

## CHANGE NOTIFICATION



Linear Technology Corporation  
1630 McCarthy Blvd., Milpitas, CA 95035-7417  
(408) 432-1900

February 21, 2017

Dear Sir/Madam:

PCN#022117

**Subject: Notification of Change to LT3791, LT3791-1 Datasheet**

Please be advised that Linear Technology Corporation has made a minor change to the LT3791, LT3791-1 product datasheet to facilitate improvement in our manufacturing yield. The changes are shown on the attached pages of the marked up datasheet. There was no change in form, fit, function, quality or reliability of the product. The product shipped after April 21, 2017 will be tested to the new limits.

Should you have any concerns, please contact me before April 21, 2017, at which time we will consider this change to be approved. Should you have any questions or concerns please contact your local Linear Technology Sales person or you may contact me at 408-432-1900 ext. 2077, or by e-mail at [JASON.HU@LINEAR.COM](mailto:JASON.HU@LINEAR.COM).

Sincerely,

Jason Hu  
Quality Assurance Engineer

## 60V 4-Switch Synchronous Buck-Boost LED Driver Controller

### FEATURES

- 4-Switch Single Inductor Architecture Allows  $V_{IN}$  Above, Below or Equal to  $V_{OUT}$
- Synchronous Switching: Up to 98.5% Efficiency
- Wide  $V_{IN}$  Range: 4.7V to 60V
- Wide  $V_{OUT}$  Range: 0V to 60V (52V LED)
- $\pm 6\%$  LED Current Accuracy:  $0V \leq V_{LED} < 52V$
- True Color PWM™ and Analog Dimming
- LED and Input Current Regulation with Current Monitor Outputs
- No Top MOSFET Refresh in Buck or Boost
- $V_{OUT}$  Disconnected From  $V_{IN}$  During Shutdown
- Open or Shorted LED Fault Protection
- Capable of 100W or Greater per IC
- 38-Lead TSSOP with Exposed Pad

### APPLICATIONS

- Automotive Head Lamps/Running Lamps
- General Purpose Lighting

### DESCRIPTION

The LT<sup>®</sup>3791 is a synchronous 4-switch buck-boost LED driver controller. The controller can regulate LED current up to 52V of LED string with input voltages above, below, or equal to the output voltage. The constant-frequency, forced-continuous current mode architecture allows its frequency to be adjusted or synchronized from 200kHz to 700kHz. No top MOSFET refresh switching cycle is needed in buck or boost operation. With 60V input, 60V output capability and seamless transitions between operating regions, the LT3791 is ideal for LED driver applications in automotive, industrial, and even battery-powered systems.

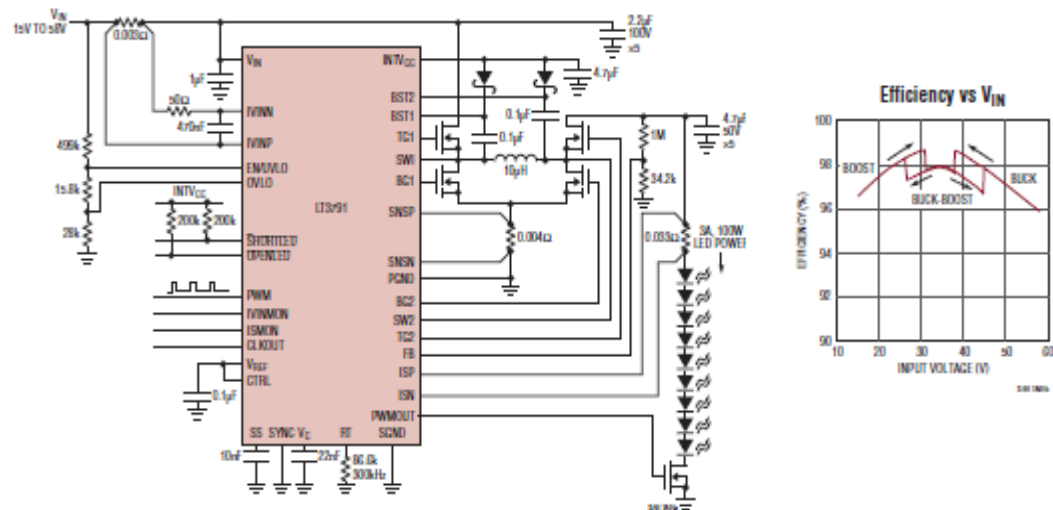
~~The LT3791 provides input current monitor, LED current monitor, and open or shorted LED fault condition, during which the LT3791 either restarts or latches off.~~

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For New designs we recommend the LT8391 : 60V Synchronous 4-Switch Buck-Boost LED controller

### TYPICAL APPLICATION

98.5% Efficient 100W (33.3V 3A) Buck-Boost LED Driver



**ELECTRICAL CHARACTERISTICS** The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 2).  $V_{IN} = 12\text{V}$ ,  $V_{EN/UVLO} = 12\text{V}$  unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
<b>Logic Inputs</b>						
EN/UVLO Falling Threshold		●	1.16	1.2	1.24	V
EN/UVLO Rising Hysteresis				15		mV
EN/UVLO Input Low Voltage	$I_{VIN}$ Drops Below $1\mu\text{A}$				0.3	V
EN/UVLO Pin Bias Current Low	$V_{EN/UVLO} = 1\text{V}$		2	3	4	$\mu\text{A}$
EN/UVLO Pin Bias Current High	$V_{EN/UVLO} = 1.6\text{V}$			10	100	nA
CTRL Input Bias Current	$V_{CTRL} = 1\text{V}$			20	50	nA
CTRL Latch-Off Threshold				175		mV
OVLO Rising Shutdown Voltage		●	2.85	3	3.15	V
OVLO Falling Hysteresis				75		mV
<b>Regulation</b>						
$V_{REF}$ Voltage		●	1.96	2.00	2.04	V
$V_{REF}$ Line Regulation	$4.7\text{V} < V_{IN} < 60\text{V}$			0.002	0.04	%/V
$V_{(ISP-ISN)}$ Threshold	$V_{CTRL} = 2\text{V}$	●	97.5	100	102.5	mV
			94	100	106	mV
	$V_{CTRL} = 1100\text{mV}$	●	87	90	93	mV
			84	90	96	mV
	$V_{CTRL} = 700\text{mV}$	●	47.5	50	52.5	mV
		●	46	50	54	mV
	$V_{CTRL} = 300\text{mV}$	●	6.5	10	13.5	mV
		●	5	10	15	mV
ISP Bias Current				110		$\mu\text{A}$
ISN Bias Current				20		$\mu\text{A}$
LED Current Sense Common Mode Range			0		60	V
LED Current Sense Amplifier $g_m$				890		$\mu\text{S}$
ISMON Monitor Voltage	$V_{(ISP-ISN)} = 100\text{mV}$	●	0.96	1	1.04	V
Input Current Sense Threshold $V_{(IVINP-IVINN)}$	$3\text{V} \leq V_{IVINP} \leq 60\text{V}$	●	46.5	50	54	mV
IVINP Bias Current				90		$\mu\text{A}$
IVINN Bias Current				20		$\mu\text{A}$
Input Current Sense Common Mode Range			3		60	V
Input Current Sense Amplifier $g_m$				2.12		mS
IVINMON Monitor Voltage	$V_{(IVINP-IVINN)} = 50\text{mV}$	●	0.96	1	1.04	V
FB Regulation Voltage		●	1.194	1.2	1.206	V
		●	1.176	1.2	1.220	V
FB Line Regulation	$4.7\text{V} < V_{IN} < 60\text{V}$			0.002	0.025	%/V
FB Amplifier $g_m$				565		$\mu\text{S}$
FB Pin Input Bias Current	FB in Regulation			100	450 200	nA
$V_C$ Standby Input Bias Current	PWM = 0V		-20		20	nA
$V_{SENSE(MAX)}$ ( $V_{SNSP-SNSN}$ )	Boost	●	42	51	60	mV
	Buck	●	-56	-47.5	-39	mV
<b>Fault</b>						
SS Pull-Up Current	$V_{SS} = 0\text{V}$			14		$\mu\text{A}$
SS Discharge Current				1.4		$\mu\text{A}$
FB Overvoltage Rising Threshold			1.22	1.25		V
Open LED Rising Threshold ( $V_{FB}$ )	$V_{(ISP-ISN)} = 0\text{V}$	●	1.127	1.15	1.173	V

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For more information [www.linear.com/LT3791](http://www.linear.com/LT3791)

# LT3791

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 2).  $V_{IN} = 12\text{V}$ ,  $V_{EN/UVLO} = 12\text{V}$  unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Open LED Falling Threshold ( $V_{FB}$ )		● 1.078	1.1	1.122	V
Open LED Falling Threshold ( $V_{(ISP-ISN)}$ )	$V_{FB} = 1.2\text{V}$	5	10	15	mV
Short LED Falling Threshold ( $V_{FB}$ )		380	400	450	mV
OPENLED Pin Output Impedance			1.1	2.0	k $\Omega$
SHORTLED Pin Output Impedance			1.1	2.0	k $\Omega$
SS Latch-Off Threshold			1.75		V
SS Reset Threshold			0.2		V
<b>Oscillator</b>					
Switching Frequency	$R_T = 147\text{k}$	190	200	210	kHz
	$R_T = 59.0\text{k}$	380	400	420	kHz
	$R_T = 29.1\text{k}$	665	700	735	kHz
SYNC Frequency		200		700	kHz
SYNC Pin Resistance to GND			90		k $\Omega$
SYNC Threshold Voltage		0.3		1.5	V
<b>Internal <math>V_{CC}</math> Regulator</b>					
INTV <sub>CC</sub> Regulation Voltage		4.8	5	5.2	V
Dropout ( $V_{IN} - \text{INTV}_{CC}$ )	$I_{\text{INTV}_{CC}} = -10\text{mA}$ , $V_{IN} = 5\text{V}$		240	350	mV
INTV <sub>CC</sub> Undervoltage Lockout		3.1	3.5	3.9	V
INTV <sub>CC</sub> Current Limit	$V_{\text{INTV}_{CC}} = 4\text{V}$		67		mA
<b>PWM</b>					
PWM Threshold Voltage		0.3		1.5	V
PWM Pin Resistance to GND			90		k $\Omega$
PWMOUT Pull-Up Resistance			10	20	$\Omega$
PWMOUT Pull-Down Resistance			5	10	$\Omega$
<b>NMOS Drivers</b>					
TG1, TG2 Gate Driver On-Resistance Gate Pull-Up Gate Pull-Down	$V_{\text{BST}} - V_{\text{SW}} = 5\text{V}$		2.6		$\Omega$
			1.7		$\Omega$
BG1, BG2 Gate Driver On-Resistance Gate Pull-Up Gate Pull-Down	$V_{\text{INTV}_{CC}} = 5\text{V}$		3		$\Omega$
			1.2		$\Omega$
TG Off to BG On Delay	$C_L = 3300\text{pF}$		60		ns
BG Off to TG On Delay	$C_L = 3300\text{pF}$		60		ns
TG1, TG2, $t_{\text{OFF(MIN)}}$	$R_T = 59.0\text{k}$		240	300 320	ns

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:** The LT3791E is guaranteed to meet performance from  $0^\circ\text{C}$  to  $125^\circ\text{C}$  junction temperature. Specification over the  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  operating junction temperature range are assured by design, characterization and correlation with statistical process controls. The LT3791I is guaranteed to meet performance specifications over the  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  operating junction temperature range. The LT3791H is guaranteed to meet performance specifications over the  $-40^\circ\text{C}$  to  $150^\circ\text{C}$

operating junction temperature range. The LT3791MP is guaranteed to meet performance specifications over the  $-55^\circ\text{C}$  to  $150^\circ\text{C}$  operating junction temperature range. High junction temperatures degrade operating lifetimes. Operating lifetime is derated for junction temperatures greater than  $125^\circ\text{C}$ .

**Note 3:** The LT3791 includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature will exceed the maximum operating junction temperature when overtemperature protection is active. Continuous operation above the specified absolute maximum operating junction temperature may impair device reliability.

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## FEATURES

- **4-Switch Single Inductor Architecture Allows  $V_{IN}$  Above, Below or Equal to  $V_{OUT}$**
- **Synchronous Switching: Up to 98.5% Efficiency**
- **Wide  $V_{IN}$  Range: 4.7V to 60V**
- **2% Output Voltage Accuracy:  $1.2V \leq V_{OUT} < 60V$**
- **6% Output Current Accuracy:  $0V \leq V_{OUT} < 60V$**
- Input and Output Current Regulation with Current Monitor Outputs
- No Top FET Refresh in Buck or Boost
- $V_{OUT}$  Disconnected from  $V_{IN}$  During Shutdown
- C/10 Charge Termination and Output Shorted Flags
- Capable of 100W or greater per IC
- 38-Lead TSSOP with Exposed Pad

## APPLICATIONS

- Automotive, Telecom, Industrial Systems
- High Power Battery-Powered System

## DESCRIPTION

The **LT<sup>®</sup>3791-1** is a synchronous 4-switch buck-boost voltage/current regulator controller. The controller can regulate output voltage, output current, or input current with input voltages above, below, or equal to the output voltage. The constant-frequency, current mode architecture allows its frequency to be adjusted or synchronized from 200kHz to 700kHz. No top FET refresh switching cycle is needed in buck or boost operation. With 60V input, 60V output capability and seamless transitions between operating regions, the LT3791-1 is ideal for voltage regulator, battery/super-capacitor charger applications in automotive, industrial, telecom, and even battery-powered systems.

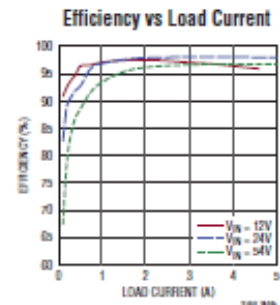
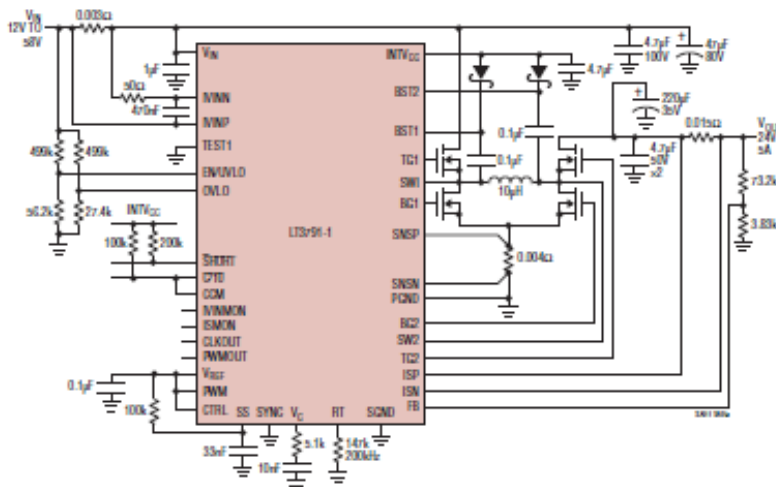
~~The LT3791-1 provides input current monitor, output current monitor, and various status flags, such as C/10 charge termination and shorted output flag.~~

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**For New designs we recommend the LT8391 : 60V Synchronous 4-Switch Buck-Boost LED controller**

## TYPICAL APPLICATION

**120W (24V 5A) Buck-Boost Voltage Regulator**



**ELECTRICAL CHARACTERISTICS** The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 2).  $V_{IN} = 12\text{V}$ ,  $V_{EN/UVLO} = 12\text{V}$  unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
<b>Logic Inputs</b>					
EN/UVLO Falling Threshold		● 1.16	1.2	1.24	V
EN/UVLO Rising Hysteresis			15		mV
EN/UVLO Input Low Voltage	$I_{VIN}$ Drops Below $1\mu\text{A}$			0.3	V
EN/UVLO Pin Bias Current Low	$V_{EN/UVLO} = 1\text{V}$	2	3	4	$\mu\text{A}$
EN/UVLO Pin Bias Current High	$V_{EN/UVLO} = 1.6\text{V}$		10	100	nA
CCM Threshold Voltage		0.3		1.5	V
CTRL Input Bias Current	$V_{CTRL} = 1\text{V}$		20	50	nA
CTRL Latch-Off Threshold			175		mV
OVLO Rising Shutdown Voltage		● 2.85	3	3.15	V
OVLO Falling Hysteresis			75		mV
<b>Regulation</b>					
$V_{REF}$ Voltage		● 1.96	2.00	2.04	V
$V_{REF}$ Line Regulation	$4.7\text{V} < V_{IN} < 60\text{V}$		0.002	0.04	%/V
$V_{(ISP-ISN)}$ Threshold	$V_{CTRL} = 2\text{V}$	● 97.5	100	102.5	mV
		● 94	100	106	mV
	$V_{CTRL} = 1100\text{mV}$	● 87	90	93	mV
		● 84	90	96	mV
	$V_{CTRL} = 700\text{mV}$	● 47.5	50	52.5	mV
	● 46	50	54	mV	
	$V_{CTRL} = 300\text{mV}$	● 6.5	10	13.5	mV
		● 5	10	15	mV
ISP Bias Current			110		$\mu\text{A}$
ISN Bias Current			20		$\mu\text{A}$
Output Current Sense Common Mode Range		0		60	V
Output Current Sense Amplifier $g_m$			890		$\mu\text{S}$
ISMON Monitor Voltage	$V_{(ISP-ISN)} = 100\text{mV}$	● 0.96	1	1.04	V
Input Current Sense Threshold $V_{(VINP-VINN)}$	$3\text{V} \leq V_{VINP} \leq 60\text{V}$	● 46.5	50	54	mV
IVINP Bias Current			90		$\mu\text{A}$
IVINN Bias Current			20		$\mu\text{A}$
Input Current Sense Common Mode Range		3		60	V
Input Current Sense Amplifier $g_m$			2.12		mS
IVINMON Monitor Voltage	$V_{(VINP-VINN)} = 50\text{mV}$	● 0.96	1	1.04	V
FB Regulation Voltage		● 1.194	1.2	1.206	V
		● 1.176	1.2	1.220	V
FB Line Regulation	$4.7\text{V} < V_{IN} < 60\text{V}$		0.002	0.025	%/V
FB Amplifier $g_m$			565		$\mu\text{S}$
FB Pin Input Bias Current	FB in Regulation		100	<del>150</del> 200	nA
$V_C$ Standby Input Bias Current	PWM = 0V		-20	20	nA
$V_{SENSE(MAX)}$ ( $V_{SNSP-SNSN}$ )	Boost	● 42	51	60	mV
	Buck	● -56	-47.5	-39	mV
<b>Fault</b>					
SS Pull-Up Current	$V_{SS} = 0\text{V}$		14		$\mu\text{A}$
SS Discharge Current			1.4		$\mu\text{A}$

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For more information [www.linear.com/LT3791-1](http://www.linear.com/LT3791-1)

**ELECTRICAL CHARACTERISTICS** The ● denotes the specifications which apply over the full operating junction temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$  (Note 2).  $V_{IN} = 12\text{V}$ ,  $V_{EN/UVLO} = 12\text{V}$  unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	
C/T0 Rising Threshold ( $V_{FB}$ )	$V_{(ISP-IGN)} = 0\text{V}$	● 1.127	1.15	1.173	V	
C/T0 Falling Threshold ( $V_{FB}$ )		● 1.078	1.1	1.122	V	
C/T0 Falling Threshold ( $V_{(ISP-IGN)}$ )	$V_{FB} = 1.2\text{V}$		5	10	mV	
SHORT Falling Threshold ( $V_{FB}$ )			380	400	450	mV
C/T0 Pin Output Impedance			1.1	2.0	k $\Omega$	
SHORT Pin Output Impedance			1.1	2.0	k $\Omega$	
SS Latch-Off Threshold			1.75		V	
SS Reset Threshold			0.2		V	
<b>Oscillator</b>						
Switching Frequency	$R_T = 147\text{k}$	190	200	210	kHz	
	$R_T = 59.0\text{k}$	380	400	420	kHz	
	$R_T = 29.1\text{k}$	665	700	735	kHz	
SYNC Frequency		200		700	kHz	
SYNC Pin Resistance to GND			90		k $\Omega$	
SYNC Threshold Voltage		0.3		1.5	V	
<b>Internal <math>V_{CC}</math> Regulator</b>						
INTV <sub>CC</sub> Regulation Voltage		4.8	5	5.2	V	
Dropout ( $V_{IN} - \text{INTV}_{CC}$ )	$I_{\text{INTV}_{CC}} = -10\text{mA}$ , $V_{IN} = 5\text{V}$		240	350	mV	
INTV <sub>CC</sub> Undervoltage Lockout		3.1	3.5	3.9	V	
INTV <sub>CC</sub> Current Limit	$V_{\text{INTV}_{CC}} = 4\text{V}$		67		mA	
<b>PWM</b>						
PWM Threshold Voltage		0.3		1.5	V	
PWM Pin Resistance to GND			90		k $\Omega$	
PWMOUT Pull-Up Resistance			10	20	$\Omega$	
PWMOUT Pull-Down Resistance			5	10	$\Omega$	
<b>NMOS Drivers</b>						
TG1, TG2 Gate Driver On-Resistance	$V_{BST} - V_{SW} = 5\text{V}$					
		Gate Pull-Up		2.6	$\Omega$	
		Gate Pull-Down		1.7	$\Omega$	
BG1, BG2 Gate Driver On-Resistance	$V_{\text{INTV}_{CC}} = 5\text{V}$					
		Gate Pull-Up		3	$\Omega$	
		Gate Pull-Down		1.2	$\Omega$	
TG Off to BG On Delay	$C_L = 3300\text{pF}$		60		ns	
BG Off to TG On Delay	$C_L = 3300\text{pF}$		60		ns	
TG1, TG2, $t_{\text{OFF(MIN)}}$	$R_T = 59.0\text{k}$		240	<del>200</del> 320	ns	

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:** The LT3791E-1 is guaranteed to meet performance from  $0^\circ\text{C}$  to  $125^\circ\text{C}$  junction temperature. Specification over the  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  operating junction temperature range are assured by design, characterization and correlation with statistical process controls. The LT3791-1 is guaranteed to meet performance specifications over the  $-40^\circ\text{C}$  to  $125^\circ\text{C}$  operating junction temperature range. The LT3791H-1 is guaranteed to meet performance specifications over the  $-40^\circ\text{C}$  to  $150^\circ\text{C}$

operating junction temperature range. The LT3791MP-1 is guaranteed to meet performance specifications over the  $-55^\circ\text{C}$  to  $150^\circ\text{C}$  operating junction temperature range. High junction temperatures degrade operating lifetimes. Operating lifetime is derated for junction temperatures greater than  $125^\circ\text{C}$ .

**Note 3:** The LT3791-1 includes overtemperature protection that is intended to protect the device during momentary overload conditions. Junction temperature will exceed the maximum operating junction temperature when overtemperature protection is active. Continuous operation above the specified absolute maximum operating junction temperature may impair device reliability.

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