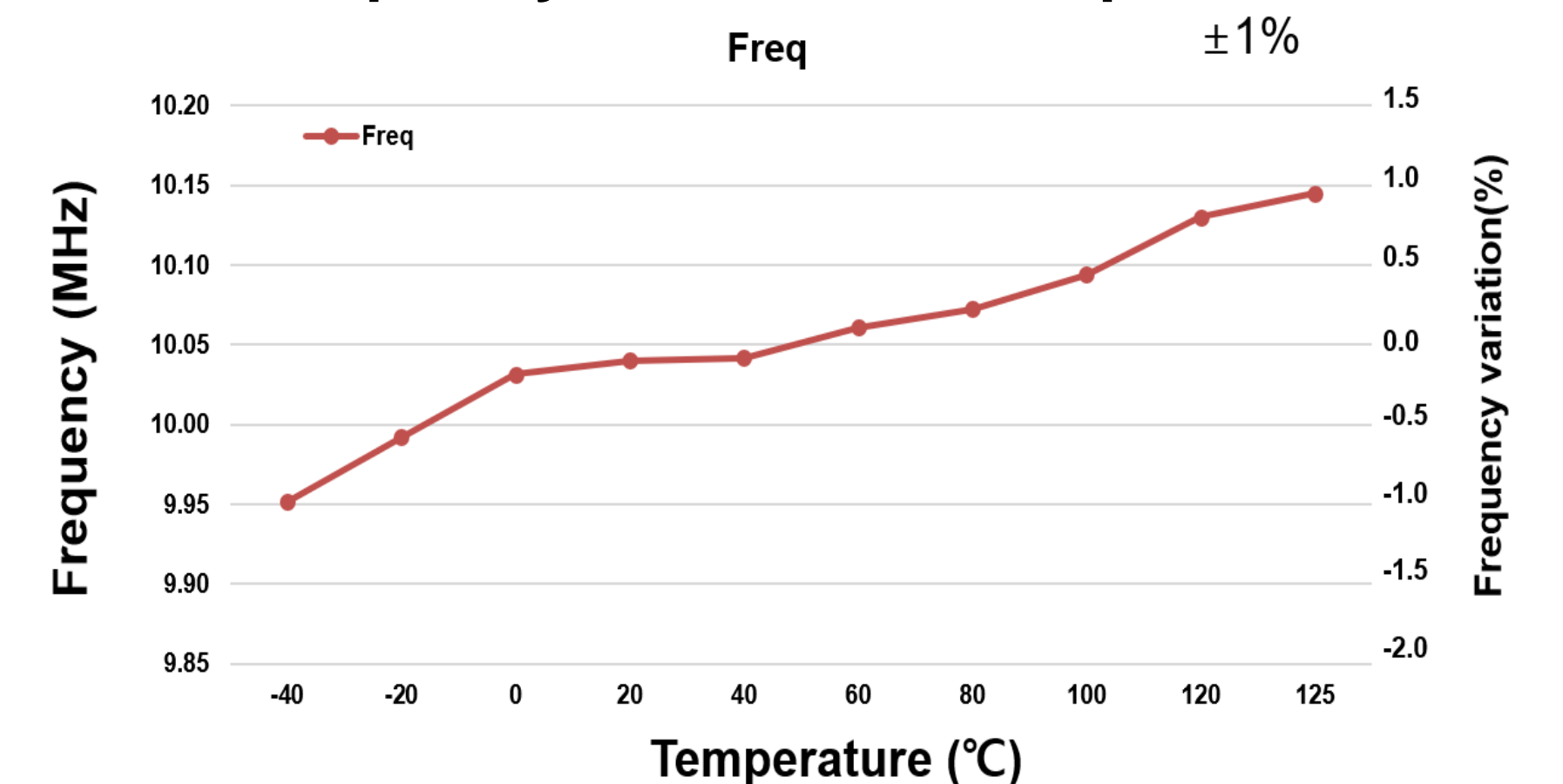
Symbol	Item	Condition	Specification			Post-simulation			Measurement			Unit	Note
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
F_{CLK}	Clock Frequency	Monte-Carlo with 3-sigma	9.5	10	10.5	9.91	10	10.13	7.61	9.14	10.39	MHz	Spec: Typ. ±5% Meas.: ±14%
ΔF_T	Temperature accuracy	1.8V, -40~125℃	9.5	10	10.5	9.96 (-0.25%)	9.98	10.01 (+0.25%)	9.95	10.13	10.15	MHz	Spec: Typ. ±5% Meas.: ±0.99%
ΔF_V	Voltage accuracy	1.62~1.98V, 25℃	9.5	10	10.5	9.88 (-1.2%)	9.98	10.02 (+1.2%)	10.11	10.13	10.13	MHz	Spec: Typ. ±5% Meas.: ±0.1%

* IDEC 지원