

Multi-phase Low Dropout Voltage Regulator

IITM Technology Available for Licensing

Problem Statement

- As smartphones and tablets become more feature-rich, they **require more power supplies**. These power supplies are typically regulated by either **linear low-dropout (LDO) regulators** or **switching DC-DC converters**.
- While switching converters are efficient for high power, LDOs are more cost-effective for low power applications.
- The challenge is to make **LDOs more efficient & compact**, especially in small devices like mobile phones.
- Traditional LDO designs require **external components** like output capacitors, making them **less space-efficient**. Digital LDOs have been used but come with **accuracy and performance trade-offs**.
- Hence, New solutions are needed to create LDOs that are **smaller, more efficient, and adaptable for various power needs in battery-powered devices**. The present patent discloses a **Multi-phase Low Dropout Voltage Regulator** that address above mentioned issues.

Technology Category/ Market

Categories: Electronics & Circuits | Internet of Things (IoT)

Industry: semiconductor and electronics industry, Industrial power management

Applications: improving power efficiency and voltage stability in consumer electronics, telecommunications, automotive, industrial equipment, and various other industries requiring precise power management, having a wide-ranging use cases from portable devices to renewable energy systems.

Market: The global low dropout voltage regulators (LDO) market is projected to grow from **USD 1.02 B in 2017 to USD 2.06 B by 2030**, at **7.5% CAGR** from 2017 to 2030.

Technology

The instant patent invention discloses a **multi-phase low dropout (LDO) voltage regulator system and method**, enabling better power management and longer battery life. It uses multiple phases, feed-forward compensation, and master-slave control, designed to **efficiently regulate & stabilize voltage** in electronic devices and system.

The method adjusts phases based on load conditions, ensuring stable voltage and better performance. **Refer FIG 1, 2 and 3.**

FIG. 1 shows a circuit diagram of slave LDO.

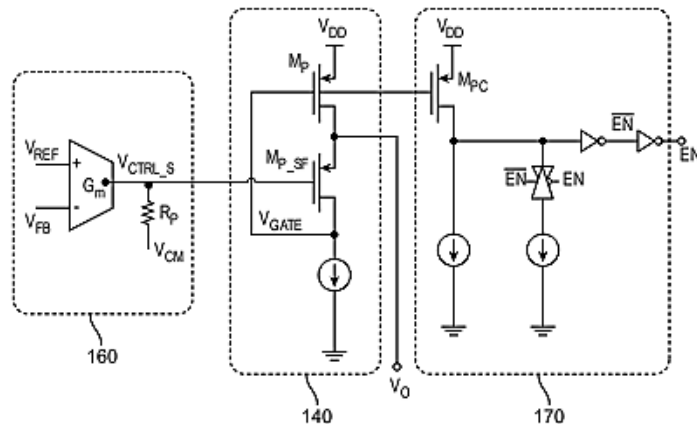
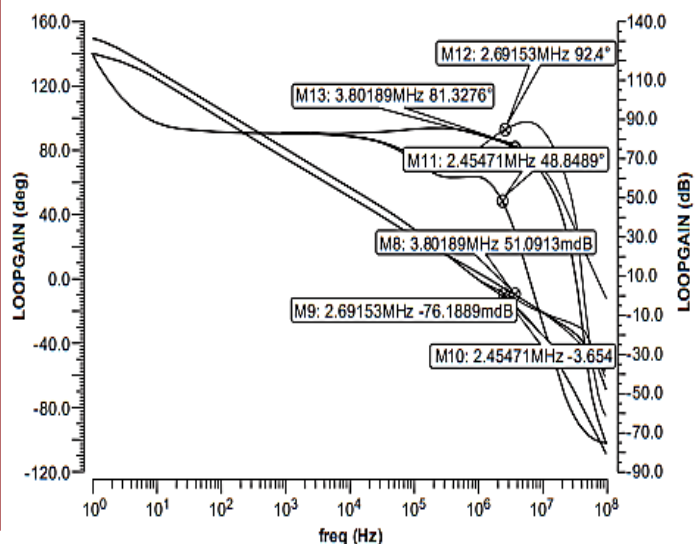


FIG. 2 shows stability response of proposed LDO.



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Multi-phase Low Dropout Voltage Regulator

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The multi-phases voltage regulator device comprises:

- An output stage that adjusts voltage based on load current.
- A feedback stage with oscillators for precise voltage control and a compensating unit.
- A regulating stage that manages phases based on load conditions, ensuring stable voltage.
- Each phase has a phase frequency detector and charge pump for accuracy.
- A loop filter and pass elements maintain a regulated output voltage.
- In this device, the compensating unit can use trans-conductance elements to control the output voltage.

Method of operating multi-phase LDO regulator

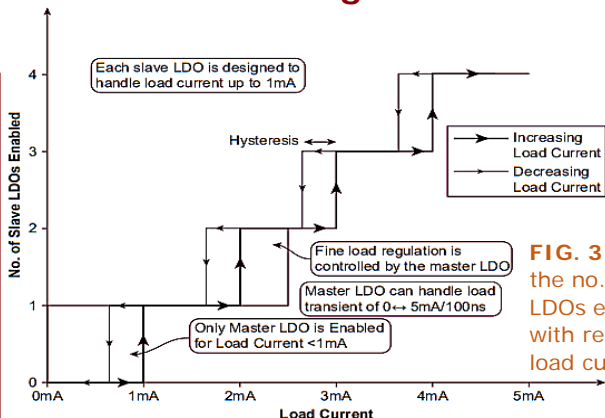
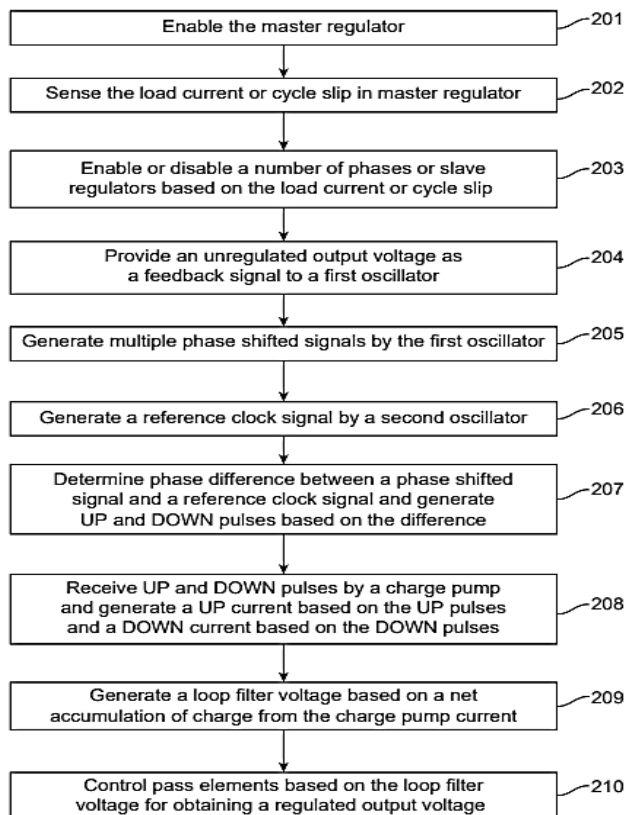


FIG. 3 shows the no. of slave LDOs enabled with respect to load current.

Key Features / Value Proposition

❖ User Perspective:

- Ensures **stable power for devices**, reducing voltage-related issues. It saves power, **prolonging battery life** and **lowering energy costs**. It Reacts quickly to power changes, improving performance.

❖ Technical Perspective:

- **Multiple Phases:** Manages load changes effectively, ensuring voltage stability.
- **Precise Control:** Advanced compensation for accurate voltage regulation.
- **Noise Resistance:** Minimizes the impact of external voltage variations.

❖ Industrial Perspective:

- Fits in **various industries**, maintaining precise power control, having **Balances efficiency & affordability**, helping promote sustainability in electronics.

Intellectual Property

IITM IDF Ref. 1696;
Patent No. 383434;
PCT No.: PCT/IN2019/050650

TRL (Technology Readiness Level)

TRL- 4, Validated in Lab

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