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Wu et al.

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- (54) **ADJUSTABLE VOLTAGE REGULATOR CIRCUITRY**
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- (56) **References Cited**
- U.S. PATENT DOCUMENTS
- | | | |
|-------------------|---------|--------------------------|
| 6,995,995 B2 | 2/2006 | Zeng et al. |
| 7,907,429 B2 | 3/2011 | Ramadass et al. |
| 9,658,666 B1 * | 5/2017 | Ghayal H02M 1/0043 |
| 10,439,492 B1 * | 10/2019 | Hsieh H02M 3/07 |
| 2007/0103994 A1 * | 5/2007 | Ahmed G11C 5/145 |
| | | 365/189.11 |
| 2018/0019667 A1 * | 1/2018 | Salem H02M 3/07 |

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OTHER PUBLICATIONS

Do Amaral et al, "Digital-LDO Switched Capacitors based for 0.5V applications," 2020 32nd International Conference on Microelectronics, Aqaba, Jordan, Dec. 14-17, 2020, doi: 10.1109/ICM50269.2020.9331773. Obtained on Mar. 27, 2024. (Year: 2020).*

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(Continued)

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(57) **ABSTRACT**

(51) **Int. Cl.**
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 G05F 1/46 (2006.01)
 H02M 1/00 (2007.01)

An adjustable voltage regulator circuit, including a voltage conversion circuit, a voltage conversion controller, and a clock generator, is provided. The voltage conversion circuit receives an input voltage to generate an output voltage. The voltage conversion controller detects the output voltage. The voltage conversion controller compares the output voltage with a reference voltage value, and outputs an enable signal based on a comparison result to control the voltage conversion circuit to adjust the output voltage. The clock generator generates a first clock signal and a second clock signal to respectively drive the voltage conversion circuit and the voltage conversion controller. The voltage conversion controller adjusts the enable signal to gradually adjust the output voltage to a predetermined voltage range.

(52) **U.S. Cl.**
 CPC H02M 3/07 (2013.01); G05F 1/465 (2013.01); H02M 1/0012 (2021.05)

(58) **Field of Classification Search**
 CPC H02M 1/0012; H02M 3/07-078; G05F 1/465; G05F 1/618; G11C 5/14; G11C 5/143-148

See application file for complete search history.

15 Claims, 13 Drawing Sheets

