Errata

Erratum to "High-Power Radiation at 1 THz in Silicon: A Fully Scalable Array Using a Multi-Functional Radiating Mesh Structure"

Zhi Hu, Mehmet Kaynak, and Ruonan Han, *Senior Member, IEEE*

In the above article [1], in (19), a factor of 2 is missing. Equations (6), (8), and (19)–(27) are impacted by this error. The corrected text from the line above (19) in the Appendix of [1] is as follows:

Use (16)–(18) and let $k(\varphi) = (R_{\text{tank}}/Z_0 \tan\varphi)$, then we have

$$\sin\Delta\theta \approx \tan\Delta\theta = \frac{2Z_0\tan\varphi}{R_{\text{tank}}}\cdot\frac{\Delta A}{A_0} = 2k(\varphi)^{-1}\cdot\frac{\Delta A}{A_0} \quad (19)$$

which can be then substituted into (13) to give

$$\begin{aligned}\Delta v &= A_0\sin\Delta\theta\sqrt{1+\frac{1}{4}k(\varphi)^2}\cdot e^{j\left(\omega_0 t+\arctan(2k(\varphi)^{-1})\right)}\\ &\approx \frac{1}{2}A_0 k(\varphi)\sin\Delta\theta\cdot e^{j\omega_0 t + j2k(\varphi)^{-1}}.\end{aligned} \quad (20)$$

Note that $k(\varphi) \gg 1$, i.e., $R_{\text{tank}} \gg Z_0\tan\varphi$, is used in the above approximation.[1] Finally, we apply the Adler's equation in the case of modulated sinusoid injection, that is

$$\frac{d\theta_{\text{osc}}}{dt} = \omega_i - \omega_0 - \frac{\omega_i}{2Q}\cdot\frac{|i_{\text{inj}}|}{|i_{\text{osc}}|}\cdot\sin(\theta_{\text{osc}} - \theta_{\text{inj}}) \quad (21)$$

where ω_i is the resonance frequency of the tank of Oscillator 1 or 2. Using (12), (14), (15), and (20), we have $|i_{\text{inj},i}|/|i_{\text{osc},i}| \approx (1/2)k(\varphi)^2\cdot\tan\Delta\theta$, $\theta_{\text{osc}} = \angle v_0 = (\Delta A/A_0)\cdot\tan\Delta\theta \approx 0$, $\theta_{\text{inj},1} = 2k(\varphi)^{-1} + \pi/2 \approx \pi/2$ and $\theta_{\text{inj},2} = 2k(\varphi)^{-1} - \pi/2 \approx -\pi/2$. Therefore, we have the following equations for Oscillators 1 and 2:

$$0 = \omega_1 - \omega_0 - \frac{\omega_1}{2Q}\cdot\frac{1}{2}k(\varphi)^2\tan\Delta\theta\cdot\sin(0+\pi/2) \quad (22)$$

$$0 = \omega_2 - \omega_0 - \frac{\omega_2}{2Q}\cdot\frac{1}{2}k(\varphi)^2\tan\Delta\theta\cdot\sin(0-\pi/2). \quad (23)$$

Adding (22) and (23), we get

$$\omega_0 = \frac{\omega_1+\omega_2}{2} - \frac{\omega_1-\omega_2}{4Q}\cdot\frac{1}{2}k(\varphi)^2\tan\Delta\theta \approx \frac{\omega_1+\omega_2}{2} \quad (24)$$

with the approximation that

$$\omega_1 \gg \frac{\Delta\omega}{Q}\cdot k(\varphi)^2\tan\Delta\theta \quad \Leftrightarrow \quad \frac{\Delta\omega\cdot L_1}{Z_0\tan\varphi}\cdot\frac{\Delta A}{A_0} \ll 1 \quad (25)$$

which is readily satisfied. Meanwhile, by subtracting (23) from (22) and using $\omega_1 + \omega_2 \approx 2\omega_0$, we have

$$\omega_1 - \omega_2 = \frac{\omega_0}{Q}\cdot\frac{1}{2}k(\varphi)^2\tan\Delta\theta \quad (26)$$

which gives the phase difference between $v_1(t)$ and $v_2(t)$

$$2\Delta\theta = 2\arctan\left(2\cdot\frac{\omega_1-\omega_2}{\omega_0}\cdot Q\cdot\frac{Z_0^2\tan^2\varphi}{R_{\text{tank}}^2}\right). \quad (27)$$

In addition, we provide the corrected equation (6)

$$2\Delta\theta = 2\arctan\left(2\cdot\frac{\omega_1-\omega_2}{\omega_0}\cdot Q\cdot\frac{Z_0^2\tan^2\varphi}{R_{\text{tank}}^2}\right) \quad (6)$$

and the corrected equation (8)

$$2\Delta\theta' = 2\arctan\left(2\cdot\frac{\omega_1-\omega_2}{\omega_0}\cdot Q\cdot\frac{Z_0^2\cot^2\varphi}{R_{\text{tank}}^2}\right). \quad (8)$$

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References

[1] Z. Hu, M. Kaynak, and R. Han, "High-power radiation at 1 THz in silicon: A fully scalable array using a multi-functional radiating mesh structure," *IEEE J. Solid-State Circuits*, vol. 53, no. 5, pp. 1313–1327, May 2018.

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Zhi Hu was with the Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139 USA. He is now with Apple Inc., Cupertino, CA 95014 USA.

Mehmet Kaynak is with the Technology Group, IHP Microelectronics, 15236 Frankfurt (Oder), Germany.

Ruonan Han is with the Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA 02139 USA (e-mail: ruonan@mit.edu).

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[1] As a side note, $k(\varphi) \gg 1$ also indicates that the amount of injected current used to tune frequency is much larger than that for power injection.