

Smart Asset Monitor and Tracking Tag

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NEXT FLEX



ASI Presenter: Richard Ellinger
ASI Project Manager: Dale Wilson
BSU Principle Investigator: David Estrada

Flexible

Chemical indicators for Temperature
First generation temperature indicators
“Go, No-Go”

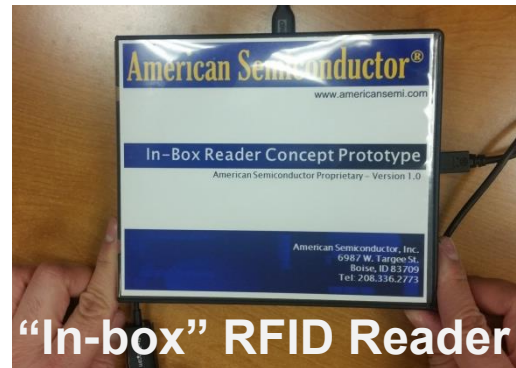


Non Flexible

Temperature/Humidity Data Loggers
Multiple sensors
Recording Data
Transmit data wirelessly



Smart Tag on Vaccines



“In-box” RFID Reader



Life Sciences

BioTech
Pharma
Clinical Trials
Diagnostics
Blood Banks
Research / Hospital
Warehouses
Distribution Centers

Logistics

In Air
On Ground
On Sea
In Port
Warehouses
Distribution Centers

Food

Manufacturers
Distribution
Wholesalers
Retailers
Gift/Specialty
Research
Farms

The Good News:

Global Environmental Tag Market is \$550 million

- Most environmental monitoring is at the truck level
- Since 2006, decreased profile packaging of environmental loggers has increased
- Advancements in wireless protocols has enhanced warehouse level monitoring
- Environmental monitoring is reaching the pallet level now

However:

The market wants and needs to reach the case, even the each level

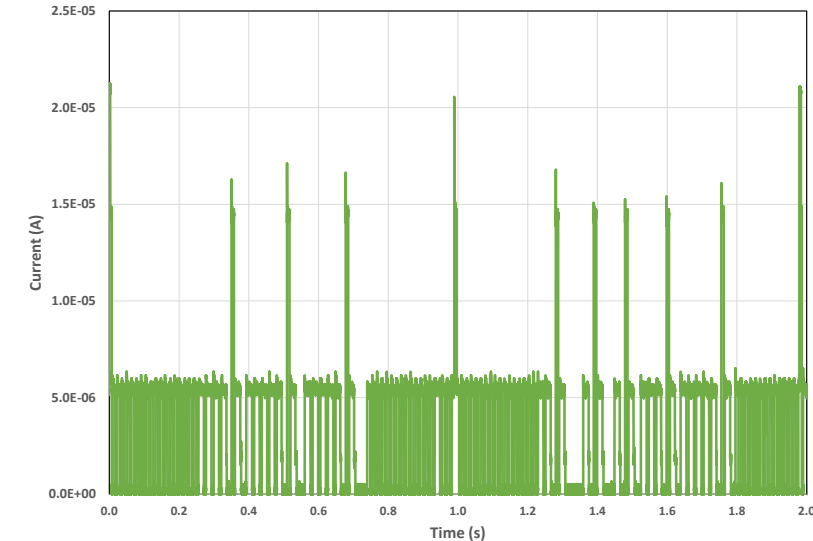
Smart Asset Monitor and Tracking Tag

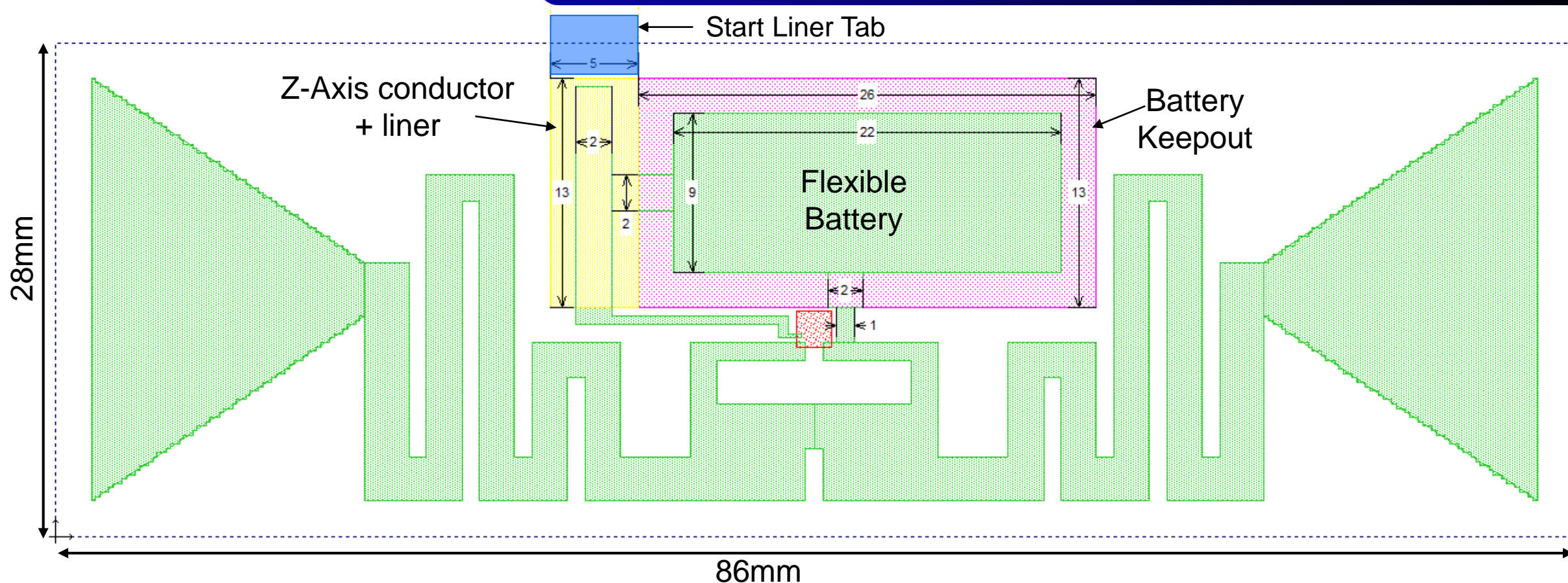
- **Program Call: 2.7**
- **Project Objectives:**
 - ▶ Deliver smart asset tracking tags
 - ▶ Automatically monitor environment data for at least two weeks
 - ▶ Small, low profile, flexible
 - ▶ Wirelessly transmit the data using industry standard RFID protocol
- **Project Team**
 - ▶ American Semiconductor
 - ▶ Boise State University
- **18-Month Program Schedule**
 - ▶ Program Start: Dec 2016
 - ▶ Program End: June 2018



- Breadboard version of the battery assisted tag has been assembled
- Firmware development to configure the IC for battery assisted operation is complete
- Power consumption testing and model development completed
- Selected flexible battery and antenna inlay manufacturer
- System layout optimization for battery size and antenna performance is in progress
- Full thickness wafers with RFID sensor IC have been delivered
- FleX Silicon-on-Polymer wafer processing is in progress
- Workforce Development is in progress

- **Measured IC power consumption in all operating modes**
 - Sleep
 - Sense
 - Data transmit
- **Developed a system power consumption model based on:**
 - Environmental data sampling rates
 - Data transmission rates
- **Flexible battery requirements derived from power model and operating life**
 - Thin
 - Flexible
 - Capacity to support > 2 week operating life





Features:

- Inlay and battery printed concurrently
- Commercial IC (flexible)
- Semi-passive operation
- Battery assisted (flexible)
- Environmental sensing capability
- 900MHz wireless data communication

- RFID reader support for environmental data collection is not standardized
- Software development is in progress for configuring, controlling and collecting data from the Smart-Tags using the RFID protocol
- **Software control GUI supports:**
 - ▶ Multiple tags
 - ▶ Tag identification code display
 - ▶ High and low temperature alarm thresholds
 - ▶ Number of samples for alarm threshold
 - ▶ Delay time before data collection begins
 - ▶ Temperature sensing sampling interval



- **Two summer interns from Boise State University working on FHE projects**
 - ▶ Anisotropic conductive adhesive processing improvements for flexible IC to flexible substrate die attach and interconnects
 - ▶ Printed interconnects for small pad size and pitch flexible IC to flexible substrates
- **New Boise State University course**
 - ▶ Material Science & Engineering MSE 550: Nanoscale Transport
 - ▶ Introduction to flexible and printed electronics
 - ▶ Emerging 2-dimensional (2D) materials such as graphene and transition metal dichalcogenides for FHE applications
 - ▶ First offering of the course was Spring Semester 2017



The Market is demanding:

1. High functioning, easy-to-read smart labels
2. Most markets need to reach information down to the case level
3. Some markets are demanding to reach information down to the each level
4. Case and each level smart tags will need to be flexible based on product size
5. All markets want more information in dB format centrally located for easy access
6. Additional sensors to create high-value asset monitoring (CO2, Shock, Tilt, Vibration, Altimeter, Accelerometer)

Project Output

Smart Asset Monitor and Tracking Tag

A working model of smart tag and reader will be on display at NextFlex in Santa Clara, upon completion

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Thank You

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American Semiconductor, Inc.

6987 W Targee St

Boise, ID 83709

Tel: 208.336.2773

Fax: 208.336.2752

www.americansemi.com