24V 150mA Ultralow Quiescent Current LDO

General Description

The EHP8042 is a high voltage, low quiescent current, low dropout regulator with 150mA output driving capacity. The EHP8042, which operates over an input range up to 24V, is stable with any capacitors, whose capacitance is larger than 1μF, and suitable for powering battery-management ICs because of the virtue of its low quiescent current consumption and low dropout voltage.

The EHP8042 is available in SOT-23-3, SOT-23-5, SOT-89-3 and uDFN1x1-4 surface mount packages.

Features

- Up to 24V input voltage range
- 150mA output current driving capacity
- Ultra low quiescent current (typical 1.5μA)
- 1200mV typical dropout at IOUT = 150 mA
- Thermal shutdown protection
- Short circuit protection
- Stable with 1μF output capacitor

Applications

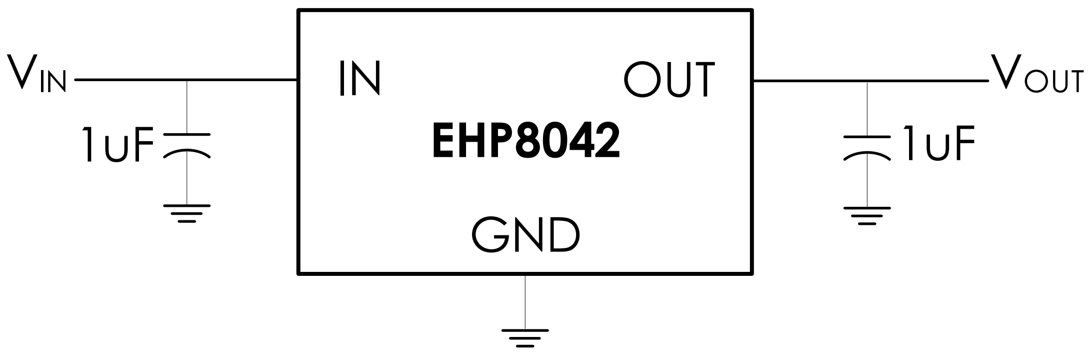
- E-meters, Water Meters and Gas Meters
- Fire Alarm, Smoke Detector
- Appliances and White Goods

Ordering Information

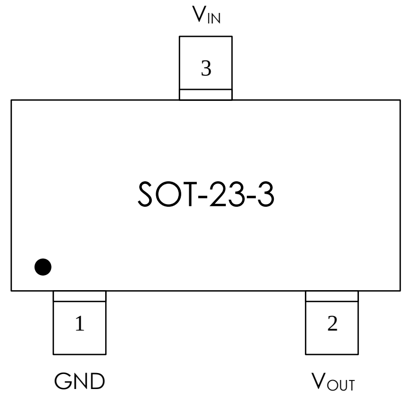
Part Number	Remark
EHP8042-XXVD03NRR	±2% output voltage tolerance
EHP8042-XXVF05NRR	±2% output voltage tolerance
EHP8042-XXVNP5NRR	±2% output voltage tolerance
EHP8042-XXVL03NRR	±2% output voltage tolerance
EHP8042-XXDC04NRR	±2% output voltage tolerance

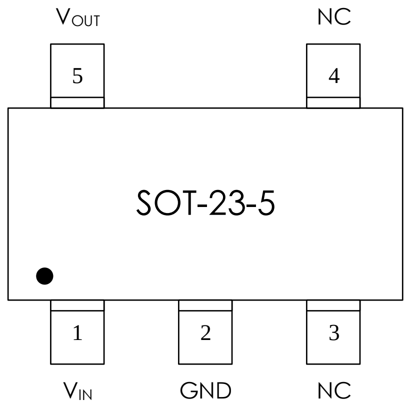
XX:15=1.5V, 18=1.8V, 25=2.5V, 30=3.0V, 33=3.3V, 50=5.0V

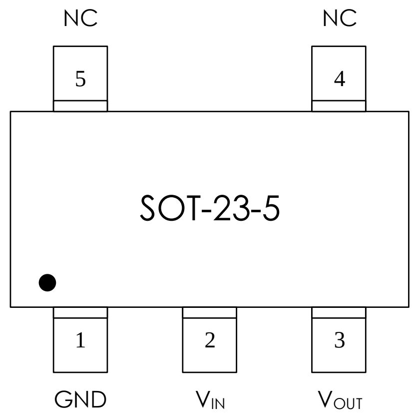
Typical Application

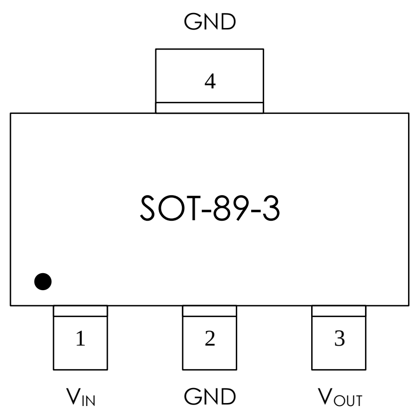


Connection Diagrams









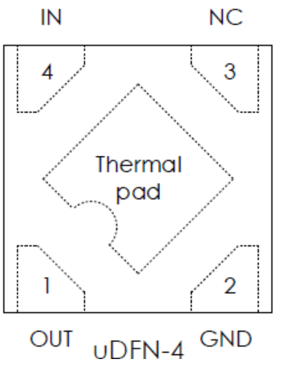
Order information

EHP8042-XXVD03NRR
XX Output voltage
VD03 SOT-23-3 Package
NRR RoHS & Halogen free package
Rating: -40 to 85°C
Package in Tape & Reel

EHP8042-XXVF05NRR
XX Output voltage
VF05 SOT-23-5 Package
NRR RoHS & Halogen free package
Rating: -40 to 85°C
Package in Tape & Reel

EHP8042-XXVNP5NRR
XX Output voltage
VNP5 SOT-23-5 Package
NRR RoHS & Halogen free package
Rating: -40 to 85°C
Package in Tape & Reel

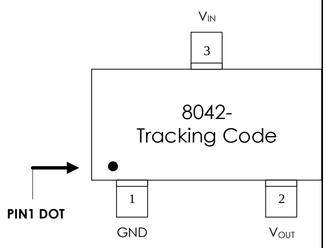
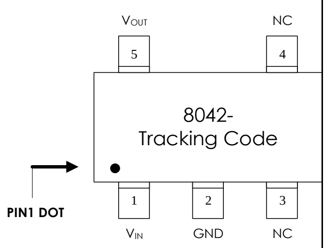
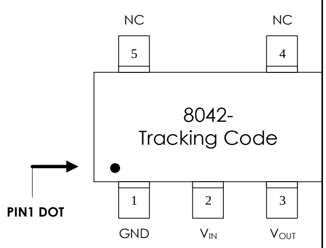
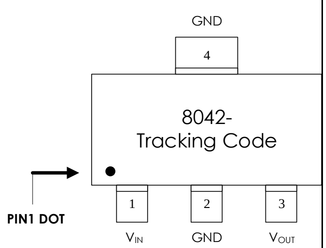
EHP8042-XXVL03NRR
XX Output voltage
VL03 SOT-89-3 Package
NRR RoHS & Halogen free package
Rating: -40 to 85°C
Package in Tape & Reel

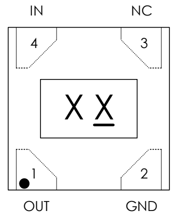
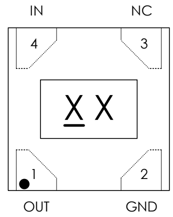
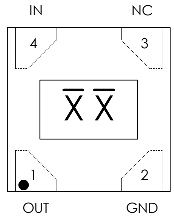
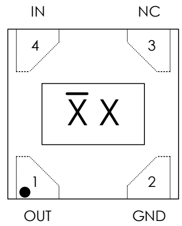
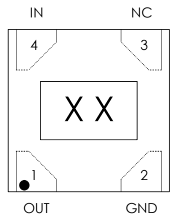
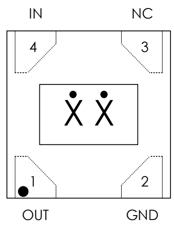


EHP8042-XXDC04NRR

XX	Output voltage	
DC04	uDFN1x1-4 Package	
NRR	RoHS & Halogen free package Rating: -40 to 85°C Package in Tape & Reel	

Order, Marking and Packing Information

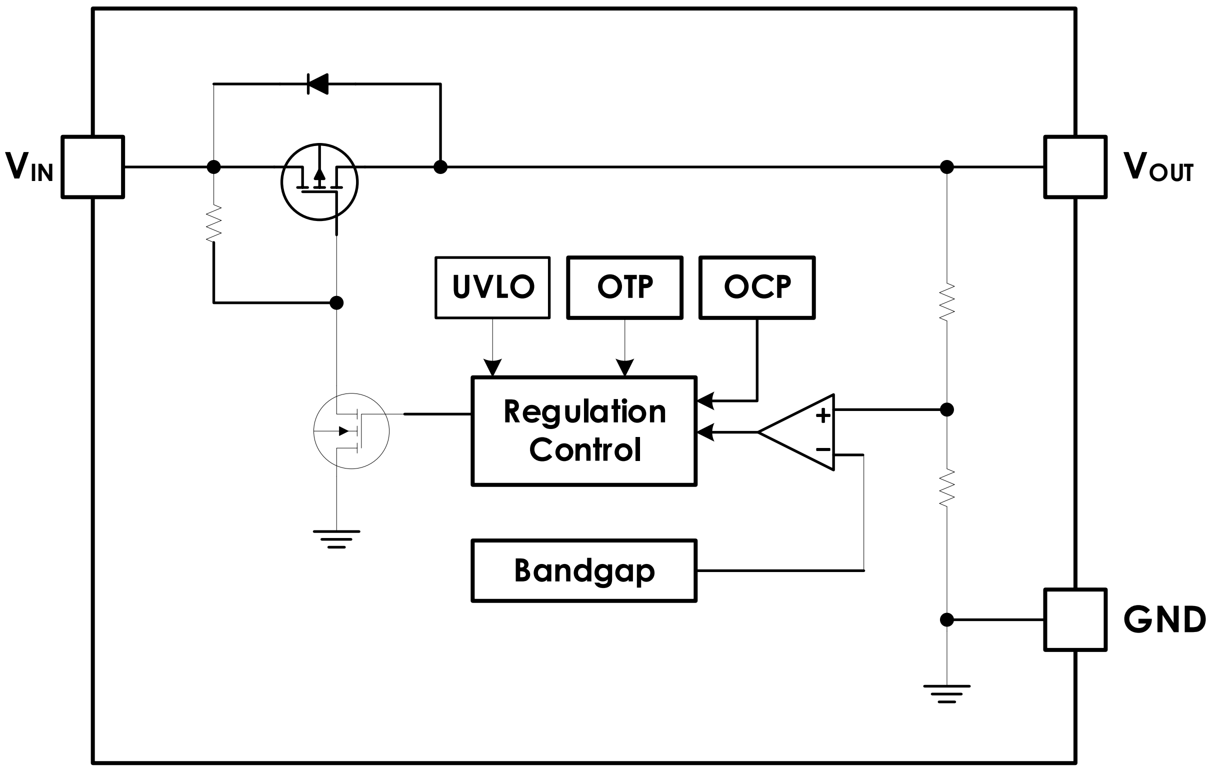
Package	Vout	Product ID.	Marking	Packing
SOT-23-3	1.5V	EHP8042-15VD03NRR		Tape & Reel 3Kpcs
	1.8V	EHP8042-18VD03NRR		
	2.5V	EHP8042-25VD03NRR		
	3.0V	EHP8042-30VD03NRR		
	3.3V	EHP8042-33VD03NRR		
	5.0V	EHP8042-50VD03NRR		
SOT-23-5	1.5V	EHP8042-15VF05NRR		Tape & Reel 3Kpcs
	1.8V	EHP8042-18VF05NRR		
	2.5V	EHP8042-25VF05NRR		
	3.0V	EHP8042-30VF05NRR		
	3.3V	EHP8042-33VF05NRR		
	5.0V	EHP8042-50VF05NRR		
SOT-23-5	1.5V	EHP8042-15VNP5NRR		Tape & Reel 3Kpcs
	1.8V	EHP8042-18VNP5NRR		
	2.5V	EHP8042-25VNP5NRR		
	3.0V	EHP8042-30VNP5NRR		
	3.3V	EHP8042-33VNP5NRR		
	5.0V	EHP8042-50VNP5NRR		
SOT-89-3	1.5V	EHP8042-15VL03NRR		Tape & Reel 1Kpcs
	1.8V	EHP8042-18VL03NRR		
	2.5V	EHP8042-25VL03NRR		
	3.0V	EHP8042-30VL03NRR		
	3.3V	EHP8042-33VL03NRR		
	5.0V	EHP8042-50VL03NRR		

uDFN1x1-4	1.5V	EHP8042-15DC04NRR	 XX=tracking code	Tape & Reel 8Kpcs
	1.8V	EHP8042-18DC04NRR	 XX=tracking code	
	2.5V	EHP8042-25DC04NRR	 XX=tracking code	
	3.0V	EHP8042-30DC04NRR	 XX=tracking code	
	3.3V	EHP8042-33DC04NRR	 XX=tracking code	
	5.0V	EHP8042-50DC04NRR	 XX=tracking code	

Pin Functions

Name	SOT-23-3	SOT-23-5		SOT-89-3	uDFN1x1-4	Function
		VF05	VNP5			
VIN	3	1	2	1	4	**Supply Voltage Input** Require a minimum input capacitor of close to 1μF to ensure stability and sufficient decoupling from the ground pin.
GND	1	2	1	2 , 4	2	**Ground Pin**
NC	N/A	3 , 4	4 , 5	N/A	3	**No connection**
VOUT	2	5	3	3	1	**Output Voltage** A small 1μF ceramic capacitor is needed from this pin to ground to assure stability.
Thermal Pad	N/A	N/A	N/A	YES	YES	The thermal pad with large thermal land area on the PCB will helpful chip power dissipation, to connect it to GND together normally.

Functional Block Diagram



Functional Block Diagram of EHP8042

Absolute Maximum Ratings (Note 1, 2)

V_{IN}	-0.3V to 26V	Vout	-0.3V to 6V
Junction Temperature (T_J)	150°C	Lead Temperature (Soldering, 10 sec.)	260°C
Storage Temperature Range	-65°C to 150°C	ESD Rating: Human Body Model	2KV

Recommended Operating Conditions (Note 1, 2)

Supply Voltage V_{IN}	2.7V to 24V	Operating Temperature Range	-40°C to 85°C
Junction Temperature Range	-40°C to 125°C		

Thermal Resistance:

Symbol	θ_{JA}(Note 3)	θ_{JC}(Note 4)
SOT-23-3	250(˚C/W)	81(˚C/W)
SOT-23-5	152(˚C/W)	81(˚C/W)
SOT-89-3	90(˚C/W)	52(˚C/W)
uDFN1x1-4	110(˚C/W)	23(˚C/W)

Electrical Characteristics

V_{IN}=V_{OUT}+2V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1uF, T_a = 25°C, unless otherwise specified

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Output Voltage	V_{OUT}		-2%		2%	V
Line Regulation	$\triangle V_{LINE}$	V_{IN}=V_{OUT} + 2V to 24V,		0.1		%
Load Regulation	$\triangle V_{LOAD}$	I_{OUT}= 1mA to 100mA		0.7		%
Dropout Voltage	V_{DROP}	Vout=3.3V, I_{OUT}=10mA		60		mV
		Vout=3.3V, I_{OUT}=50mA		300		mV
		Vout=3.3V, I_{OUT}=100mA		650		mV
		Vout=3.3V,I_{OUT}=150mA		1200		mV
Quiescent Current	I_Q	T_a= 25℃, I_{OUT}=0mA		1.5	4.0	uA
Current Limit	I_{CL}		170	210		mA
Thermal Shutdown	T_{SD}			140		°C
Thermal Shutdown Hysteresis	T_{HY}			20		°C
Power-supply rejection ratio	PSRR	f = 1kHz, Vin=4.3V Vo = 3.3V, Ripple 0.2Vp-p, Iout = 1mA		55		dB

Note 1: Absolute Maximum ratings indicate limits beyond which damage may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

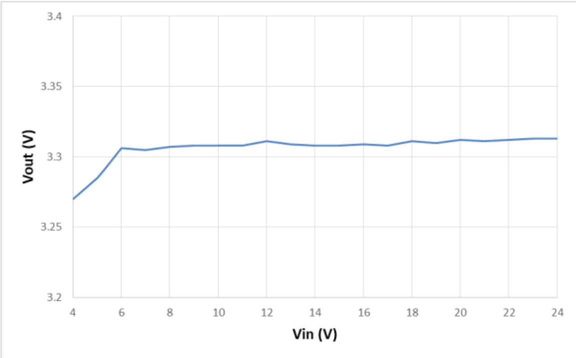
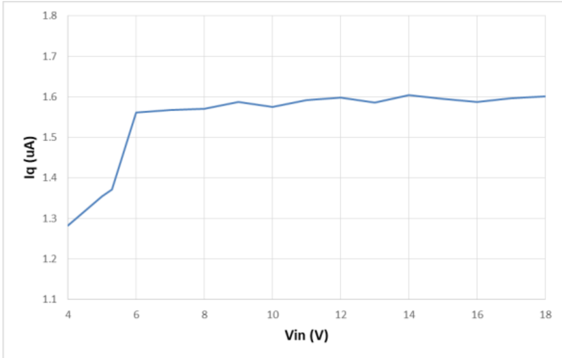
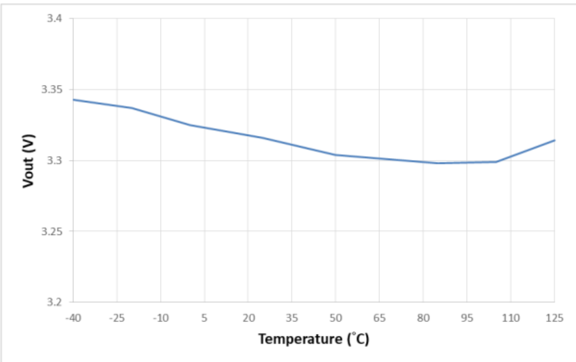
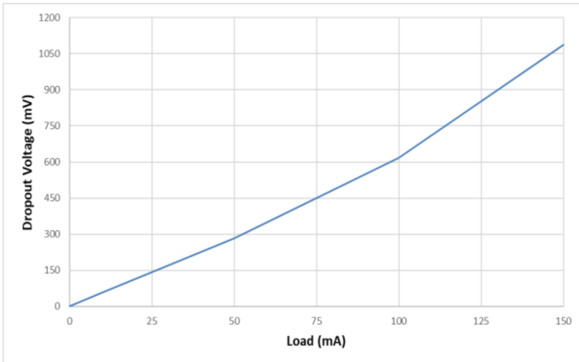
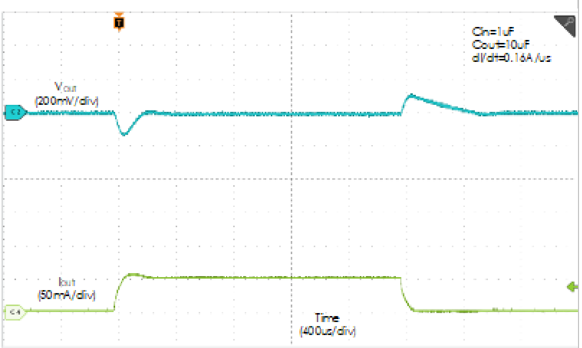
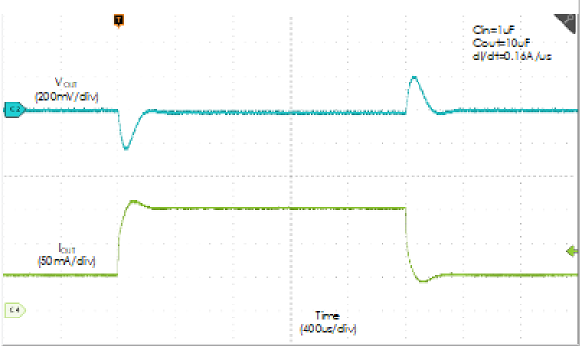
Note 2: All voltages are with respect to the potential at the ground pin.

Note 3: θ_{JA} is measured in the natural convection at T_J=25˚C on a high effective thermal conductivity test board (2 layers, 2S0P).

Note 4: θ_{JC} represents the resistance to the heat flows the chip to package top case.

Typical Performance Characteristics

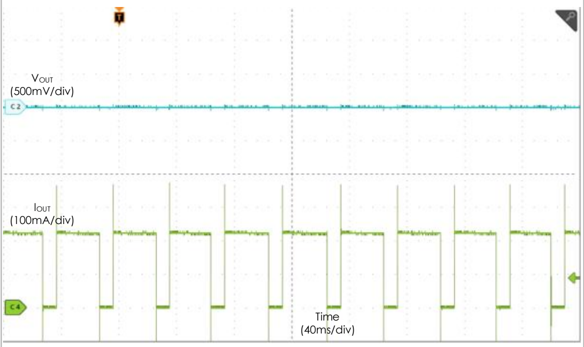
V_{IN}=V_{OUT}+2V, I_{OUT}=1mA, V_{OUT}=3.3V, C_{IN}=C_{OUT}=1uF, T_A=25℃, unless otherwise specified

V_{OUT} vs. V_{IN}	I_Q vs. V_{IN}
	
V_{OUT} vs. Temperature	Dropout voltage vs. Load current
	
Load Transient (1 to 50mA)	Load Transient (50 to 150mA)
	

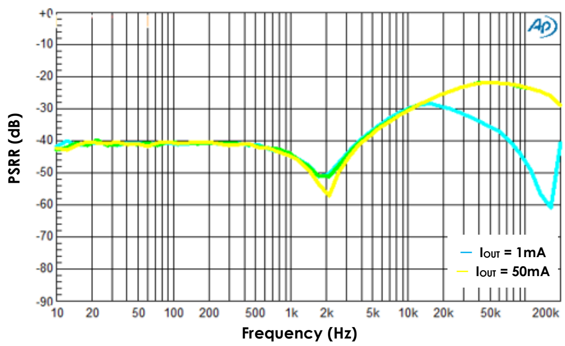
Typical Performance Characteristics

V_{IN}=V_{OUT}+2V, I_{OUT}=1mA, V_{OUT}=3.3V, C_{IN}=C_{OUT}=1uF, T_a=25℃, unless otherwise specified

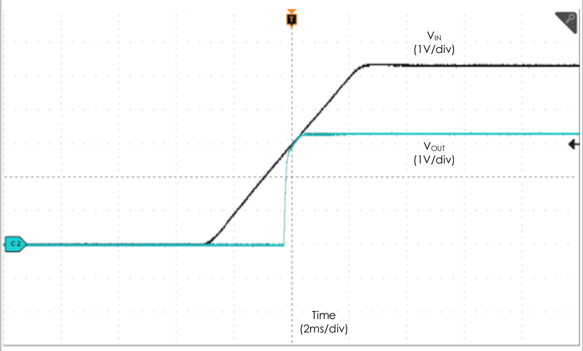
V_{OUT} Short to GND



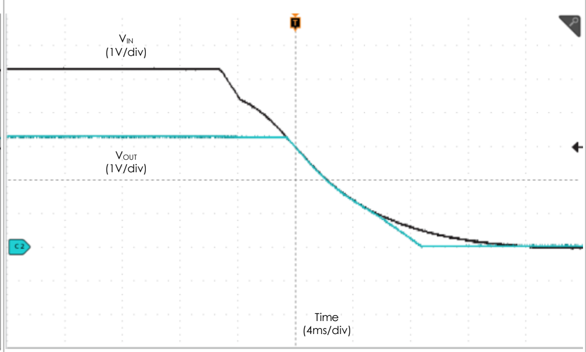
PSRR vs. Frequency (V_{IN}=4.3V)



V_{IN} Power up



V_{IN} Power Off



Application Information

Output Capacitor

The EHP8042 is specially designed for use with ceramic output capacitors of as low as 1μF to take advantage of the savings in cost and space as well as the superior filtering of high frequency noise. Capacitors of higher value or other types may be used, but it is important to make sure its equivalent series resistance (ESR) is restricted to less than 0.5Ω. The use of larger capacitors with smaller ESR values is desirable for applications involving large and fast input or output transients, as well as for situations where the application systems are not physically located immediately adjacent to the battery power source. Typical ceramic capacitors suitable for use with the EHP8042 are X5R and X7R. The X5R and the X7R capacitors are able to maintain their capacitance values to within ±20% and ±10%, respectively, as the temperature increases.

Input Capacitor

A minimum input capacitance of 1μF is required for EHP8042. The capacitor value may be increased without limit. Improper workbench set-ups may have adverse effects on the normal operation of the regulator. A case in point is the instability that may result from long supply lead inductance coupling to the output through the gate capacitance of the pass transistor. This will establish a pseudo LCR network, and is likely to happen under high current conditions or near dropout. A 10μF tantalum input capacitor will dampen the parasitic LCR action thanks to its high ESR. However, cautions should be exercised to avoid regulator short-circuit damage when tantalum capacitors are used, for they are prone to fail in short-circuit operating conditions.

Power Dissipation and Thermal Shutdown

Thermal overload results from excessive power dissipation that causes the IC junction temperature to increase beyond a safe operating level. The EHP8042 relies on dedicated thermal shutdown circuitry to limit its total power dissipation. An IC junction temperature T_J exceeding 140°C will trigger the thermal shutdown logic, turning off the P-channel MOS pass transistor. The pass transistor turns on again after the junction cools off by about 20°C. When continuous thermal overload conditions persist, this thermal shutdown action then results in a pulsed waveform at the output of the regulator. The concept of thermal resistance θ_{JA} (°C/W) is often used to describe an IC junction's relative readiness in allowing its thermal energy to dissipate to its ambient air. An IC junction with a low thermal resistance is preferred because it is relatively effective in dissipating its thermal energy to its ambient, thus resulting in a relatively low and desirable junction temperature. The relationship between θ_{JA} and T_J is as follows:

$$T_J = \theta_{JA} \times (P_D) + T_A$$

T_A is the ambient temperature, and P_D is the power generated by the IC and can be written as:

$$P_D = I_{OUT} (V_{IN} - V_{OUT})$$

As the above equations show, it is desirable to work with ICs whose θ_{JA} values are small such that T_J does not increase strongly with P_D. To avoid thermally overloading the EHP8042, refrain from exceeding the recommended maximum junction temperature rating of 125°C under continuous operating conditions. Overstressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Maximum power dissipation for the device is calculated using the following equation:

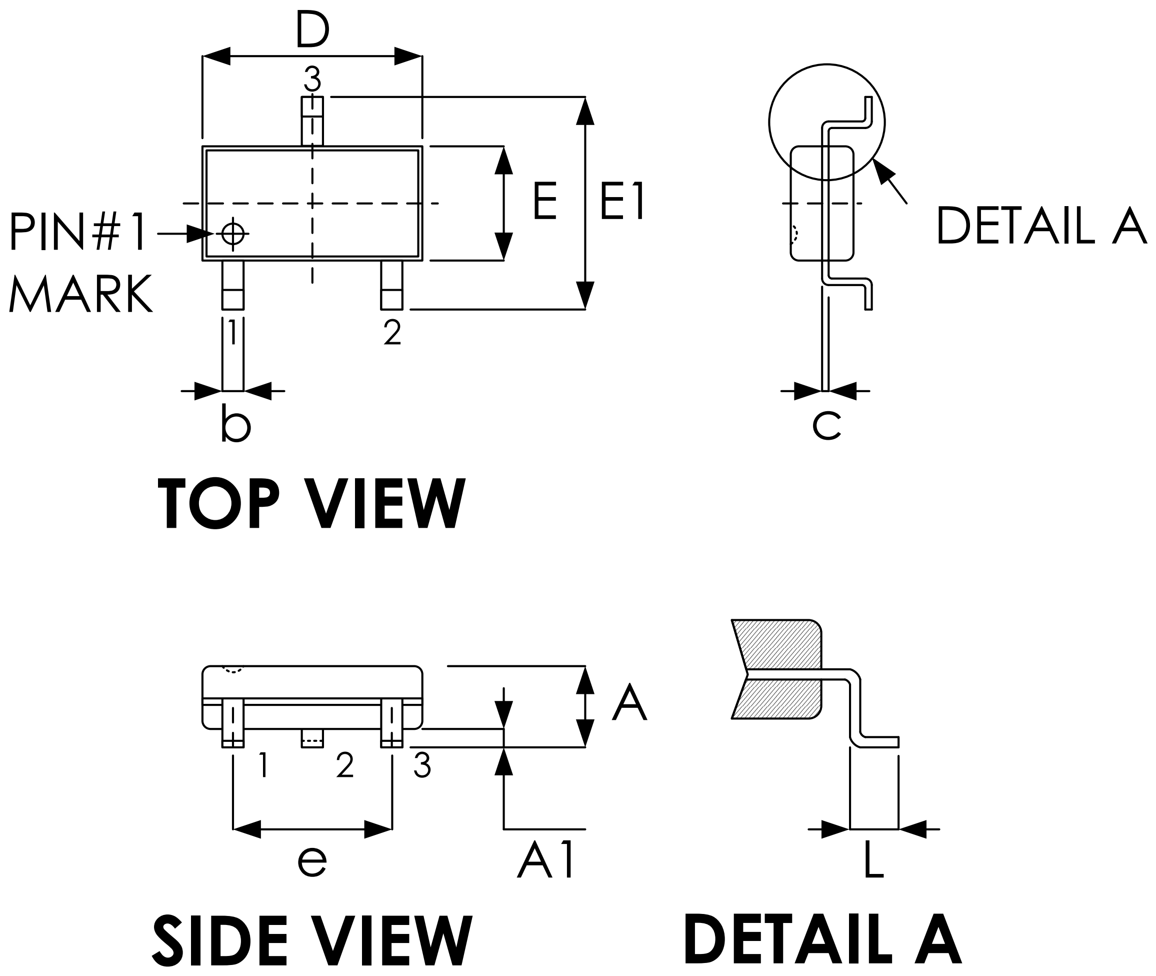
$$PD = \frac{\mathrm{TJ(max)} - \mathrm{TA}}{\mathrm{\Theta JA}}$$

Where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction-to-ambient thermal resistance. For example,

- SOT-23-3 package, θ_{JA}=250°C/W, $T_{J(MAX)}$=125°C and using T_A=25°C, the maximum power dissipation is 0.4W.
- SOT-23-5 package, θ_{JA}=152°C/W, $T_{J(MAX)}$=125°C and using T_A=25°C, the maximum power dissipation is 0.65W.
- SOT-89-3 package, θ_{JA}=90°C/W, $T_{J(MAX)}$=125°C and using T_A=25°C, the maximum power dissipation is 1.1W.
- uDFN1x1-4 package, θ_{JA}=110°C/W, $T_{J(MAX)}$=125°C and using T_A=25°C, the maximum power dissipation is 0.9W.

Package Outline Drawing

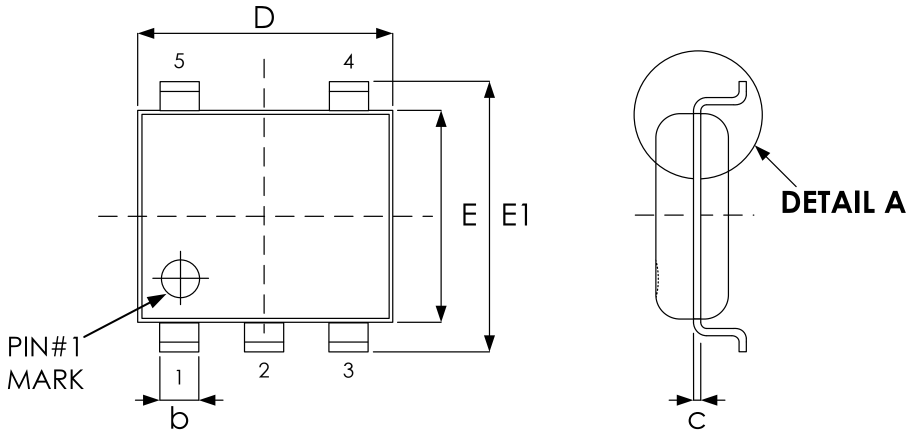
SOT-23-3



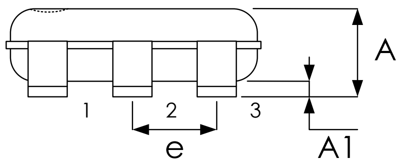
Symbol	Dimension in mm	
	Min.	Max.
A	0.90	1.45
A1	0.00	0.15
b	0.30	0.50
c	0.08	0.25
D	2.70	3.10
E	1.40	1.80
E1	2.60	3.00
e	1.90 BSC	
L	0.30	0.60

Package Outline Drawing

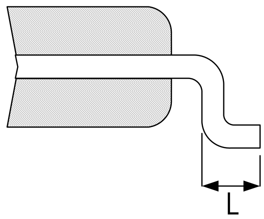
SOT-23-5



TOP VIEW



SIDE VIEW

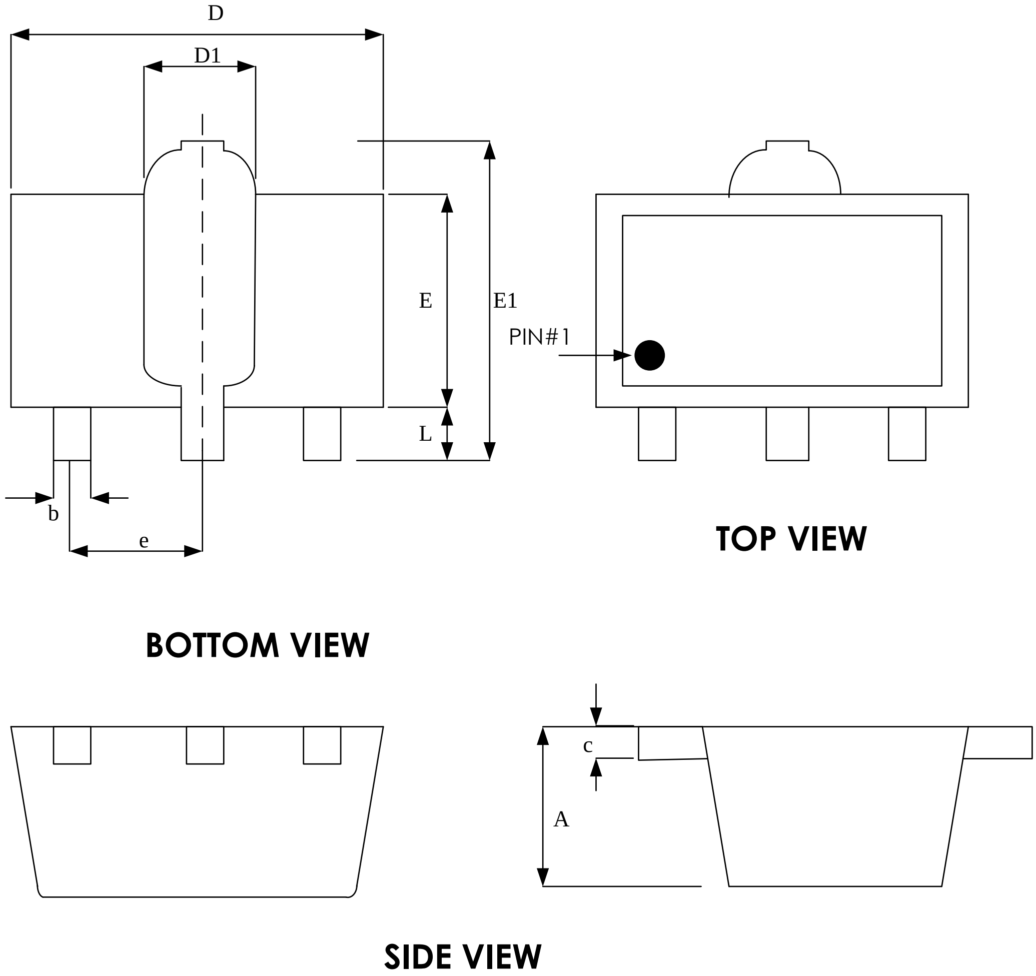


DETAIL A

Symbol	Dimension in mm	
	Min.	Max.
A	0.90	1.45
A1	0.00	0.15
b	0.30	0.50
c	0.08	0.25
D	2.70	3.10
E	1.40	1.80
E1	2.60	3.00
e	0.95 BSC	
L	0.30	0.60

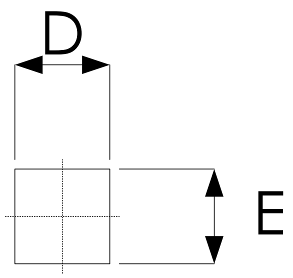
Package Outline Drawing

SOT-89-3

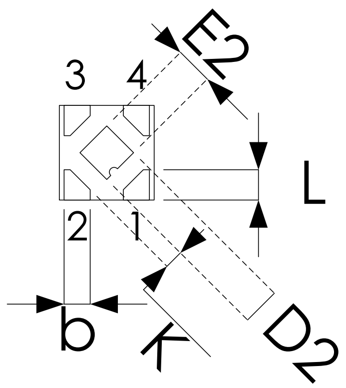


Symbol	Dimension in mm	
	Min	Max
A	1.4	1.6
b	0.4	0.56
c	0.35	0.41
D	4.4	4.6
D1	1.5	1.83
E	2.29	2.6
E1	3.94	4.25
e	1.50 BSC	
L	0.89	1.2

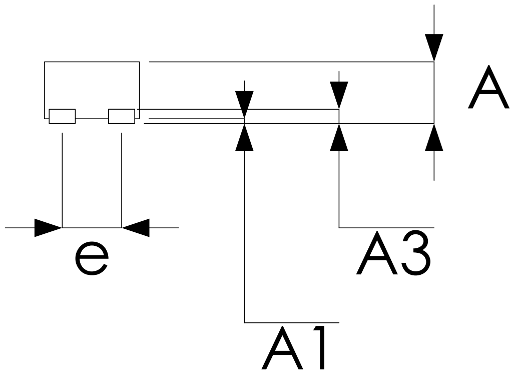
Package Outline Drawing
uDFN-4 (1mm x 1mm)



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Symbol	Dimension in mm	
	Min	Max
A	0.35	0.60
A1	0.00	0.05
A3	0.12 REF.	
b	0.175	0.275
D	1.00 BSC	
E	1.00 BSC	
e	0.65 BSC	
L	0.20	0.30
K	0.20 REF.	

Exposed pad

	Dimension in mm	
	Min	Max
D2	0.40	0.60
E2	0.40	0.60

Revision History

Revision	Date	Description
1.0	2025.05.27	Original
1.1	2025.09.17	Add Vout=3.0V
1.2	2026.01.20	Add dropout voltage when Io=10mA, 50mA

Important Notice

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