General Description

The LTP843 is a low-power linear regulator that supplies power to systems with high voltage batteries. It includes a wide 3V to 40V input range, low-dropout voltage and a low quiescent-supply current. The low quiescent current and low dropout voltage allows operations at extremely low-power levels. Therefore, the LTP843 is ideal for low-power micro controllers and battery-powered equipment.

The LTP843 provides a wide variety of fixed output-voltage options (if requested): 1.8V, 1.9V, 2.3V, 2.5V, 3.0V, 3.3V, 3.45V, 5.0V and 15V; also, it provides the output-adjustable option (from 1.25V to 15V).

The regulator output current is limited internally, and the device is protected against short-circuit, over-load, and over-temperature conditions.

The LTP843 includes thermal shutdown (TSD), current-limiting fault protection, and is available in ESOP-8L package.

Features and Benefits

- 3V to 40V Input Range
- Stable with Low-Value Output Ceramic Capacitor (> 1μF)
- Fixed Output Versions and Adjustable Output (1.25V to 15V) Versions
- Specified Current Limit
- Power Good
- Programmable Power Good Delay
- Thermal Shutdown and Short-Circuit Protection
- -40°C to +125°C Specified Junction Temperature Range
- Available in ESOP-8L Package

Applications

- Industrial/Automotive Applications
- Portable/Battery-Powered Equipment
- Ultra-Low Power Micro Controllers
- Cellular Handsets
- Medical Imaging

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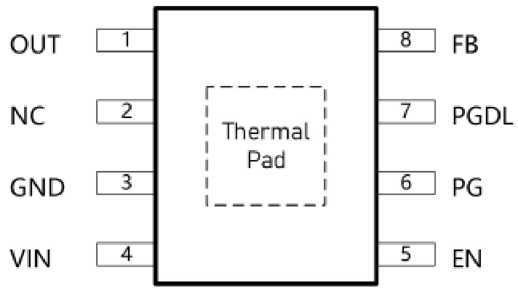
Ordering Information

Part Number [1]	Package Type	Package Quantity	ECO Class	Mark Code
LTP843-AEXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	8A43
LTP843-xxEXS8/R8	ESOP-8L	Tape and Reel, 4 000	Green (RoHS & no Sb/Br)	GTXX

(1) Notes: xx stands for 1.8V, 1.9V, 2.3V, 2.5V, 3.0V, 3.3V, 3.45V, 5.0V and 15V.

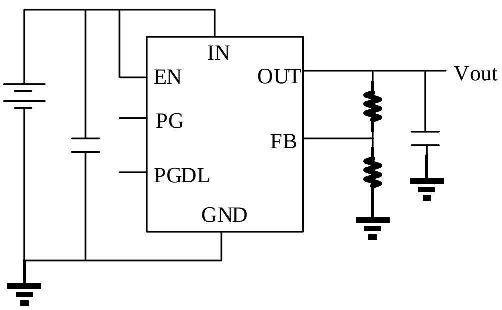
Pin Configuration (Top View)

LTP843
ESOP-8L

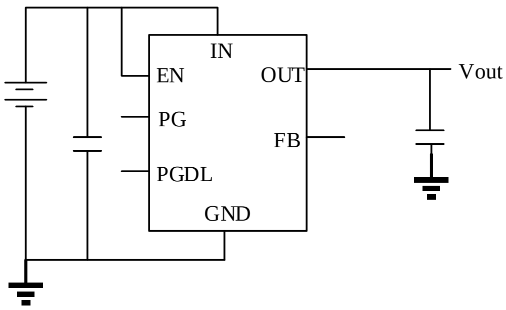


PIN Name	ESOP-8L	Description
OUT	1	Regulated Output Voltage. Only a low-value ceramic capacitor (⩾ 1μF) on the output is required for stability.
NC	2	No Connection. Do NOT connect.
GND	3	Ground. Connect the exposed pad and GND to the same ground plane
VIN	4	Input Voltage. Connect a 3V to 40V supply to VIN.
EN	5	Regulator On/Off Control Input. Logic low shuts down the IC; logic high starts up the IC. Connect EN to VIN for automatic start-up.
PG	6	Power Good. If not used, pin can be left floating.
PGDL	7	Programmable Power-Good Delay Time. If not used, pin can be left floating.
FB	8	Feedback input of the adjustable output version. The FB of the fixed version is left floating on the periphery; it can be grounded, and powering is prohibited. The FB of the adjustable version needs to be connected according to Figure 3 in the Application Information, and the final output voltage should comply with the R1 formula.

Typical Application



Output-Adjustable Version



Output-Fixed Version

Absolute Maximum Ratings

Parameter	Absolute Maximum Rating
IN，EN，PG	-0.3V to +42V
OUT	-0.3V to +17V
FB	-0.3V to +6V
Junction Temperature	+150°C
Lead Temperature	+260°C
Storage Temperature	-65°C to +150°C
Continuous Power Dissipation (T_A = +25°C)	ESOP-8L -2.5W

ESD Ratings

Parameter	Level	UNIT
Human body model (HBM), per ANSI/ESDA/JEDEC JS-001	±2000	V
Charged device model (CDM), per ANSI/ESDA/JEDEC JS-002	±750	V

Recommended Operating Conditions

Parameter	Absolute Maximum Rating
Supply Voltage, V_{IN}	3V to 40V
Output Voltage, V_{OUT}	1.25V to 15V
Operating Temperature, T_J	-40°C to +125°C

Thermal Information

Thermal Metric	Package	θ_{JA}	θ_{JC}	Unit
Package Thermal Resistance	ESOP-8L	50	15	°C/W

Electrical Characteristics

V_{IN} = V_{EN} = 13.5V, T_A =+25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}		3		40	V
Output Voltage	V_{OUT}		1.25		15	V
GND Current	I_{GND}	0＜I_{LOAD}＜1mA		11	15	µA
		1mA＜I_{LOAD}＜30mA		67	150	
		30mA＜I_{LOAD}＜300mA		255	380	
Shutdown Supply Current	I_S	V_{EN} = 0 V		0.8	1.5	µA
Load Current Limit	I_{LIMIT}	V_{IN} = 7V， V_{OUT} = 0V		530	900	mA
FB Voltage	V_{FB}	LTP843， FB = OUT， I_{LOAD} = 5mA	1.225	1.25	1.275	V
Output Voltage Accuracy		LTP843(3.3V)， I_{LOAD} = 5mA	3.234	3.3	3.366	V
		LTP843(5.0V)， I_{LOAD} = 5mA	4.9	5	5.1	
Dropout Voltage	$V_{DROPOUT}$	LTP843 — V_{OUT} = 5V， I_{LOAD} = 150mA		160	350	mV
		LTP843 — V_{OUT} = 5V， I_{LOAD} = 300mA		280	500	
FB Input Current	I_{FB}	LTP843 — V_{FB} = 1.25V		2	100	nA
Line Regulation		LTP843 — V_{IN} = 3V to 40V， I_{LOAD} = 5mA， V_{OUT} =5V	-10	1	10	mV
Load Regulation		LTP843 — I_{LOAD} = 5mA to 300mA， V_{OUT} = 5V		8	15	mV
Output Voltage PSRR		100Hz， C_{OUT} = 10µF， I_{LOAD} = 10mA		84		dB
		1kHz， C_{OUT} = 10µF， I_{LOAD} = 10mA		87		
		100kHz， C_{OUT} = 10µF， I_{LOAD} = 10mA		59		
Start-Up Response Time		LTP843 — R_{LOAD} = 500Ω， V_{OUT} = 5V， C_{OUT} = 22µF， V_{OUT} = from 10% to 90%		0.22	1	ms
EN Threshold Voltage	V_{IL}				0.3	V
	V_{IH}		1.8			V
EN Input Current		EN = 0V or 15V		0.65		µA
PG Rising Threshold		LTP843	89%	93%	97%	V_{FB}
PG Rising Threshold Hysteresis				2%		V_{FB}
PGDL Charging Current		V_{PGDL}= 1V	3	5.5	9	µA
PGDL Rising Threshold			1.4	1.7	2	V
PGDL Falling Threshold			0.2	0.4	0.7	V
PG Delay Time		C_{PGDL} = 47nF	5	15	20	ms
PG Reaction Time		C_{PGDL} = 47nF		1.4	2	µs
Thermal Shutdown	T_{SD}			175		℃
Thermal Shutdown Hysteresis	△TSD			35		℃

Typical Characteristics

C_{IN} = 1μF, C_{OUT} = 22μF, V_{OUT} = 5V, T_A = 25℃, unless otherwise noted.

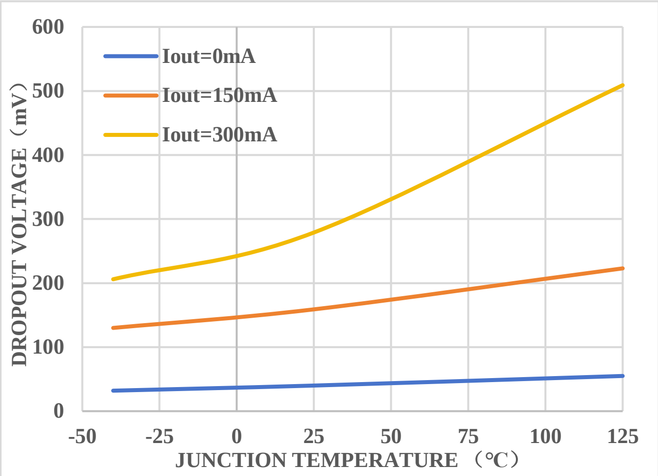


Figure 1. Dropout Voltage vs Junction Temperature（V_{OUT} =5V）

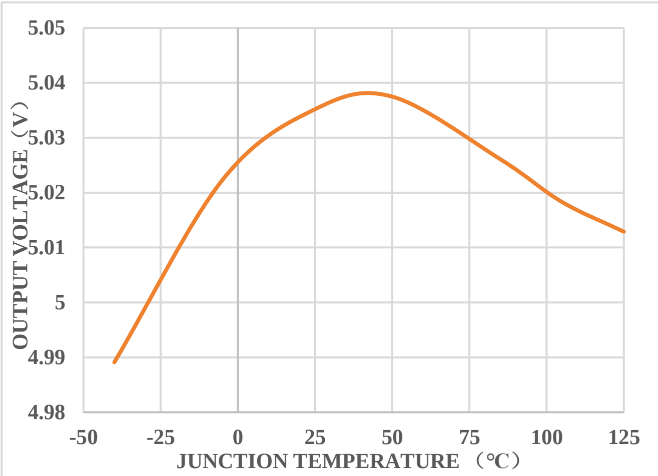


Figure 2. Output Voltage vs Junction Temperature（V_{OUT} =5V）

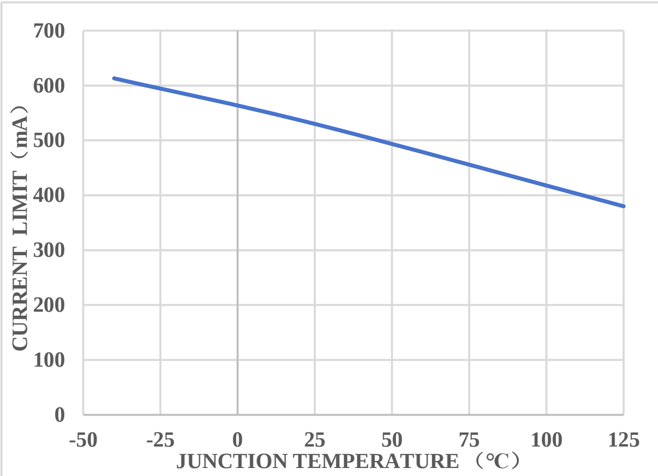


Figure 3. Current Limit vs Junction Temperature（V_{IN} = 6V）

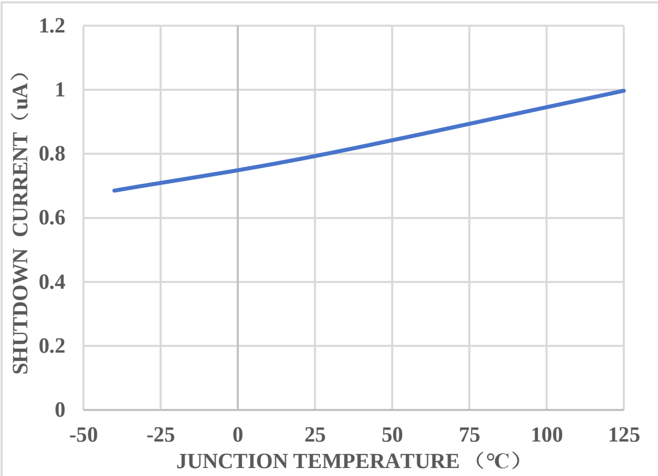


Figure 4. Shutdown Current vs Junction Temperature（V_{IN} = 13.5V）

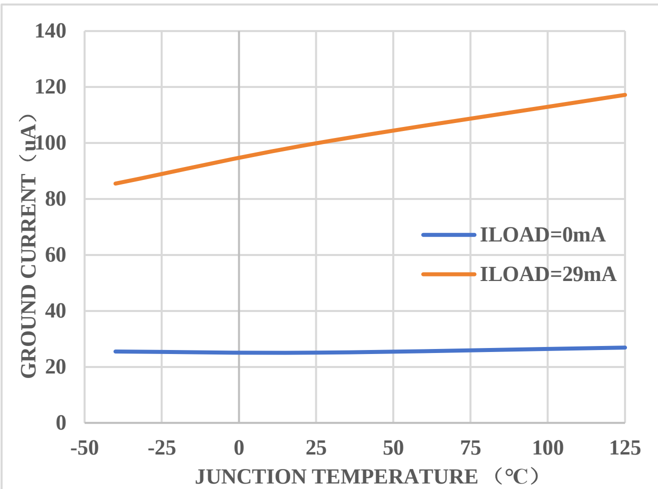


Figure 5. GND Current vs Junction Temperature（V_{IN} = 13.5V）

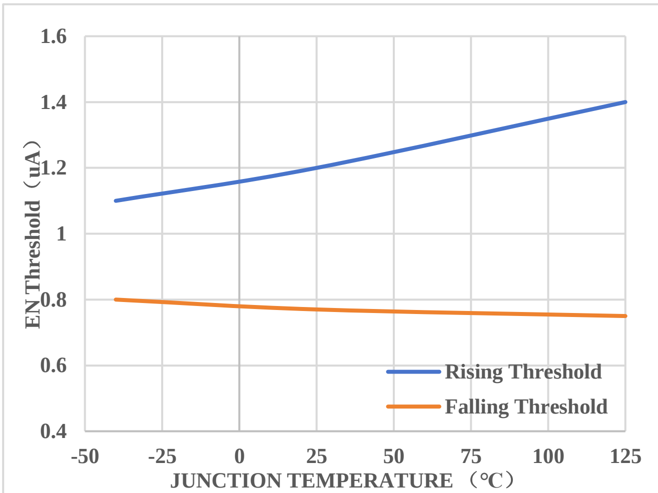


Figure 6. EN Threshold vs Junction Temperature（V_{IN} = 13.5V）

Typical Characteristics (Cont.)

C_{IN} = 1μF, C_{OUT} = 22μF, V_{OUT} = 5V, T_A = 25℃, unless otherwise noted.

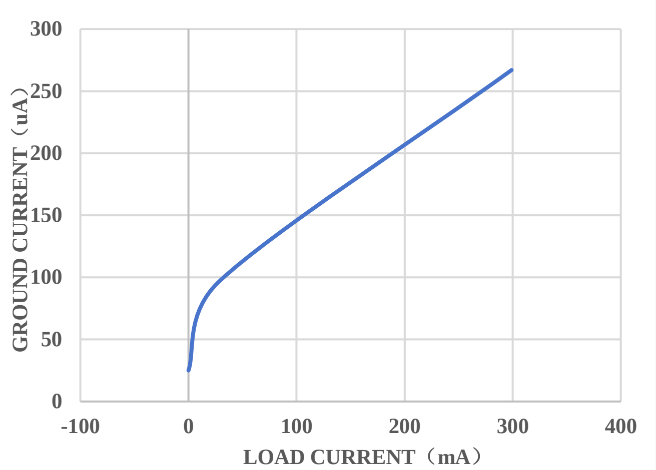


Figure 7.Ground Current vs Load Current（V_{IN} = 6V）

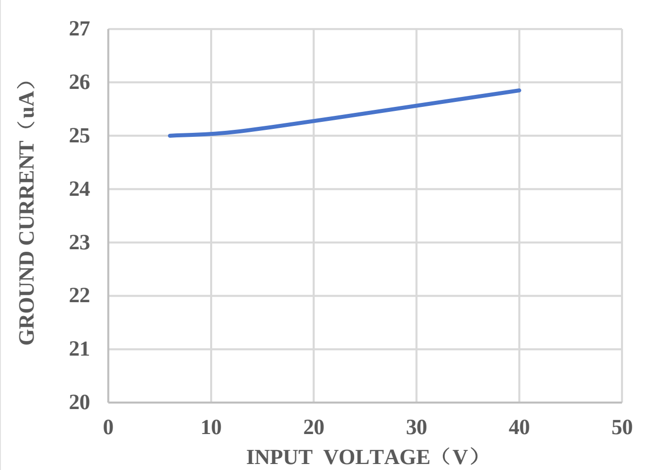


Figure 8.Ground Current vs V_{IN}（I_{OUT} = 0mA）, Vout=5V

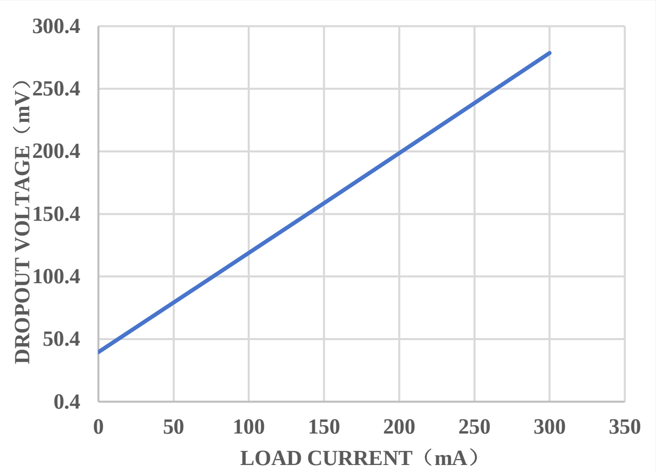


Figure 9. Dropout Voltage vs Load Current

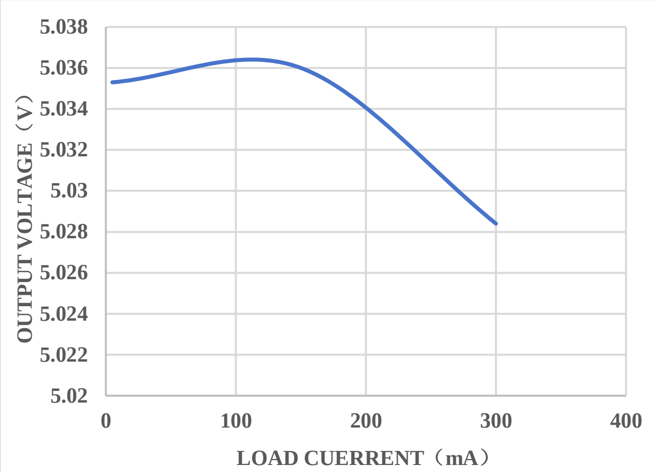


Figure 10. V_{OUT} vs I_{OUT}

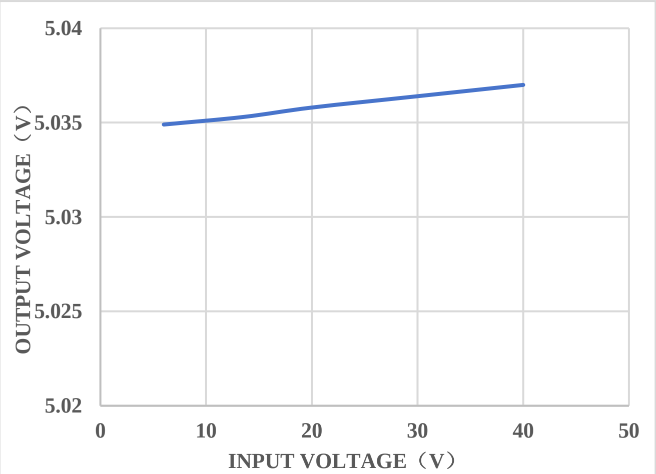


Figure 11. V_{OUT} vs V_{IN}

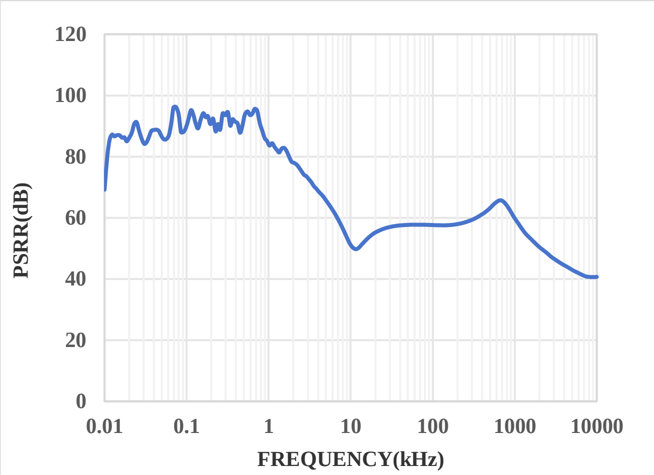


Figure 12. PSRR vs Frequency

Typical Characteristics (Cont.)

C_{IN} = 1μF, C_{OUT} = 22μF, V_{OUT} = 5V, T_A = 25℃, unless otherwise noted.

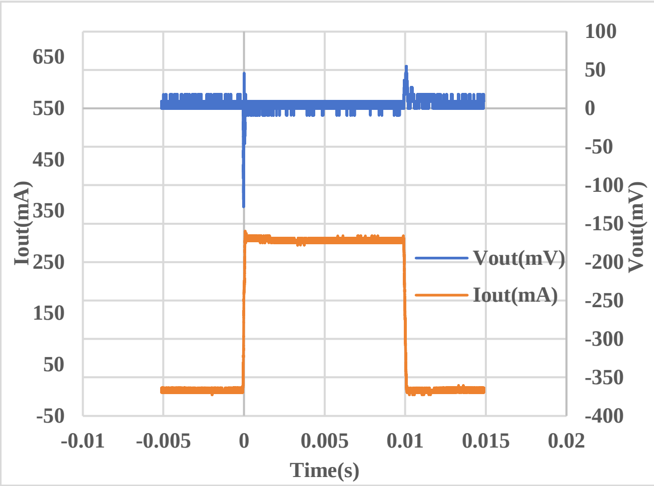


Figure 13. Load Transient （V_{IN} = 12V,I_{OUT} = 300mA）

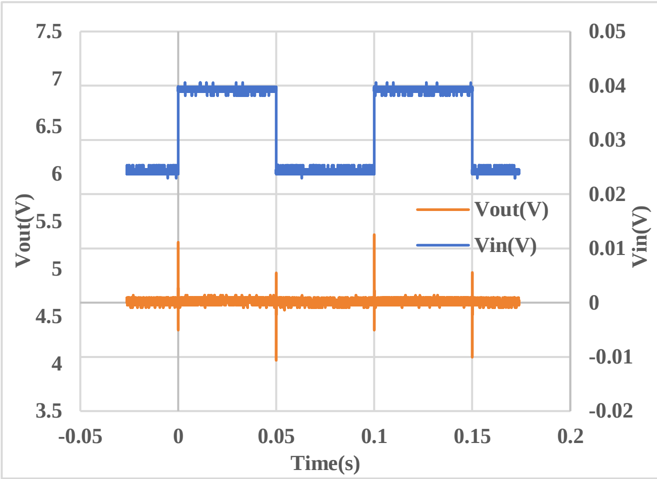


Figure 14.Line Transient （V_{IN} = 6V-7V,I_{OUT} = 300mA）

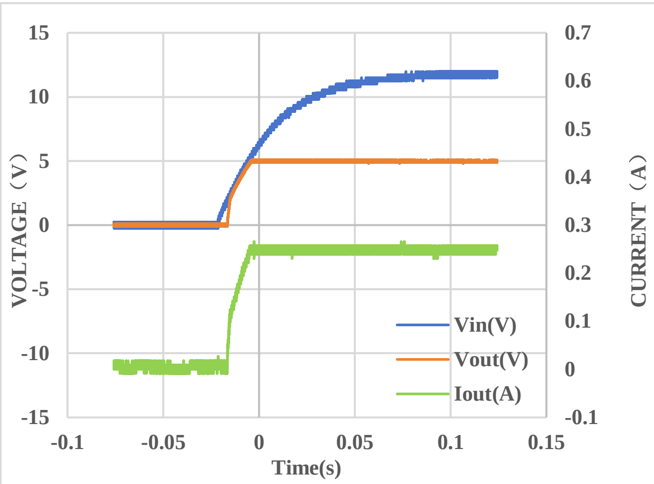


Figure 15.Start-Up through V_{IN} （V_{IN} = 12V,I_{OUT} = 300mA）

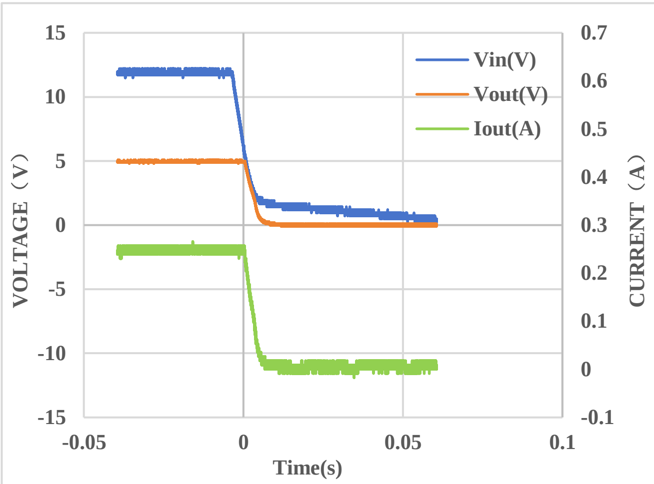


Figure 16.Shutdown through V_{IN} （V_{IN} = 12V,I_{OUT} = 300mA）

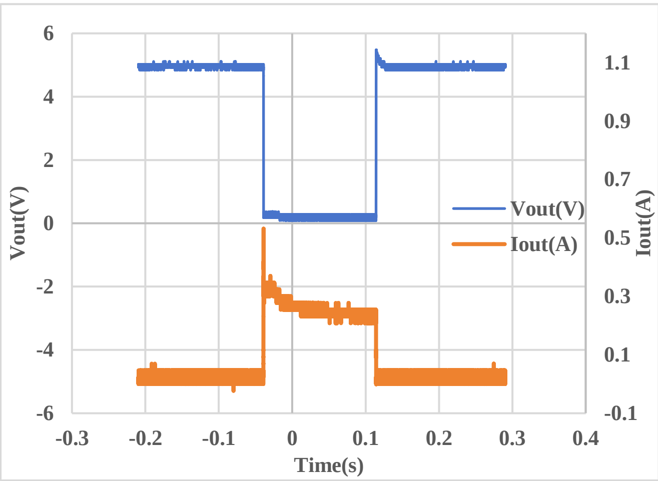


Figure 17.Short-Circuit Entry and Recovery

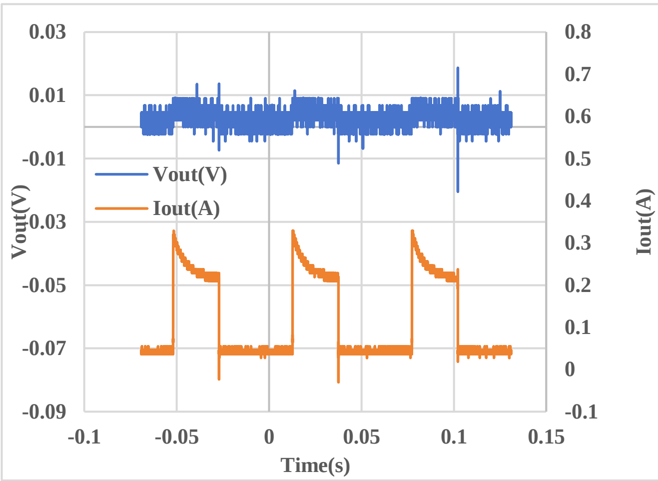


Figure 18.Short-Circuit Steady State （V_{IN} = 12V）

Operation

The LTP843 is a linear regulator that supplies power to systems with high-voltage batteries. It includes a wide 3V to 40V input range, low dropout voltage, and a low quiescent-supply current (see Fig. 1). The LTP843 provides a wide variety of fixed output-voltage options: 3.3V, 5V and 15.0V; also, it provides the output-adjustable option (from 1.25V to 15V).

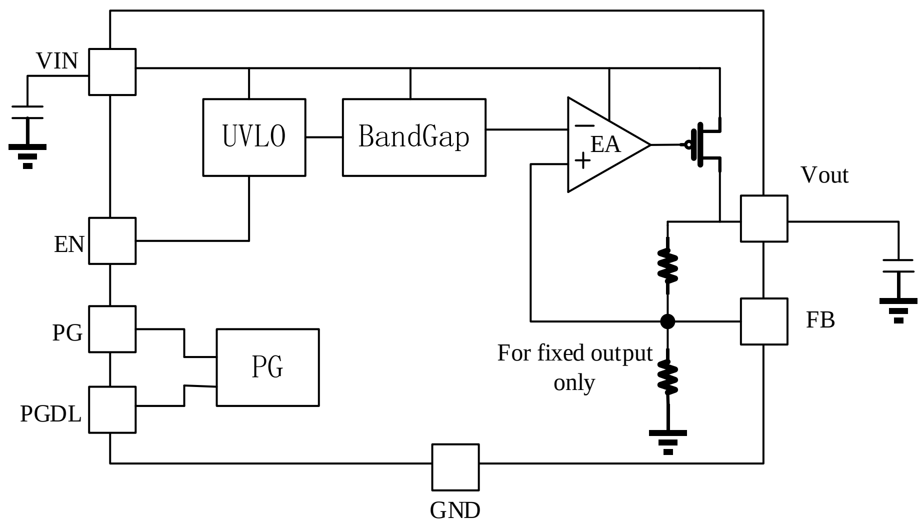


Figure 1. Functional Block Diagram

The output-adjustable version has an output that is adjustable from 1.25V to 15V with a simple resistor divider. It uses external feedback, allowing the user to set the output voltage with an external resistor divider. The FB threshold is 1.25V, typically. The IC enters shutdown mode when EN is low. In shutdown mode, the pass transistor, control circuitry, reference, and all biases turn off; this reduces the supply current to $<$ 1μA. Connect EN to VIN for automatic start-up.

The regulator output current is limited internally, and the device is protected against over-load, and over-temperature conditions (see Fig. 2). When the junction temperature is too high, the thermal sensor sends a signal to the control logic which shuts down the IC. The IC will re-start when the temperature has cooled sufficiently.

The maximum power output current is a function of the package's maximum power dissipation for a given temperature. The maximum power dissipation is dependent on the thermal resistance of the case and the circuit board, the temperature difference between the die junction and the ambient air, and the rate of air flow. GND and the exposed pad must be connected to the ground plane for proper dissipation.

Power Good and PG delay description

LTP843 has one power good (PG) pin. The PG pin is the open drain of an internal MOSFET. It should be connected to V_{OUT} or external voltage source(<15V) through a resistor (i.e. 10kohm). After the V_{FB} reaches 93% of nominal value, the MOSFET turns off and PG pin is pulled to high by V_{OUT} or external voltage source. When the V_{FB} drops to 88% of nominal value, the PG voltage is pulled to GND.

There is a delay time when PG asserts high. The delay time can be programmed by adding a capacitor on PGDL. To select a capacitor for PGDL, use below equation:

$$C_{PGDL}(nF) = \frac{t_{PGDL}(ms) \times I_{PGDL}(uA)}{V_{th\_PGDL}(V)}$$

Where t_{PGDL} is the desired delay time for PG asserts high, I_{PGDL} is the PGDL charging current and V_{th_PGDL} is 1.7V. Figure 2 shows the power good timing.

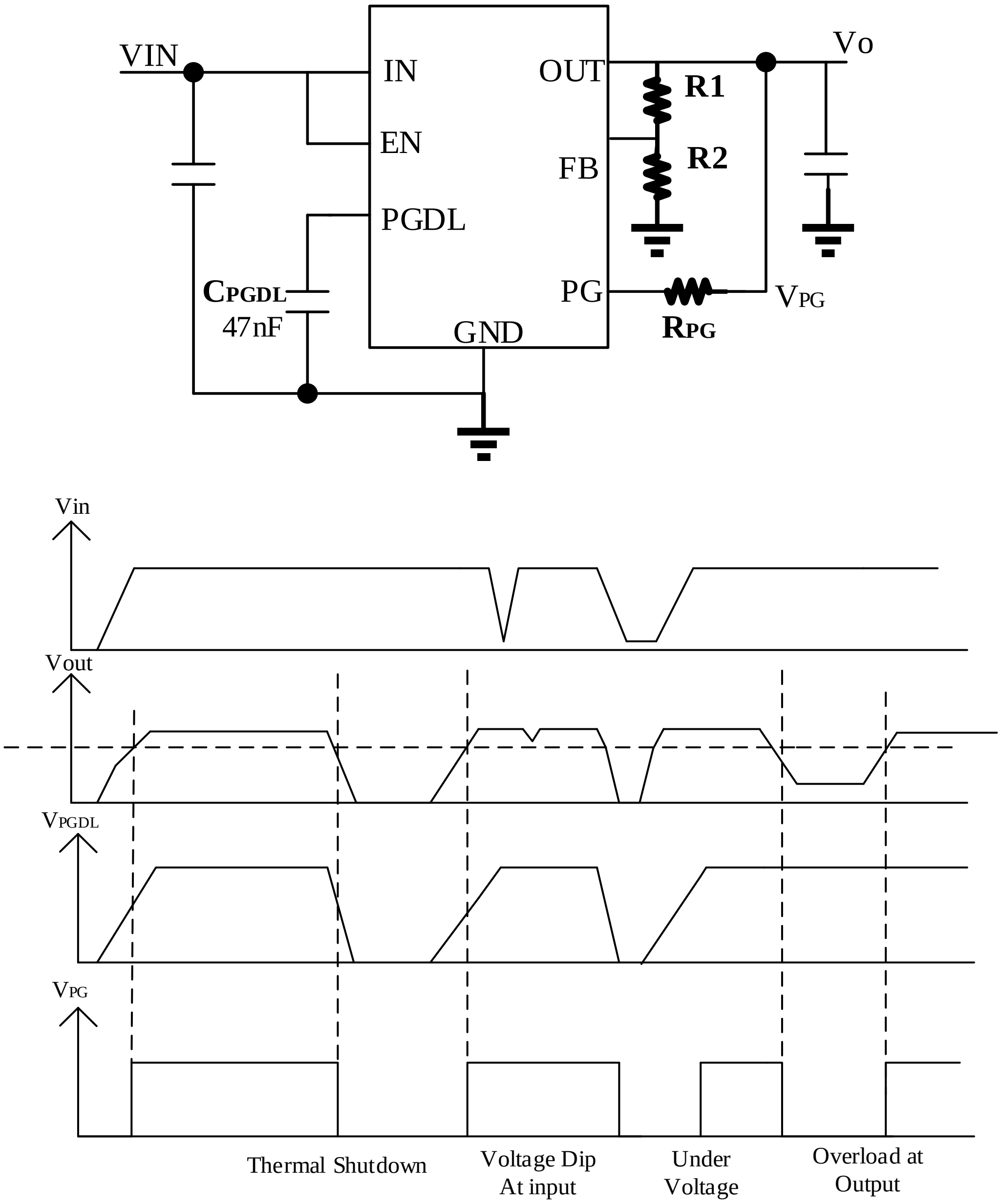


Figure 2. Power Good Timing

Application Information

Component Selection

Setting the Output Voltage

Set the output voltage of the LTP843 by using a resistor divider (see Fig. 3).

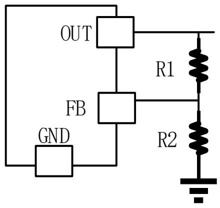


Figure 3. FB Resistor Divider to Set Vout

Choose R2=1MΩ to maintain a 1.215µA minimum load. Calculate the value for R1 using the following equation:

$$R1 = R2 \times \left(\frac{V_{OUT}}{1.25V} - 1\right)$$

For a fixed-output version, let FB floating or connect FB to GND. No external resistor is connected between V_{out} and FB.

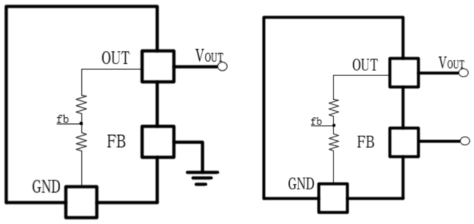


Figure 4. FB Divider for Fixed-Output Version

Enable Control (EA)

EN is a digital control pin that turns the regulator on and off. When EN is pulled below 0.3V, the chip shuts down. When EN is pulled above 1.8V, the chip starts up. If this function is not used, EN can be connected to V_{IN} directly.

Input Capacitor

For efficient operation, place a ceramic capacitor, (C1) between 1µF and 10µF of dielectric type (X5R or X7R) between the input pin and ground. Larger values in this range improve line transient response.

Output Capacitor

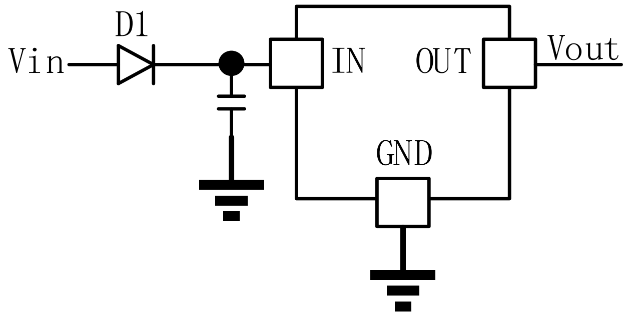
For stable operation, use a ceramic capacitor (C2) of type X5R or X7R between 1µF and 22µF. Larger values in this range improve load transient response and reduce noise. Output capacitors of other dielectric types may be used, but they are not recommended as their capacitance can deviate greatly from their rated value over temperature. To improve load transient response, add a small ceramic (X5R, X7R, or Y5V dielectric) 2.2nF feed-forward capacitor in parallel with R1. The feed-forward capacitor is not required for stable operation.

Output Noise

The LTP843 exhibits noise on the output during normal operation. This noise is negligible for most applications. However, in applications that include analog-to-digital converters (ADCs) of more than 12 bits, consider the ADC's power supply rejection specifications. The feed-forward capacitor C2 across R1 reduces significantly the output noise.

External Reverse Voltage Protection

In some situations, e.g. a backup battery is connected as LTP843 load, the output voltage may be held up while the input is either pulled to ground, pulled to some intermediate voltage or is floating. Thus, the output voltage is higher than input voltage. Since the LTP843 PMOS pass element has a body diode, a current will conduct from the output to input and is not internally limited. It's possible that the IC will be damaged by this unlimited reverse current. To avoid this, it's recommended to place an external diode at input like below.



PCB Layout Guidelines

Efficient PCB layout is critical to achieve good regulation, ripple rejection, transient response, and thermal performance. It is recommended highly to duplicate the EVB layout for optimum performance.

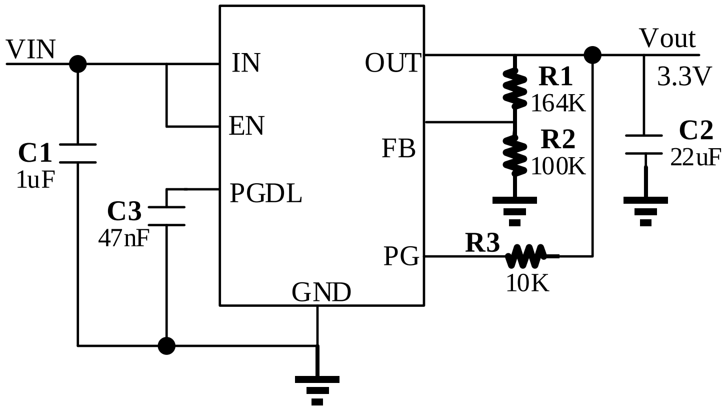
If changes are necessary, follow the guidelines below:

1) Place input and output bypass ceramic capacitors close to IN and OUT, respectively.

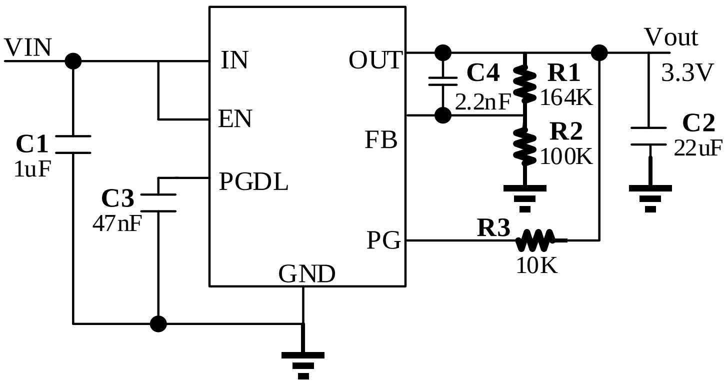
2) Ensure all feedback connections are short and direct. Place the feedback resistors and compensation components as close to the chip as possible.

3) Connect IN, OUT, and especially, GND, respectively, to a large copper area to cool the chip. This improves thermal performance and long-term reliability.

Typical Application Circuits



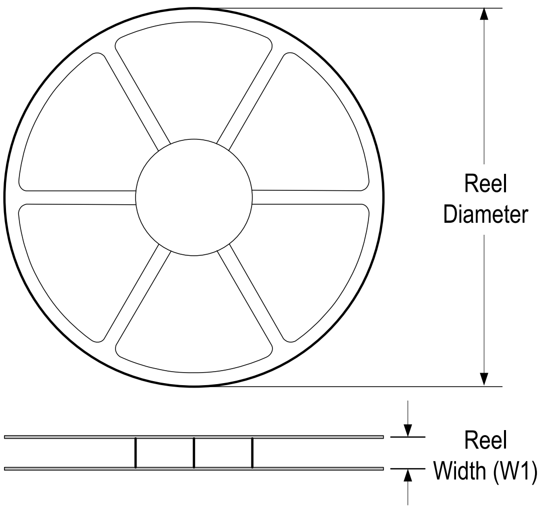
3.3V Output Typical Application Circuit



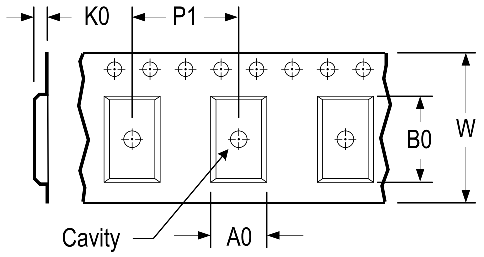
3.3V Output with Feed-Forward Capacitor

Tape and Reel Information

REEL DIMENSIONS

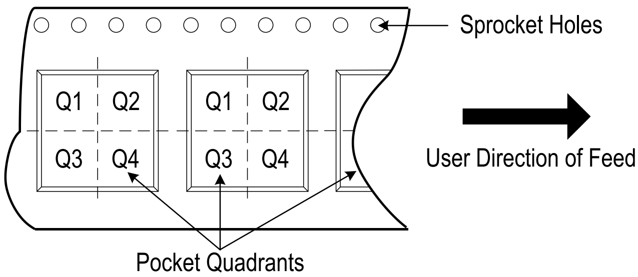


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIETATION IN TAPE

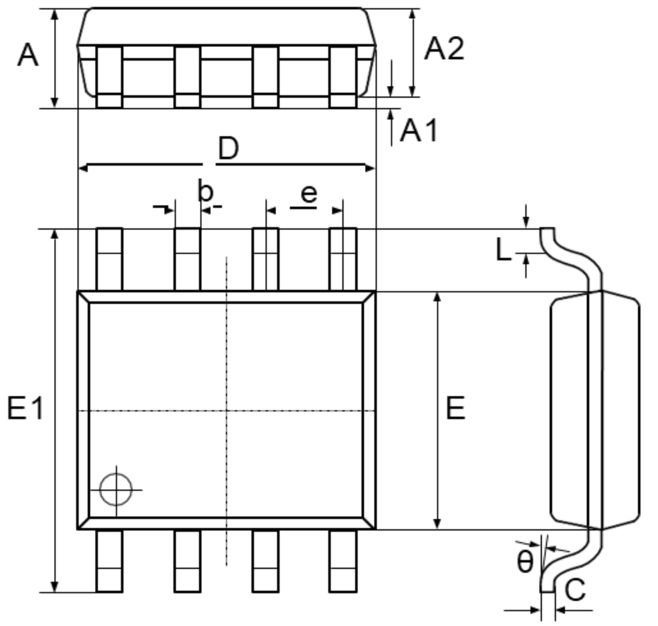


* All dimensions are nominal

Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin 1 Quadrant
LTP843-AEXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1
LTP843-xxEXS8/R8	ESOP	8	4 000	330	12.5	6.6	5.3	2.0	8.0	12.0	Q1

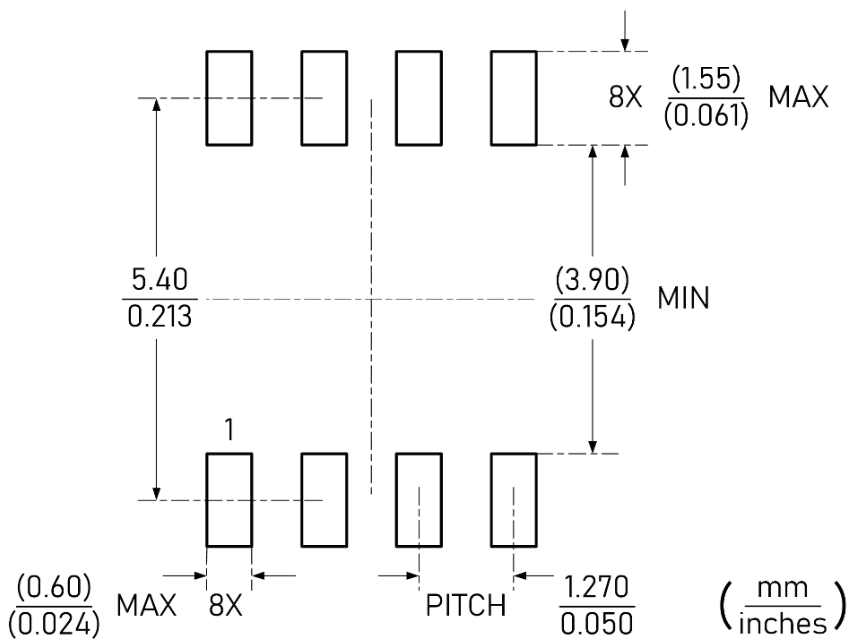
Package Outlines

DIMENSIONS, ESOP-8L



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.370	1.670	0.054	0.066
A1	0.070	0.170	0.003	0.007
A2	1.300	1.500	0.051	0.059
b	0.306	0.506	0.012	0.020
C	0.203 TYP.		0.008 TYP.	
D	4.700	5.100	0.185	0.201
E	3.820	4.020	0.150	0.158
E1	5.800	6.200	0.228	0.244
e	1.270 TYP.		0.050 TYP.	
L	0.450	0.750	0.018	0.030
θ	0°	8°	0°	8°

RECOMMENDED SOLDERING FOOTPRINT, ESOP-8L



Important Notice

Linearin is a global fabless semiconductor company specializing in advanced high-performance high-quality analog/mixed-signal IC products and sensor solutions. The company is devoted to the innovation of high performance, analog-intensive sensor front-end products and modular sensor solutions, applied in multi-market of medical & wearable devices, smart home, sensing of IoT, intelligent industrial & smart factory (industry 4.0), and automotives. Linearin's product families include widely-used standard catalog products, solution-based application specific standard products (ASSPs) and sensor modules that help customers achieve faster time-to-market products. Go to http://www.linearin.com for a complete list of Linearin product families.

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