GaN-on-Si in Power Conversion

Alex Lidow, CEO

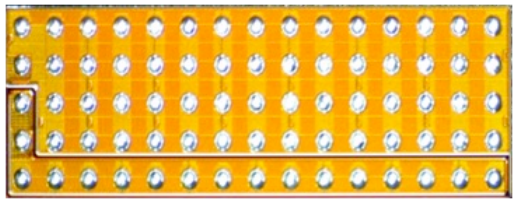
October 2016

Agenda

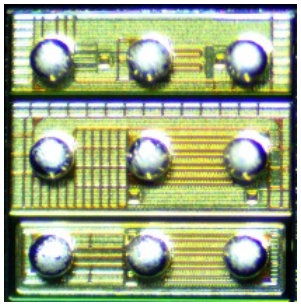
- How far have we come?
- What paths are we taking?
- Where is the leverage for integration?
- The road ahead.

Fast Moving Technology

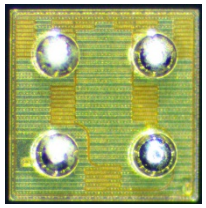
Gen 1,2,3,4 FETs and ICs
2010-2015
30 V - 450 V



Higher Scale
Integrated Circuits



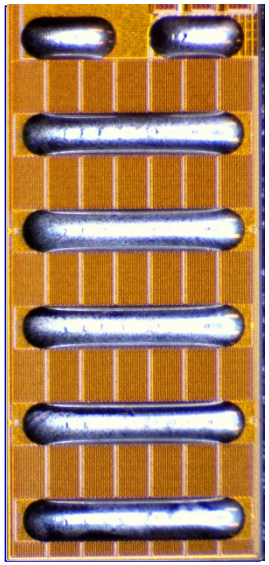
Generation 5
Smaller, Faster, Less Cost



Gen 5: ½ size and 2X performance

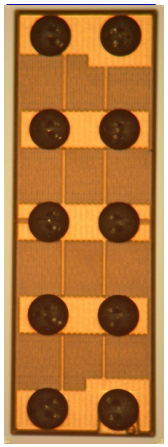
EPC2010C
25 mOhm

6.06 mm2



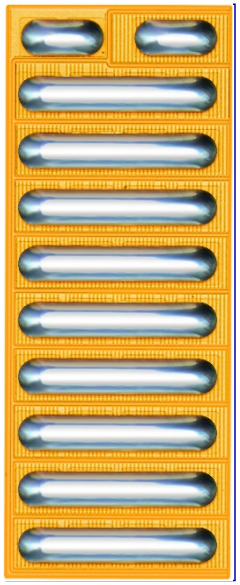
EPC2046
25 mOhm

2.82 mm2



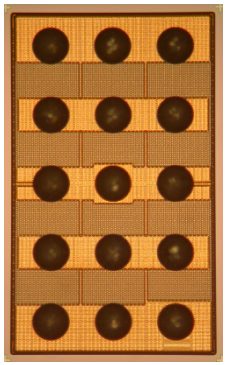
EPC2001C
7 mOhm

6.99 mm2



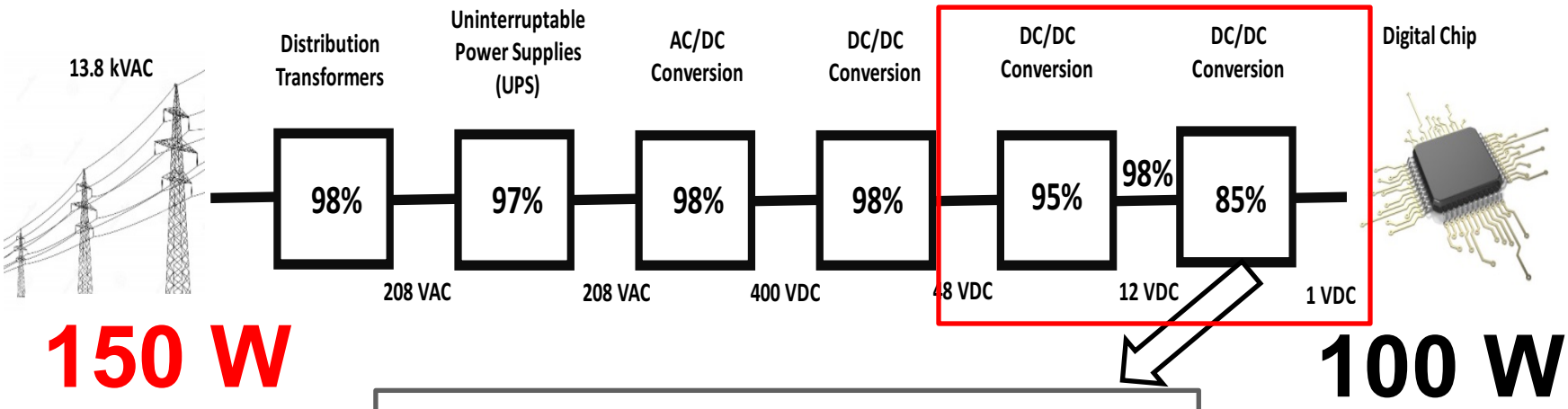
EPC2045
7 mOhm

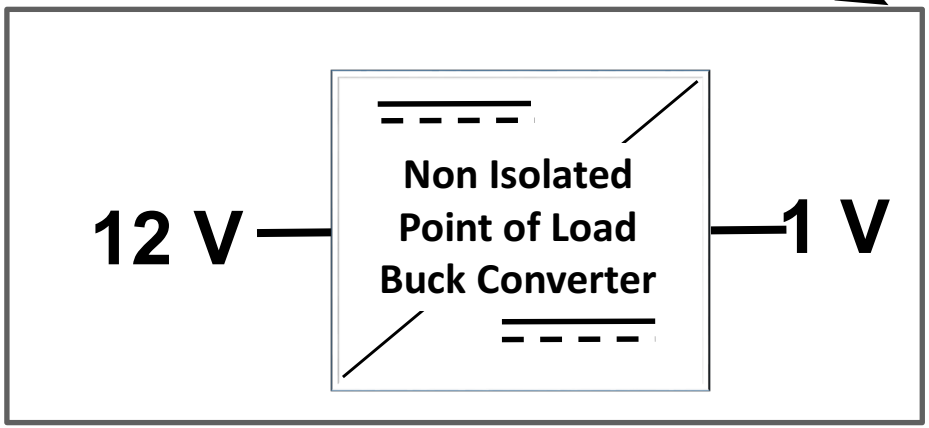
3.96 mm2



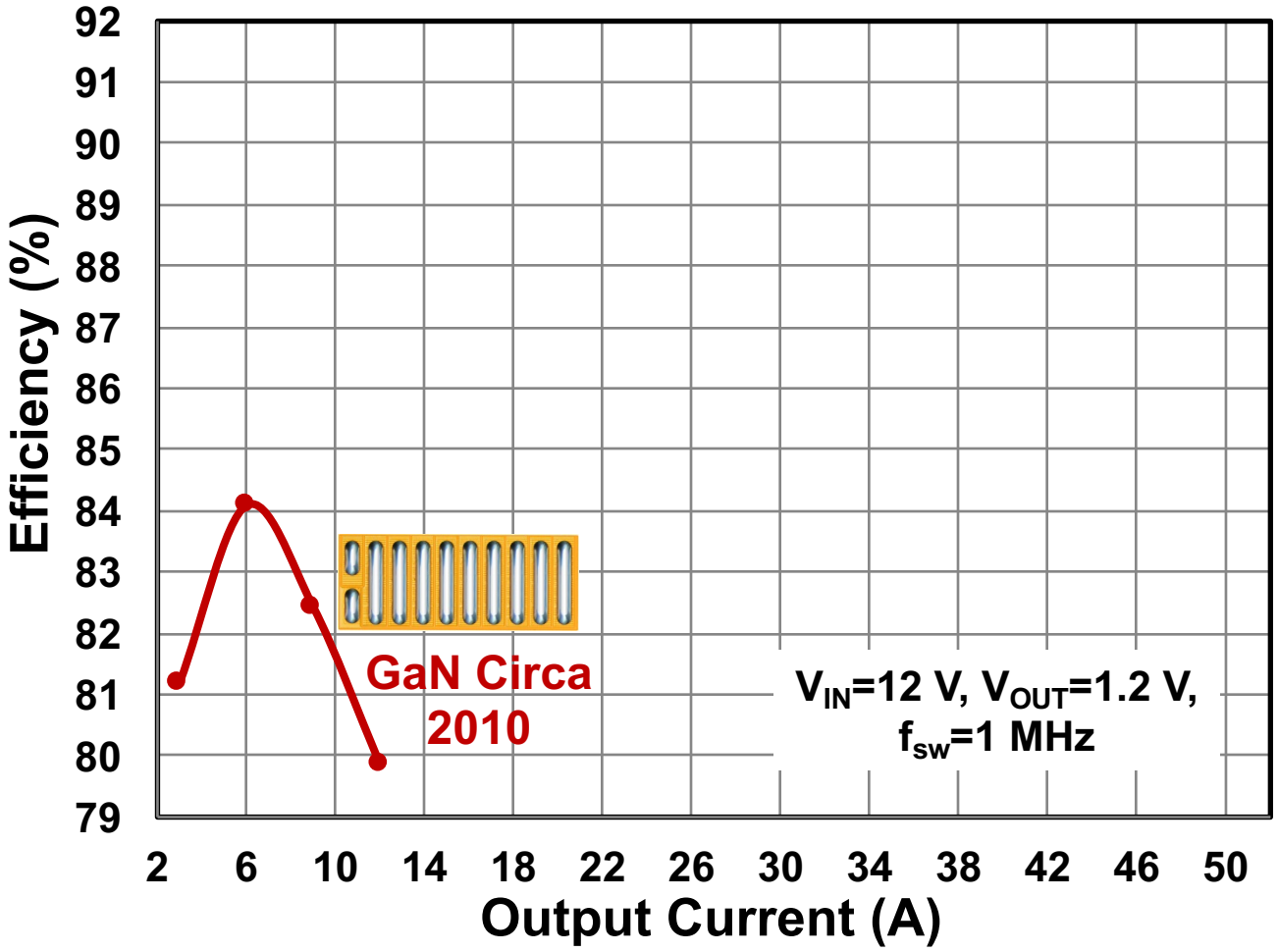
Coming October 31, 2016

79% Efficient

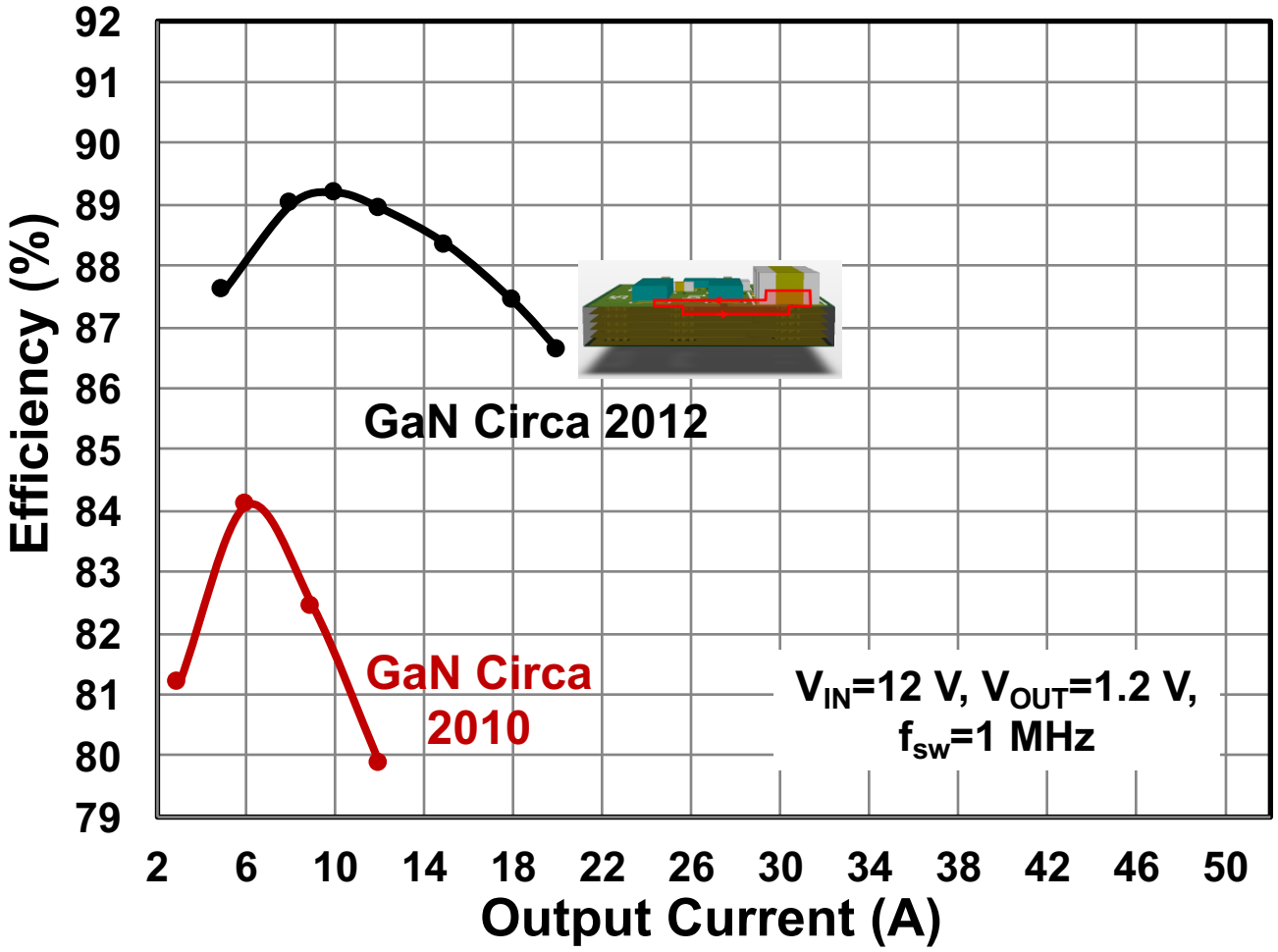




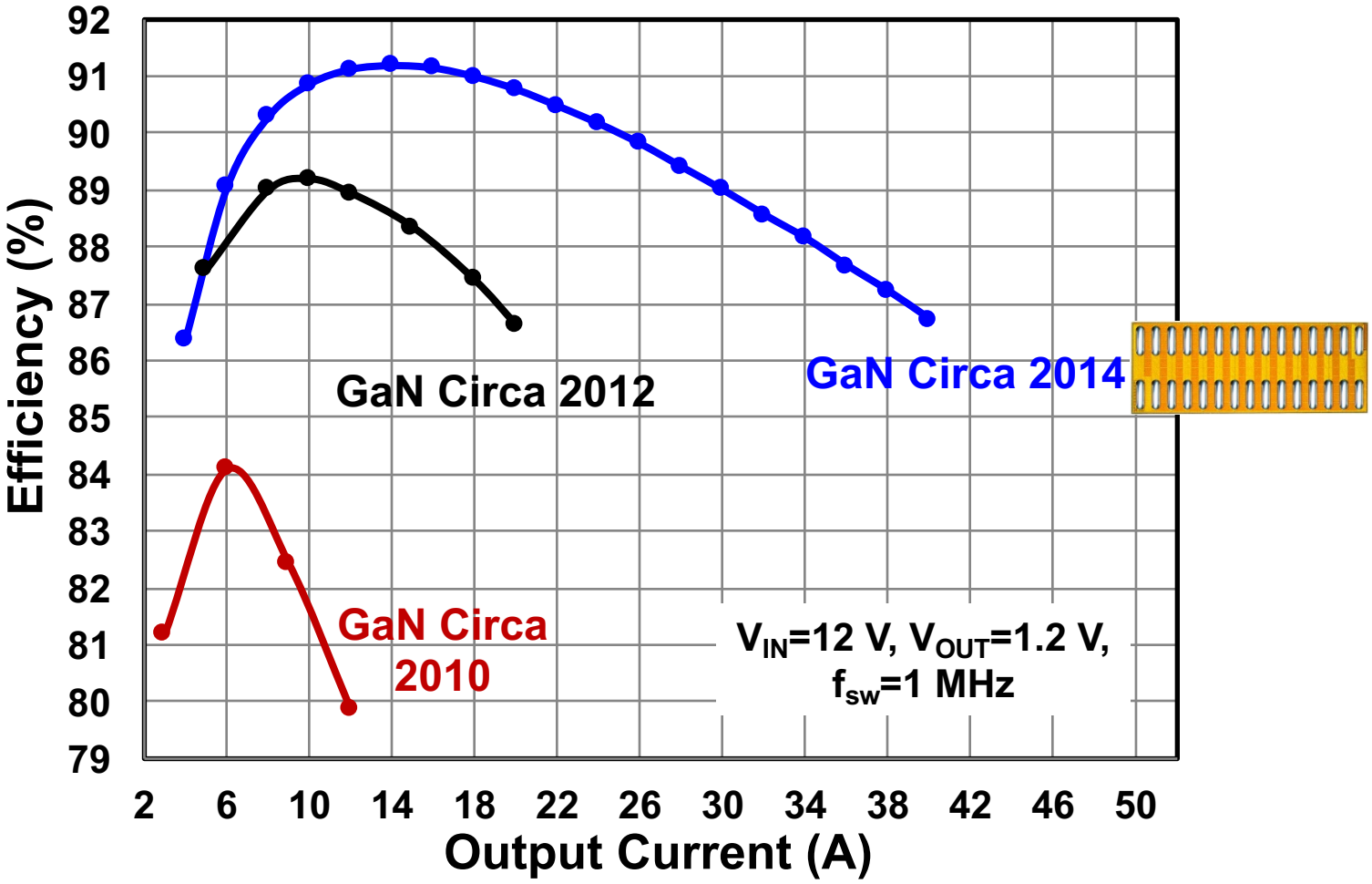
First Generation eGaN® FET



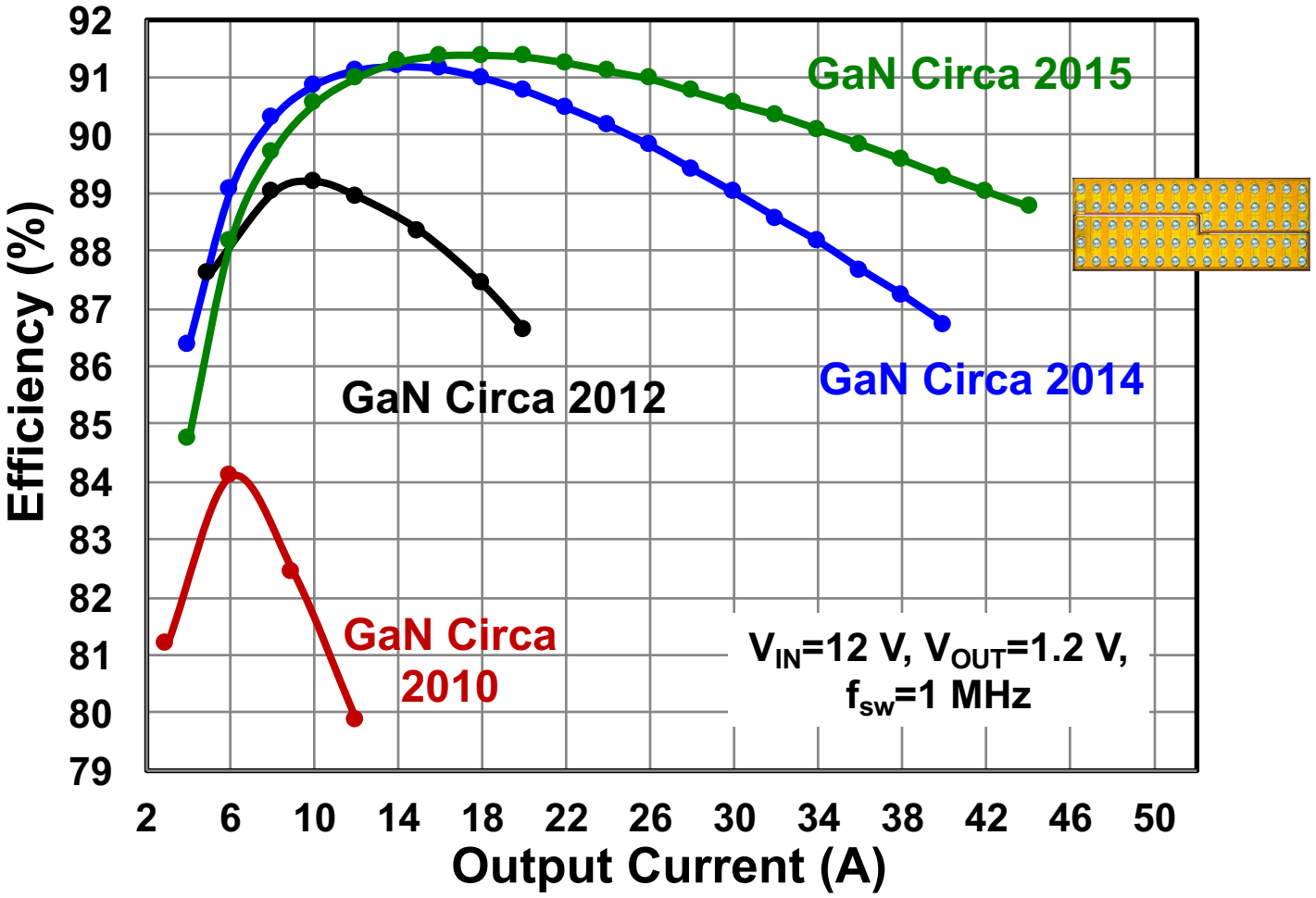
Improved Layout



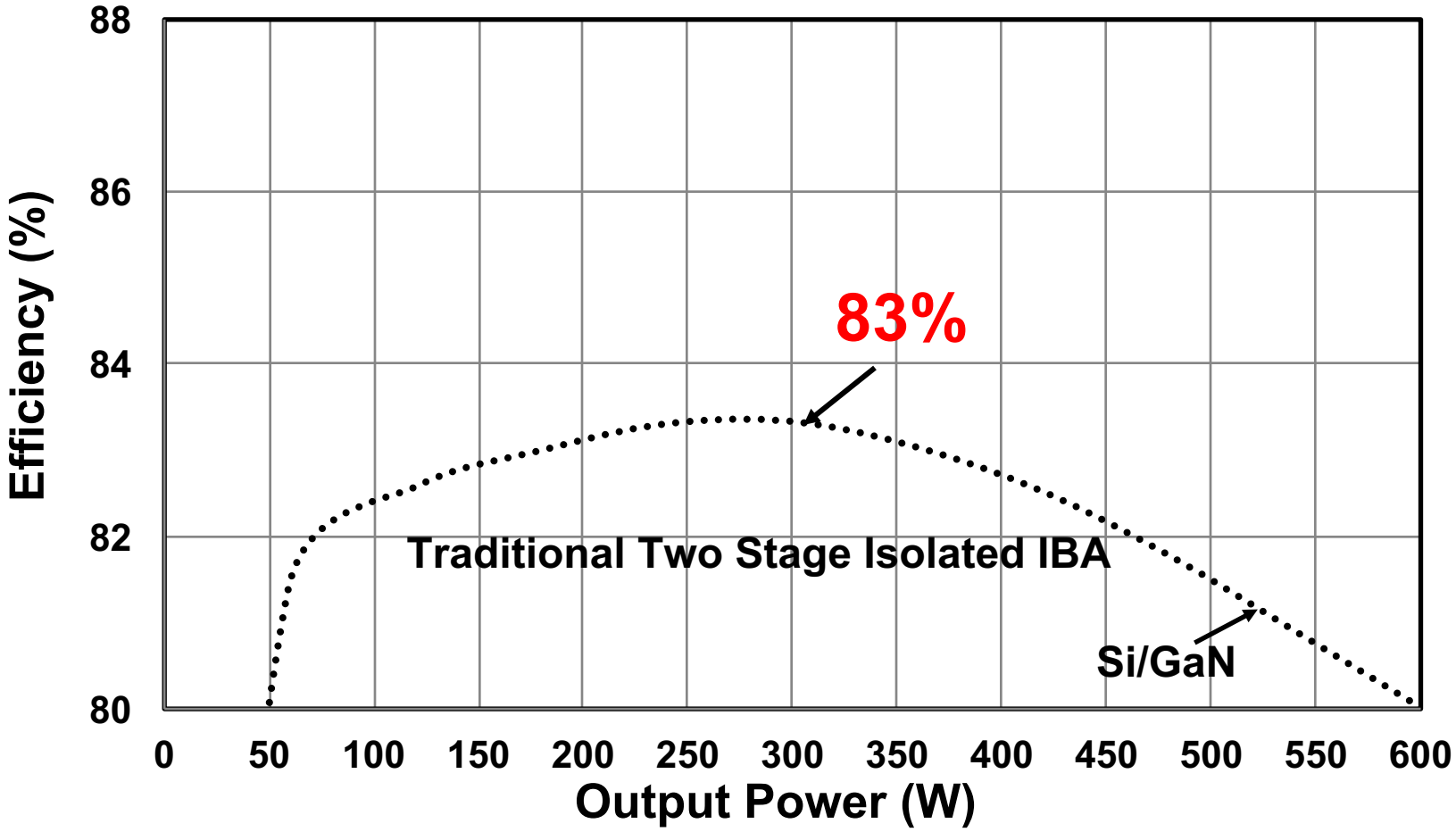
Fourth Generation eGaN FET



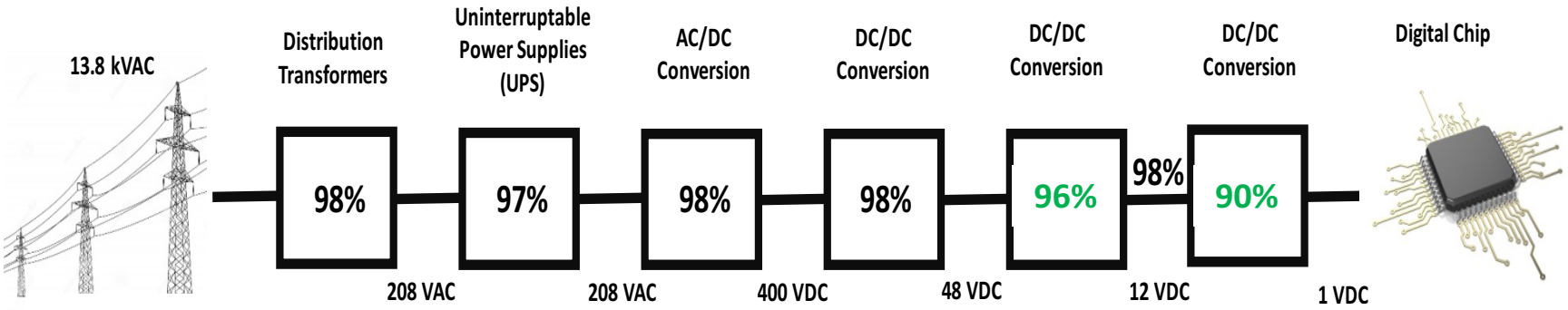
Monolithic Half Bridge



Silicon IBC and GaN POL



eGaN FETs and ICs

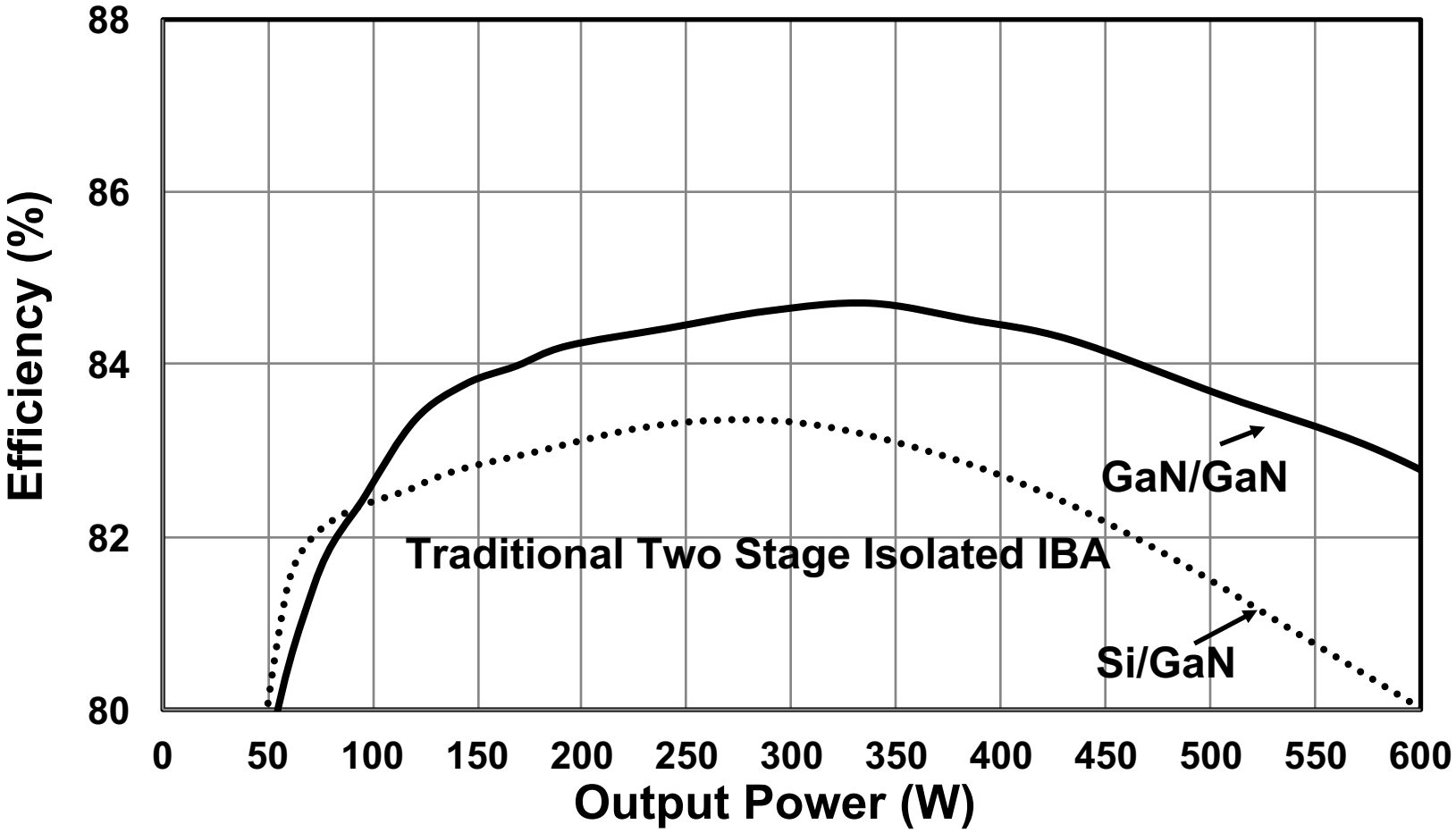


140 W

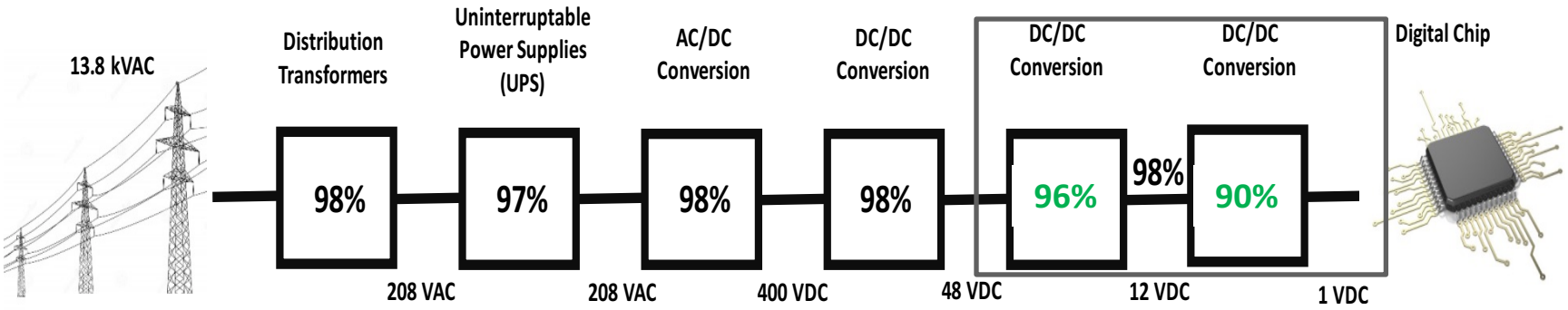
85% Efficient

100 W

eGaN FETs and ICs



Eliminate 12 V Bus



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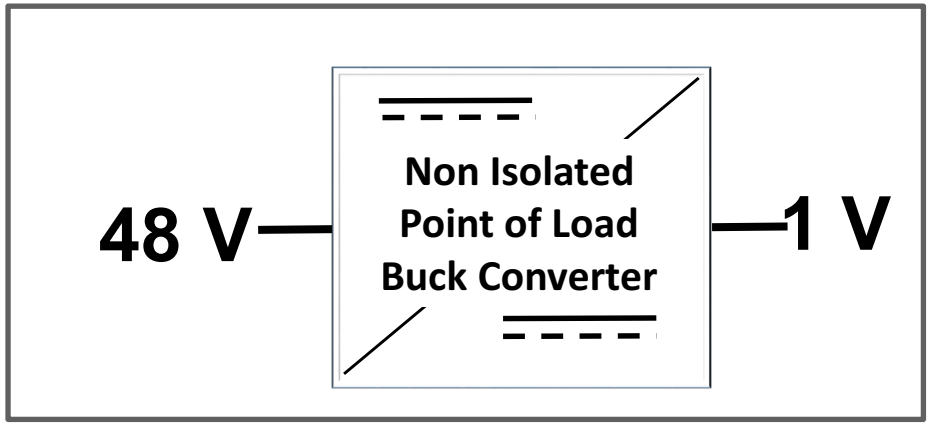
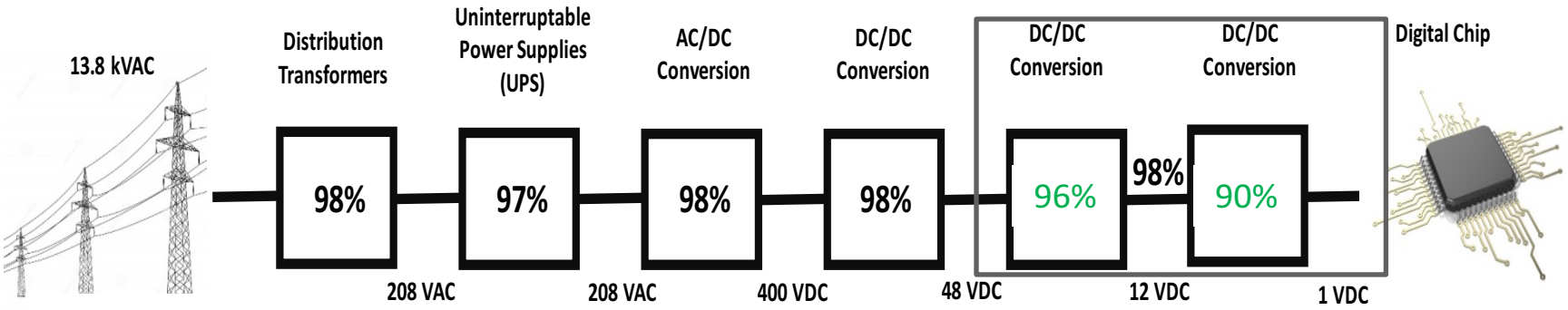
One Stage Conversion



Eliminate 12 V Bus



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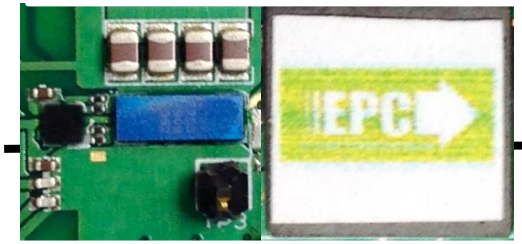
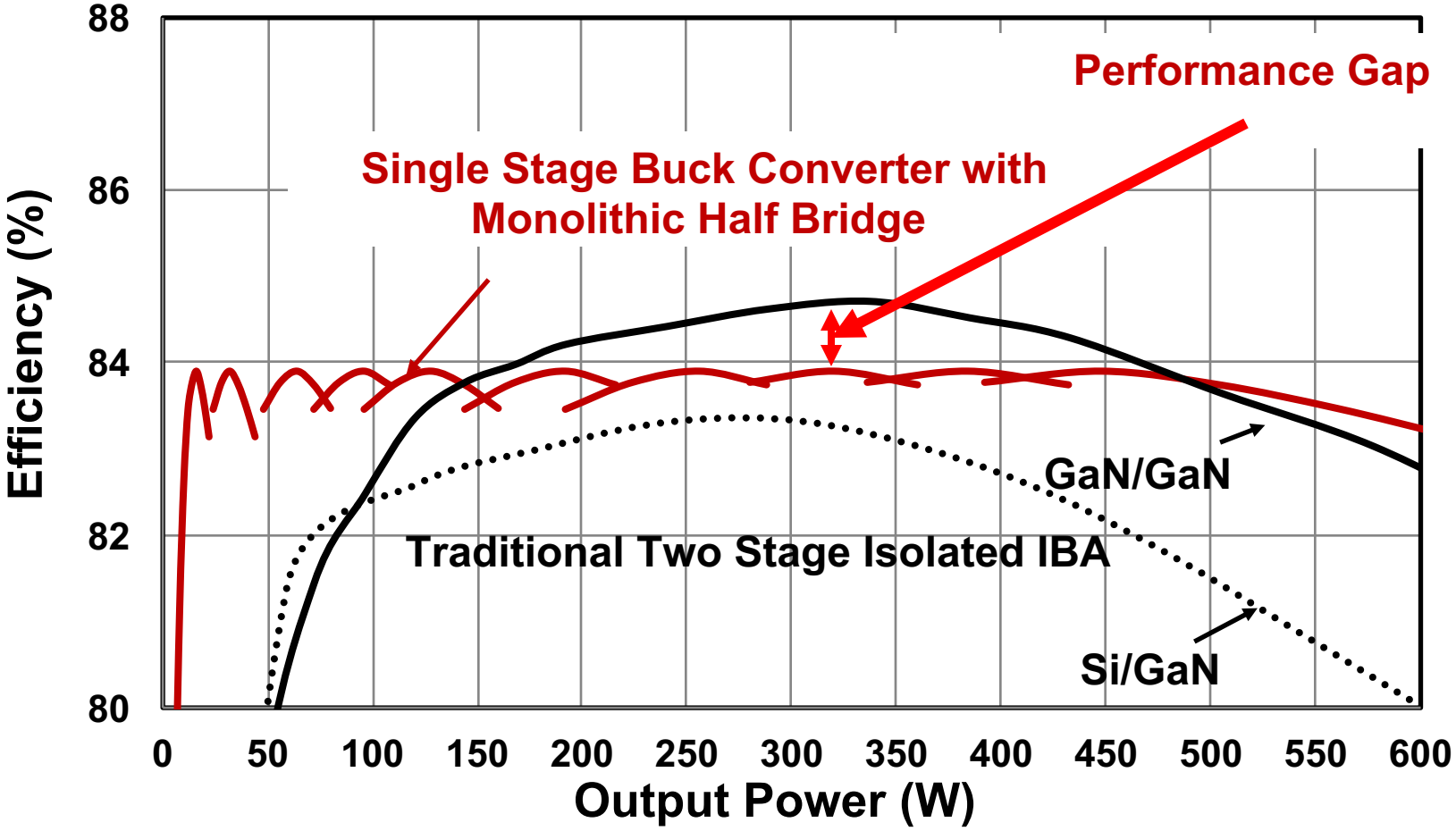
One Stage Conversion

48 V  **1 V**

Monolithic Half Bridge


Performance Gap
Single Stage Buck Converter with
Monolithic Half Bridge
GaN/GaN
Traditional Two Stage Isolated IBA
Si/GaN
Efficiency (%)
88
86
84
82
80
0
50
100
150
200
250
300
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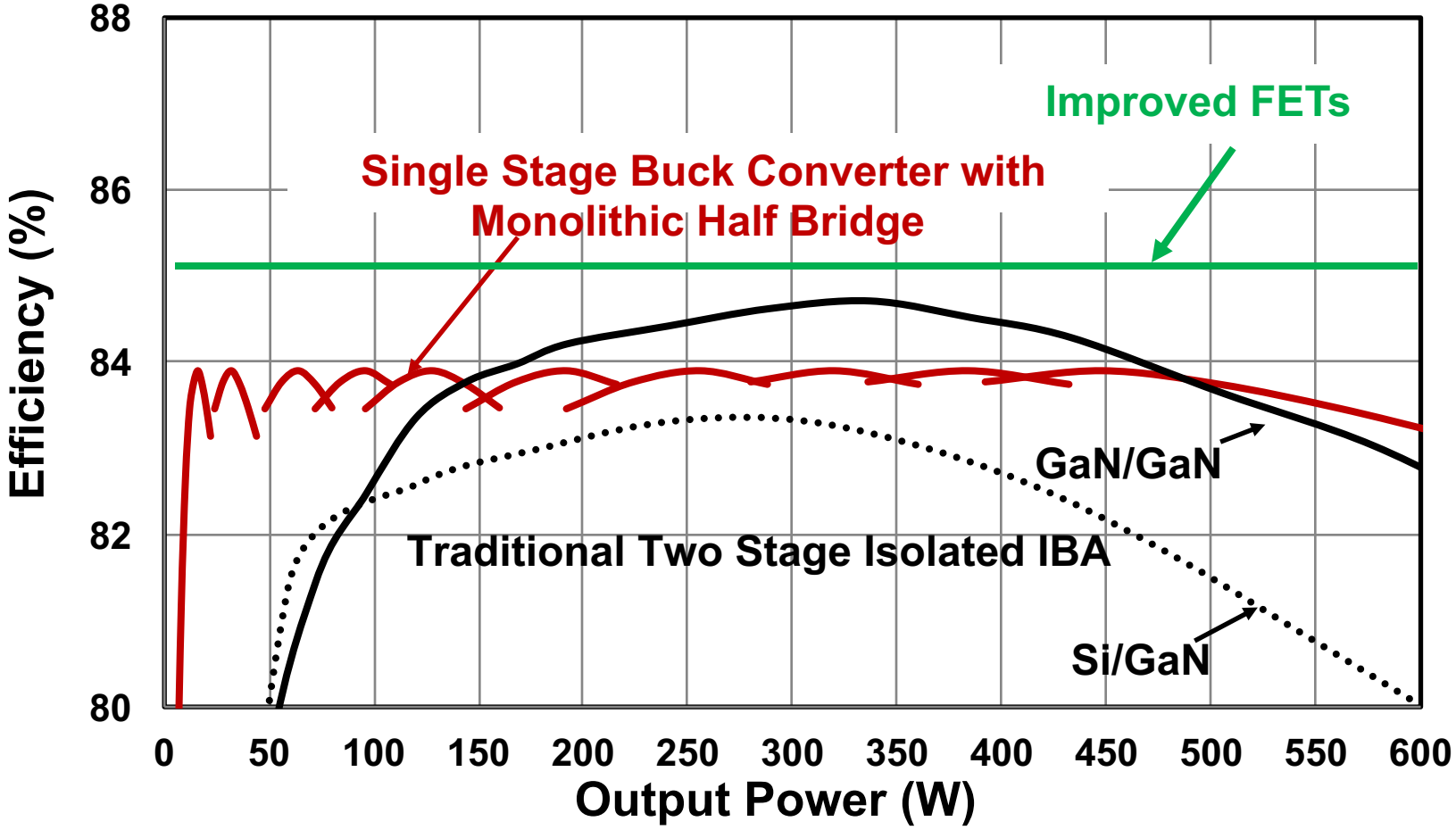
500
550
600
Output Power (W)


Improved FETs
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GaN Integrated Circuit Roadmap

- ✓ Monolithic Half Bridge
- ✓ Half Bridge plus Bootstrap
- Integrated FET and low side driver
- Integrated half bridge with level shift and drivers
- Monolithic Buck IC

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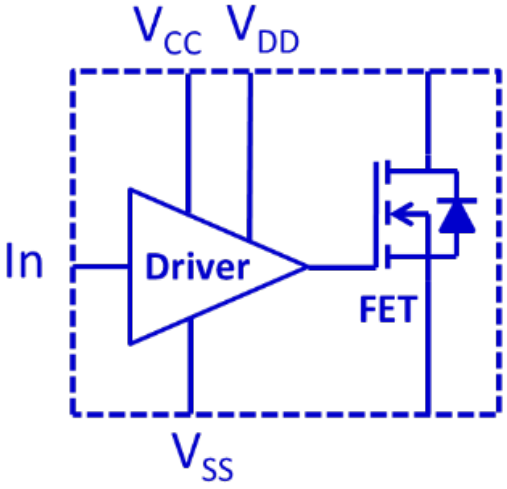
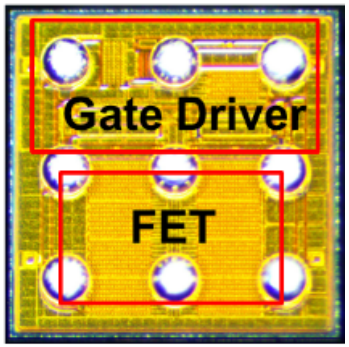
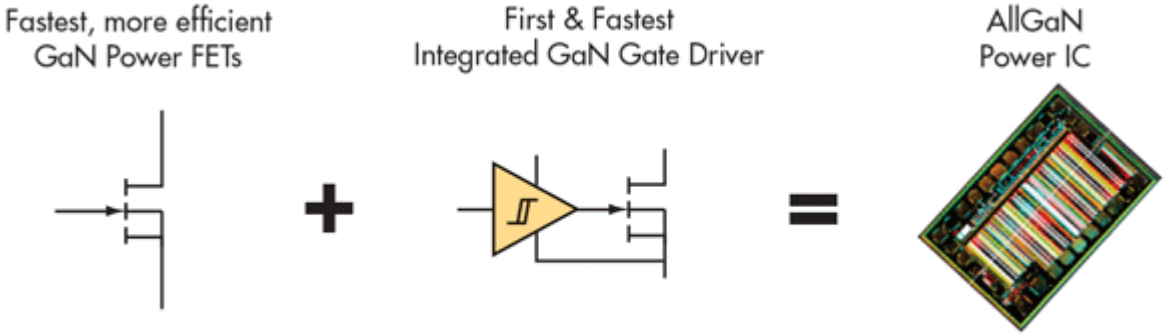
First Step - Integrated FET and Low Side Driver



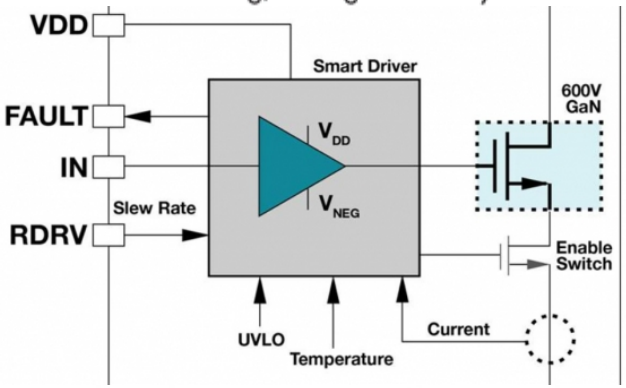


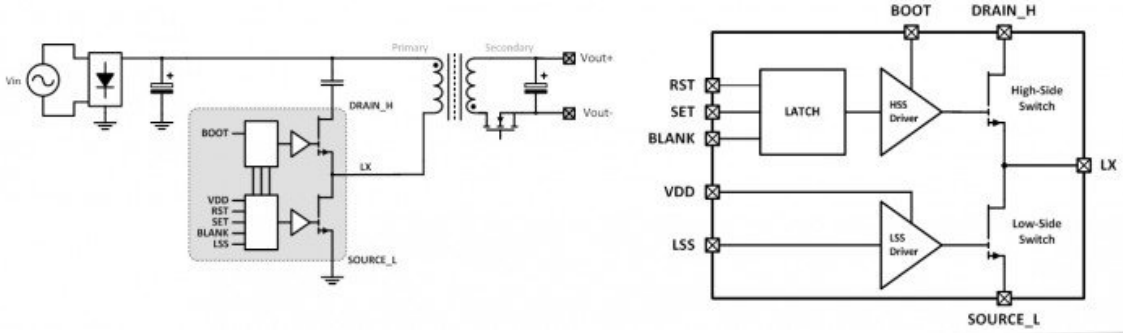
Monolithic Gate Driver and FET



Navitas SEMICONDUCTOR

Up to 40 MHz switching, 4x higher density & 20% lower system cost





dialog SEMICONDUCTOR

GaN Integrated Circuit Roadmap

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- ✓ Half Bridge plus Bootstrap
- Integrated FET and low side driver
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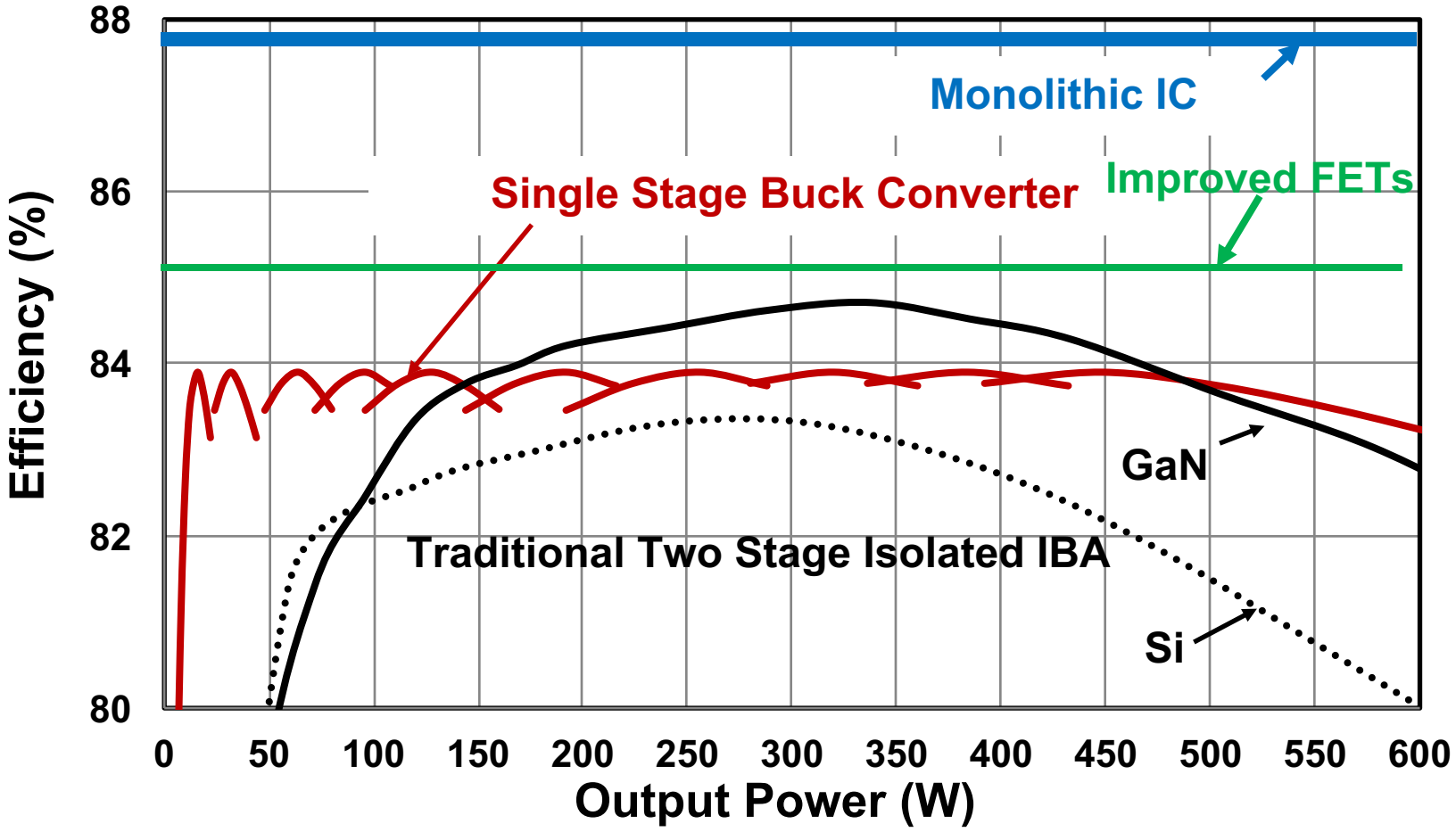
Monolithic IC
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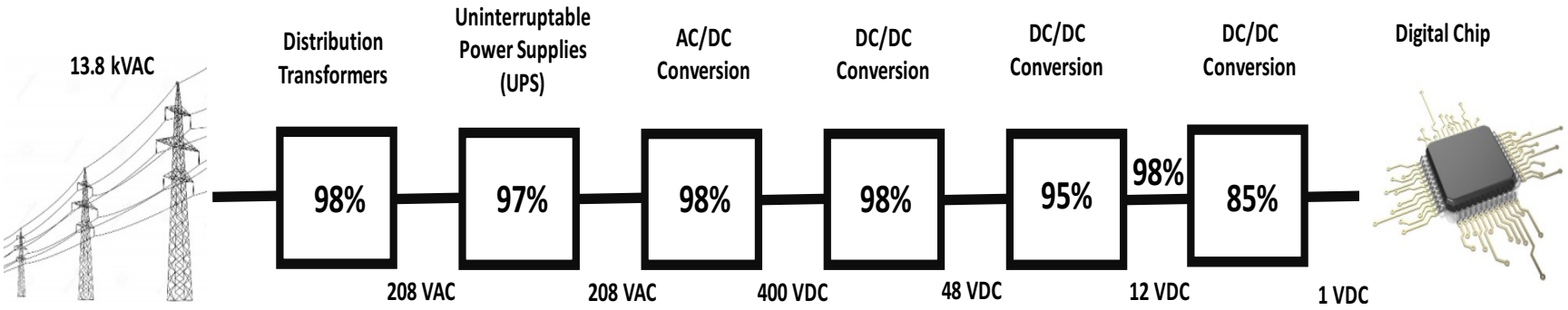
Output Power (W)



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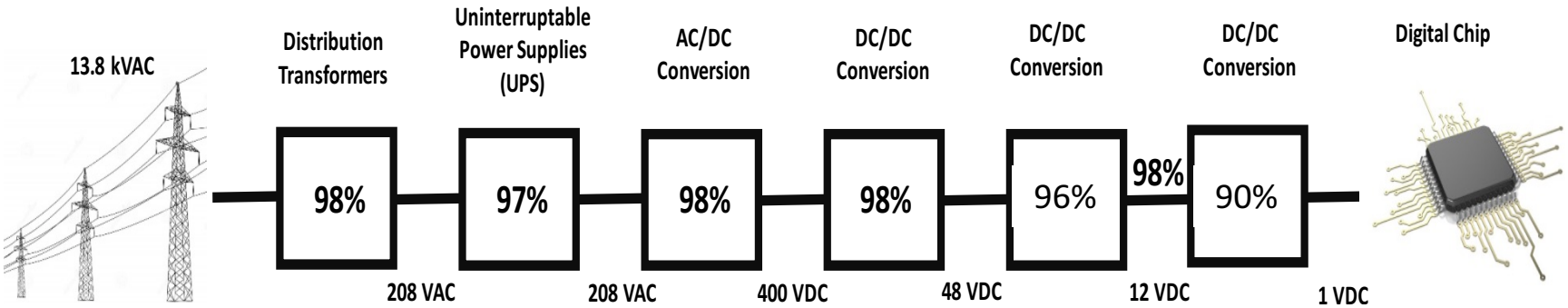

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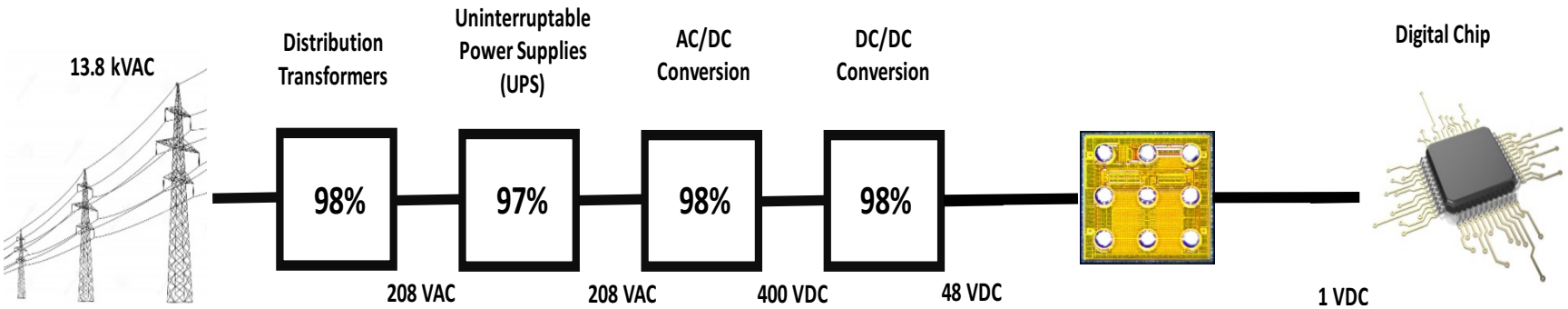
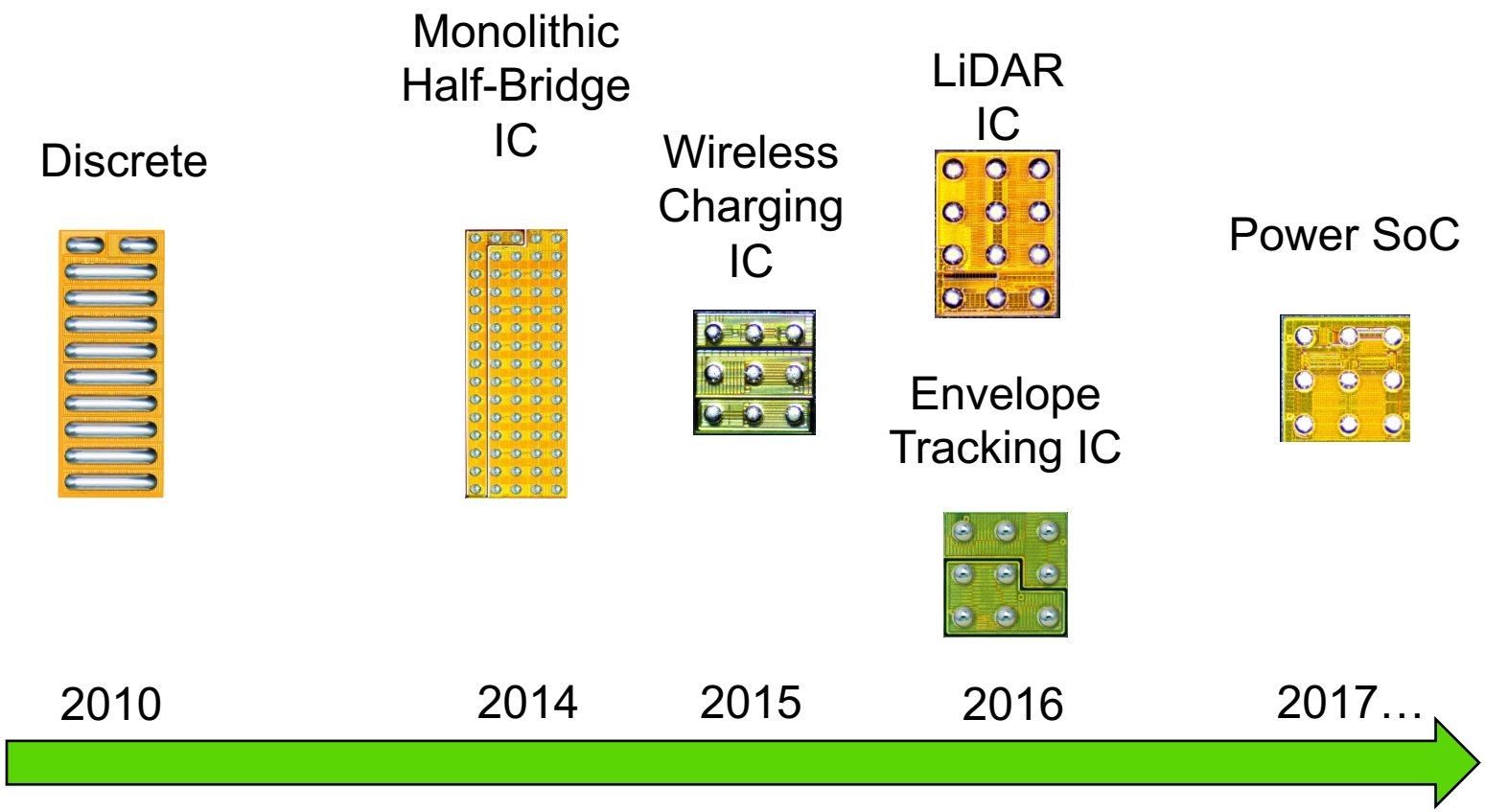
eGaN Integrated Circuit



134 W **100 W**

88% Efficient

eGaN Integration Roadmap



Summary

- GaN integration creates a lot of performance leverage.
- The first steps in integration involve reducing parasitic inductance and integration of drive circuitry.
- The second stage involves including level shift and current sense.
- The third stage will include control circuitry in both analog and digital.