

# LM8850 Evaluation Board Application Note

National Semiconductor  
Application Note 2119  
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March 30, 2011



## General Description

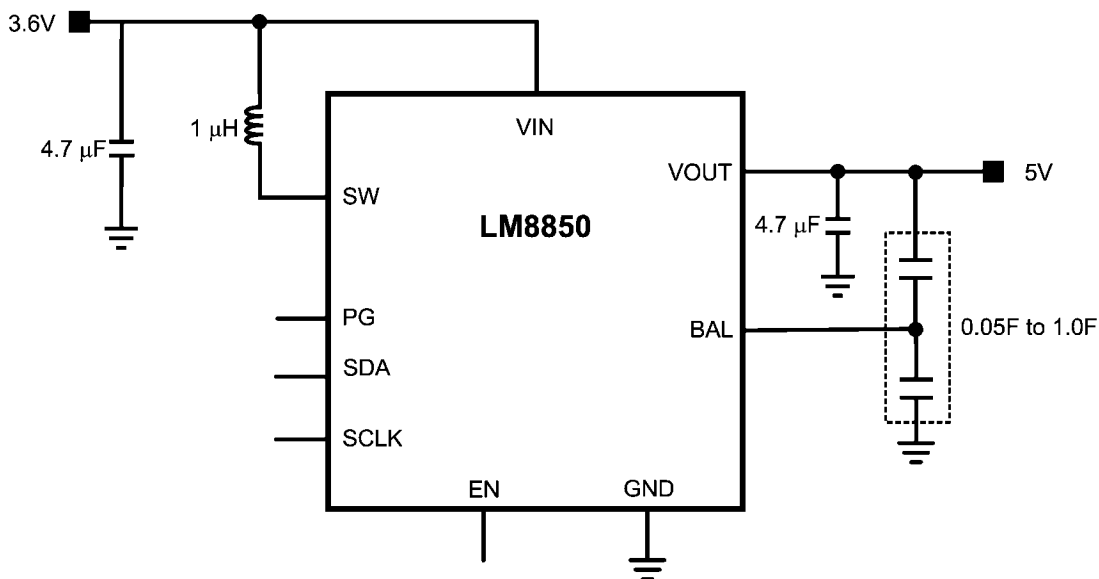
The LM8850 evaluation board is a working demonstration of a step-up DC-DC converter that has been optimized for use with a super-capacitor. The super-capacitor protects a battery from power surges and enables new high-power applications in mobile device architectures. The LM8850 creates an ideal rail from 3.6V to 5.7V from an input voltage range of 2.3V to 5.5V,  $V_{IN}$  must be 10% lower than expected  $V_{OUT}$ .

An I<sup>2</sup>C interface controlling multiple output voltage settings, input current limits, and load currents up to 1A provides superior user flexibility. The LM8850 operates in Auto mode,

where the converter is in PFM mode at light loads and switches to PWM mode at heavy loads or in forced PWM mode. Hysteretic PFM extends the battery life by reducing the quiescent current to 7 $\mu$ A (typ.) during light load and standby conditions. Synchronous operation provides true shutdown isolation and improves the efficiency at medium to full load conditions.

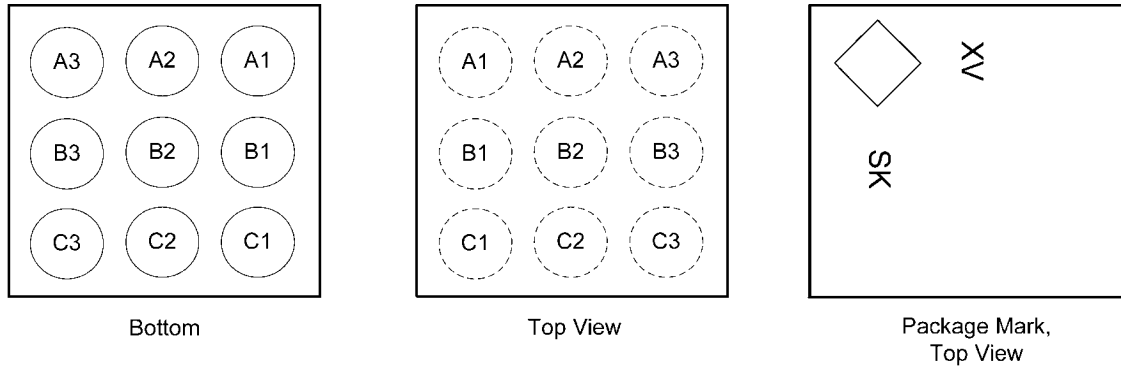
High switching frequency enables smaller passive components. Internal compensation is used for a broader range of inductor and output capacitor values to meet system demand and achieve small system solution size.

## Typical Application Circuit with Super-Capacitor



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## Connection Diagram and Package Mark Information



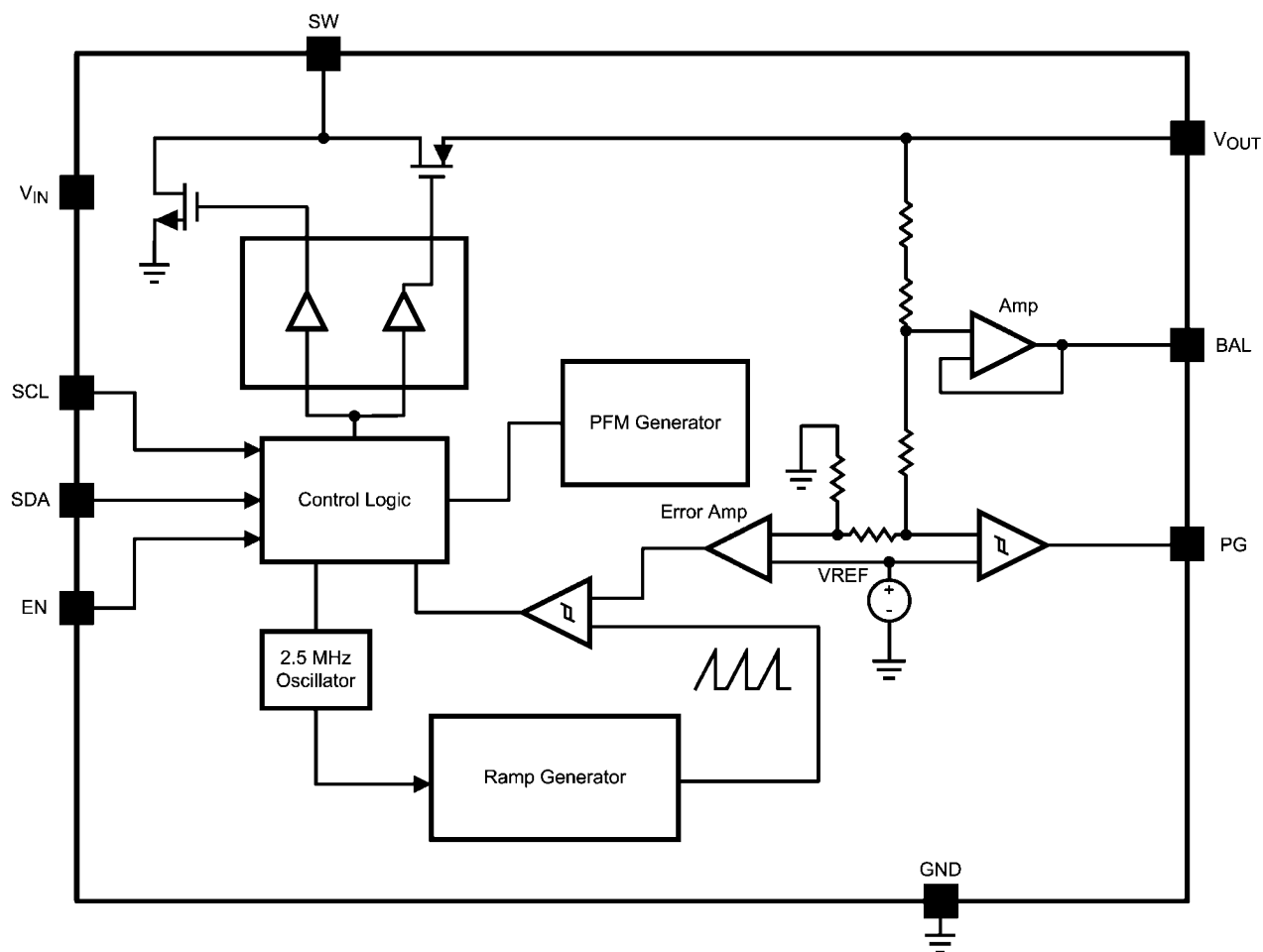
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**FIGURE 1. 9-Bump micro SMD Package**

## Pin Descriptions

Pin #	Name	Description
A1	VIN	Power Supply Input. Connect to input filter capacitor (see Typical Application Circuit).
A2	SW	Switching node. Connection to the internal NFET switch and PFET synchronous rectifier.
A3	GND	Ground Pin
B1	SDA	I <sup>2</sup> C data (Use a 2k $\Omega$ pullup resistor.)
B2	PG	Power Good indicator
B3	VOUT	Output pin.
C1	SCLK	I <sup>2</sup> C Clock (Use a 2K $\Omega$ pull up resistor.)
C2	EN	Enable pin. The device is in shutdown when voltage to this pin is < 0.4V and enabled when > 1.2V. Do not leave this pin floating.
C3	BAL	Balancing pin for active voltage balancing of super-capacitor.

## Block Diagram



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## Board Operation

To operate the LM8850, connections to VIN, Ground and the jumper on the enable pin must be in the H position. To start out, supply 3.6V to VIN. With a valid supply, Vout should power up to 5V within 5 seconds.

Once enabled, the LM8850 charges the supercapacitor utilizing all of the default settings in the registers. The I<sup>2</sup>C must

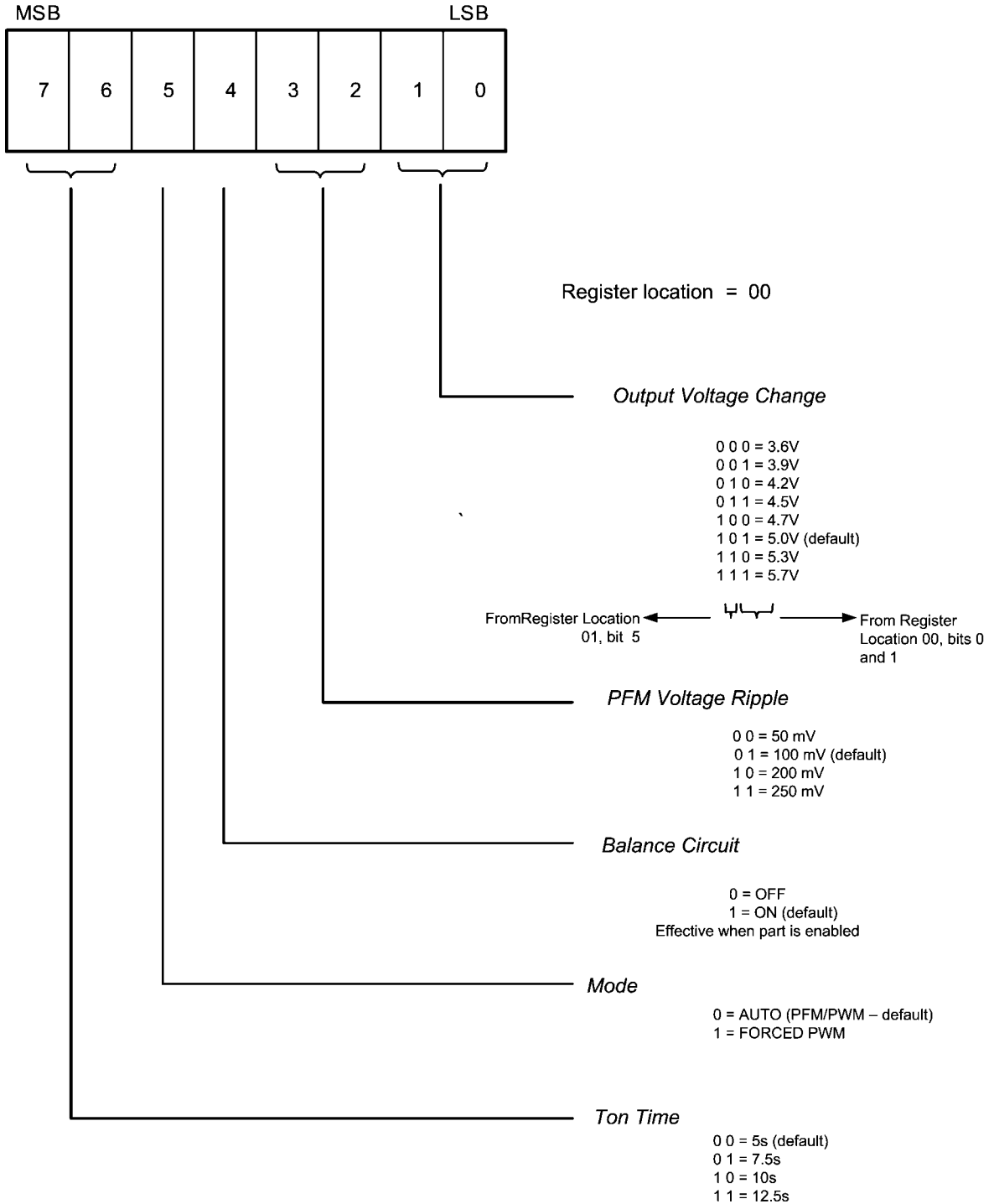
be used to change the default settings and this can only be done with the LM8850 enabled. Once a register is written to, the changes will transition immediately. Every time the EN pin transitions from VIL to VIH, registers 0 and 1 are reset to their defaults settings and any settings needed must be rewritten into the appropriate registers.

## I<sup>2</sup>C-Compatible Chip Address

The device address for LM8850 is 60 (HEX).

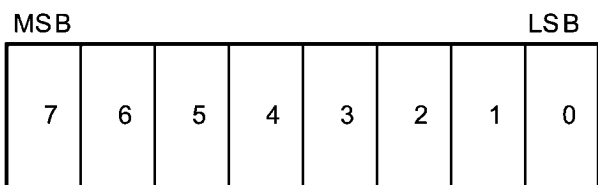
Register Name	Location	Type	Register
CONTROL	00	R/W	Control Register 1
CONTROL	01	R/W	Control Register 2

### CONTROL REGISTER 0 Register Location = 00



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# CONTROL REGISTER 1 Register Location = 01



Register location = 01

## Switch Current Limit – (Max values)

111 = 1500 mA (default)  
 101 = 1025 mA  
 001 = 740 mA  
 000 = 530 mA

## Balmode

0 = OFF (default)  
 1 = ON  
 Effective when part is disabled

## Enable

0 = OFF  
 1 = ON (default)

## Bit 5 used to determine output voltage

000 = 3.6V  
 001 = 3.9V  
 010 = 4.2V  
 011 = 4.5V  
 100 = 4.7V  
 101 = 5.0V (default)  
 110 = 5.3V  
 111 = 5.7V

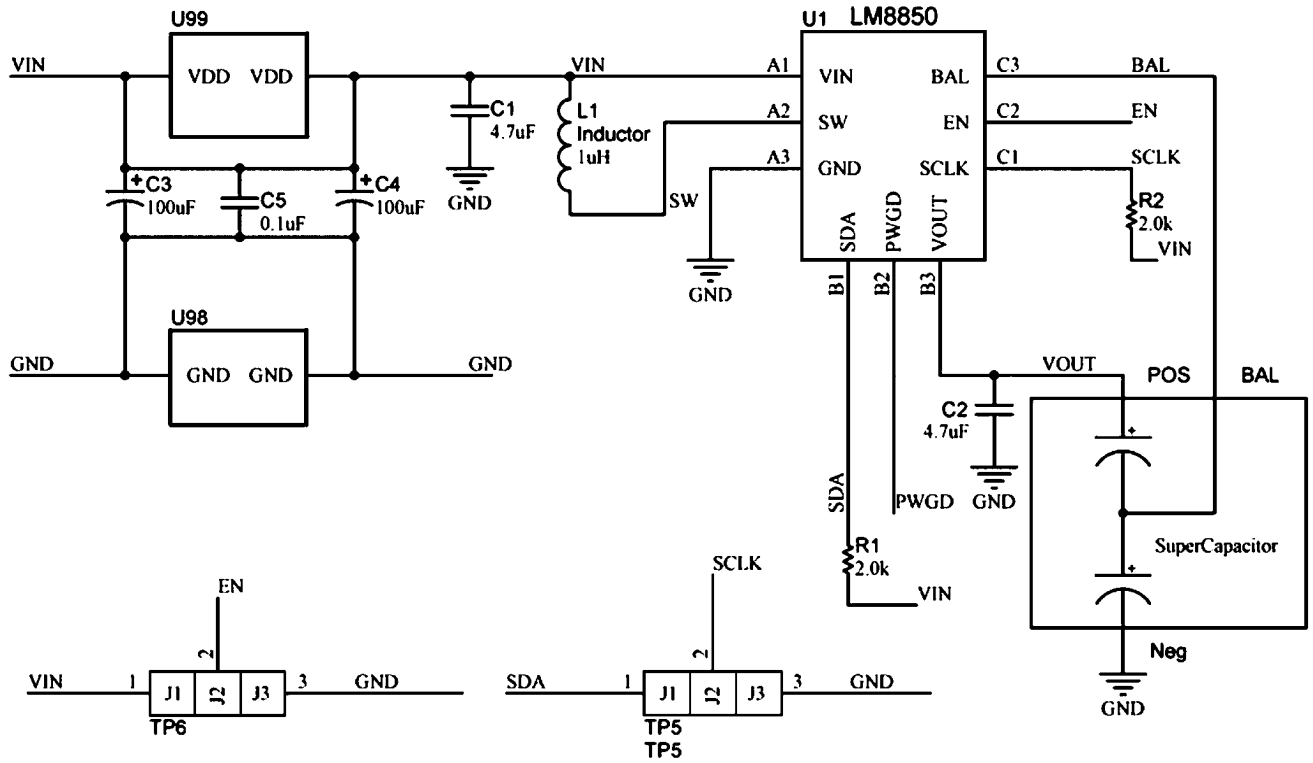
From Register  
Location 01, bit 5

From Register  
Location 00,  
bits 0 and 1

## PGOOD (Read only)

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## LM8850 Evaluation Board Schematic



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There are a few solder mask openings for various supercapacitor packages. If you plan on changing to a different supercapacitor than what is initially assembled, be sure to assemble using the best solder pad openings for your super-

capacitor footprint. Below, in the circled areas, are the initial pads used for the TDK supercap initially assembled. If the given pads aren't acceptable, the solder mask can be removed to expose the copper for any footprint needed.



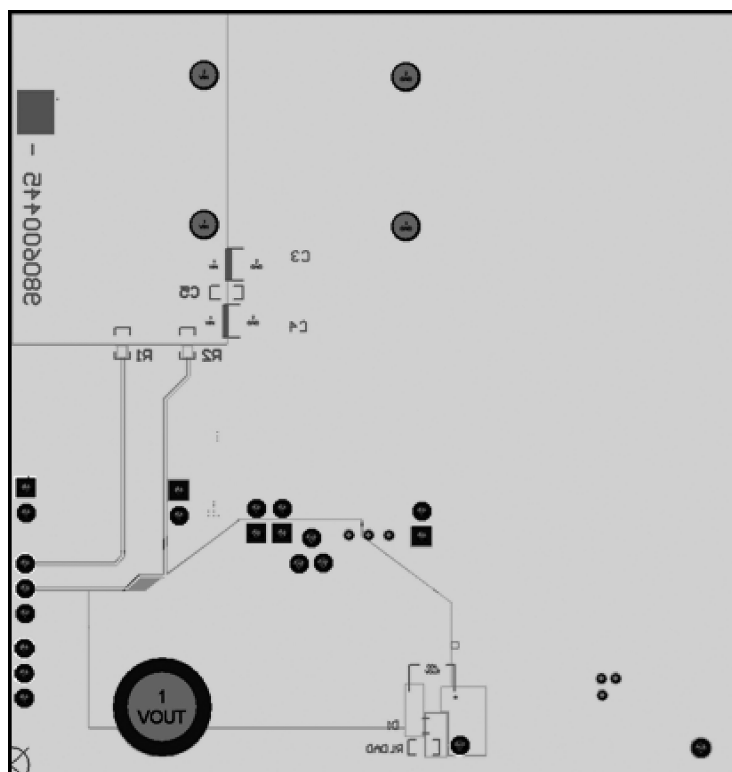
## Top Layer



### Mid- Layer 1



### Bottom Layer





## LM8850 Evaluation Board BOM

	Qty.	Value	Part Number	Description
C1 (CIN)	1	10 $\mu$ F	C1608X5R0J106M	0603, 6.3V, TDK
C2 (COUT)	1	4.7 $\mu$ F	CL10A475KP8NNNB	0603, 10V, SAMSUNG
C3 = C4 (FILTER CAP)	2	100 $\mu$ F	TPSC107M006R0075	0805, 10V, AVX
C5 (AC FILTER CAP)	1	100 nF	CL05F104Z05NNB	0402, 10V, SAMSUNG
L1	1	1 $\mu$ F	KSLI-252012AG-1R0	2520, 1.5A, HITACHI
VDD CONNECTOR	1	-	93K4533	NEWARK
GND CONNECTOR	1	-	80P3616	NEWARK
SuperCapacitor	1	500Mf	EDLC272020-501-2F-50	Super Capacitor
U1	1		LM8850TL	Boost Regulator
Total	10			

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LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Packaging	<a href="http://www.national.com/packaging">www.national.com/packaging</a>
Power Management	<a href="http://www.national.com/power">www.national.com/power</a>	Green Compliance	<a href="http://www.national.com/quality/green">www.national.com/quality/green</a>
Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>	Distributors	<a href="http://www.national.com/contacts">www.national.com/contacts</a>
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Voltage References	<a href="http://www.national.com/vref">www.national.com/vref</a>	Design Made Easy	<a href="http://www.national.com/easy">www.national.com/easy</a>
PowerWise® Solutions	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>	Applications & Markets	<a href="http://www.national.com/solutions">www.national.com/solutions</a>
Serial Digital Interface (SDI)	<a href="http://www.national.com/sdi">www.national.com/sdi</a>	Mil/Aero	<a href="http://www.national.com/milaero">www.national.com/milaero</a>
Temperature Sensors	<a href="http://www.national.com/tempsensors">www.national.com/tempsensors</a>	SolarMagic™	<a href="http://www.national.com/solarmagic">www.national.com/solarmagic</a>
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