Why Not A Wire?
The case for wireless power

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TEXAS INSTRUMENTS

http://dailyreporter.com/files/2009/07/powertheft-070709.jpg

Wireless Power – Replaces A Wire

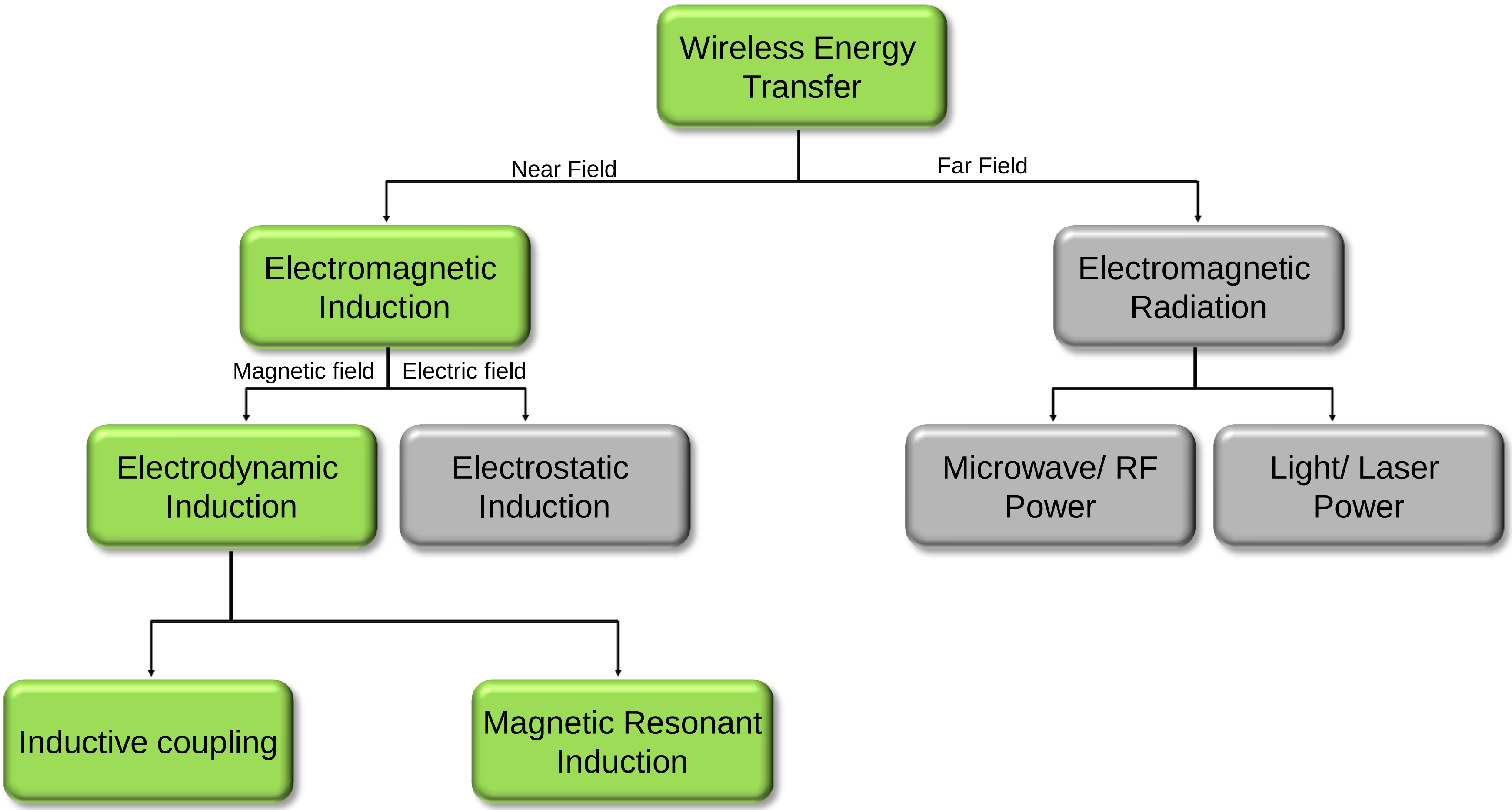
- Wireless Power is a convenient method of transferring energy from one physical device to a second physical device without contacts

- This allows devices to be powered or batteries to be charged

- It is mostly a convenience issue for consumers and offers

- Different methods or wireless power transfer are available based upon power level requirement and use case
  - Inductive resonant charging
  - Capacitive
  - Solar/Light
  - Vibratory
  - Audio

Wireless Energy Transfer – Overview



Why Do Wireless Charging

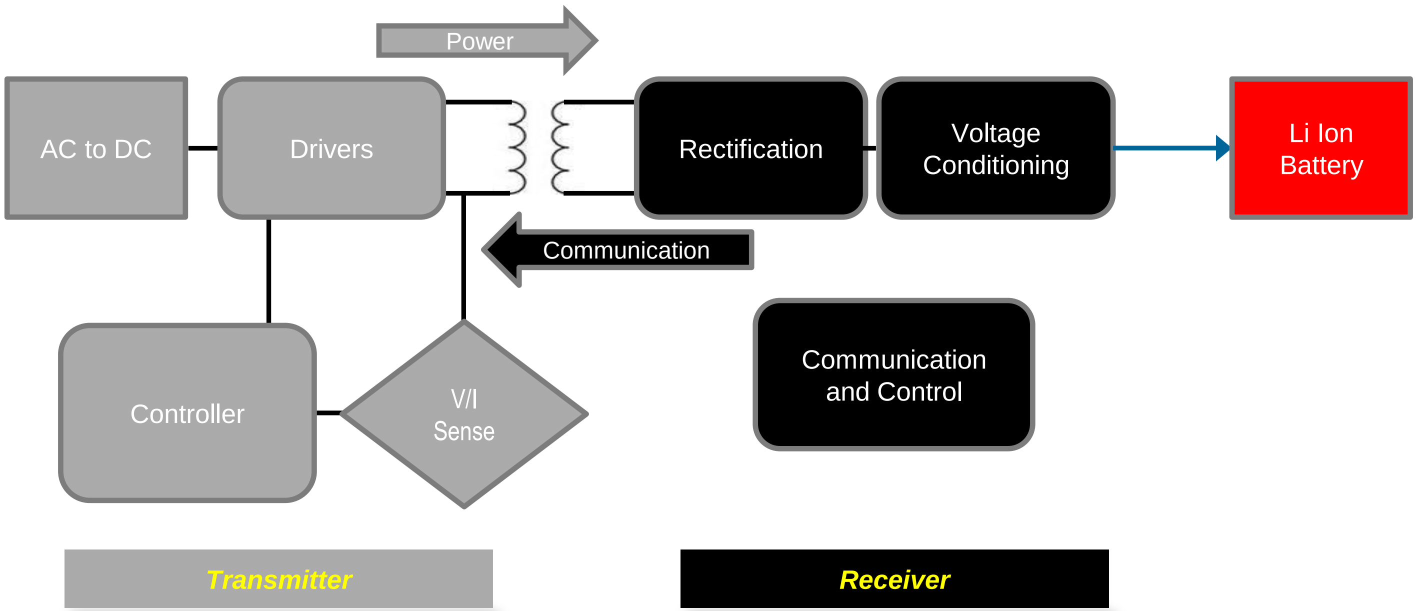
- Convenience
- Convenience
- Convenience
- Connector fatigue and failure can be avoided
- Hermetically sealed devices are possible
- Ability to “graze” energy rather than “gorge” means users will have well charged devices when they pick up a device and go

But It's Not As Efficient As A Wire?!

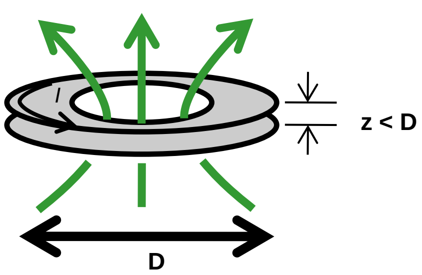
- Isn't a wire inherently more efficient than wireless?
- Isn't a wire 100% efficient?
- What's the maximum efficiency of wireless power transfer anyway?

http://gomadic.us/imgs-prod/charger/sony-bloggie-touch-rapid-wall-ac-charger.jpg

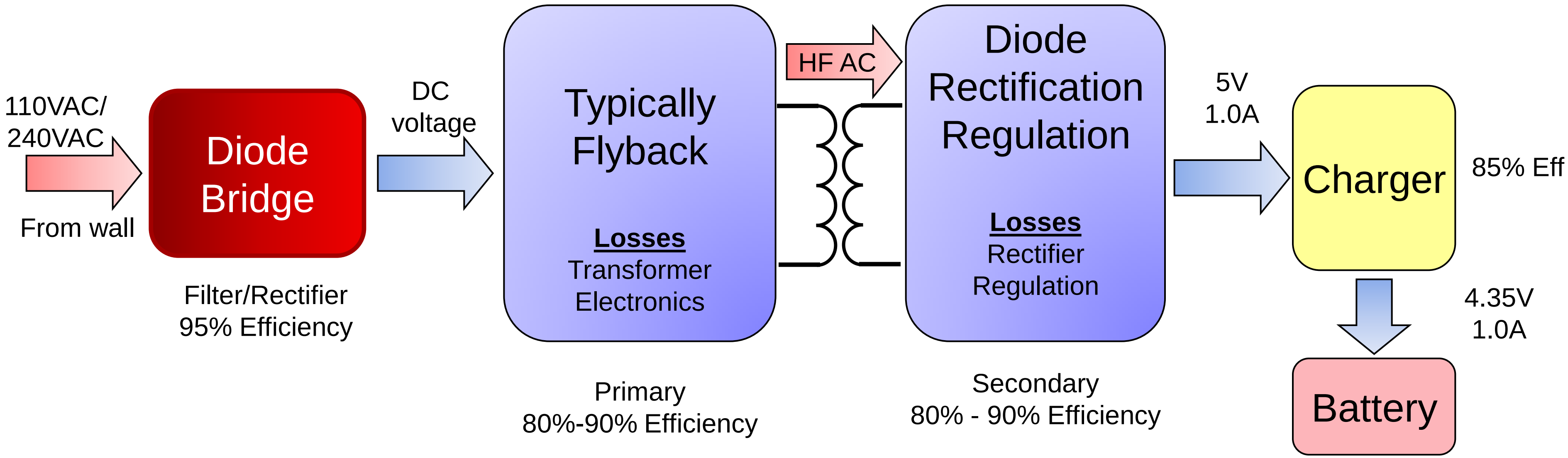
Wireless Power System Overview



- Power transmitted through shared magnetic field
  - Transmit coil creates magnetic field
  - Receive coil in proximity converts field into voltage
  - Shielding material on each side directs field
- Power transferred only when needed
  - Transmitter waits until its field has been perturbed
  - Transmitter sends seek energy and waits for a digital response
  - If response is valid, power transfer begins
- Power transferred only at level needed
  - Receiver constantly monitors power received and delivered
  - Transmitter adjusts power sent based on receiver feedback
  - If feedback is lost, power transfer stops



Current Wired charger

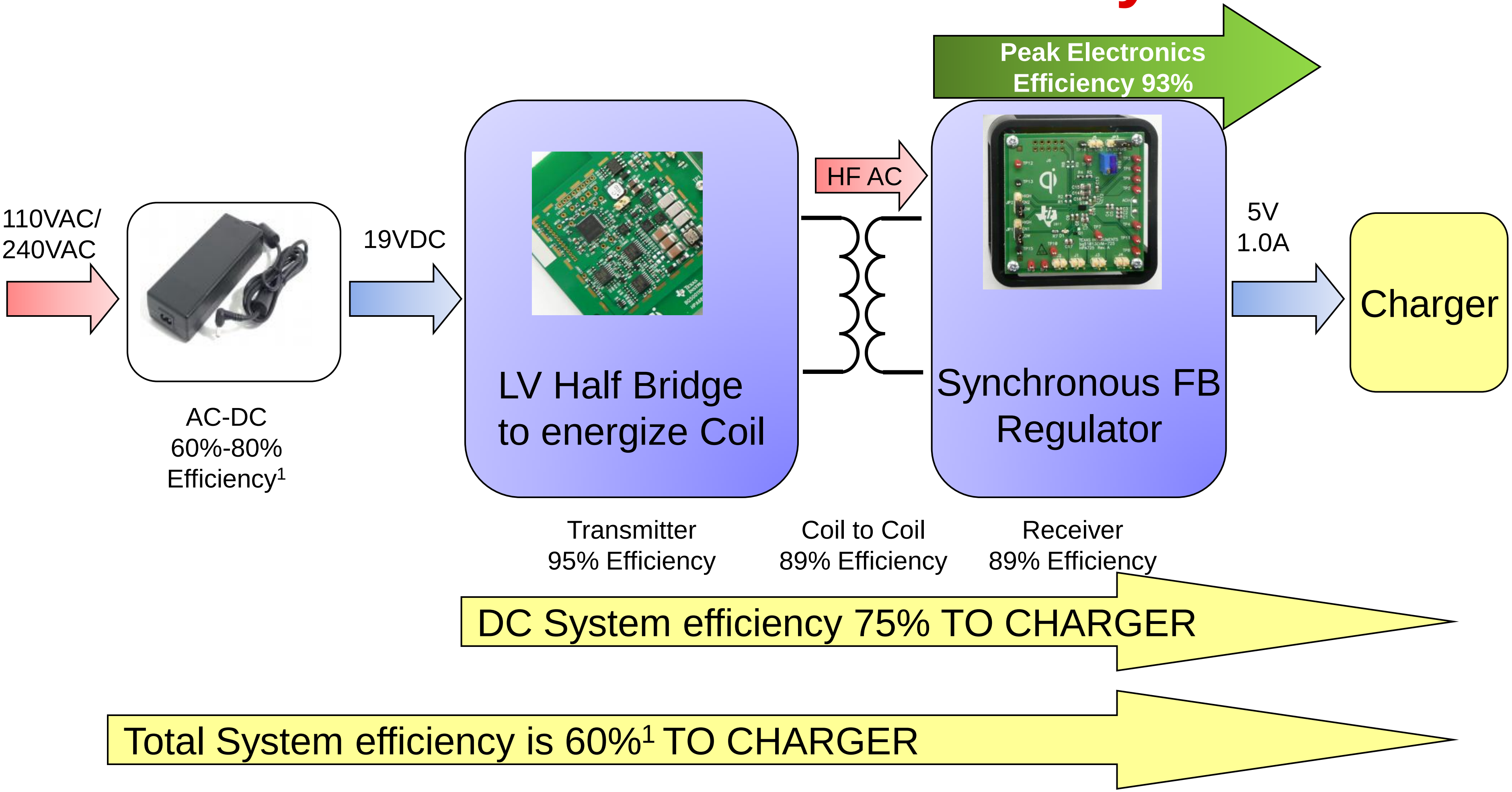


Total System efficiency is ~ 60% to 76% TO CHARGER

Total System efficiency is ~ 50% to 64% TO BATTERY

When efficiency of wire (~95%) is included, System efficiency can be ~72% TO CHARGER or even less than 47% TO BATTERY

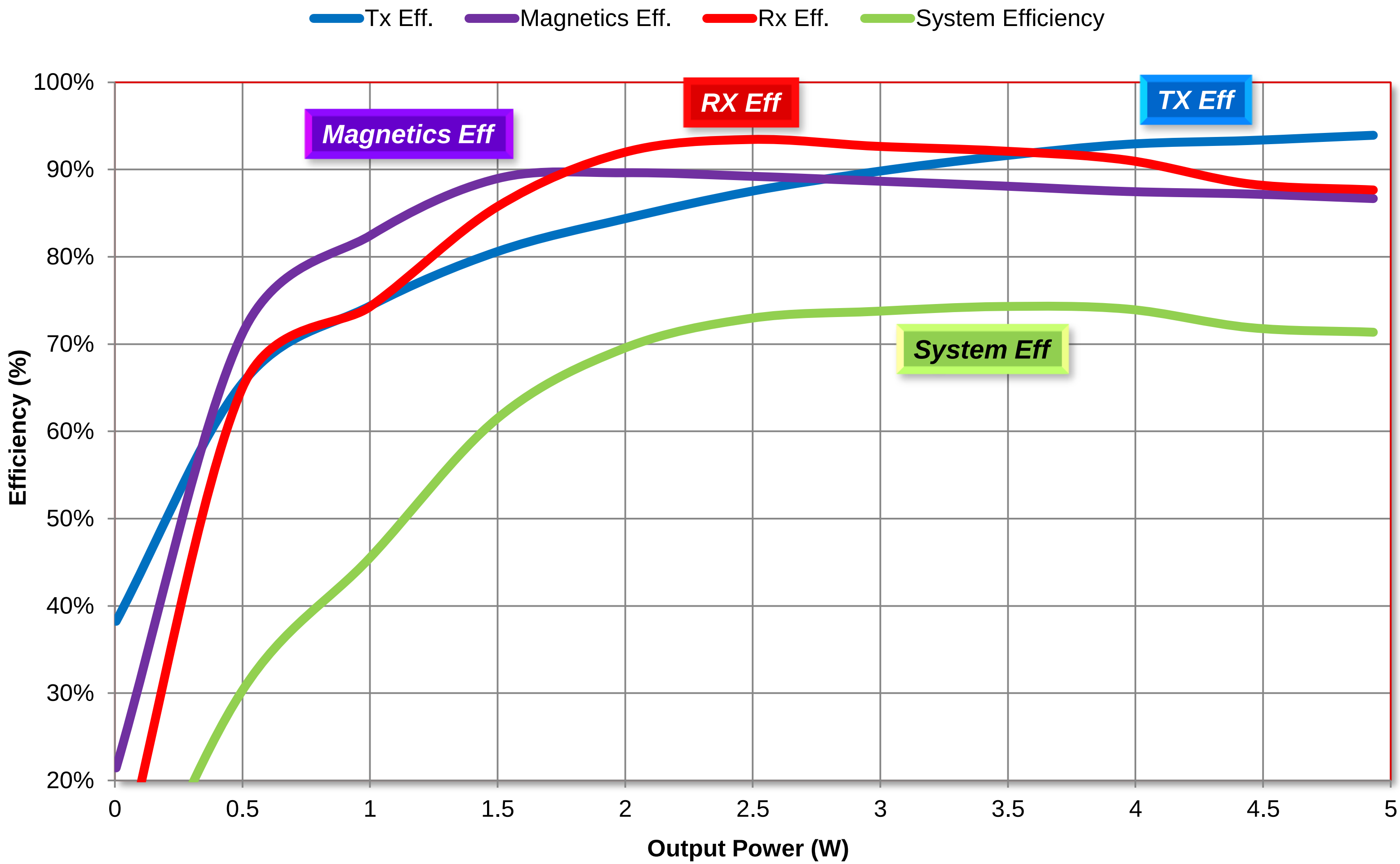
Current TI Wireless Power EVM System



1. Assuming 80% Adapter efficiency
2. All numbers are typical of a nominal interface gap of 3.7mm, optimal position
3. Peak efficiency shown is shown at 3.5W output power

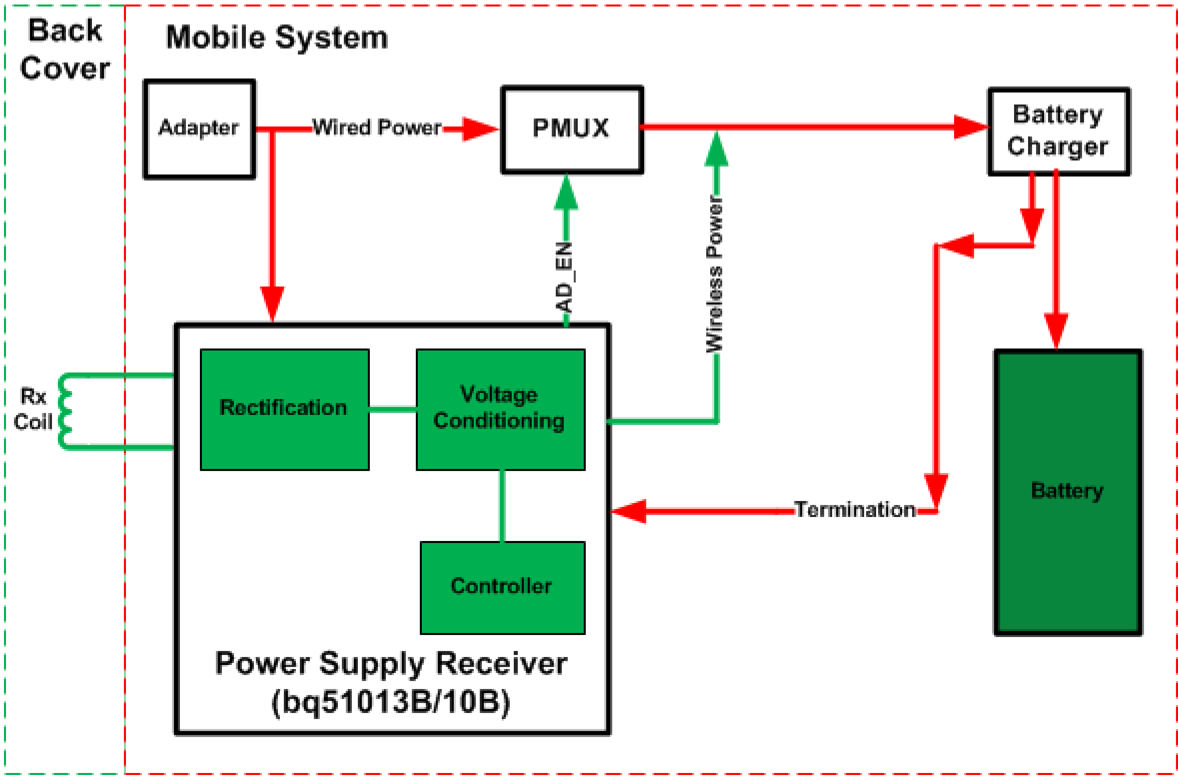
bqTesla System Efficiency Breakdown

Measured from DC input of Transmitter to DC output of Receiver



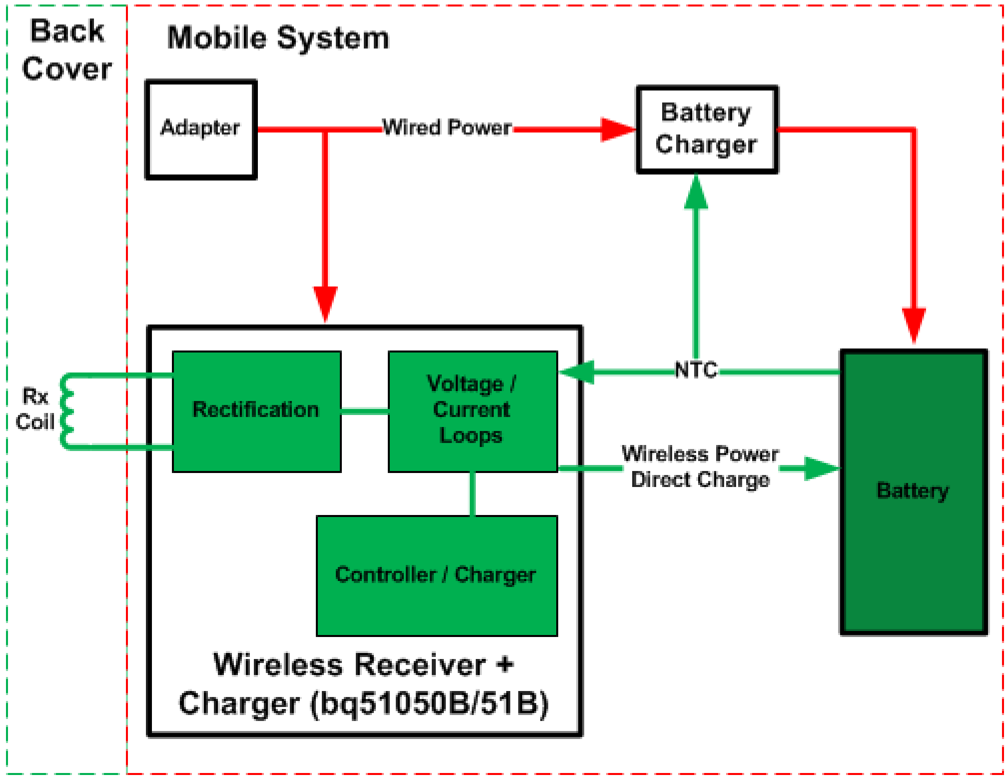
Texas Instruments

RX Architecture – Main Board Power Supply



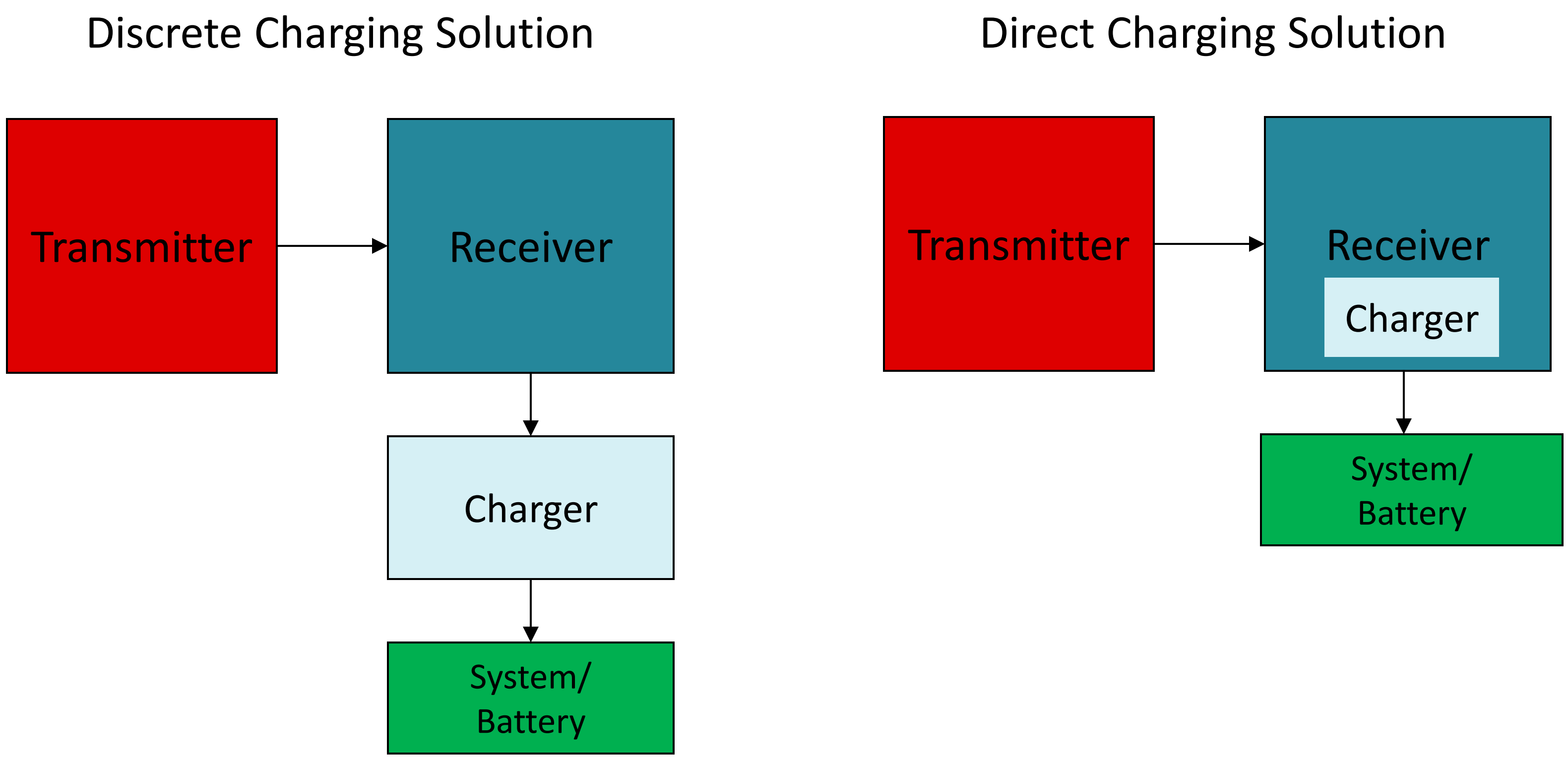
- Wireless power in series with existing system
- Adapter sense turns off wireless power when adapter is present
- Termination disables wireless power once charge is complete

RX Architecture – Main Board Charger



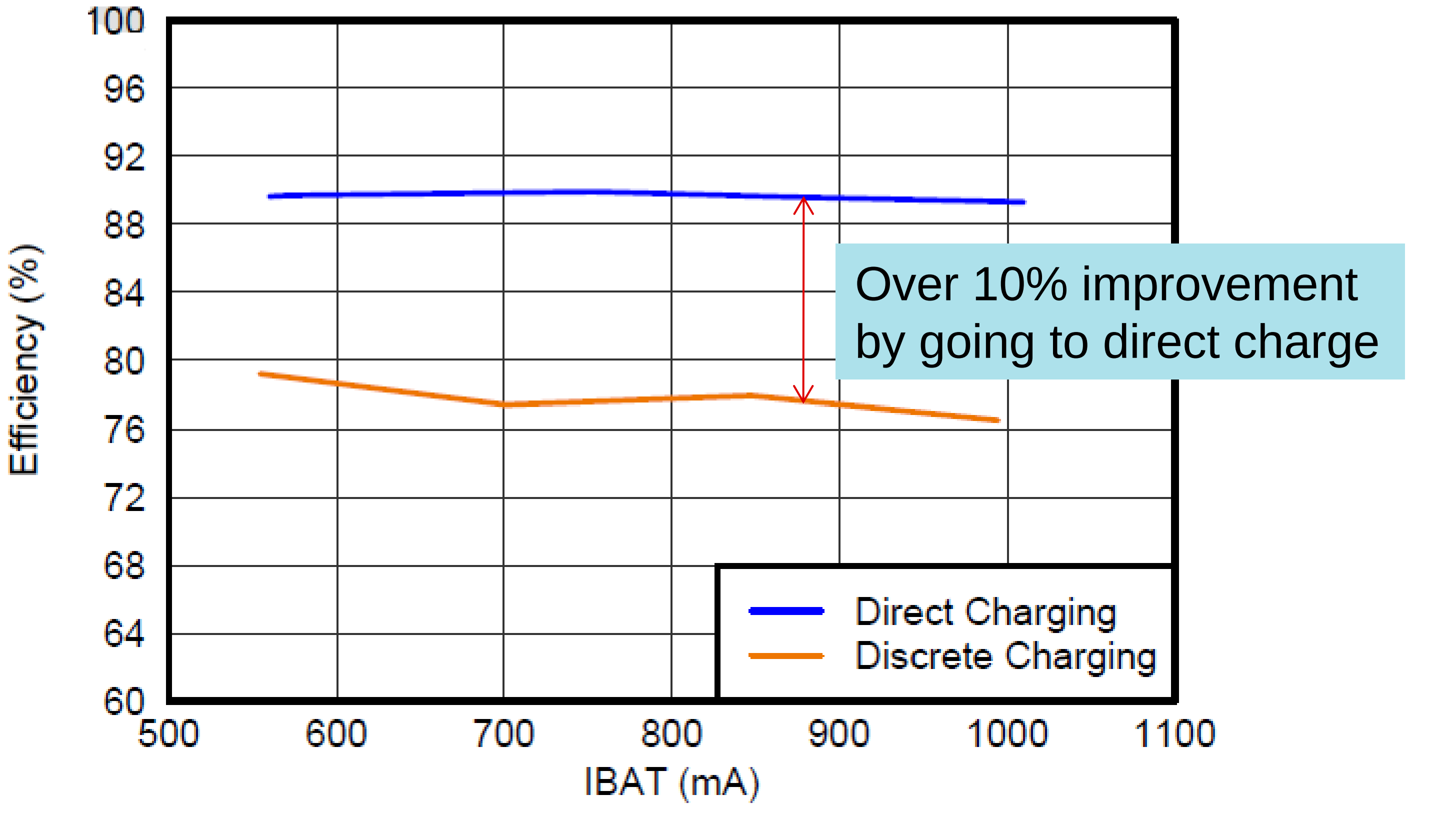
- Wired and wireless charger in parallel
- Adapter sense turns off wireless charger when adapter is present
- Highest efficiency solution when observing power transferred to the battery

Direct Charging vs. Discrete Charging



Direct charging allows the RX to become the battery charger allowing for elimination of a power stage. This allows highest efficiency path and maximal use of thermal budget

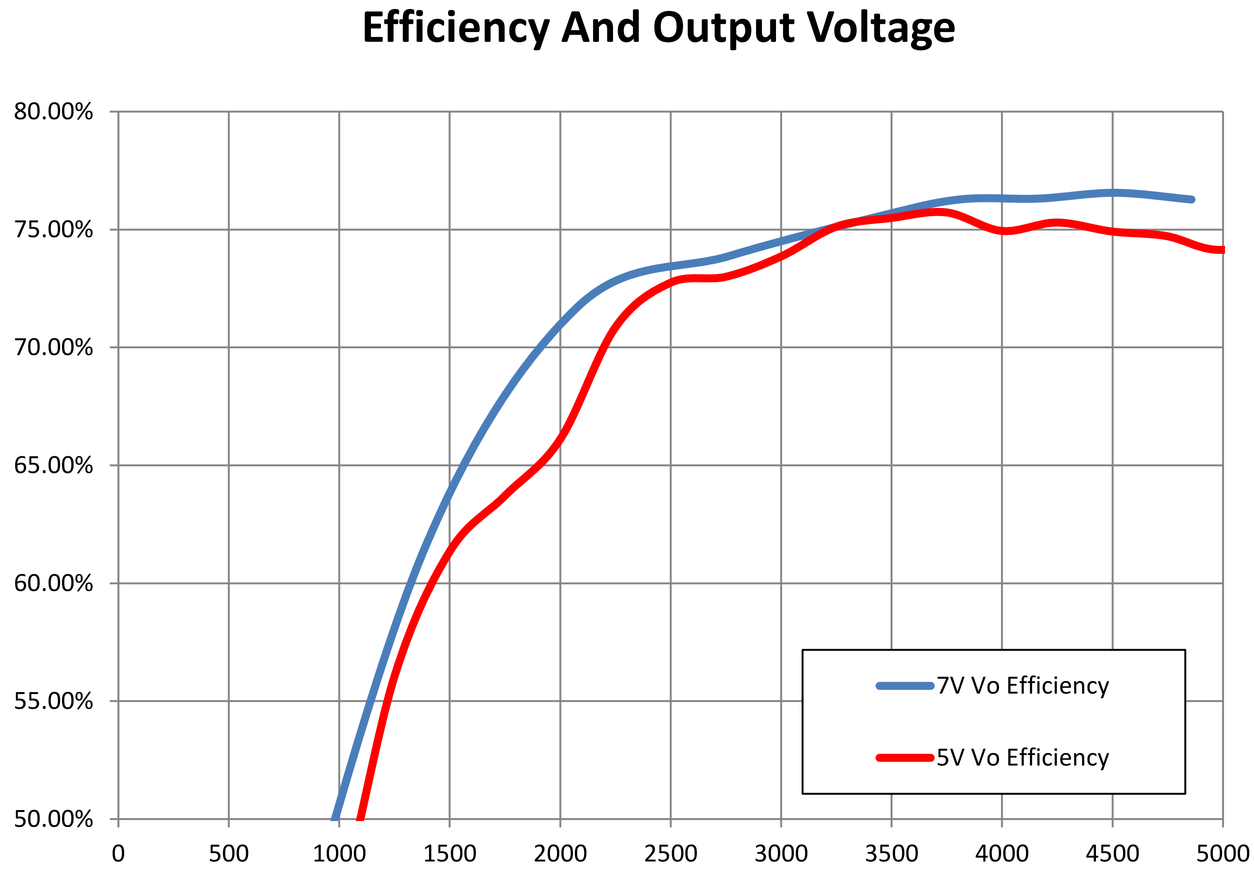
Efficiency Data Comparison-Direct vs. Discrete Charging Topologies



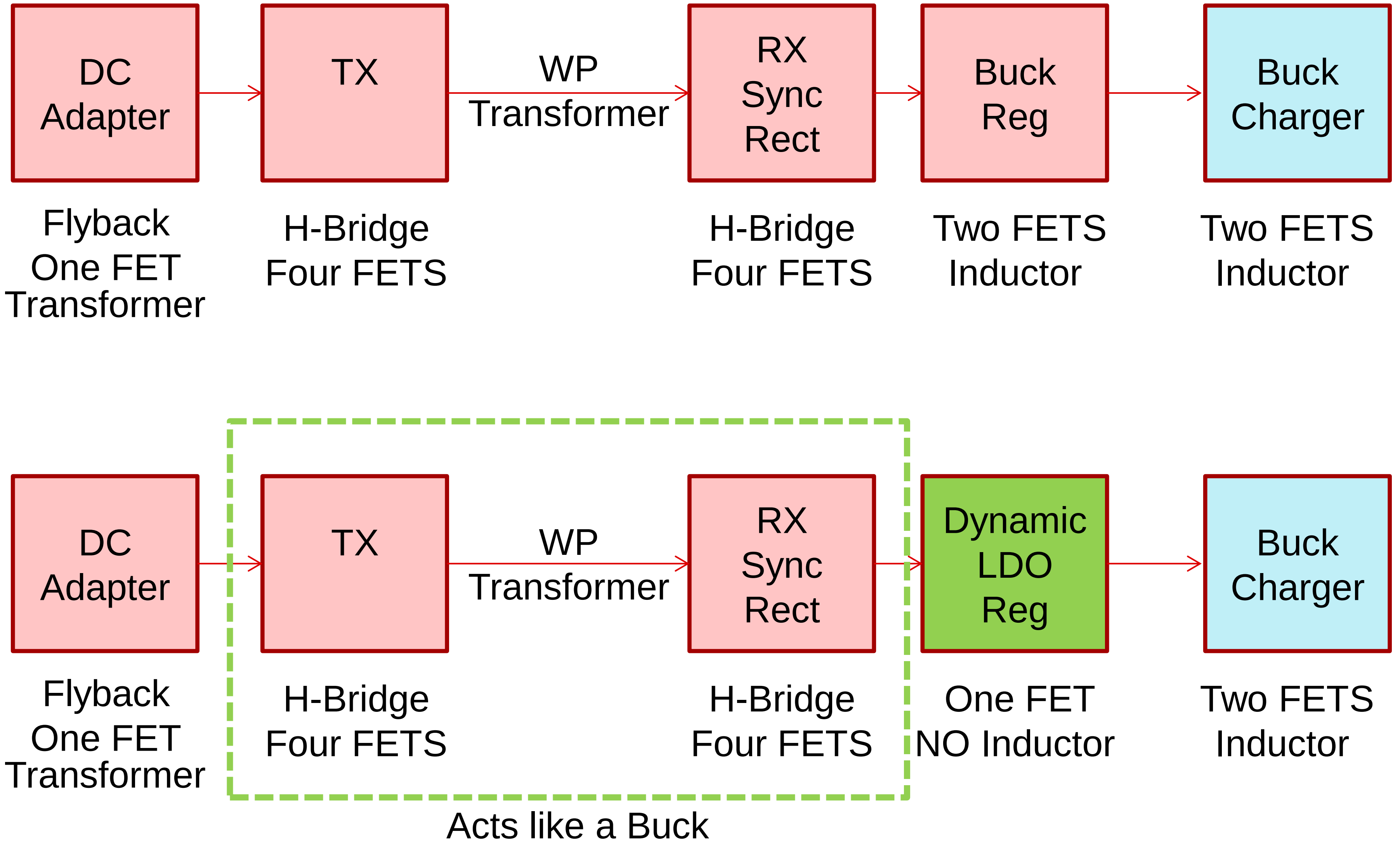
Direct charge solution allow you to turn off the “wired” charger and thus allow you to allocate the thermal budget of the “wired” charger to the “wireless” charger.

RX Architecture – Output Voltage

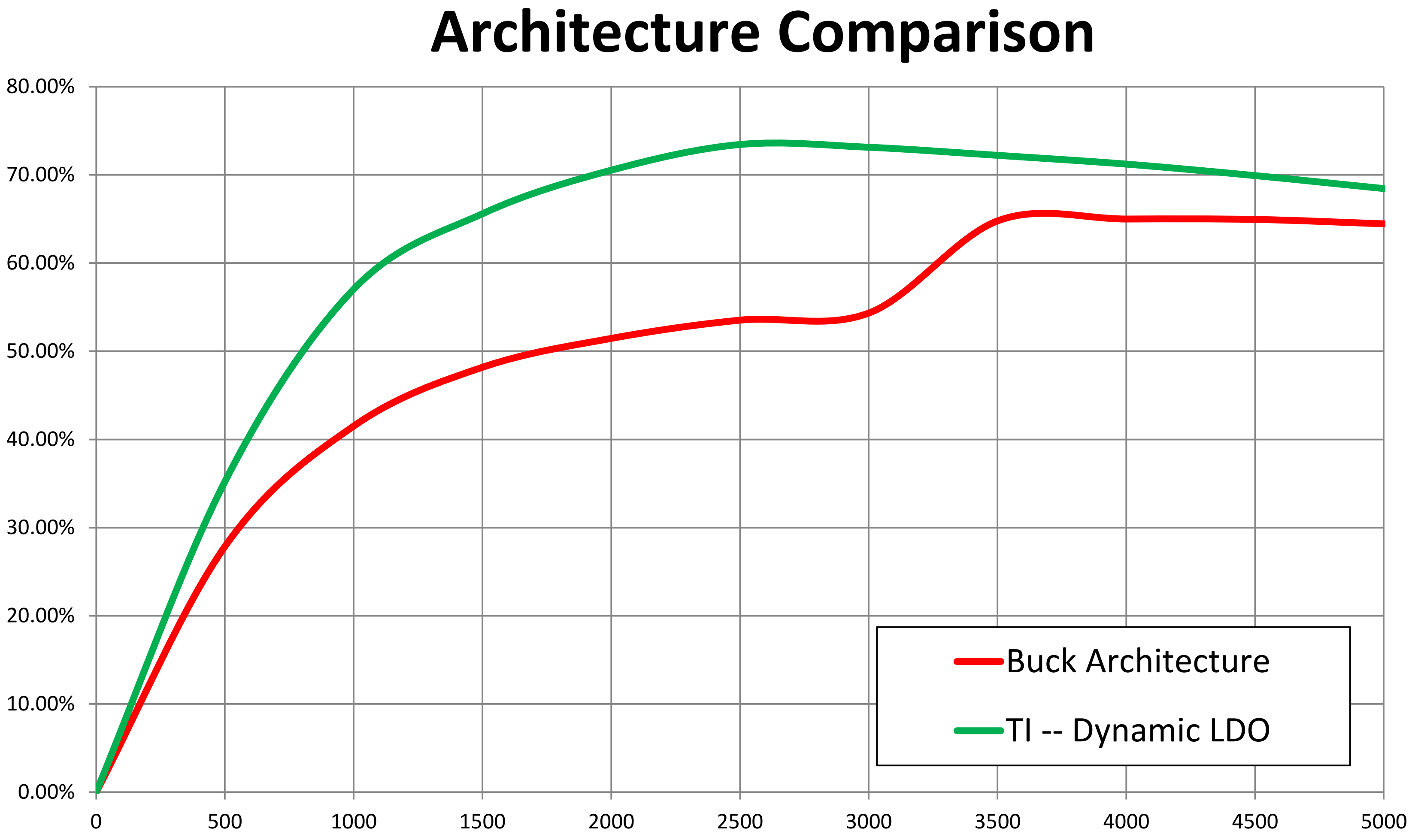
- Output Voltage can have a great impact on the efficiency
- Coil and synchronous rectifier I^2R losses are current based



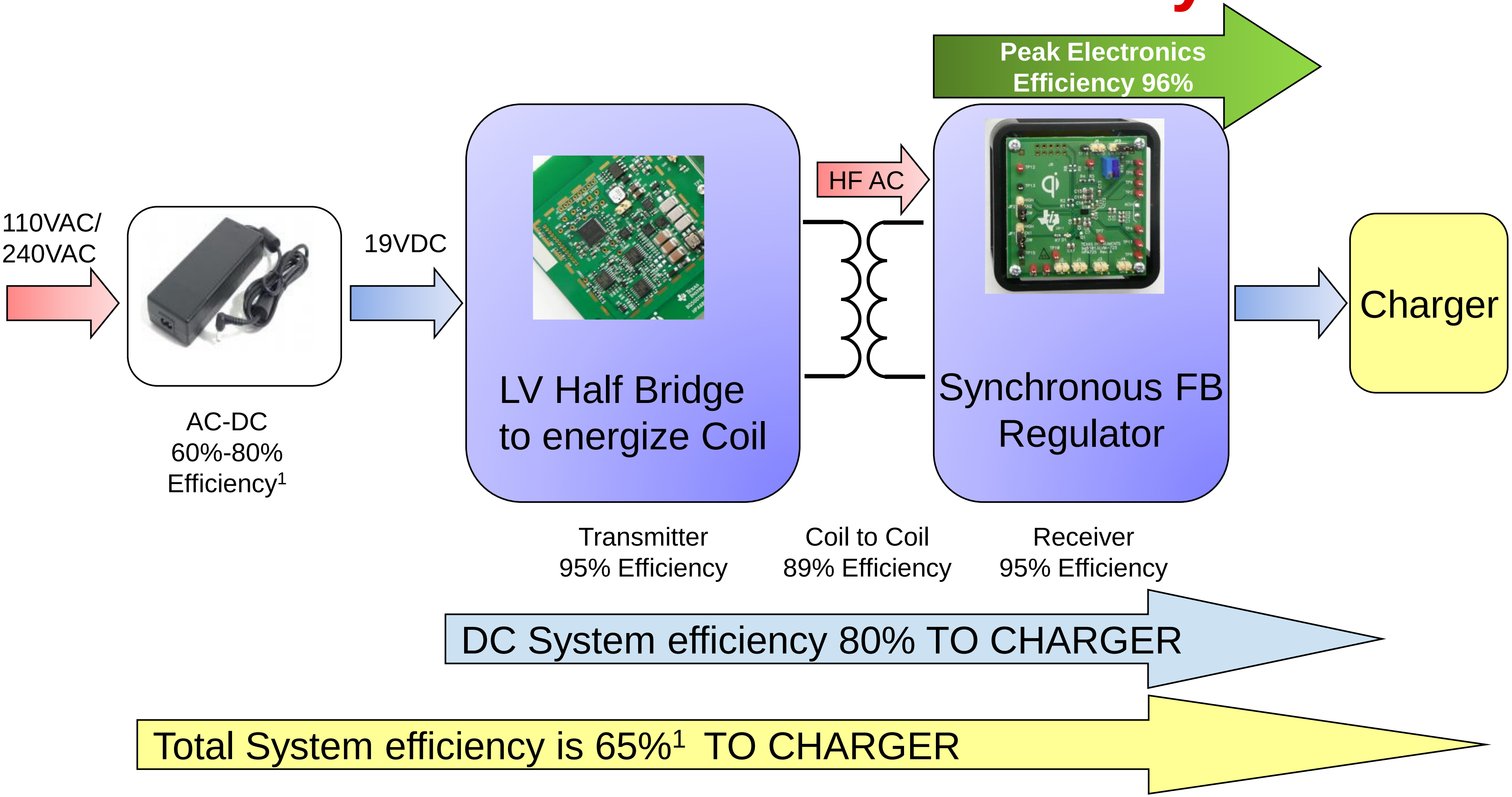
Voltage Regulation Architecture



Architecture Comparison



Next Gen TI Wireless Power EVM System



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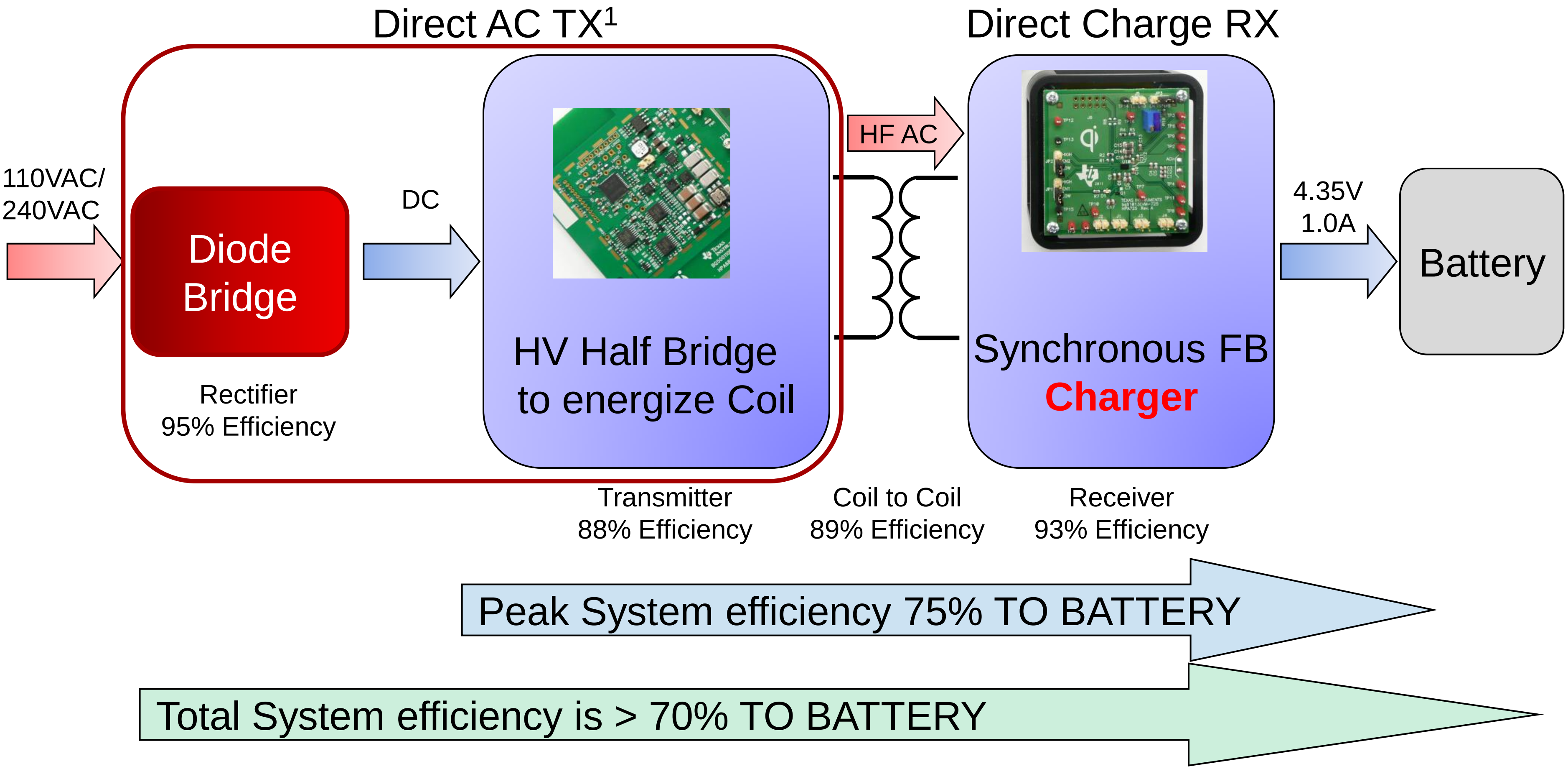
What Architecture Works Best?



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Potential Wireless Charging Implementations Compared

Wall Adapter	Transmitter	Receiver	Expect Eff. AC to Battery	Comments
Current Wired Charger	N/A	N/A	~50- 65%	As low as 47% when cable eff is included
19V DC Out	Single Coil No Magnet	7V into Charger	52%	Best available Wireless Solution Today
5V DC Out	Single Coil No Magnet	7V into Charger	45%	5V Adapter Design important
19V DC Out	Single Coil No Magnet	Next Gen Direct charge	62%	Direct charge offers higher efficiency
None	Direct AC TX	Next Gen Direct charge	65-70%	As good as wired?

Thank you