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# Advanced Linear EAPP Digital 6-Phase Green PWM Controller for Digital Power Management With NVM and AUTO Phase Shedding

## ISL6388

The ISL6388 is a **smart** and **smallest** 6-Phase **Green** PWM controller, designed to be compliant to Intel VR12.5/VR12 specifications and control the microprocessor core or memory voltage regulator. It includes programmable functions and telemetries for easy use, system flexibility and over-clocking applications using SMBus, PMBus, or I<sup>2</sup>C interface, which is designed to be conflict free with CPU's SVID bus and to program NVM banks up to 8 different compensations and system parameters. This **minimizes** external components and significantly reduces design complexity and PCB area, and **simplifies** the manufacturing process.

The ISL6388 utilizes Intersil's proprietary **Advanced Linear EAPP** (Enhanced Active Pulse Positioning) **Digital** control scheme to achieve the extremely fast linear transient response with fewer output capacitors and overcomes many hurdles of traditional digital approach, which uses non-linear, discrete control method for both voltage loop and current balance loop and runs into beat frequency oscillation and non-linear response. The ISL6388 accurately monitors the load current via the IMON pin and reports this information via the I<sub>OUT</sub> register to the microprocessor, which sends a PSI# signal to the controller at low power mode via SVID bus. The controller enters 1- or 2-phase operation in low power mode (PSI1); in the ultra low power mode (PSI2, PSI3), it operates in single phase with diode emulation option. In low power modes, the magnetic core and switching losses are significantly reduced, yielding high efficiency at light load. After the PSI# signal is de-asserted, the dropped phase(s) are added back to sustain heavy load transient response and efficiency. In addition, the ISL6388 features auto-phase shedding to optimize the efficiency from light to full load for **Greener Environment** without sacrificing the transient performance.

The ISL6388 senses the output current continuously by a dedicated current sense resistor or the DCR of the output inductor. The sensed current flows through a digitally programmable 1% droop resistor for precision load-line control. Current sensing circuits also provide the needed signals for channel-current balancing, average overcurrent protection and individual phase current limiting. The TM pin senses an NTC thermistor's temperature, which is internally digitized for thermal monitoring and for integrated thermal compensation of the current sense elements of the regulator.

The ISL6388 features remote voltage sensing and completely eliminates any potential difference between remote and local grounds. This improves regulation and protection accuracy. The threshold-sensitive enable input is available to accurately coordinate the start-up of the ISL6388 with other voltage rails.

## Features

- Intel VR12.5/VR12 compliant for core and memory
  - Programmable IMAX, TMAX, BOOT, DVID rate, address
- SMBus/PMBus/I<sup>2</sup>C compatible
  - Up to 1.5MHz bus interface with SVID conflict free
  - NVM to store up to 8 configurations with programmable frequency, droop, auto, faults (OCP, UVP, CFP), etc.
  - No firmware required and hassle free with checksum
- **Advanced Linear EAPP Digital** control scheme (patented)
  - Digitally programmable compensation
  - Auto phase shedding option for greener environment
  - Variable frequency control during load transients to reduce beat frequency oscillation
  - Linear control with evenly distributed PWM pulses for better phase current balance during load transients
  - Voltage feed-forward and ramp adjustable options
  - High frequency and PSI compensation
  - Active phase adding and dropping with diode emulation scheme for enhanced light load efficiency
- Phase doubler and coupled-inductor compatibility
- Differential remote voltage sensing with ±0.5% accuracy
- Programmable 1- or 2-phase operation in PSI1 mode
- Programmable slew rate of fast dynamic VID with dynamic VID compensation (DVC)
- Support 5V PWM or 3.3V PWM DrMOS and driver
- Zero current shutdown with ISL6627
- Precision resistor or DCR differential current sensing
  - Accurate load-line (Droop) programming and control
  - Accurate current monitoring and channel-current balancing with calibration capability
- True input current sensing for catastrophic failure protection
- Average overcurrent protection and channel-current limiting
- High common mode current sense input (VCC-1.5V)
- Open sensing and single point of loop failure protection
- Thermal monitoring and integrated compensation
- 1- to 6-Phase option and up to 2MHz per phase
- Start-up into pre-charged load
- Pb-Free (RoHS Compliant) 40 Ld 5x5 Plastic Package

## Applications

- Core and memory for Intel VR12/VR12.5 based processor
- High performance server core or memory rail
- High performance graphic rail
- High-end desktop with over-clocking option

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