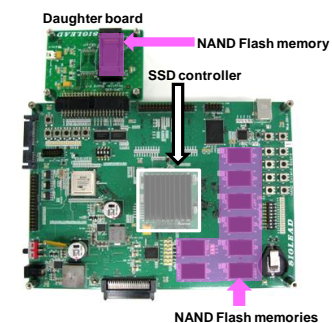
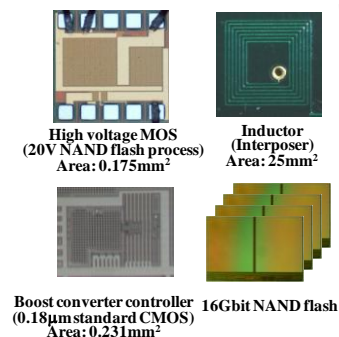
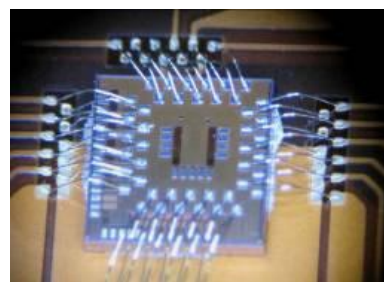
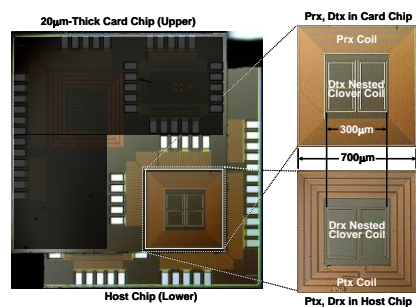
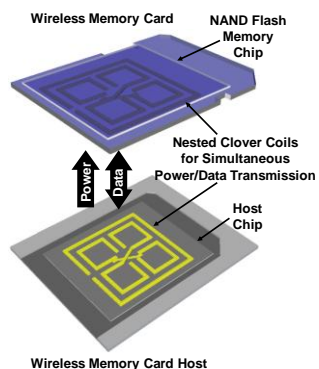


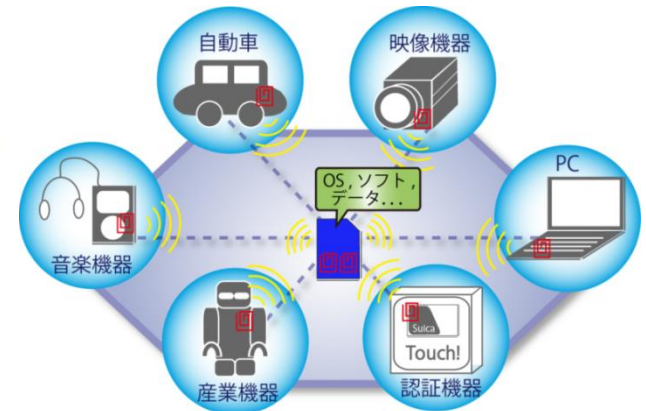
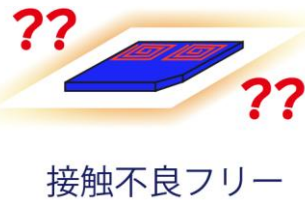
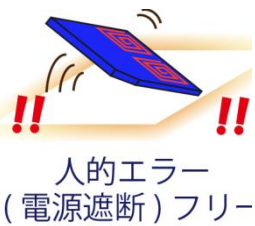
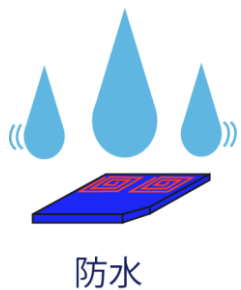
# Dependable Wireless Solid-State Drive (SSD)



Ken Takeuchi, Chuo University  
Tadahiro Kuroda, Keio University  
Hiroki Ishikuro, Keio University

# Objectives of Research

- **Wireless SSD/Memory card and its host system**
- **Robust against memory cell error, contact error, ESD, EMI and waterproof**
- **High-speed near field wireless communication**
  - Target : 10-50Gbps at 1mm distance
- **Wireless power delivery with MHz load variability**
  - Target : 1-3W



# 9 ISSCC Presentations

## ■ ISSCC 2013

- Takeuchi “Unified Solid-State Storage”
- Kuroda, Ishikuro “A 0.15-mm-Thick Non-Contact Connector for MIPI”
- Kuroda “Inductive-Coupling Wake-Up Transceiver for Non-Contact Memory Card”
- Kuroda “Retrodirective Transponder Array with Universal On-Sheet Reference for Wireless Mobile Sensor Networks”

## ■ ISSCC 2012

- Takeuchi “Error-Prediction LDPC”
- Kuroda, Ishikuro “7Gb/s/Link Non-Contact Memory Module”
- Ishikuro “Voltage-Boosting Wireless Power Delivery System”

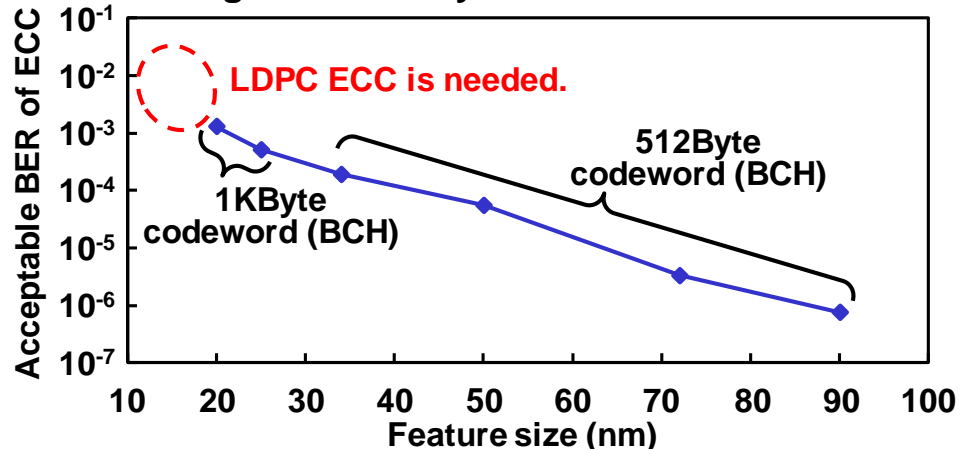
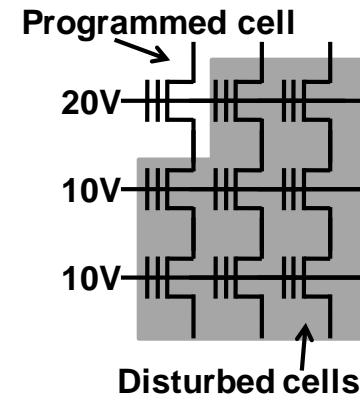
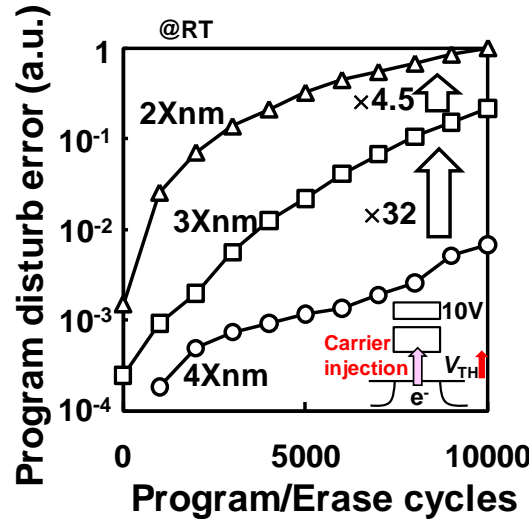
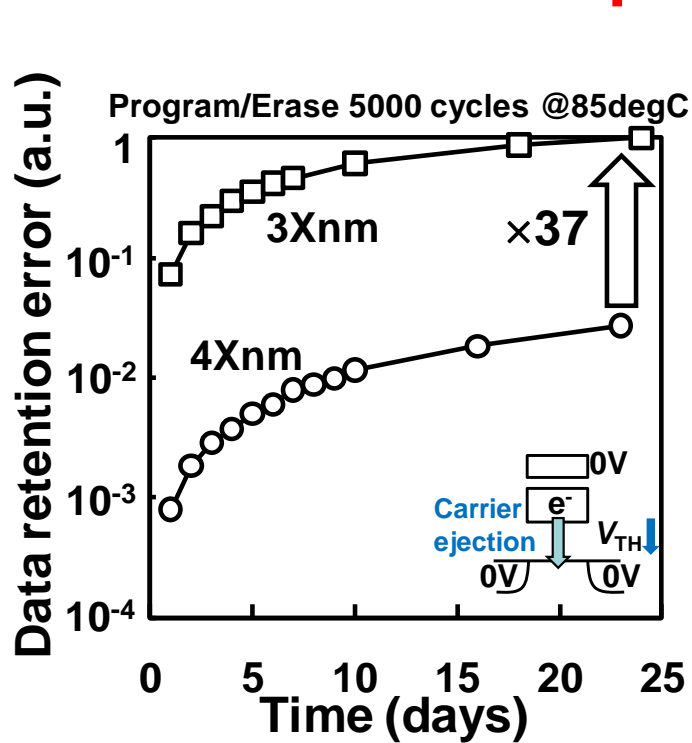
## ■ ISSCC 2011

- Takeuchi “Asymmetric Coding for SSD”
- Kuroda, Ishikuro “12Gb/s non-contact interface”

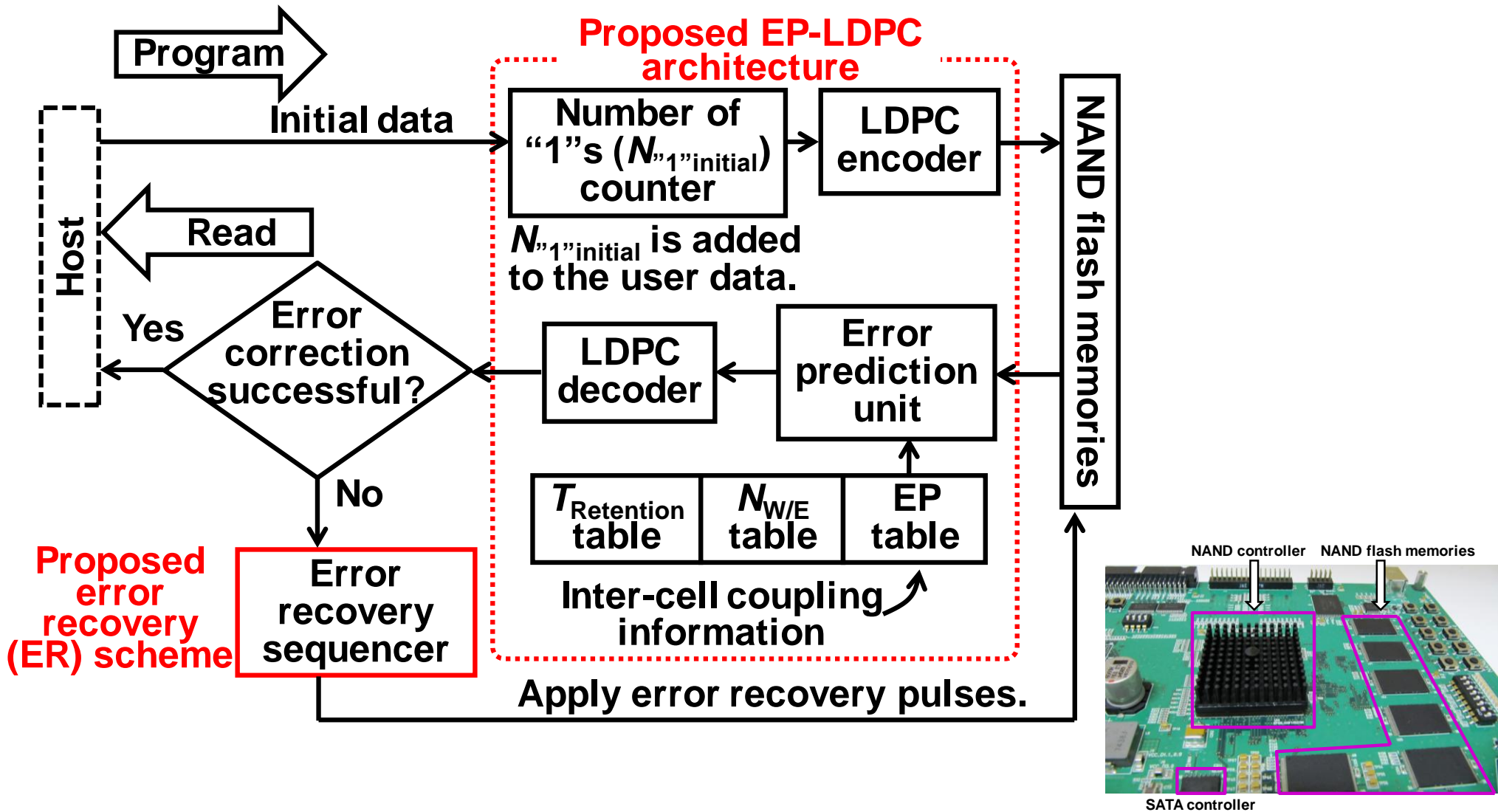


# Dependable Memory System

- Data retention error and program disturb error become worse as the memory cell is scaled.
- **ECC should be improved with the device scaling.**

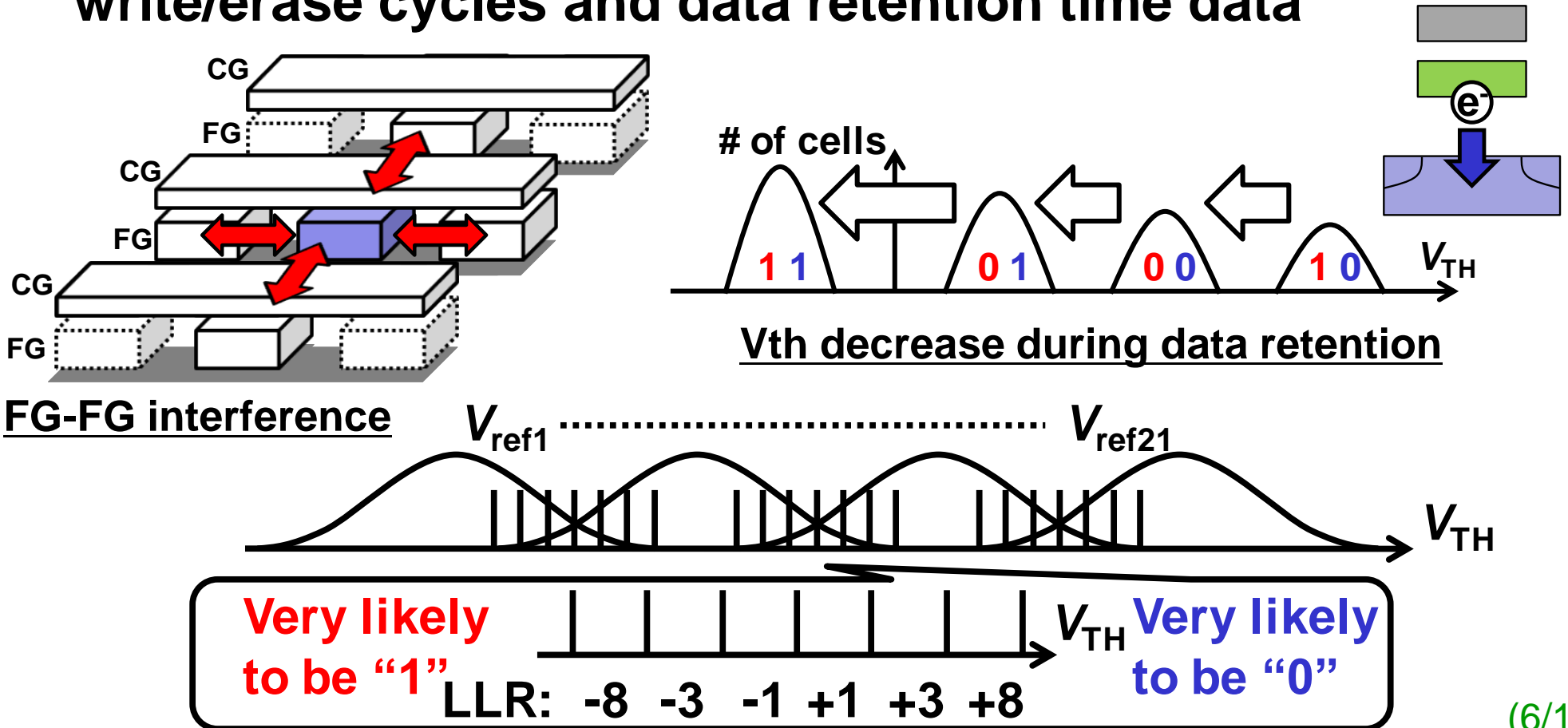


# Dependable SSD System (ISSCC 2012)



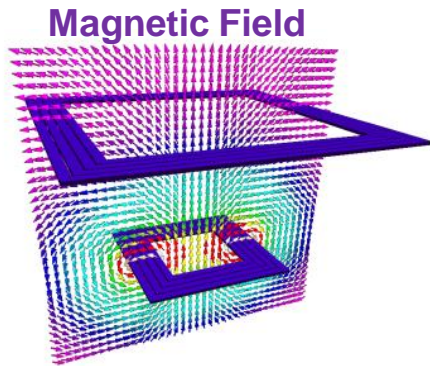
# X 11 Better Reliability, Error Predicting LDPC

- Compensate the capacitive interference by using the neighboring cell data
- Compensate the  $V_{th}$  decrease during data retention by write/erase cycles and data retention time data

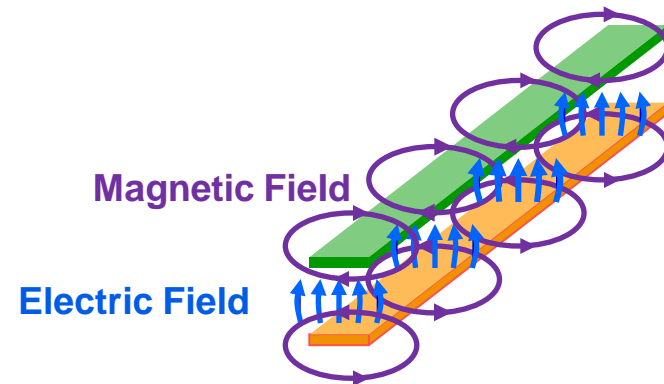


# Dependable Near-Field Link

- **Near-field** provides dependable link
  - Mechanical tolerance by flexible link (for attaching/removing/vibration)
  - ESD/water-proof by hermetically seal
  - High speed ( $>10\text{Gbps}$ ), low energy ( $<1\text{pJ/b}$ )
- **ThruChip Interface (TCI)**
  - Chip stacking in package
  - Lumped parameter circuit
- **Transmission Line Coupler (TLC)**
  - Module connector on circuit board
  - Distributed parameter circuit



**Magnetic Coupling**

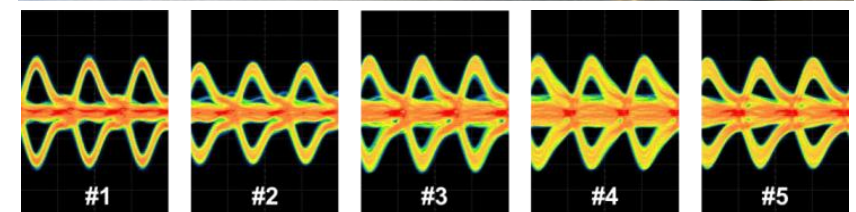
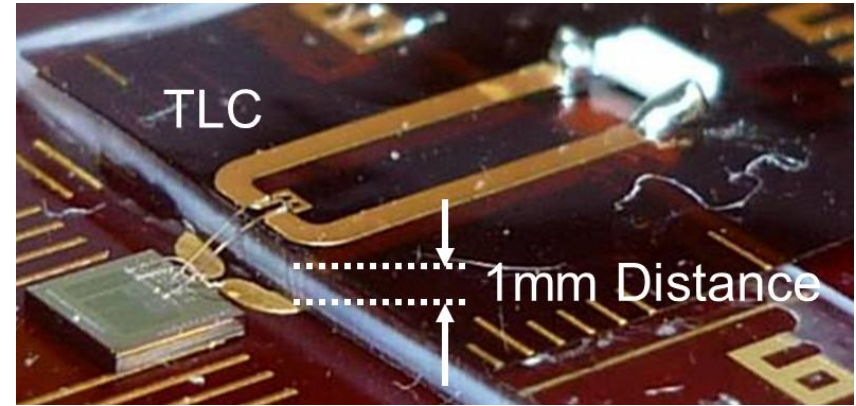
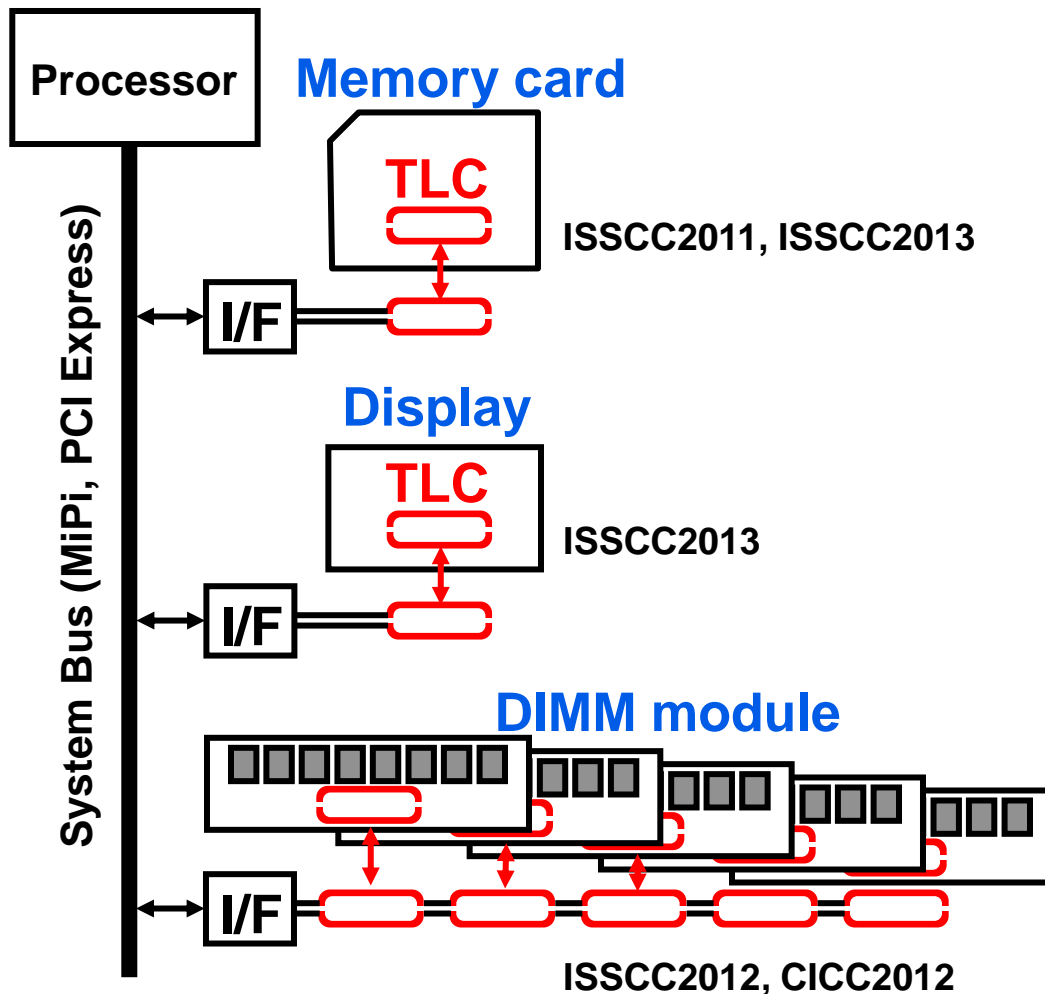


**Electromagnetic Coupling**



# Non-Contact Connector by TLC

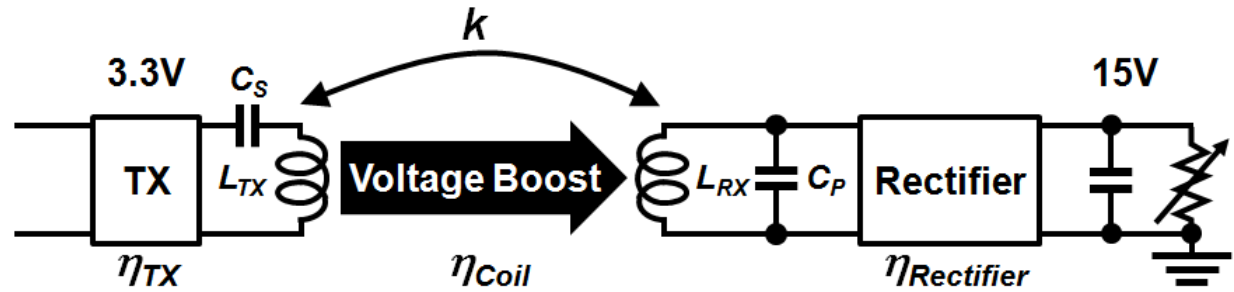
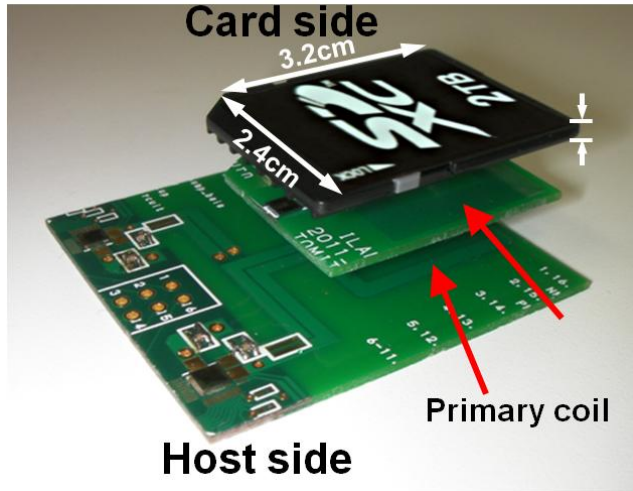
- Dependable module assembly is made possible



Energy equipartitioned to each memory module



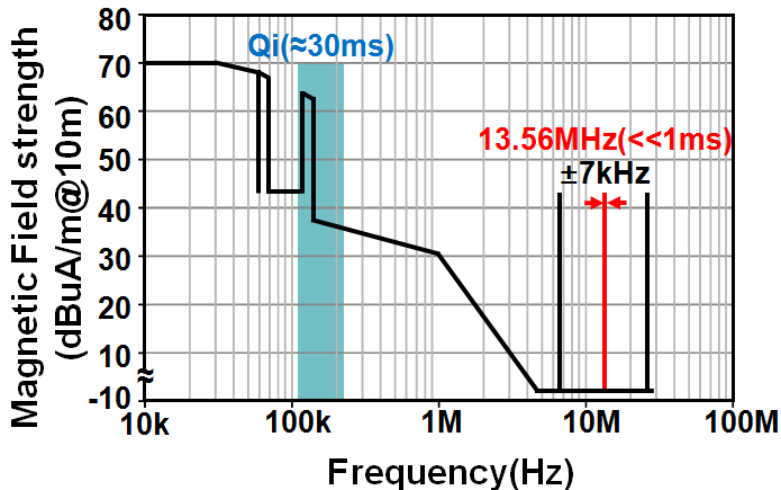
# Dependable Wireless Power Delivery System



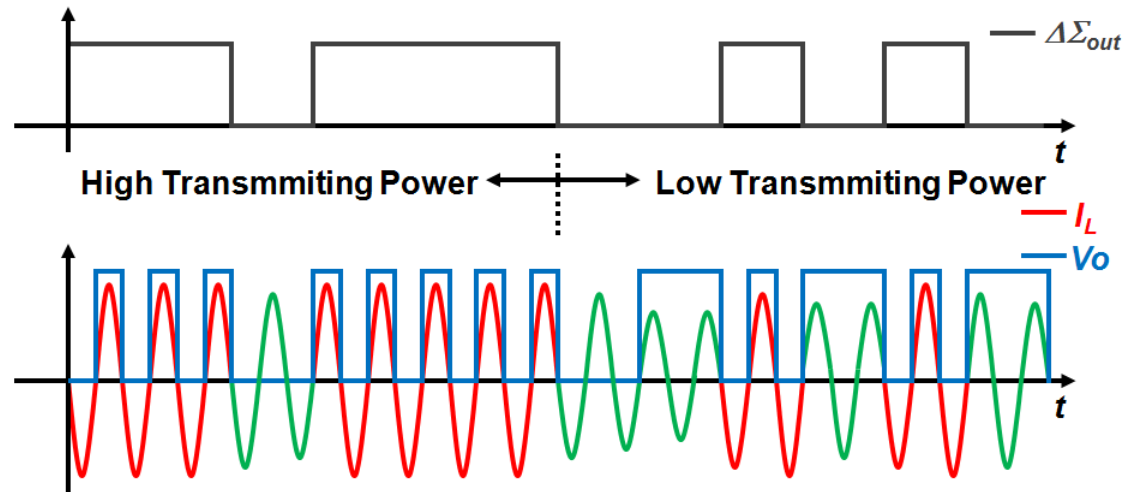
Small size, battery-less application

Requirement :

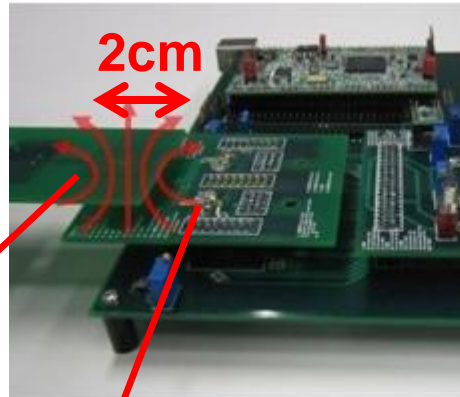
Fast load tracking and low EMI



Switch between  $f_{res}$ , and  $f_{res}/3$

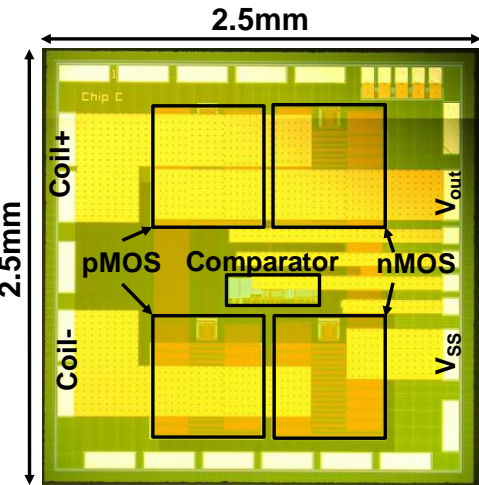


# Wireless Power Delivery System

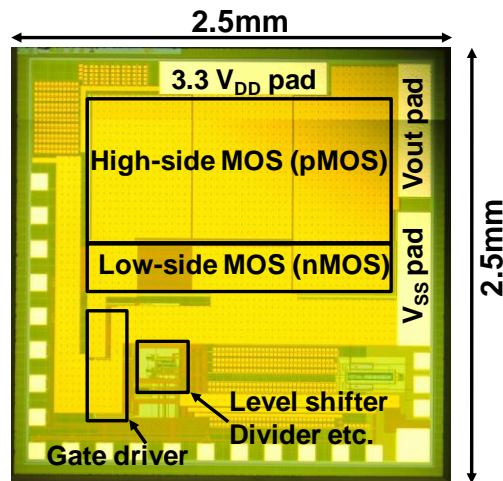


Fast response

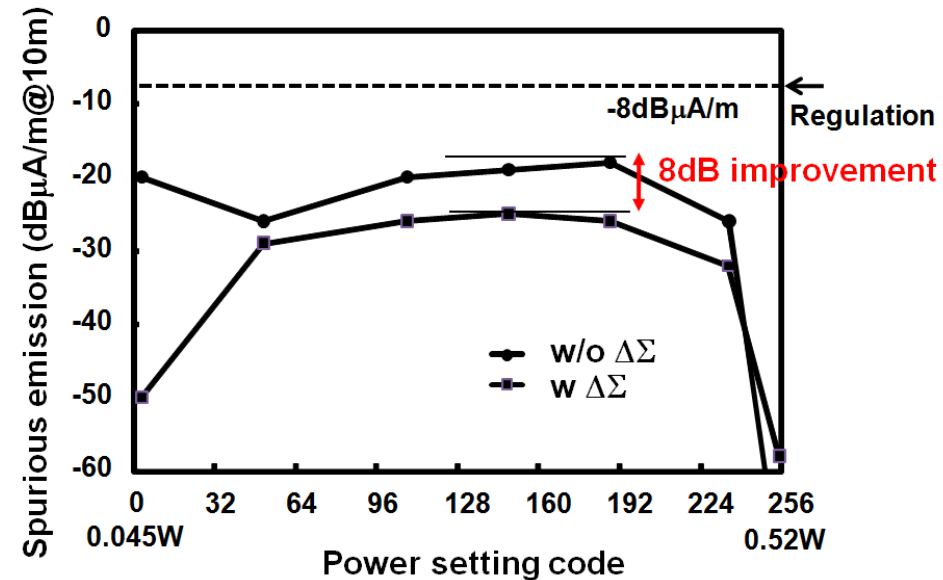
Load transition point  
(From 45mW to 500mW)



Rectifier chip



Transmitter chip



Low EMI

(10/10)