

Segmented DAC Linearity Improvement With Layout Technique Using Magic Square

Masashi Higashino and Haruo Kobayashi

Division of Electronics and Informatics, Gunma University

● What's Magic Square ?

Constant sum



Good balance

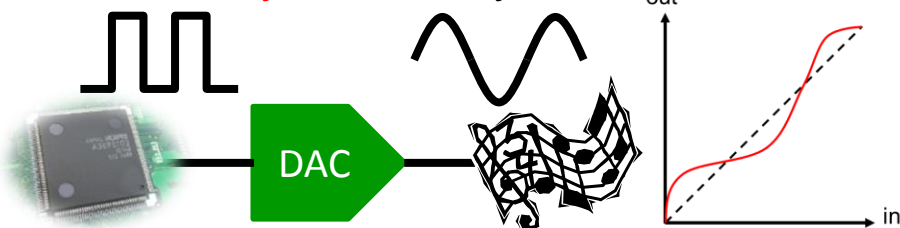
4	9	7	14
16	5	11	2
13	8	10	3
1	12	6	15



● Problem in Analog IC Design

Digital-to-Analog Converter (DAC)

non-linearity caused by element variations



● Propose

Layout of DAC elements
In **magic square** manner

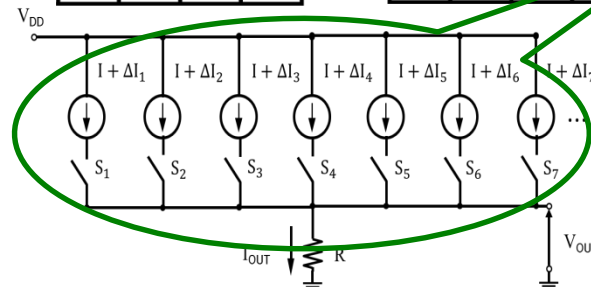
Random Walk

I ₁	I ₂	I ₃	I ₄
I ₅	I ₆	I ₇	I ₈
I ₉	I ₁₀	I ₁₁	I ₁₂
I ₁₃	I ₁₄	I ₁₅	I ₁₆

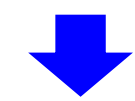


Magic Square

4	9	7	14
16	5	11	2
13	8	10	3
1	12	6	15



Cancel variations



Linear DAC characteristics 😊

