

(21) Application No: **2312999.2**
 (22) Date of Filing: **24.03.2022**
 Date Lodged: **25.08.2023**
 (30) Priority Data:
 (31) **17212651** (32) **25.03.2021** (33) **US**
 (86) International Application Data:
PCT/GB2022/050744 En 24.03.2022
 (87) International Publication Data:
WO2022/200800 En 29.09.2022

(51) INT CL:
H02M 3/07 (2006.01) **G05F 1/613** (2006.01)
H02M 1/00 (2006.01)
 (56) Documents Cited:
US 20210057992 A1 **US 20210013798 A1**
US 20110068857 A1 **US 20060145748 A1**
TAN YI ET AL, "A Discrete-Time Model for Frequency Modulated Charge Pumps with Synchronized Controller", 2020 IEEE 63RD INTERNATIONAL MIDWEST SYMPOSIUM ON CIRCUITS AND SYSTEMS (MWSCAS), IEEE, (20200809), doi:10.1109/MWSCAS48704.2020.9184537, pages 929 - 932.
LUO ZHICONG ET AL, "Regulated Charge Pump With New Clocking Scheme for Smoothing the Charging Current in Low Voltage CMOS Process", IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS I: REGULAR PAPERS, US, vol. 64, no. 3, doi:10.1109/TCSI.2016.2619693, ISSN 1549-8328, (20170301), pgs 528 - 536, (20170223)

(71) Applicant(s):
Lion Semiconductor Inc.
332 Townsend St, San Francisco, CA 94107,
United States of America
 (72) Inventor(s):
Hans Meyvaert
 (74) Agent and/or Address for Service:
Haseltine Lake Kempner LLP
One Portwall Square, Portwall Lane, BRISTOL,
BS1 6BH, United Kingdom

(58) Field of Search:
 INT CL **H02M**
 Other: **EPO-Internal, WPI Data**

(54) Title of the Invention: **DC voltage converters**
 Abstract Title: **DC voltage converters**

(57) This application relates to methods and apparatus for DC voltage conversion. A DC converter (100) is described, with a charge pump circuit comprising a plurality of charge pump stages (1401, 1402-2, 1402-2) each charge pump stage comprising connections for respective first and second capacitors for that stage (C1A, C1B; C2A, C2B; C3A, C3B). The charge pump also has a switch network, wherein the switch network comprises, between each successive stage, four switching paths (S7AA, S7AB, S7Ba, S7BB; S6AA, S6AB, S6Ba, S6BB) for separately connecting a respective first electrode of each of the first and second capacitors of one stage to a first electrode either of the first and second capacitors of the preceding stage, so that the relevant capacitor of the one stage can be charged by the relevant capacitor of the preceding stage.

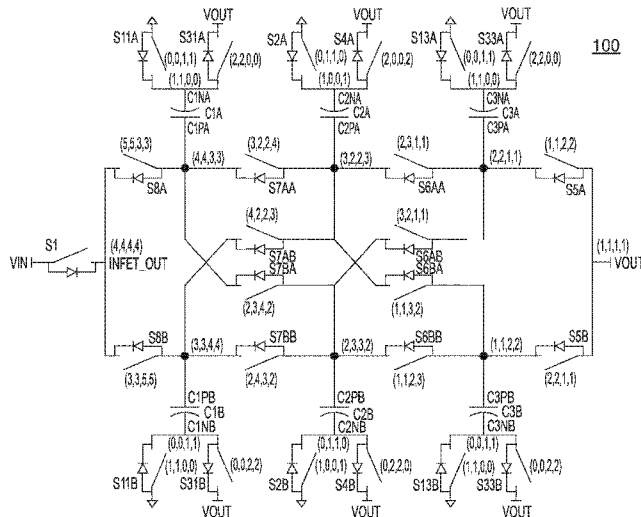


FIG. 2