

Brief Description

The ZSPM4141 is an ultra-low-power linear regulator optimized for minimal quiescent current losses via advanced, proprietary technology. It can improve energy efficiency and reduce heat due to power dissipation because it draws low nA-level quiescent current for light loads, yet it can regulate current loads as high as 200mA. The linear regulated output voltage is factory-configured to an option from 1.2V to 4.2V in 100mV steps. The ZSPM4141 also provides over-current protection.

Features

- Low operating voltage range: 2.5V to 5.5V
- Power-Down Mode for 100pA quiescent current
- Over-current protection: 250mA
- Output voltage options of 1.2V to 4.2V in 100mV steps (programmed at manufacturing)

Benefits

- Ultra-low 100pA quiescent current in power down mode
- Best-in-class quiescent current of 20nA at I_{LOAD}=0
- 0.5% DC line regulation (typical)
- Extends battery life
- Enables power harvesting applications
- · High level of integration minimizes board space

Related IDT Smart Power Products

 ZSPM4121 Under-Voltage Load Switch for Smart Battery Management

Available Support

- ZSPM4141W12KIT Evaluation Kit
- Support Documentation

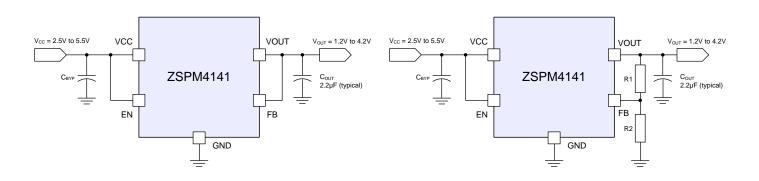
Physical Characteristics

Package: 8-pin DFN (2mm x2mm)

Typical ZSPM4141 Application Circuits

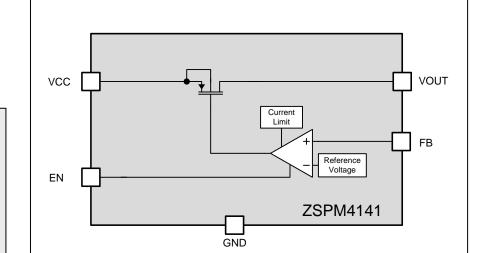
ZSPM4141 Basic (Fixed Output) Application

ZSPM4141Al1W12 Variable VOUT via Resistor Divider





ZSPM4141 Block Diagram



Typical Applications

- · Portable Electronics
- Industrial
- Medical
- Smart Cards
- RFID
- Energy-Harvesting Systems

Ordering Information

Ordering Code*	Description	Package
ZSPM4141AI1 <i>W</i> 12	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 1.2V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 18	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 1.8V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 25	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 2.5V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 30	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.0V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 31	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.1V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 33	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.3V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 42	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 4.2V	8-pin DFN / Reel
ZSPM4141W12KIT	ZSPM4141 Evaluation Kit w/Vout adjusting resistors (default 1.2 Vout)	

^{*} W for 7" reel with 2500 parts. Custom V_{OUT} values are also available: 1.2V to 4.2V (typical) in 100mV increments.



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1 ZSPM4141 Characteristics

Important: Stresses beyond those listed under "Absolute Maximum Ratings" (section 1.1) may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" (section 1.3) is not implied. Exposure to absolute—maximum—rated conditions for extended periods could affect device reliability.

1.1. Absolute Maximum Ratings

Over operating free—air temperature range unless otherwise noted. All voltage values are with respect to network ground terminal.

Table 1.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Maximum input/output on VCC, VOUT, EN, and FB pins		-0.3 to 6.0	V
Electrostatic Discharge – Human Body Model, according to the respective JESD22 JEDEC standard		2	kV
Electrostatic Discharge – Charged Device Model, according to the respective JESD22-C101 JEDEC standard		500	V
Operating Junction Temperature Range	TJ	-20 to 85	°C
Storage Temperature Range	T _{stg}	-65 to 150	°C
Lead Temperature (soldering, 10 seconds)		260	°C

1.2. Thermal Characteristics

Table 1.2 Thermal Characteristics for 8-pin DFN (2x2) Package

	θ _{JA} (°C/W) ¹⁾	θ _{JC} (°C/W) ²⁾	
	73.1	10.7	
1)	1) This assumes a FR4 board only.		
2)	2) This assumes a 1oz. copper JEDEC standard board with thermal vias. See section 6.1 for more information.		



1.3. Recommended Operating Conditions

Table 1.3 Recommended Operating Conditions

Parameter	Symbol	Min	Тур	Max	Unit
Unregulated Supply Input at VCC pin	Vcc	2.5		5.5	V
Enable Input (EN pin)	V _{EN}	0		5.0	V
Typical Regulated Supply Output Voltage	V _{OUT}	1.2		4.2	V
Operating Ambient Temperature 1)	T _A	-20		55	°C
Operating Junction Temperature	TJ	-20		85	°C

¹⁾ Operating ambient temperature is only intended as a guideline. The operating junction temperature requirements must not be exceeded.

1.4. Electrical Characteristics

Electrical characteristics, V_{CC} = 2.5V to 5V (unless otherwise noted). Minimum and maximum characteristics tested at T_J = 25°C.

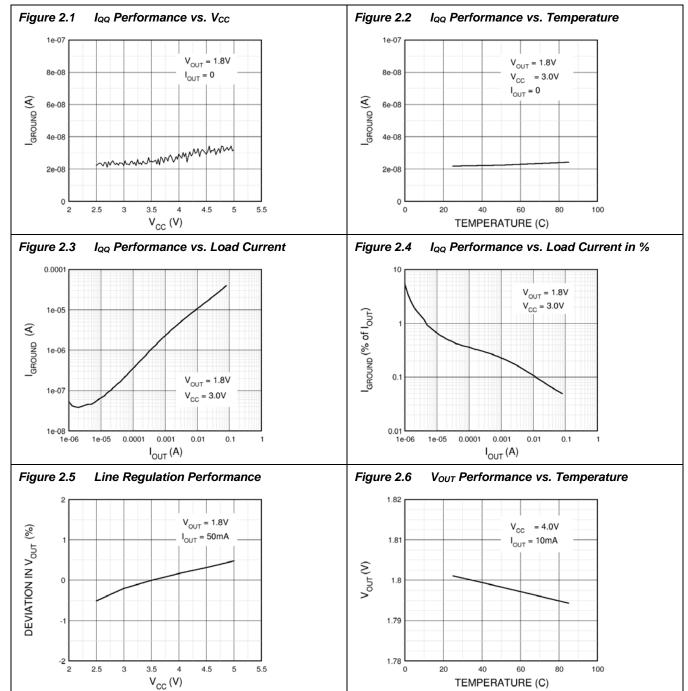
Table 1.4 Electrical Characteristics

Parameter	Symbol	Condition	Min	Тур	Max	Unit
Input Supply Voltage	V _{CC}		2.5		5.5	V
Input Low Logic Level	Vil _{EN}				0.3*V _{CC}	V
Input High Logic Level	Vih _{EN}		0.7*V _{CC}			V
Output Bypass Capacitor	C _{OUT}		1	2.2	4.7	μF
Input Bypass Capacitor	C _{BYP}			0.1		μF
Quiescent Current:	I _{QQ}	$V_{CC} = 4.2V, I_{OUT} = 0$		20		nA
Quiescent Current: Power- Down Mode	I_{QQpd}	I _{OUT} =0, EN = 0		100		pA
Operating Current	I _{OP-GND}	V _{CC} = 2.5V, I _{OUT} = 200mA		200		μΑ
		$V_{CC} = 3.3V$, $I_{OUT} = 200mA$		200		μΑ
		$V_{CC} = 5.5V, I_{OUT} = 200mA$		200		μΑ
Load Capability	I _{OUT}		0		200	mA
DC Line Regulation	V _{LINE}	V_{CC} = 2.5V to 5V, V_{OUT} =1.8V, I_{OUT} = 50mA		0.5	1	%
DC Load Regulation	V _{LOAD}	$V_{CC} = 4.2V$, $I_{OUT} = 0.02$ mA to 200mA, $V_{OUT} = V_{OUT,nominal} + 300$ mV		1	2	%
Current Limit	I _{LIMIT}	I _{OUT} measured at V _{OUT} = 0.9*V _{OUT} ,nominal		250		mA

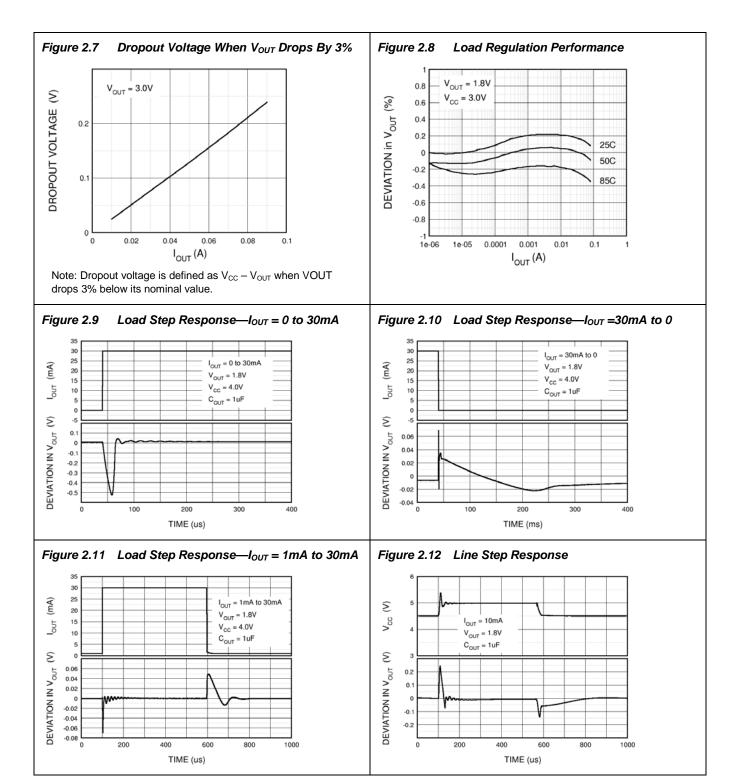


2 Typical Performance Characteristics

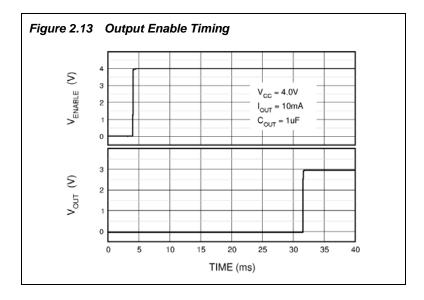
 $C_{IN} = 10 \mu F$ and $T = 25 ^{\circ}C$ (unless otherwise noted)







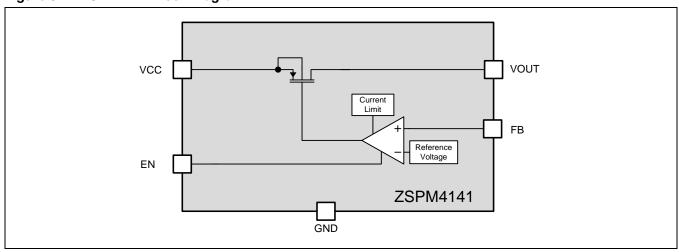




3 Description of Circuit

The ZSPM4141 is an ultra-low-power linear regulator optimized for minimal quiescent current losses via advanced, proprietary technology. It draws low nA-level quiescent current for light loads, yet it can regulate current loads as high as 200mA. The linear regulated output voltage is factory-configured to an option from 1.2V to 4.2V in 100mV steps. The ZSPM4141 also provides over-current protection (see Table 1.4).

Figure 3.1 ZSPM4141 Block Diagram





4 Application Circuits

4.1. Selection of External Components

4.1.1. Output Bypass Capacitor Cout

Connect a bypass capacitor (C_{OUT}) from the VOUT pin to ground. The typical value for C_{OUT} is 2.2 μ F. See Table 1.4 for further specifications.

4.1.2. Input Bypass Capacitor CBYP

Connect a bypass capacitor (C_{BYP}) from the VCC pin to ground. The typical value for C_{OUT} is 0.1µF.

4.1.3. Output Voltage Adjustment Resistors R1 and R2

The ZSPM4141W12KIT includes a set of output adjustment resistors for R1 and R2 shown in the variable output circuit on page 2. Refer to Table 4.1 for the effect of different combinations of the resistors on the output voltage and the resulting increase in I_{QQ} current.

Table 4.1 Output Voltage Adjustment Resistors and Resulting IQQ Increase

Vout	R1 (+/-0.1%)	R2 (+/-1%)	I _{QQ} increase
1.2	0		
1.5	1.00ΜΩ	4.02ΜΩ	0.30μΑ
1.8	1.00ΜΩ	2ΜΩ	0.60μΑ
3	1.00ΜΩ	665kΩ	1.80µA
3.3	1.00ΜΩ	576kΩ	2.10µA
4.2	1.00ΜΩ	402kΩ	3.00µA



4.2. Typical Application Circuit

Figure 4.1 Basic ZSPM4141 Application Circuit—Fixed Output

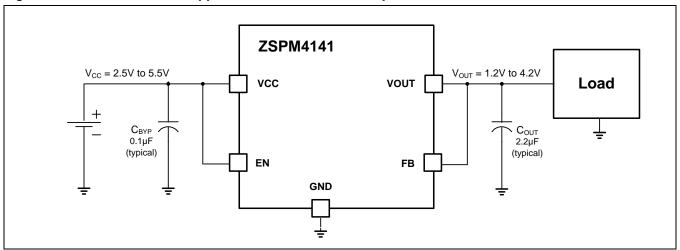
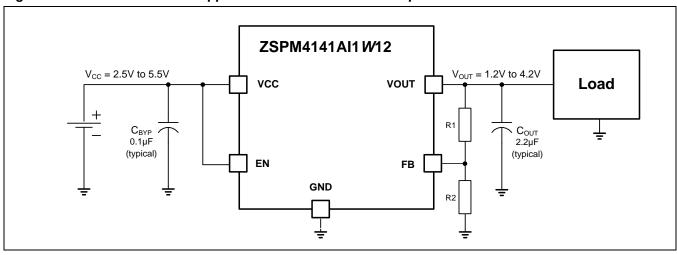


Figure 4.2 ZSPM4141AI1W12 Application Circuit—Variable Output

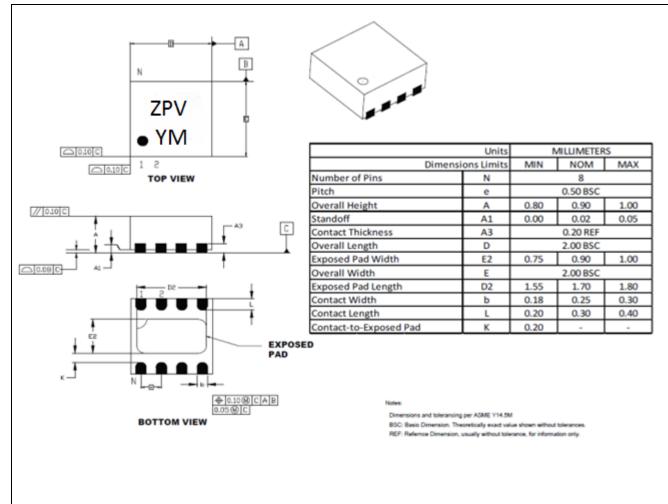




5 Pin Configuration and Package

5.1. ZSPM4141 Package Dimensions and Marking Diagram

Figure 5.1 ZSPM4141 Package Drawing



MARKING CODES:

Z: ZMDI

P: Product Code: 1 = ZSPM4141

V: Voltage levels: 0 = 1.2, 1 = 1.3, 2 = 1.4, 3 = 1.5, 4 = 1.6, 5 = 1.7, 6 = 1.8, 7 = 1.9, 8 = 2.0, 9 = 2.1,

A = 2.2, B = 2.3, C = 2.4, D to U = 2.5 to 4.2

YM: Date Code (Year, Month)

The ZSPM4141 is packaged as an 8-pin DFN (2mm x2mm).



5.2. Pin Assignments

Figure 5.2 ZSPM4141 Pin Assignments (top view)

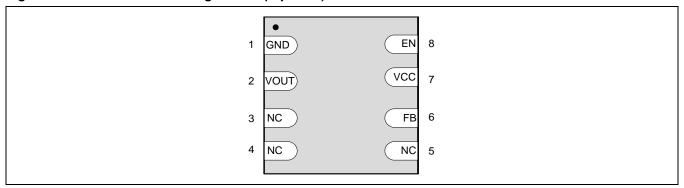


Table 5.1 Pin Description, 8-Pin DFN (2mmx2mm)

		, -	,
Pin #	Name	Function	Description
1	GND	Ground	GND
2	VOUT	Output	Regulated Output Voltage
3	NC		No Connection (connect to GND or float)
4	NC		No Connection (connect to GND or float)
5	NC		No Connection (connect to GND or float)
6	FB	Input	Feedback Input
7	VCC	Supply	Input Power
8	EN	Input	Enable Input

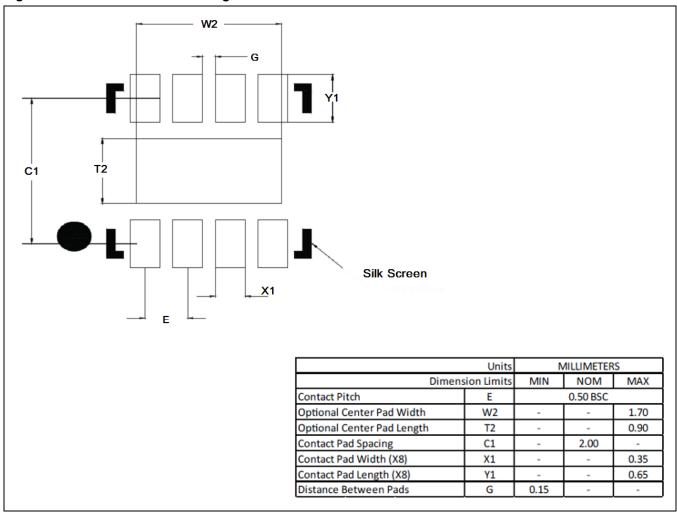


6 Layout and Soldering Requirements

To maximize the efficiency of this package for applications on a single layer or multi-layer printed circuit board (PCB), certain guidelines must be followed when laying out this part on the PCB.

6.1. Recommended Landing Pattern for PCBs

Figure 6.1 Recommended Landing Pattern for 8-Pin DFN





6.2. Multi-Layer PCB Layout

The following are guidelines for mounting the exposed pad ZSPM4141 on a multi-layer PCB with ground a plane. In a multi-layer board application, the thermal vias are the primary method of heat transfer from the package thermal pad to the internal ground plane. The efficiency of this method depends on several factors, including die area, number of thermal vias, and thickness of copper, etc.

Figure 6.2 Package and PCB Land Configuration for Multi-Layer PCB

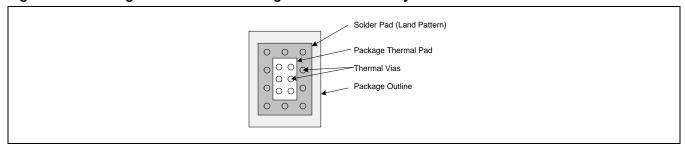


Figure 6.3 JEDEC Standard FR4 Multi-Layer Board - Cross-Sectional View

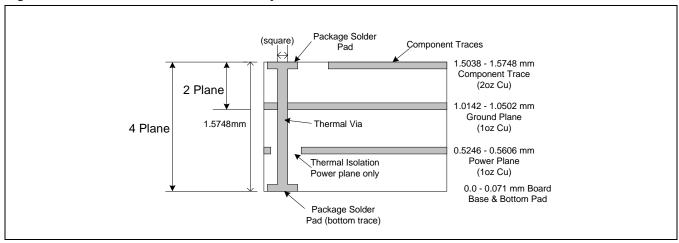


Figure 6.4 is a representation of how the heat can be conducted away from the die using an exposed pad package. Each application will have different requirements and limitations, and therefore the user should use sufficient copper to dissipate the power in the system. The output current rating for the linear regulators might need to be de-rated for ambient temperatures above 85°C. The de-rated value will depend on calculated worst-case power dissipation and the thermal management implementation in the application.



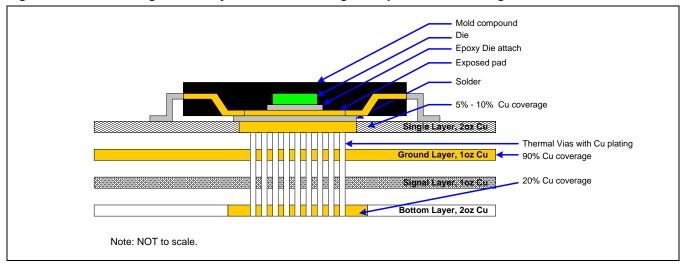


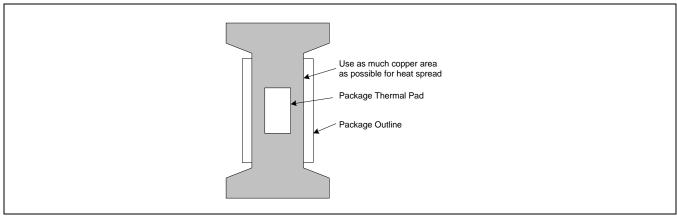
Figure 6.4 Conducting Heat Away from the Die using an Exposed Pad Package

6.3. Single-Layer PCB Layout

Layout recommendation for a single-layer PCB: utilize as much copper area for power management as possible. In a single-layer board application, the thermal pad is attached to a heat spreader (copper areas) by using a low thermal impedance attachment method (solder paste or thermal conductive epoxy).

In both of the methods mentioned above, it is advisable to use as much copper trace as possible to dissipate the heat.





Important: If the attachment method is NOT implemented correctly, the functionality of the product is not guaranteed. Power dissipation capability will be adversely affected if the device is incorrectly mounted onto the circuit board.



7 Ordering Information

Ordering Code*	Description	Package
ZSPM4141AI1 <i>W</i> 12	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 1.2V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 18	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 1.8V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 25	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 2.5V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 30	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.0V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 31	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.1V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 33	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 3.3V	8-pin DFN / Reel
ZSPM4141AI1 <i>W</i> 42	ZSPM4141 Ultra-Low Power Line Regulator —V _{OUT} factory set to 4.2V	8-pin DFN / Reel
ZSPM4141W12KIT	ZSPM4141 Evaluation Kit w/Vout adjusting resistors (default 1.2 Vout)	

Custom V_{OUT} values are also available: 1.2V to 4.2V (typical) in 100mV increments.

8 Related Documents

Document
ZSPM4141 Feature Sheet
ZSPM4141 Evaluation Kit Description
ZSPM4141 Application Note—Low Power Battery Control and Voltage Regulator Solutions for Remote Sensor Networks

Visit IDT's website www.IDT.com or contact your nearest sales office for the latest version of these documents.



9 Document Revision History

Revision	Date	Description
1.00	August 6, 2012	First release.
2.00	January 11, 2013	Addition of variable output illustration and Table 4.1. Update for ordering codes and contact information. Update for "Electrostatic Discharge" specification in Table 1.1.
	January 29, 2016	Changed to IDT branding.



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