



**CYPRESS**<sup>®</sup>  
EMBEDDED IN TOMORROW™

# Energy Harvesting PMIC

Q1 2018

Cypress Roadmap



# Energy Harvesting PMIC<sup>1</sup> Portfolio

Series Solar Cell by Panasonic (AM-1801)



Single Solar Cell by Ningbo Hebe Solar (HSC125155)



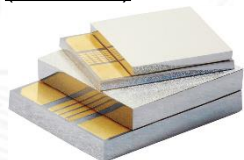
Piezoelectric Device by Thrive (K7520BS3)



Electromagnetic Device by Perpetuum (PMG-FSH)



TEG by Micropelt (TGP-651)



Light Series Solar Cell

Light Single Solar Cell

Vibration Piezoelectric, Electromagnetic

Heat Thermoelectric Generator (TEG)

Energy Harvesting Method	Wearable Activity Monitor	Residential WSNs <sup>2</sup> for HVAC <sup>3</sup> , Level of Light Emitted, Temperature, Humidity, Motion	Building WSNs for HVAC, Level of Light Emitted, Temperature, Humidity, Motion, BLE <sup>4</sup> Beacon <sup>5</sup>	Industrial WSNs for Infrastructure, Agriculture, Transportation, Factory Automation, Animal Monitoring	
	Indoor/Outdoor			Indoor	Outdoor
Light Series Solar Cell	<b>NEW</b> S6AE101A Linear, Power Gating <sup>6</sup> , Multiplexer <sup>7</sup> , 10-pin QFN	<b>NEW</b> S6AE101A Linear, Power Gating, Multiplexer, 10-pin QFN	<b>NEW</b> S6AE102A Linear, Power Gating, Multiplexer, LDO <sup>8</sup> , Comparator, 20-pin QFN	<b>NEW</b> S6AE103A Linear, PowerGating, Multiplexer, LDO, Timer, Comparator, 24-pin QFN	
Light Single Solar Cell		MB39C811 Buck DC/DC, Dual-Bridge Rectifier, Power Good, 40-pin QFN	MB39C811 Buck DC/DC, Dual-Bridge Rectifier, Power Good, 40-pin QFN	MB39C811 Buck DC/DC, Dual-Bridge Rectifier, Power Good, 40-pin QFN	MB39C831 Boost DC/DC, MPPT <sup>9</sup> , Li-ion Protection, 40-pin QFN
Vibration Piezoelectric, Electromagnetic		MB39C811 Buck DC/DC, Dual-Bridge Rectifier, Power Good, 40-pin QFN	MB39C811 Buck DC/DC, Dual-Bridge Rectifier, Power Good, 40-pin QFN		
Heat Thermoelectric Generator (TEG)			MB39C831 Boost DC/DC, MPPT, Li-ion Protection, 40-pin QFN		

Market Segment →

Status Availability

Concept 
 Development 
 Sampling 
 Production

<sup>1</sup> Power Management IC

<sup>2</sup> Wireless Sensor Nodes

<sup>3</sup> Heating, ventilation, air conditioning

<sup>4</sup> Bluetooth Low Energy

<sup>5</sup> A wireless device that transmits data (e.g., signal strength and ID) over a periodic radio signal from a known location

<sup>6</sup> Output power control circuit that controls power provided to the system load

<sup>7</sup> Power source switch circuit for primary battery or Energy Harvesting Device

<sup>8</sup> Low dropout regulator

<sup>9</sup> Maximum Power Point Tracking

# S6AE101A

## Solar-Optimized Energy Harvesting Power Management IC (PMIC)

### Applications

Series solar cell energy harvesting<sup>1</sup> and wireless sensor nodes<sup>2</sup>

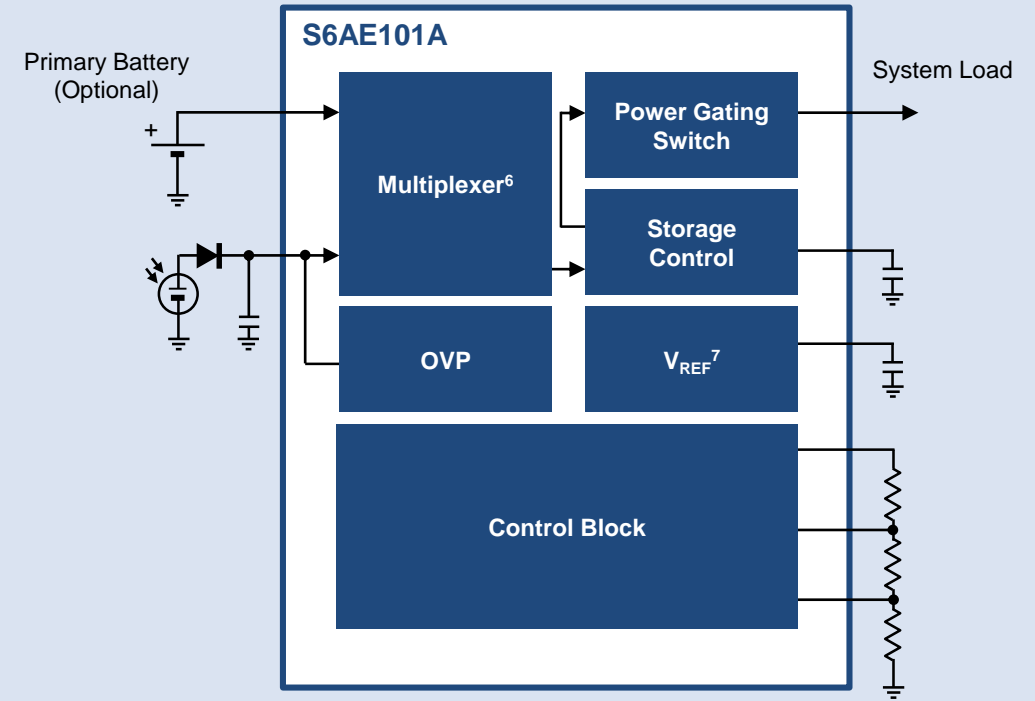
### Features

- **Ultra-Low Power**
  - Enables 1 cm<sup>2</sup> minimum solar cell size for startup operation<sup>3</sup>
- **Input Voltage Range**
  - 2.0–5.5 V (series solar cell and primary battery)
- **1.1–5.2-V Output Voltage Range**
- **250-nA Quiescent Current<sup>4</sup>**
- **1.2- $\mu$ W Startup Power**
- **Power Gating<sup>5</sup> Switch Circuit**
- **Storage Control Circuit**
- **Multiplexer<sup>6</sup> Circuit (battery vs. solar cell)**
- **Overvoltage Protection (OVP)**
- **Packages**
  - 3.0 mm x 3.0 mm 10-pin SON

### Collateral

**Datasheet:** [S6AE101A Datasheet](#)  
**Development Kits:** [Solar-Powered IoT Device Kit](#)  
[S6AE10xA Evaluation Board](#)  
**Software:** [Easy DesignSim™ Software](#)

### S6AE101A: Solar-Optimized Energy Harvesting PMIC



### Availability

**Production:** Now

<sup>1</sup> The process of capturing and converting tiny amounts of energy (e.g., from light, vibration or heat) into electricity

<sup>2</sup> A sensor-based device that monitors conditions such as temperature, humidity and pressure and wirelessly transmits that data to a control unit, such as a PC or a mobile device

<sup>3</sup> Estimate based on solar cell power = 2  $\mu$ W/cm<sup>2</sup> at 100 lx

<sup>4</sup> Current consumed at no load condition

<sup>5</sup> Output power control circuit that controls power provided to the system load

<sup>6</sup> Power source switch circuit for primary battery and Energy Harvesting Device

<sup>7</sup> Voltage reference circuit for internal block



# S6AE102A

## Solar-Optimized Energy Harvesting Power Management IC (PMIC)

### Applications

Series solar cell energy harvesting<sup>1</sup> and wireless sensor nodes<sup>2</sup>

### Features

- **Ultra-Low Power**
  - Enables 1 cm<sup>2</sup> minimum solar cell size for startup operation<sup>3</sup>
- **Input Voltage Range**
  - Series solar cell: 2.0–5.5 V (series solar cell and primary battery)
- **1.1–5.2-V Output Voltage Range**
- **280-nA Quiescent Current<sup>4</sup>**
- **1.2- $\mu$ W Startup Power**
- **400-nA Low Quiescent Current Low Dropout Regulator (LDO)**
- **Dual-Channel Power Gating<sup>5</sup> Switch Circuit with Interrupt Request (IRQ) Control Function for Power Management**
- **Signal Output Circuit of Power Gating Switch Control**
- **Multiplexer<sup>6</sup> Circuit (battery vs. solar cell)**
- **Hybrid Storage Control Circuit<sup>7</sup> and Overvoltage Protection (OVP)**
- **Packages**
  - 4.0 mm x 4.0 mm 20-pin QFN

### Collateral

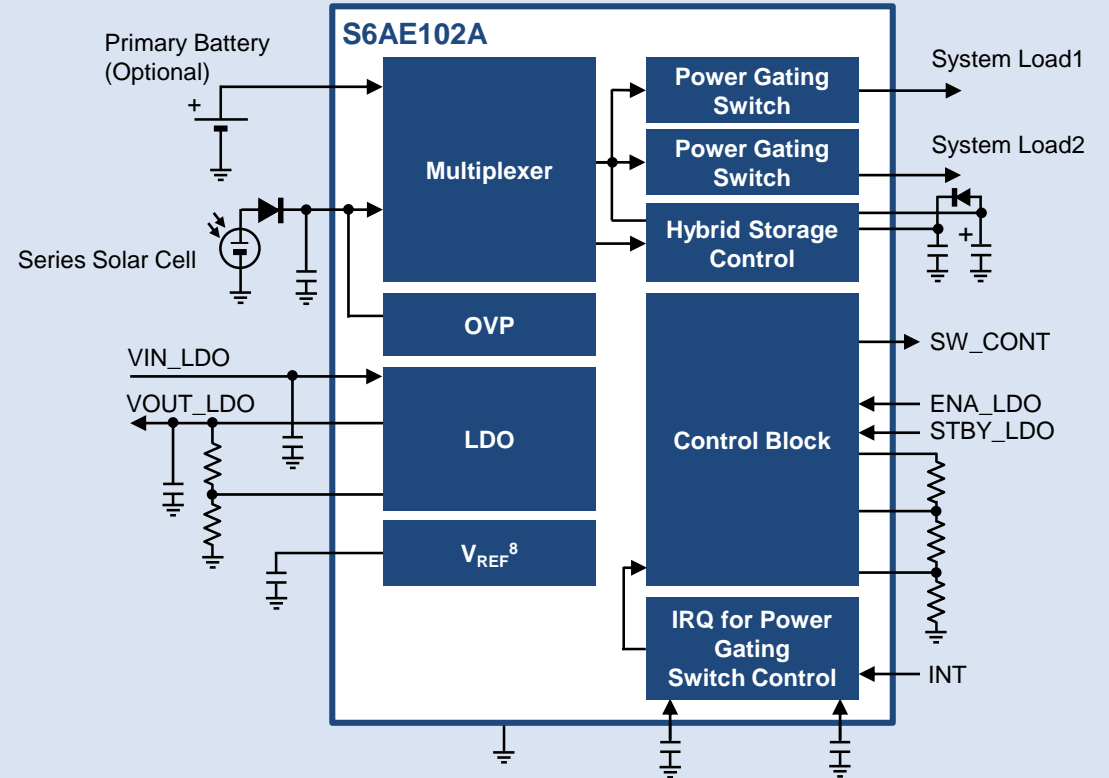
**Datasheet:** [S6AE102A Datasheet](#)

**Development Kits:** [S6AE10xA Evaluation Board](#), [CYALKIT-E04](#)

**Software:** [Easy DesignSim™ Software](#)

<sup>1</sup> The process of capturing and converting tiny amounts of energy (e.g., from light, vibration or heat) into electricity  
<sup>2</sup> A sensor-based device that monitors conditions such as temperature, humidity and pressure and wirelessly transmits that data to a control unit, such as a PC or a mobile device  
<sup>3</sup> Estimate based on solar cell power = 2  $\mu$ W/cm<sup>2</sup> at 100 lx  
<sup>4</sup> Current consumed at no load condition

### S6AE102A: Solar-Optimized Energy Harvesting PMIC



### Availability

**Production:** Now

<sup>5</sup> Output power control circuit that controls power provided to the system load

<sup>6</sup> Power source switch circuit for primary battery or series solar cell

<sup>7</sup> Uses a small and large capacitor to automatically store excess power for backup

<sup>8</sup> Voltage reference circuit for internal block

# S6AE103A

## Solar-Optimized Energy Harvesting Power Management IC (PMIC)

### Applications

Series solar cell energy harvesting<sup>1</sup> and wireless sensor nodes<sup>2</sup>

### Features

- **Ultra-Low Power**
  - Enables 1 cm<sup>2</sup> minimum solar cell size for startup operation<sup>3</sup>
- **Input Voltage Range**
  - 2.0-5.5 V (series solar cell and primary battery)
- **1.1–5.2 V Output Voltage Range**
- **280 nA Quiescent Current<sup>4</sup>**
- **1.2 μW Startup Power**
- **400 nA Low Quiescent Current Low Dropout Regulator (LDO)**
- **30 nA Low Consumption Current CR Timer<sup>5</sup>**
- **20 nA General-Purpose Low Consumption Current Comparator**
- **Dual-Channel Power Gating<sup>6</sup> Switch Circuit with Interrupt Request (IRQ) Control Function for Power Management**
- **Signal Output Circuit of Power Gating Switch Control**
- **Multiplexer<sup>7</sup> Circuit (battery vs. solar cell)**
- **Hybrid Storage Control Circuit<sup>8</sup> and Overvoltage Protection (OVP)**
- **Packages**
  - 4.0 mm x 4.0 mm 20-pin QFN

### Collateral

**Datasheet:** [S6AE103A Datasheet](#)

**Development Kits:** [S6AE10xA Evaluation Board](#), [CYALKIT-E04](#)

**Software:** [Easy DesignSim™ Software](#)

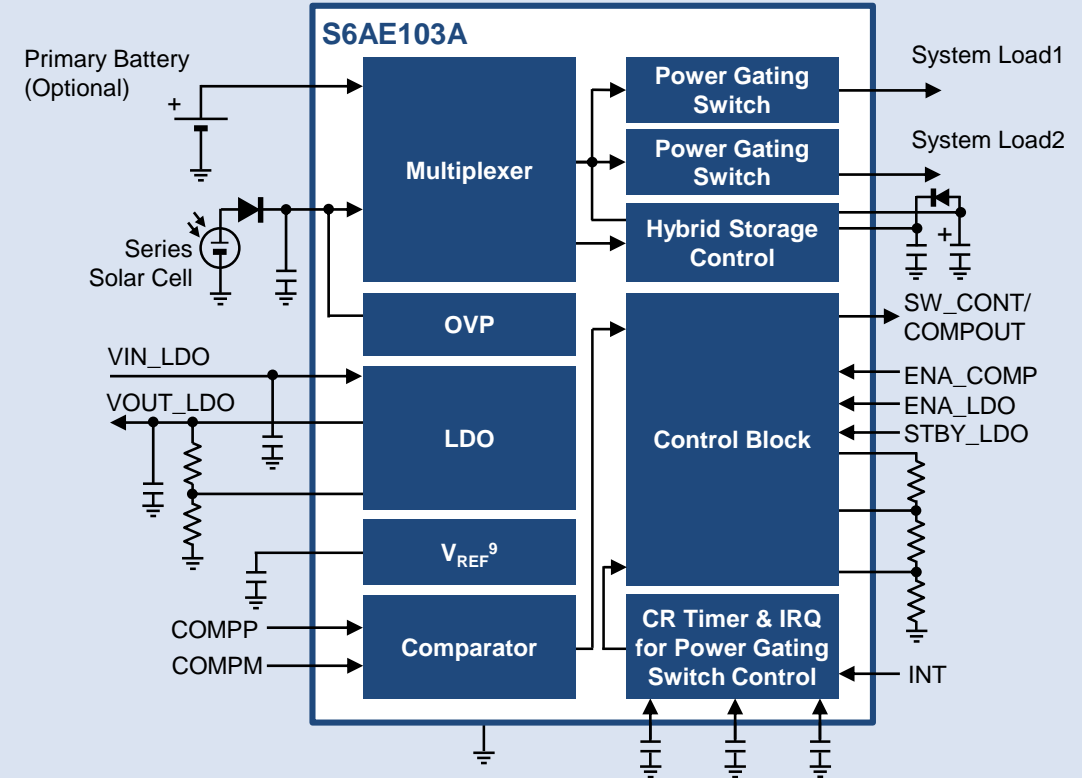
<sup>1</sup> The process of capturing and converting tiny amounts of energy (e.g., from light, vibration or heat) into electricity

<sup>2</sup> A sensor-based device that monitors conditions such as temperature, humidity and pressure and wirelessly transmits that data to a control unit, such as a PC or a mobile device

<sup>3</sup> Estimate based on solar cell power = 2 μW/cm<sup>2</sup> at 100 lx

<sup>4</sup> Current consumed at no load condition

### S6AE103A: Solar-Optimized Energy Harvesting PMIC



### Availability

**Production:** Now

<sup>6</sup> Output power control circuit that controls power provided to the system load

<sup>7</sup> Power source switch circuit for primary battery or series solar cell

<sup>8</sup> Uses a small and large capacitor to automatically store excess power for backup

<sup>9</sup> Voltage reference circuit for internal block

# MB39C811

## General Purpose Energy Harvesting Power Management IC (PMIC)

### Applications

Series solar cell energy harvesting<sup>1</sup>, Piezoelectric<sup>2</sup> energy harvesting and wireless sensor nodes (WSN)<sup>3</sup>

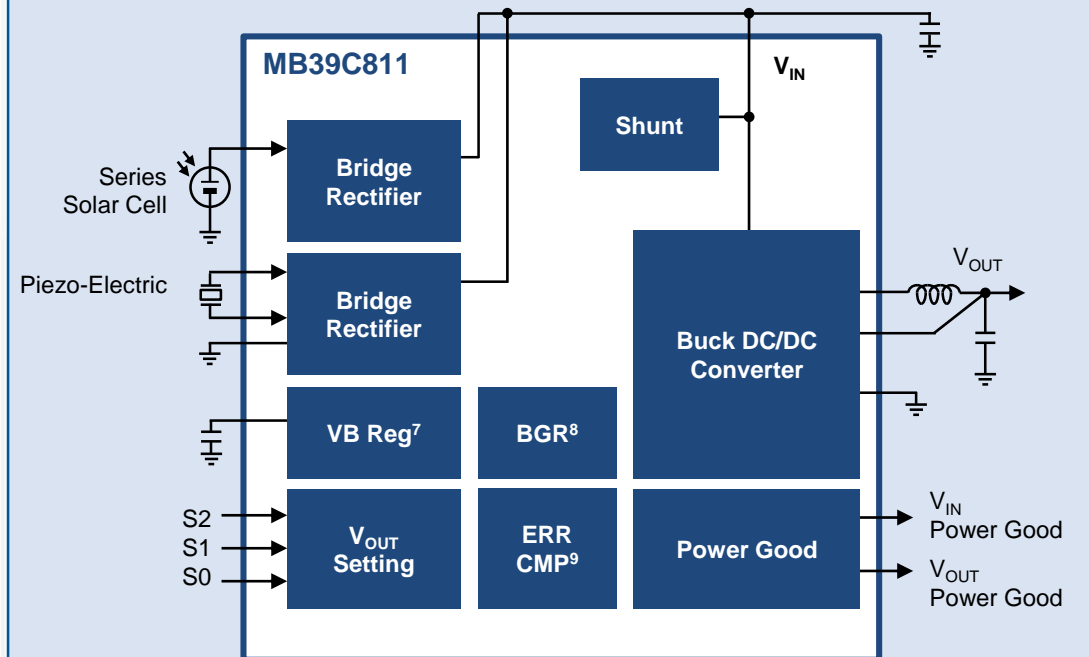
### Features

- **Ultra-Low-Power Buck DC/DC Converter Dual-Bridge Rectifiers**
- **1.5  $\mu\text{A}$  Quiescent Current<sup>4</sup>**
- **2.6–23-V Input Voltage Range**
- **Output Voltage**
  - 1.5 V, 1.8 V, 2.5 V, 3.3 V, 3.6 V, 4.1 V, 4.5 V and 5.0 V
- **100 mA (maximum) Output Current**
- **Overcurrent Protection (OCP)**
- **Low-Loss Full-Wave Bridge Rectifier**
  - $V_F^5 = 0.28\text{ V}$  ( $I_F = 10\ \mu\text{A}$ ),  $I_R^6 = 20\ \text{nA}_{\text{MAX}}$  ( $V_{\text{REVERSE}} = 18\text{ V}$ )
- **Shunt for Input Protection**
  - $V_{\text{IN}} \geq 21\text{ V}$  (up to 100-mA pulldown)
- **Input and Output Power Good Monitoring**
- **Package**
  - 6.0 mm x 6.0 mm 40-pin QFN

### Collateral

**Datasheet:** [MB39C811 Datasheet](#)  
**Development Kits:** [Energy Harvesting Starter Kit](#)  
[MB39C811 Evaluation Board](#)  
**Software:** [Easy DesignSim™ Software](#)

### MB39C811: General Purpose Energy Harvesting PMIC



### Availability

**Production: Now**

<sup>1</sup> The process of capturing and converting tiny amounts of energy (e.g., from light, vibration or heat) into electricity

<sup>2</sup> Power generation device using vibration

<sup>3</sup> A sensor-based device that monitors conditions such as temperature, humidity and pressure and wirelessly transmits that data to a control unit, such as a PC or a mobile device

<sup>4</sup> Current consumed at no load condition

<sup>5</sup> Bridge rectifier reverse breakdown voltage

<sup>6</sup> Bridge rectifier reverse bias leak current

<sup>7</sup> Regulator for internal block

<sup>8</sup> Band Gap Reference

<sup>9</sup> Error Comparator

# MB39C831

## General Purpose Energy Harvesting Power Management IC (PMIC)

### Applications

Single solar cell energy harvesting<sup>1</sup>, thermoelectric generator<sup>2</sup> energy harvesting and wireless sensor nodes<sup>3</sup>

### Features

- **Ultra-Low-Voltage Startup Boost DC/DC Converter**
- **0.3–4.75-V Input Voltage Range**
- **0.35-V Startup Voltage**
- **Output Voltage (constant voltage mode only)**
  - 3.0 V, 3.3 V, 3.6 V, 4.1 V, 4.5 V and 5.0 V
- **32- $\mu$ A Quiescent Current<sup>4</sup>**
- **Output Current**
  - 8 mA ( $V_{DD} = 0.6$  V,  $V_{OUT} = 3.3$  V) and 80 mA ( $V_{DD} = 3.0$  V,  $V_{OUT} = 3.3$  V)
- **200-mA Input Peak Current Limit**
- **Built-In Maximum Power Point Tracking (MPPT)<sup>5</sup> Function**
- **Built-In Li-ion Charge Function**
- **Input and Output Power Good Monitoring**
- **Package**
  - 6.0 mm x 6.0 mm 40-pin QFN

### Collateral

**Datasheet:** [MB39C831 Datasheet](#)  
**Development Kits:** [MB39C831 Evaluation Board](#)  
**Software:** [Easy DesignSim™ Software](#)

<sup>1</sup> The process of capturing and converting tiny amounts of energy (e.g., from light, vibration or heat) into electricity

<sup>2</sup> Power Generation Device using heat

<sup>3</sup> A sensor-based device that monitors conditions such as temperature, humidity and pressure and wirelessly transmits that data to a control unit, such as a PC or a mobile device

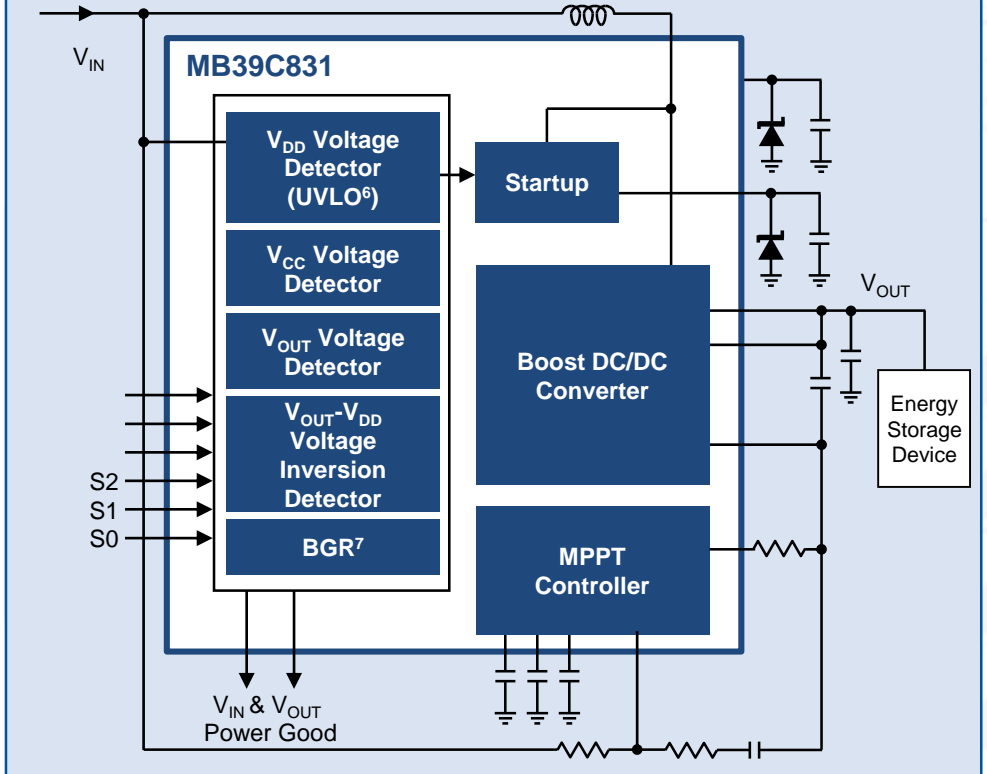
<sup>4</sup> Current consumed at no load condition

<sup>5</sup> Maximum Power Point Tracking maximizes the Energy Harvest by adjusting current drawn from a solar panel

<sup>6</sup> Undervoltage lockout

<sup>7</sup> Band Gap Reference

### MB39C831: General Purpose Energy Harvesting PMIC



### Availability

**Production:** Now



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