Energy Harvesting IC for Illuminating Sights

Douglas Cox and John Ambrose
Presented at the Joint Armaments Conference
May 15, 2014
by Douglas Cox
info@mix-sig.com

Mixed Signal Integration
2157-50 O’Toole Avenue
San Jose, CA  95131
+1 408-434-6305
www.mix-sig.com
What is Energy Harvesting?

• Vibration detection
  – Using transducer
  – Piezoelectric device
• RF energy
• Magnetic/Hall Effect
Power Capabilities

- Maximum Voltage output 4 VDC
  - Internal Protection
  - Prevents damage to Silicon
- Typical current: 200μA
  - Limited by Input Source
  - Piezo wafers have greatest output
Analog Signal Processing
Functional Capabilities

- Filters
- Op Amps/Comparators
- Multiplexors
- Data Converters
- Limiter/Companders
- Phase Locked Loop
- Analog Front End
Signal Processing Example

IN

MSMXVHF

MSU2F1

MSU2F1

Charge Pump

SSB OUT
Applications

- Powering laser sights
- Illuminating red-dot sights
- Short range communications
- Remote programming
MSRFIF Block Diagram

Radio Frequency Interface Integrated Circuit
MSRFIF Die Plot
MSRFIF Package Options

Radio Frequency Interface Integrated Circuit
Energy Harvesting Application Board
Application Schematic

- **RFIN**
  - VA = PIEZOELECTRIC
  - VO = 3VPP
  - V1

- **VSSA**

- **RF**

- **VDD**

- **C1**
  - 0.1u

- **AGND**

- **SUB**
  - PDO
  - DEMOD
  - MOD2
  - MSRF1F
  - VSSA
  - MOD1

- **IN1**

- **IN2**

- **DEMOD_OUT**

- **POWERDOWN_OUT**

- **X1**
Red Dot Rifle Sight
Bench Evaluation Data

- Piezoelectric wafer is tuned
- Voltage generated by Motion fed to charge pump of MSRFIF.
- VDD out is 2.5V at 200 μA
- Adjust capacitor to increase on-time
Other Potential Uses

• Remote Programming
  – Safe and Arm time
  – Fuzing
• Bluetooth™
Remote Programming Example
Technical Challenges

• Piezo efficiency
  – Amount of motion limited for application

• Piezo size
  – Need larger size for voltage/current needs

• Charge pump efficiency
  – Optimized for RF

• Antenna size

• Capacitor size
Summary

• MSRFIF provides:
  – Charge pump for power
    • Perfect for high efficiency LEDs
  – Communications Channel

• Piezo wafer generates energy

• Potential to achieve higher current and more functions in future designs
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