Do We Need to Progress Towards GHz Switching in High Power Systems and Applications?

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APEC, Rap Session 2, March 28th 2017
Linear vs. SMPS Market Adoption

Based on AC-DC unit shipments

Year

Market Share

'65 '70 '75 '80 '85 '90 '95 '00 '05 '10 '15

Linear

SMPS

1st commercial SMPS designs

1st PWM analog control IC

HEXFET™ Intro

20% → 70% adoption growth over a 10 year period

Source: Darnell Group, March 2016
Time for Another Disruption...

Linear Regulators → 25 kHz Switching Regulators → 100 kHz Switching Regulators → 3 MHz Switching Regulators

- **Power Density (W/in³)**
  - 0.5 W/in³
  - 1.5 W/in³
  - 10 W/in³
  - 30 W/in³

- **Improvements**
  - 2x Lower Losses
  - 2x Lower $/W
  - 3x Increase in 5 years
  - <5%/yr power loss improvements
  - <5%/yr $/W improvement
  - 5%/yr improvement over 35 years

- **Switching Regulators**
  - 25 kHz
  - 100 kHz
  - 3 MHz
High-Voltage Power Transistors

Performance Figure of Merit

Bipolar
Silicon FET
GaN FET

Silicon FET
GaN FET

600V Silicon RxQoss
600V GaN RxQoss
600V Silicon RxQg
600V GaN RxQg
Magnetics Frequencies – 10x Every Decade

\[ F_{3/4} = B f^{3/4} \text{ (T Hz}^{3/4}) \]

\[ P_v = 500 \text{ mW/cm}^2 \]

- **ML91S** (Hitachi Metal) ~2010s
- **3F35** (Ferroxcube) ~2015s
- **3C90** (Ferroxcube) ~2000s
- **67** (Fair-Rite) ~2010s

Future


High-Frequency SMPS Market Adoption

20% → 70% adoption growth over a 10 year period

SMPS
(100 kHz hard switching)

High-Freq SMPS
(300 kHz – MHz+ resonant)

Based on AC-DC unit shipments
Source: Navitas Semi estimates, March 2016

1st commercial HF SMPS designs
1st GaN FET
AllGaN™ IC

0%
20%
40%
60%
80%
100%

Market Share

Year
'05 '10 '15 '20 '25 '30 '35 '40 '45