

## LTC7804 Low $I_Q$ Synchronous Boost Controller

### DESCRIPTION

Demonstration circuit DC2846A is a DC/DC synchronous boost converter featuring the [LTC®7804](#) (MSE package), a spread spectrum or constant frequency current mode synchronous boost controller. The DC2846A generates a 24V output voltage and provides up to 6A of output current.

The 500kHz constant switching frequency operation results in a small and efficient circuit.

The main features of this board include:

- Wide input voltage range: from 6V to 24V
- Relatively high output power, up to 150W
- Extremely low quiescent current, it's 15 $\mu$ A at sleep mode and as low as 1 $\mu$ A at shutdown
- Onboard low power bias supply
- Ability to select spread spectrum or fixed frequency
- Pulse-skipping mode, forced continuous operation or low ripple Burst Mode® operation at light loads
- Synchronization with external clock

- If  $V_{IN} > V_{OUT}$ , the DC2846A eliminates the usual boost topology losses by keeping the top MOSFET on continuously.

The converter provides high output voltage accuracy (typically  $\pm 2\%$ ) over a wide load range with no minimum load requirement.

The DC2846A supports two ways of biasing step-up controllers: directly from the input voltage or output rail. The third possibility is connecting voltage source to EXT $V_{CC}$  terminal.

The DC2846A extremely wide switching frequency range from 100kHz to 3MHz. It can be synchronized to the external clock anywhere inside this range. The spread spectrum operation is used for reducing the peak radiated and conducted noise to simplify compliance with electromagnetic interference (EMI) standards

The DC2846A has small circuit footprint. It is a high performance and cost-effective solution for telecom, automotive and Power over Ethernet applications.

[Design files for this circuit board are available.](#)

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### PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

| PARAMETER   | CONDITIONS                          | VALUE        | UNITS |
|---|-------------------------------------|--------------|-------|
| Minimum Input Supply Voltage                                    |                                     | 6            | V     |
| Maximum Input Supply Voltage                                    |                                     | 24           | V     |
| Output Voltage Range  | $V_{IN} = 6\text{V to } 20\text{V}$ | 24 $\pm 2\%$ | V     |
| Typical Switching Frequency                                     |                                     | 500          | kHz   |
| Typical Output Ripple ( $V_{OUT}, 48\text{V}$ )                 | $I_{LOAD} = 3\text{A}$              | 200          | mV    |
| Efficiency Typical ( $V_{OUT}, 48\text{V}, V_{IN} 12\text{V}$ ) |                                     | 95           | %     |

## QUICK START PROCEDURE

Demonstration circuit 2846 is easy to set up to evaluate the performance of the LTC7804 controllers. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

**NOTE.** When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the  $V_{IN}$  or  $V_{OUT}$  and GND terminals. See Figure 2 for proper scope probe technique.

1. Place jumper RUN (J2) in ON position, place jumper MODE (JP1) in PULSE SKIP position, place jumper FREQSET (JP4) into FIX FREQ position.
2. Place jumper VBIAS (JP3) in VIN position.
3. With power off, connect the input power supply to  $V_{IN}$  and GND.

Turn the input power source on and slowly increase the input voltage to 12V. Be careful not to exceed 24V.

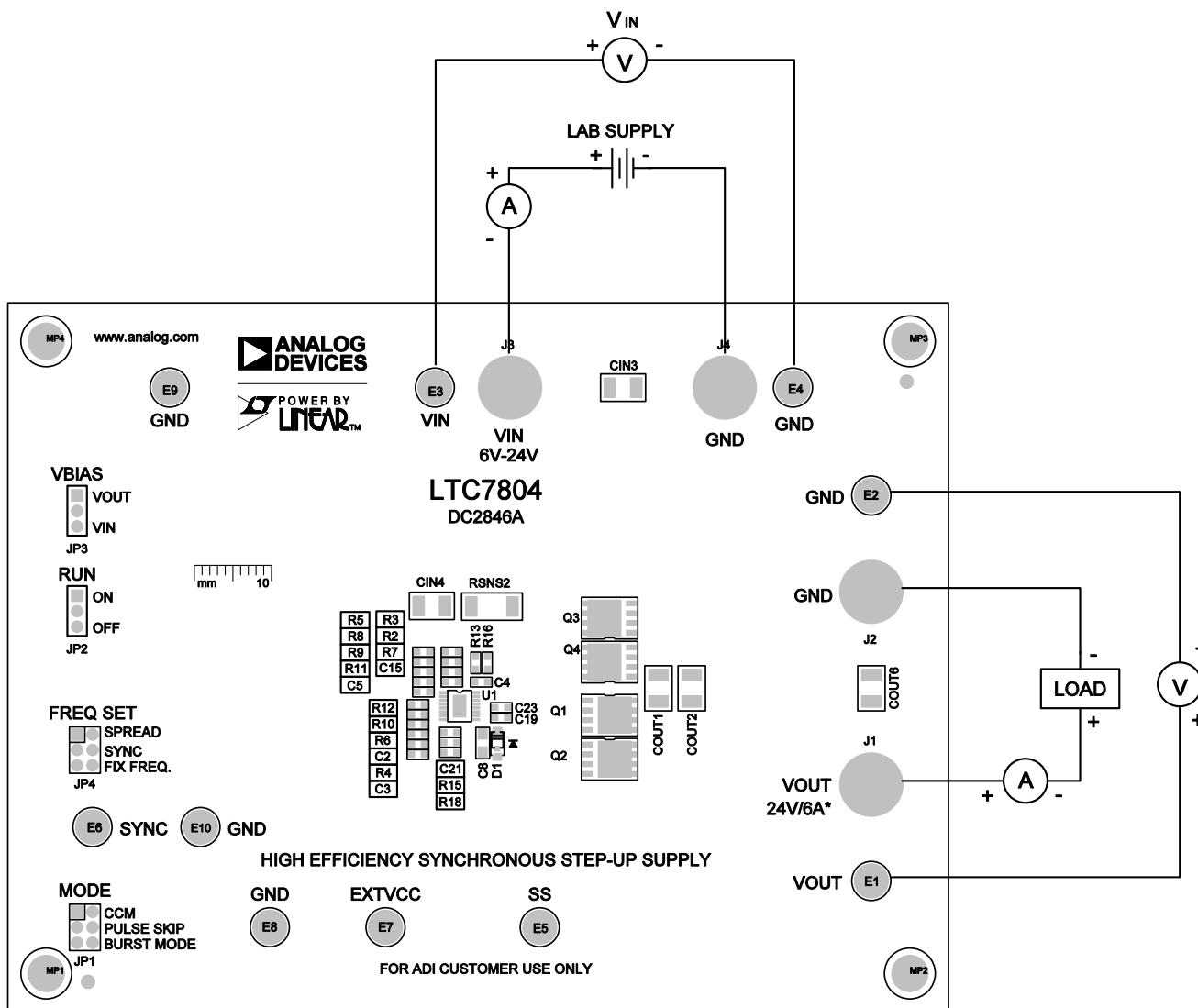


Figure 1. Proper Measurement Equipment Setup

## QUICK START PROCEDURE

**NOTE:** Make sure that the input voltage  $V_{IN}$  does not exceed 20V. If higher operating voltage is required, power components with higher voltage ratings should be used.

4. Check for the proper output voltage of 24V. If there is no output, temporarily disconnect the load to make sure that the load is not set too high.
5. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, ripple voltage, efficiency and other parameters.

To synchronize DC2846A with external clock insert jumper FREQSET (JP4) in SYNC position and apply clock signals to terminal SYNC (E6).

## CONVERTER EFFICIENCY

DC2846SA yields 96% efficiency at 16V input voltage generating 24V at 6A, see Figure 3. DC2846A able to deliver 6A output current down to 9V of input; however, output current should be reduced at lower voltage per Figure 4. All efficiency measurements were conducted at room temperature, natural convection cooling with no air flow.

## DC2846A SPRED SPECTRUM

The demo board DC2846AA shipped with fixed frequency operation. To employ the spread spectrum operation, insert the jumper PLLIN/SPREAD (JP4) in into SPREAD position. In this setting the switching frequency will change in  $\pm 15\%$  range relatively to the preset value.

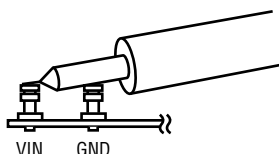


Figure 2. Measuring Input or Output Ripple

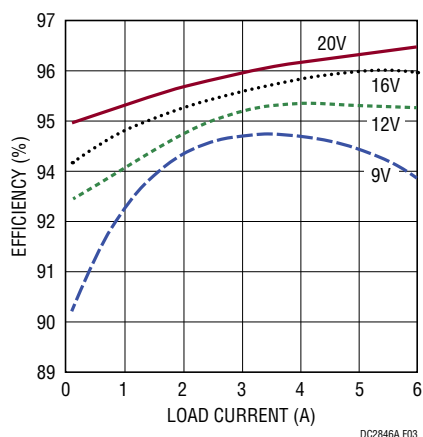


Figure 3. Efficiency vs Load for Different Input Voltage

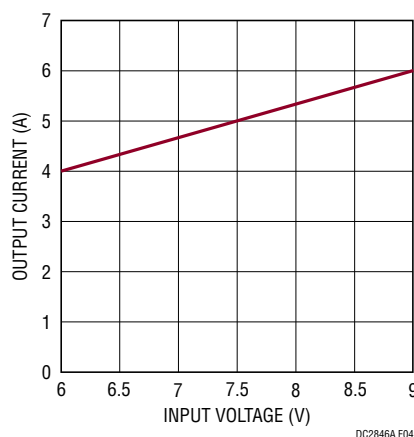


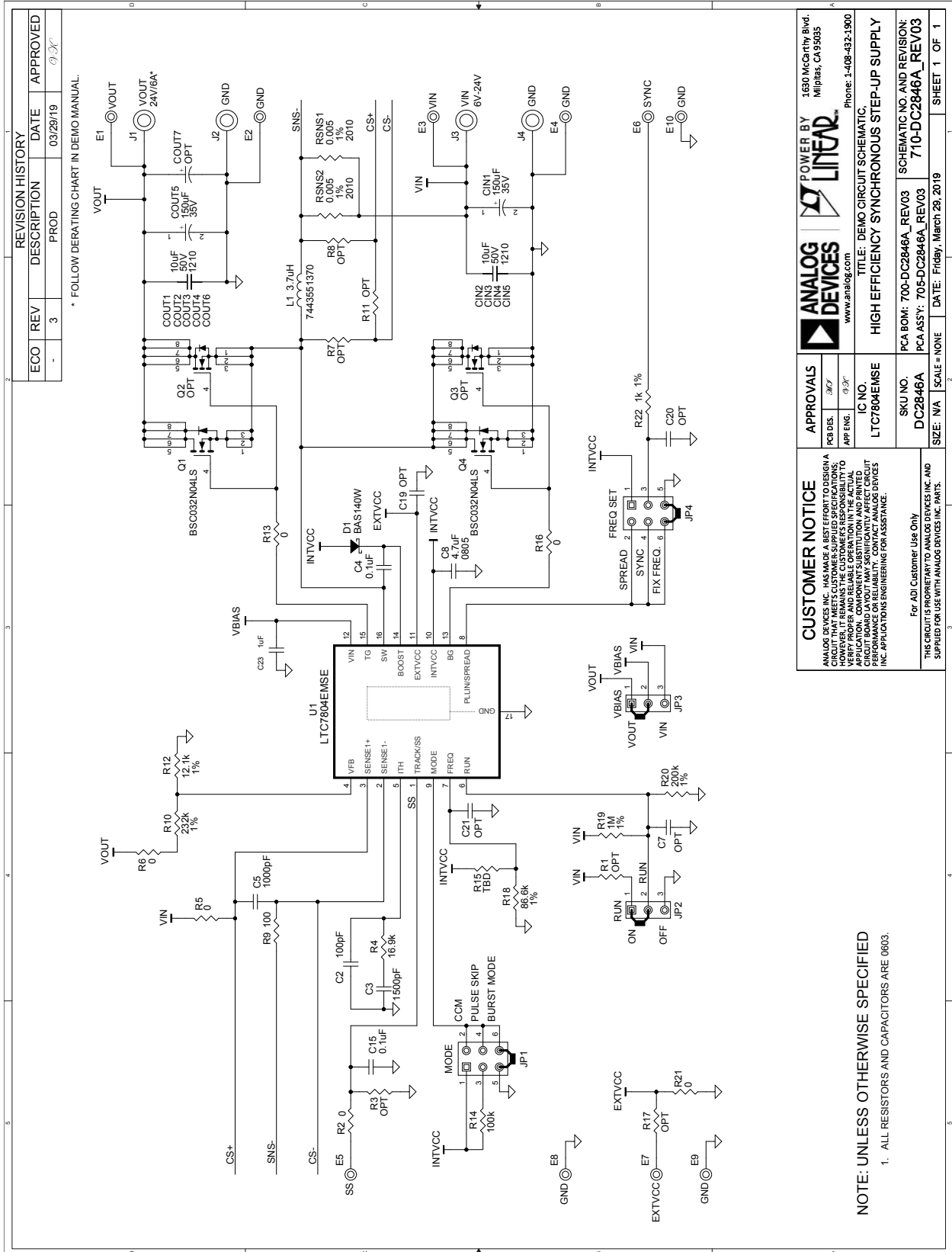
Figure 4. Maximum Output Current vs Input Voltage

# DEMO MANUAL DC2846A

## PARTS LIST

| ITEM  | QTY | REFERENCE   | PART DESCRIPTION  | MANUFACTURER/PART NUMBER          |
|---|-----|---|---|-----------------------------------|
| <b>Required Circuit Components</b>              |     |   |   |                                   |
| 1   | 1   | C2  | CAP, 100pF, COG, 25V, 10%, 0603                         | AVX, 06033A101KAT2A               |
| 2   | 1   | C3  | CAP, 1500pF, X7R, 25V, 10%, 0603                        | AVX, 06033C152KAT2A               |
| 3   | 2   | C4, C15   | CAP, 0.1µF, X5R, 25V, 10%, 0603                         | AVX, 06033D104KAT2A               |
| 4   | 1   | C5  | CAP, 1000pF, COG, 25V, 10%, 0603                        | AVX, 06033A102KAT2A               |
| 5   | 1   | C8  | CAP, 4.7µF, X5R, 25V, 10%, 0805                         | MURATA, GRM219R61E475KA73D        |
| 6   | 2   | C19, C23  | CAP, 1µF, X5R, 50V, 10%, 0603                           | AVX, 06035D105KAT2A               |
| 7   | 2   | CIN1, COUT5   | CAP, 150µF, ALUM ELECT, 35V, 20%, SMD                   | SUN ELECT, 35HVH150M              |
| 8   | 9   | CIN2, CIN3, CIN4, CIN5,<br>COUT1, COUT2, COUT3,<br>COUT4, COUT6 | CAP, 10µF, X5R, 50V, 10%, 1210                          | TDK, C3225X5R1H106K250AB          |
| 9   | 1   | D1  | DIODE, SCHOTTKY, 60V, 1A, SOD-123F                      | DIODES, B160S1F-7                 |
| 10  | 1   | L1  | IND, 2.8µH, WE-HCI, FLAT WIRE, SMD                      | WURTH, 7443551280                 |
| 11  | 2   | Q1, Q4  | XSTR, MOSFET, N-CH, 40V, 98A, TDSON-8                   | INFINEON, BSC032N04LS             |
| 12  | 5   | R2, R5, R6, R13, R16  | RES, AEC-Q200, 0Ω, 1/10W, 0603                          | VISHAY, CRCW06030000Z0EA          |
| 13  | 1   | R4  | RES, AEC-Q200, 16.9kΩ, 1%, 1/10W, 0603                  | NIC, NRC06F1692TRF                |
| 14  | 1   | R9  | RES, 100Ω, 1%, 1/10W, 0603                              | YAGEO, RC0603FR-07100RL           |
| 15  | 1   | R10   | RES, AEC-Q200, 232kΩ, 1%, 1/10W, 0603                   | VISHAY, CRCW0603232KFKEA          |
| 16  | 1   | R12   | RES, AEC-Q200, 12.1kΩ, 1%, 1/10W, 0603                  | VISHAY, CRCW0603100KFKEA          |
| 17  | 1   | R14   | RES, AEC-Q200, 100kΩ, 1%, 1/10W, 0603                   | VISHAY, CRCW0603100KFKEA          |
| 18  | 1   | R18   | RES, AEC-Q200, 76.8kΩ, 1%, 1/10W, 0603                  | PANASONIC, ERJ3EKF7682V           |
| 19  | 1   | R19   | RES, AEC-Q200, 1MΩ, 1%, 1/10W, 0603                     | VISHAY, CRCW06031M00FKEA          |
| 20  | 1   | R20   | RES, 200kΩ, 1%, 1/10W, 0603                             | VISHAY, CRCW0603200KFKEA          |
| 21  | 1   | R22   | RES, AEC-Q200, 1kΩ, 1%, 1/10W, 0603                     | VISHAY, CRCW06031K00FKEA          |
| 22  | 2   | RSNS1, RSNS2  | RES, SENSE, AEC-Q200, 0.005Ω, 1%, 1/2W, 2010            | VISHAY, WSL20105L000FEA           |
| 23  | 1   | U1  | IC, LOW I <sub>Q</sub> SYNC BOOST CONTROLLER, SSOP-16   | ANALOG DEV INC, LTC7804EMSE#PBF   |
| <b>Additional Demo Board Circuit Components</b> |     |   |   |                                   |
| 1   |     | C7, C20, C21, C22   | CAP, OPTION, 0603                                       | OPT                               |
| 2   |     | COUT7   | CAP, OPTION, ALUM ELECT, SMD                            | OPT                               |
| 3   |     | Q2, Q3  | XSTR, OPTION, MOSFET N-CH, PG-TDSON-8                   | OPT                               |
| 4   |     | R1, R3, R7, R8, R11, R15, R17                                   | RES, OPTION, 0603                                       | OPT                               |
| <b>Hardware: For Demo Board Only</b>            |     |   |   |                                   |
| 1   | 10  | E1, E2, E3, E4, E5, E6, E7, E8,<br>E9, E10                      | TEST POINT, TURRET, 0.094", MTG HOLE                    | MILL-MAX, 2501-2-00-80-00-00-07-0 |
| 2   | 4   | J1, J2, J3, J4  | CONN, BANANA JACK, FEMALE, THT, NON-INSULATED,<br>SWAGE | KEYSTONE, 575-4                   |
| 3   | 2   | JP1, JP4  | CONN, HDR, MALE, 2 × 3, 2mm, VERT, STR, THT             | WURTH, 62000621121                |
| 4   | 2   | JP2, JP3  | CONN, HDR, MALE, 1 × 3, 2mm, STR, THT                   | WURTH, 62000311121                |

SCHEMATIC DIAGRAM



| REVISION HISTORY |     |             |
|------------------|-----|-------------|
| ECO              | REV | DESCRIPTION |
| -                | 3   | PROD        |

| DATE     | APPROVED           |
|----------|--------------------|
| 03/29/19 | <i>[Signature]</i> |

\* FOLLOW DERATING CHART IN DEMO MANUAL.

|   |   |  |
|---|---|--|
|   |   | POWER BY<br>1650 McCarthy Blvd.<br>Milpitas, CA 95035<br>Phone: 1-408-432-1900 |
|   | APPROVALS<br>PCB DES. <i>[Signature]</i><br>APP ENG. <i>[Signature]</i> | IC NO.<br>LTC7804EMSE  |
| CUSTOMER NOTICE<br>ANALOG DEVICES INC. HAS MADE A BEST EFFORT TO DESIGN A CIRCUIT THAT IS FUNCTIONAL AND REPRODUCIBLE. HOWEVER, IT REMAINS THE CUSTOMER'S RESPONSIBILITY TO VERIFY PROPER AND RELIABLE OPERATION IN THE ACTUAL APPLICATION. ANALOG DEVICES DOES NOT WARRANT THE PERFORMANCE OR RELIABILITY OF ANY SPECIFIC APPLICATION OR CIRCUIT. APPLICATIONS ENGINEERING FOR ASSISTANCE. | SKU NO.<br>DC2846A  | SCHEMATIC NO. AND REVISION:<br>710-DC2846A_REV03                               |
| For ADI Customer Use Only<br>THIS CIRCUIT IS PROPRIETARY TO ANALOG DEVICES INC. AND SUPPLIED FOR USE WITH ANALOG DEVICES INC. PARTS.  | SIZE: N/A<br>SCALE = NONE   | DATE: Fri, Mar 29, 2019  |
|   |   | SHEET 1 OF 1   |

NOTE: UNLESS OTHERWISE SPECIFIED  
 1. ALL RESISTORS AND CAPACITORS ARE 0603.



## ESD Caution

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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