

# TLE4287G

5-V Voltage Regulator

Data Sheet

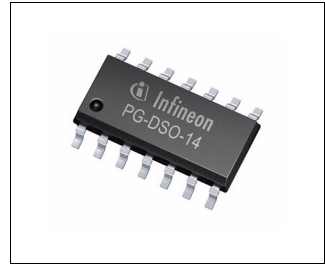
Rev. 1.41, 2012-01-30

Automotive Power



## Features

- Output voltage tolerance  $\leq \pm 2\%$
- Very low standby current consumption
- Input voltage up to 42 V
- Reset function down to 1 V output voltage
- Adjustable reset time
- On/Off logic
- Overtemperature protection
- Reverse polarity protection
- Short-circuit proof
- Very wide temperature range
- Very small output capacitor
- Green Product (RoHS compliant)
- AEC Qualified



## Functional Description

The **TLE4287G** is a monolithic integrated 5 V voltage regulator in **PG-DSO-14** package. It supplies an output current  $I_Q > 250$  mA. The IC is short circuit proof and incorporates temperature protection which turns off the device at overtemperature.

The input voltage  $V_I$  is regulated in the range of  $7.5 \text{ V} < V_I < 40 \text{ V}$  to  $V_{Q,nom} = 5 \text{ V}$ . Therefore a reference voltage, which is kept highly accurate by resistance adjustment, is compared via a control amplifier to a voltage that is proportional to the output voltage. The control amplifier drives the base of the series transistor by a buffer.

A comparator in the reset-generator block compares a reference voltage that is independent of the input voltage to the scaled-down output voltage. In the case of an output voltage  $V_Q < 4.5 \text{ V}$  the reset delay capacitor is discharged and a reset signal is generated by setting the reset output LOW. The reset delay time can be set by choosing the external capacitor over a wide range. When the output voltage rises above  $V_Q \geq 4.5 \text{ V}$  the reset delay capacitor is charged again. As soon as the delay capacitor voltage reaches the upper switching threshold the reset output pin is set HIGH again.

Type	Package
TLE4287G	PG-DSO-14

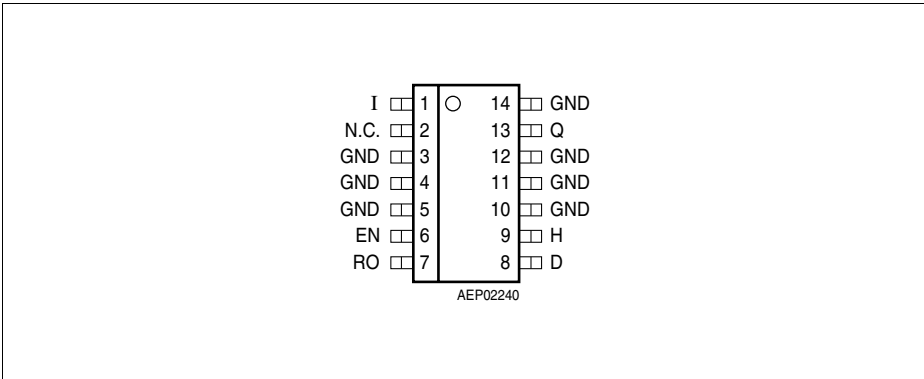
The device has two logic inputs, EN and H. It is turned ON by a voltage > 4 V at EN, for example by the ignition and remains active in case H is set LOW, even if the voltage at EN goes LOW. This makes it possible to implement a self-holding circuit without external components. When the device is turned OFF, the output voltage drops to 0 V and current consumption tends towards 0  $\mu$ A (see [Table 1](#)).

### Design Notes for External Components

The input capacitor  $C_1$  is necessary for compensation line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx. 1  $\Omega$  in series with  $C_1$ . The output capacitor is necessary for the stability of the regulating circuit. Stability is guaranteed for  $C_Q \geq 100$  nF within the operating temperature range.

**Table 1 State Table for Turn-On/Turn-Off Logic**

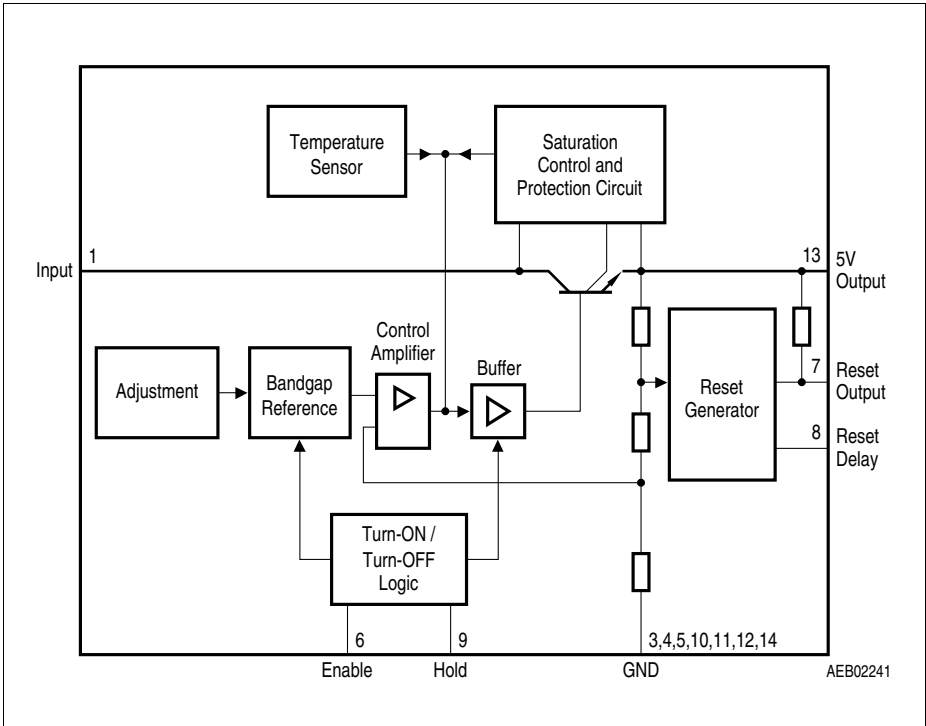
Enable EN	Hold H	$V_Q$	Remarks
L	X	0 V	Initial state
H	X	5 V	Regulator switched on via pin 6, by ignition for example
H	L	5 V	Pin 9 clamped active to GND by controller while pin 6 is still HIGH
X	L	5 V	Previous state remains, even ignition is shut off: self-holding state
L	L	5 V	Ignition shut off while regulator is in self-holding state
L	H	0 V	Regulator shut down by releasing of pin 9 while pin 6 remains LOW, final state. No active clamping required by external self-holding circuit ( $\mu$ C) to keep regulator shut off



**Figure 1 Pin Configuration** (top view)

**Table 2 Pin Definitions and Functions**

Pin No.	Symbol	Function
1	I	<b>Input</b> ; block to ground directly at the IC by a ceramic capacitor
2	N.C.	Not connected
3, 4, 5, 10, 11, 12, 14	GND	<b>Ground</b>
6	EN	<b>Enable</b> ; active high, device is turned ON by HIGH signal at this pin, internally connected to GND via pull-down resistor of 100 kΩ
7	RO	<b>Reset Output</b> ; open-collector output, internally connected to Q via a pull-up resistor of 30 kΩ
8	D	<b>Reset Delay</b> ; connect to GND via external delay capacitor for setting delay time
9	H	<b>Hold</b> and release; active low, see <a href="#">Table 1</a> for function, connected to Q via a pull-up resistor of 50 kΩ
13	Q	<b>Output</b> ; block to GND with a capacitor $C_Q \geq 100$ nF



**Figure 2 Block Diagram**

**Table 3 Absolute Maximum Ratings**

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
<b>Input I</b>					
Voltage	$V_I$	-0.5	42	V	–
Current	$I_I$	–	–	mA	internally limited
<b>Output Q</b>					
Voltage	$V_Q$	-0.3	7	V	–
Current	$I_Q$	–	–	–	internally limited
<b>Reset Output RO</b>					
Voltage	$V_R$	-0.3	7	V	–
Current	$I_R$	–	–	–	internally limited
<b>Reset Delay D</b>					
Voltage	$V_D$	-0.3	42	V	–
Current	$I_D$	–	–	–	–
<b>Enable EN</b>					
Voltage	$V_{EN}$	-42	42	V	–
Current	$I_{EN}$	-5	5	mA	$t \leq 400$ ms
<b>Hold H</b>					
Voltage	$V_H$	-2	7	V	–
Current	$I_H$	–	–	–	internally limited
<b>Ground GND</b>					
Current	$I_{GND}$	-0.5	–	A	–
<b>Temperatures</b>					
Junction temperature	$T_j$	-40	150	°C	–
Storage temperature	$T_{stg}$	-50	150	°C	–
<b>ESD Susceptibility</b>					
ESD Resistivity to GND	$V_{ESD}$	-1.5	1.5	kV	HBM <sup>1)</sup>

1) ESD susceptibility, Human Body Model HBM according to EIA/JESD 22-A114B

*Note: Maximum ratings are absolute ratings; exceeding any one of these values may cause irreversible damage to the integrated circuit.*

**Table 4 Operating Range**

Parameter	Symbol	Limit Values		Unit	Remarks
		Min.	Max.		
Input voltage	$V_I$	7.5	42	V	–
Junction temperature	$T_j$	-40	150	°C	–

**Thermal Resistances**

Junction pin	$R_{thj-pin}$	–	32	K/W	measured to pin 4
Junction ambient	$R_{thj-a}$	–	112	K/W	<sup>1)</sup>

1) Package mounted on PCB 80 × 80 × 1.5 mm<sup>3</sup>; 35μ Cu; 5μ Sn; Footprint only; zero airflow.

**Table 5 Electrical Characteristics**
 $7.5\text{ V} \leq V_I \leq 40\text{ V}$ ;  $-40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$ ;  $V_{\text{EN}} > 4\text{ V}$  (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Output voltage	$V_Q$	4.90	5.0	5.10	V	$5\text{ mA} < I_Q < 200\text{ mA}$ $7.5\text{ V} < V_I < 22\text{ V}$
Output voltage	$V_Q$	4.90	5.0	5.10	V	$5\text{ mA} < I_Q < 80\text{ mA}$ $7.5\text{ V} < V_I < 36\text{ V}$
Output current limitation	$I_Q$	250	–	–	mA	$V_I < 22\text{ V}$
Drop voltage	$V_{\text{DR}}$	–	1.8	2.5	V	$I_Q = 200\text{ mA}^{(1)}$
Current consumption $I_q = I_I - I_Q$	$I_q$	–	1.0	10	$\mu\text{A}$	Regulator OFF: $T_j < 125\text{ }^\circ\text{C}$ , $V_{\text{EN}} = 0\text{ V}$ , H = open $7.5\text{ V} \leq V_I \leq 16.5\text{ V}$
Current consumption $I_q = I_I - I_Q$	$I_q$	–	2.3	5	mA	$5\text{ mA} < I_Q < 200\text{ mA}$ , $V_I = 16\text{ V}$
Load regulation	$\Delta V_{Q,lo}$	-25	–	+25	mV	$5\text{ mA} < I_Q < 200\text{ mA}$
Line regulation	$\Delta V_{Q,li}$	-25	–	+25	V	$7.5\text{ V} < V_I < 22\text{ V}$ $I_Q = 20\text{ mA}$
Power Supply Ripple Rejection	$PSRR$	–	55	–	dB	$f_r = 100\text{ Hz}$ ; $V_r = 0.5\text{ V}_{\text{pp}}$
Temperature output voltage drift	$\Delta V_Q/\Delta T$	–	0.5	–	mV/K	–
Output capacitance	$C_Q$	100	–	–	nF	–

**Reset Generator**

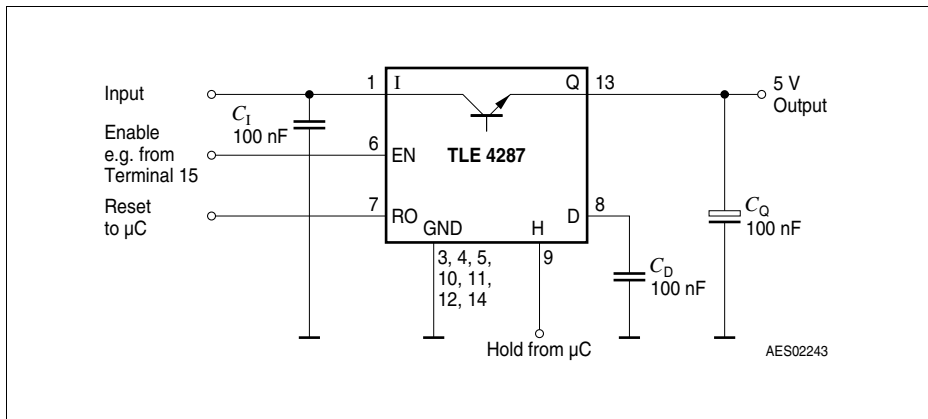
Reset switching threshold	$V_{Q,rt}$	4.50	4.65	4.80	V	–
Reset output low voltage	$V_{\text{RL}}$	–	0.1	0.4	V	$R_{\text{ext}} = 4.7\text{ k}\Omega$ to $V_Q^{(2)}$
Reset output high voltage	$V_{\text{RH}}$	4.5	–	5.05	V	$R_{\text{ext}} = \infty$
Reset pull-up resistor	$R_{\text{R}}$	20	30	40	$\text{k}\Omega$	internally connected to Q
Reset charging current	$I_{\text{D,c}}$	10	15	38	$\mu\text{A}$	$V_{\text{D}} = 1.5\text{ V}$
Upper timing threshold	$V_{\text{DU}}$	2.2	3	3.6	V	–
Lower timing threshold	$V_{\text{DL}}$	0.1	0.43	0.8	V	–
Delay saturation voltage	$V_{\text{D,sat}}$	–	50	–	mV	$V_Q < V_{Q,rt}$

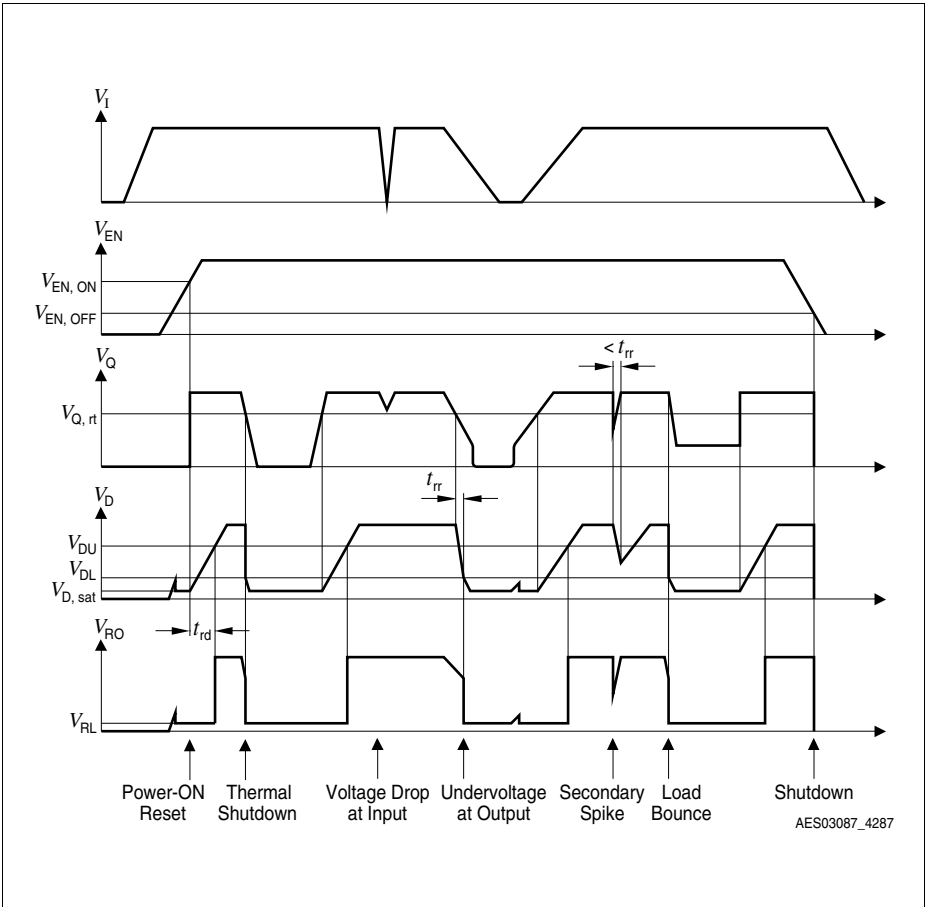


**Table 5 Electrical Characteristics (cont'd)**
 $7.5\text{ V} \leq V_I \leq 40\text{ V}$ ;  $-40\text{ }^\circ\text{C} < T_j < 150\text{ }^\circ\text{C}$ ;  $V_{EN} > 4\text{ V}$  (unless otherwise specified)

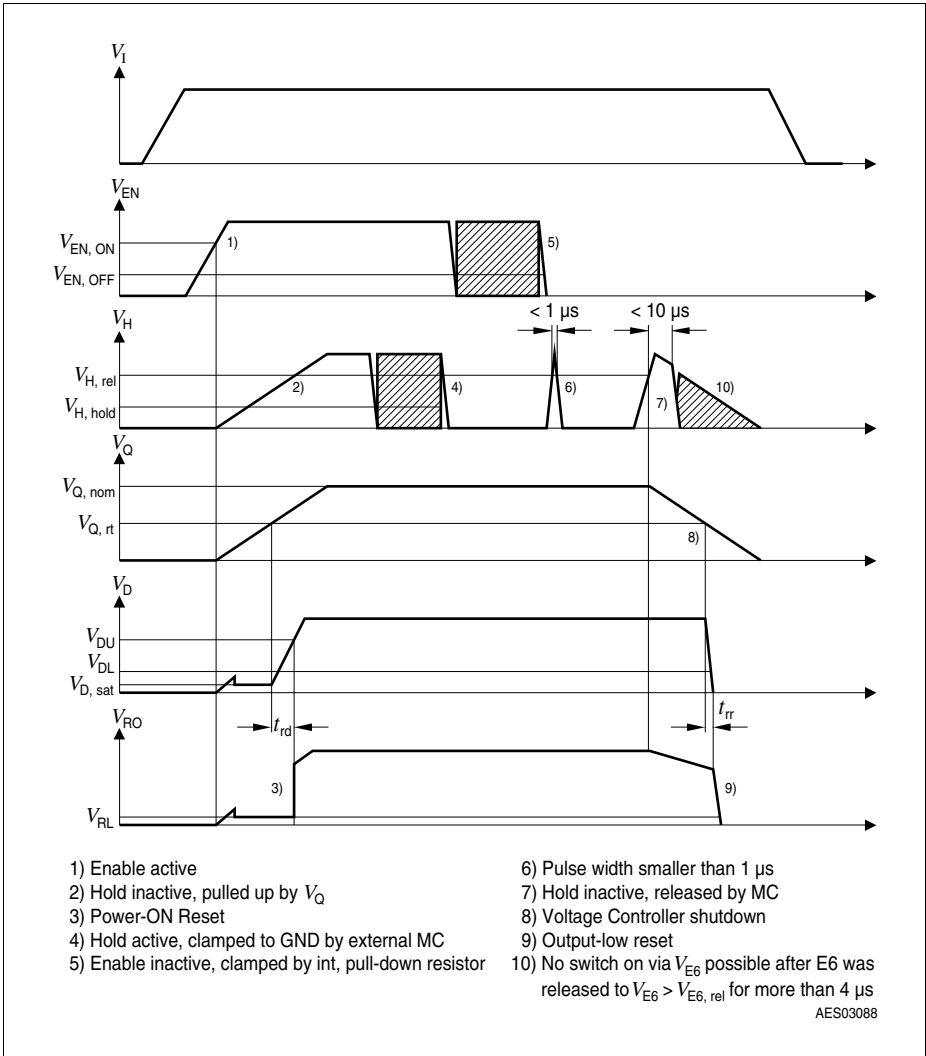
Parameter	Symbol	Limit Values			Unit	Test Condition
		Min.	Typ.	Max.		
Reset delay time	$t_{rd}$	7.5	20	30	ms	$C_D = 100\text{ nF}$
Reset reaction time	$t_{rr}$	0.5	2.0	4.0	$\mu\text{s}$	$C_D = 100\text{ nF}$
<b>Enable EN, Hold H</b>						
Enable turn-ON voltage	$V_{EN}$	2.3	3.0	4.0	V	IC turned-ON
Enable turn-OFF voltage	$V_{EN}$	2.0	2.5	3.5	V	IC turned-OFF
Enable pull-down resistor	$R_{EN}$	50	100	200	$\text{k}\Omega$	internally connected to GND
Enable hysteresis	$\Delta V_{EN}$	0.2	0.4	0.8	V	–
Enable input current	$I_{EN}$	–	35	100	$\mu\text{A}$	$V_{EN} = 4\text{ V}$
Hold keep on voltage	$V_H$	30	35	50	%	referred to $V_Q$ ; $V_Q > 4.5\text{ V}$
Hold release voltage	$V_H$	60	70	80	%	referred to $V_Q$ ; $V_Q > 4.5\text{ V}$
Hold pull-up resistor	$R_H$	20	50	100	$\text{k}\Omega$	internally connected to Q

 1) Measured when the output voltage  $V_Q$  has dropped 100 mV from the nominal value.

 2) The reset output is LOW between  $V_Q = 1\text{ V}$  and  $V_{rt}$ .

**Figure 3 Application Circuit**



**Figure 4 Time Response**



**Figure 5 Enable and Hold Behavior**

Package Outlines

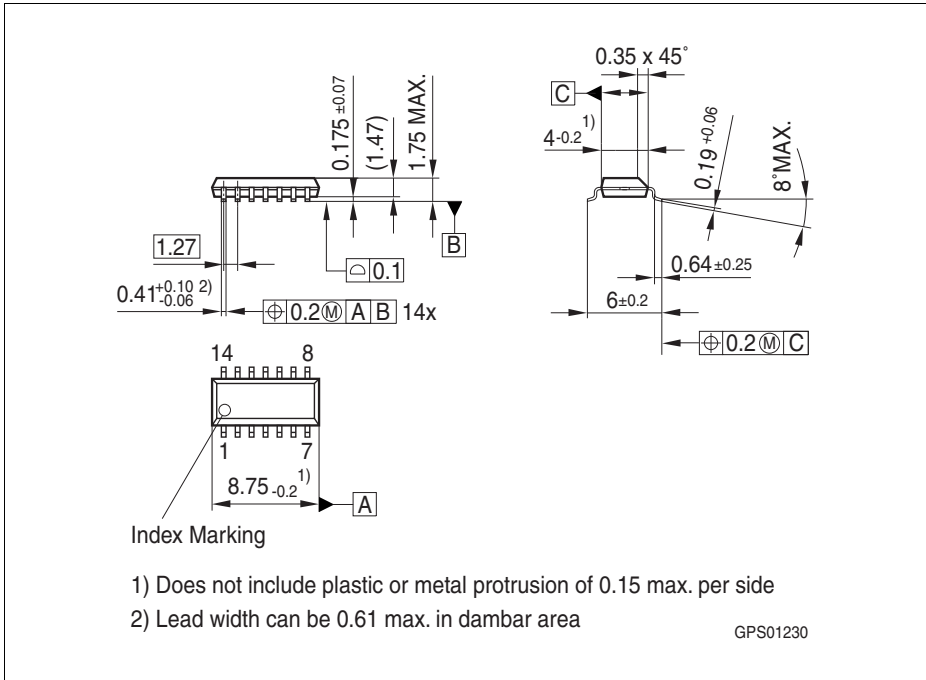


Figure 6 PG-DSO-14 (Plastic Dual Small Outline)

Green Product (RoHS compliant)

To meet the world-wide customer requirements for environmentally friendly products and to be compliant with government regulations the device is available as a green product. Green products are RoHS-Compliant (i.e Pb-free finish on leads and suitable for Pb-free soldering according to IPC/JEDEC J-STD-020).

Find more information on Infineon packages on the Infineon internet page "Packages": <http://www.infineon.com/packages>.

SMD = Surface Mounted Device

Dimensions in mm

**Revision History**

Version	Date	Changes
Rev. 141	2012-01-30	Editorial changes: added coverpage changed Product name TLE4287G (without blanks) Typo on page 7: Junction temperature max: 150°C
Rev. 1.4	2009-01-12	Initial datasheet of RoHS-compliant product of TLE4287G. <b>Page 1</b> and <b>Page 7</b> : “ESD 2kV” statements removed. <b>Page 6</b> : ESD specification added: HBM 1.5kV <b>Page 6</b> : Maximum Junction Temperature modified to $-40^{\circ}\text{C} < T_j < 150^{\circ}\text{C}$ <b>Table 5</b> : Respecified Current Consumption $I_q$ when Regulator OFF. <b>Page 1</b> : “AEC certified” statement added <b>Page 1</b> and <b>Page 12</b> : RoHS compliance statement and Green product feature added <b>Page 1</b> and <b>Page 12</b> : Package changed to RoHS compliant version Legal Disclaimer updated

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