A bandgap for PM applications

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A bandgap that generates the following reference voltages:
- Bandgap voltage: ~ 1.24V
- 1.2V, 1.1V, 1.0V, ……0.1V

Temperature range: -40°C - 130°C

Very small variance of output voltages vs. temperature: 0.1%

High PSRR: -90dB at low frequency and high frequency, -50 dB at intermediate frequencies. Can be further improved by adding a modular supply filter.
- Very low variance vs supply voltage: <10mV
- Can be floated.
- Very low current consumption: 10uA
- High voltage supply dynamic range 4.5V – 42V
Principle

\[ I_{Q1} = I_{Q2} \]
\[ V_{bg} = V_{be1} + V_{R2} \]
\[ V_{R2} = I_{R2} \cdot R_2 = 2 \cdot I_{R1} \cdot R_2 = 2 \cdot V_{R1} \cdot \frac{R_2}{R_1} \]
\[ V_{R1} = V_{be1} - V_{be2} = \Delta V_{be} = \frac{kT}{q} \ln \left( \frac{J_{C1}}{J_{C2}} \cdot \frac{R_2}{R_1} \right) = \frac{kT}{q} \ln (N) \cdot \frac{R_2}{R_1} \]
\[ V_{bg} = V_{be1} + 2 \cdot \frac{kT}{q} \ln (N) \cdot \frac{R_2}{R_1} \]
Variation vs. temperature of the bandgap voltage
Variation vs. temperature of the 1.0V output voltage
Monte Carlo Simulation
Current consumption  @T=50 deg supply = 5V

Consumption vs. temperature

Consumption vs. supply voltage
Variation of the bandgap voltage. Vs. supply voltage $T=50$ deg
Variation of the 1.0v output vs. temperature
PSRR

Without supply filter

With supply filter

8.792 kHz | 69.208 dB

freq (Hz)
Layout

309 µ

593 µ
Measurement results
Measurements

Temperature dependency

Site 7

-50 0 50 100 150

BGREF

Site 8

-50 0 50 100 150

BGREF
DC PSRR

Bandgap voltage vs. High Voltage graph.