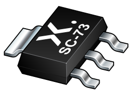


NEX94215-Q100

150 mA, 40 V low-dropout voltage regulator

Rev. 1 — 15 October 2025 Product data sheet

1. General description

The NEX94215-Q100 device is a Low-Dropout (LDO) linear regulator with fixed output voltage of 3.3 V or 5 V which can supply loads up to 150 mA. The device supports a wide input voltage range from 4 V to 40 V (up to 45 V transient) to withstand cold-cranking and load-dump transient conditions.

The device integrates multiple protection features. When configured as a power supply for off-board components (e.g., sensors) with external cables, the built-in short-to-battery and reverse polarity protections (-42 V) safeguard the system against harness failures.

The device employs a back-to-back PMOS topology to block reverse current without requiring an external diode. The device also supports current-limit protection to protect against output short-to-ground or overloading conditions that will eventually trigger thermal shutdown if shorting or overloading lasts long.

The device switches to standby mode by pulling down the EN pin, which enables an ultra-low shutdown current of 0.65 µA typical to extend battery life.

It operates across an ambient temperature range from -40 °C to 125 °C, and a junction temperature range from -40 °C to 150 °C.

Additionally, this device is available in SOT223 package.

Table 1. Device information

Part number	Package	Body size (nom)
NEX94215ADG-Q100	SOT223	6.5 mm x 3.5 mm
NEX94215BDG-Q100		

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Ambient temperature (T_{amb}): -40 °C to 125 °C
  - Junction temperature (T_j): -40 °C to 150 °C
- Input voltage range: 4 V to 40 V
  - Absolute maximum input range: -42 V to 45 V
- Output voltage range: 3.3 V and 5 V (fixed)
  - Absolute maximum output range: -1 V to 45 V
- Output voltage accuracy: ±1.5% (max)
- Maximum output current: 150 mA
- Low dropout voltage:
  - 320 mV typical at 150 mA (V_{OUT} = 5 V)
- Low quiescent current (I_Q):
  - 40 µA typical quiescent current at light loads
  - 0.65 µA typical shutdown current
- Active output discharge with a typical discharge current of 800 µA
- Stable with a wide range of ceramic output-stability cap:
  - ESR from 0.001 Ω to 5 Ω; output capacitor from 2.2 µF to 470 µF
- Integrated fault protection features:
  - Reverse polarity on input
  - Short-to-battery protection on output
  - Reverse current protection
  - Short-circuit and overcurrent protection
  - Thermal shutdown
- Package: 4-pin SOT223
  - $R_{\theta JA}$ = 106.4 °C/W

3. Applications

- Power supplies for off-board sensors
- Powertrain of electric vehicles (EV) and hybrid electric vehicles (HEV)
- Body control modules (BCMs)
- Automotive head units & clusters

4. Ordering information

Table 2. Ordering information

Type number	Temperature range (T_j)	Name	Description	Version
NEX94215ADG-Q100	-40 °C to 150 °C	SOT223	plastic surface-mounted package with increased heatsink; 4 leads	SOT223
NEX94215BDG-Q100				

5. Marking

Table 3. Marking codes

Type number	Marking code
NEX94215ADG-Q100	N9215A
NEX94215BDG-Q100	N9215B

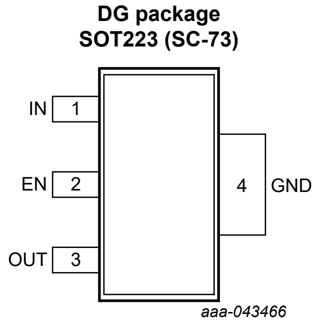
6. Device comparison

Table 4. Device comparison

Type number	Package	Output voltage
NEX94215ADG-Q100	SOT223	3.3 V
NEX94215BDG-Q100	SOT223	5 V

7. Pin configuration and description

7.1. Pin configuration



7.2. Pin description

Table 5. Pin description

Symbol	Pin	I/O	Description
IN	1	I	Input power-supply voltage pin. Place a small ceramic capacitor as close to the input of the device as possible to reduce line interference.
EN	2	I	Enable logic pin, high level is enabled, low level is disabled.
OUT	3	O	Output voltage pin. Place a capacitor as close to the output of the device as possible, follow the capacitance and ESR requirements described in Table 9.
GND	4	G	Ground pin. This pin is connected to ground internally.

8. Limiting values

Table 6. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to ground (ground = 0 V).[1]

Symbol	Parameter	Min	Max	Unit
V_{IN}	input voltage	-42	45	V
V_{EN}	enable voltage	-42	45	V
V_{OUT}	output voltage	-1	45	V
T_{amb}	ambient temperature	-40	125	°C
T_j	junction temperature	-40	150	°C
T_{stg}	storage temperature	-65	165	°C

[1] Stresses beyond those conditions under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

9. ESD ratings

Table 7. ESD ratings

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{ESD}	electrostatic discharge voltage	HBM: ANSI/ESDA/JEDEC JS-001 class 3A [1]	-4000	-	4000	V
		CDM: ANSI/ESDA/JEDEC JS-002 class C3 [2]	-1000	-	1000	V

[1] HBM stress testing was performed in accordance with AEC-Q100-002.
[2] CDM stress testing was performed in accordance with AEC-Q100-011.

10. Thermal information

Table 8. Thermal information

Thermal resistance according to JEDEC51-5 and -7.

Symbol	Parameter	SOT223 (SC-73)	Unit
$R_{θJA}$	junction to ambient thermal resistance	106.4	°C/W
$R_{θJC(top)}$	junction to case (top) thermal resistance	63.2	°C/W
$R_{θJB}$	junction to board thermal resistance	20.6	°C/W
$Ψ_{JT}$	junction to top char parameter	9.5	°C/W

11. Recommended operating conditions

Table 9. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IN}	input voltage		4	-	40	V
I_{OUT}	output current	[1]	-	-	150	mA
V_{EN}	enable voltage		0	-	40	V
C_{IN}	input capacitance		-	1	-	µF
C_{OUT}	output capacitance	[2]	2.2	-	470	µF
ESR	output capacitor ESR requirements	[3]	0.001	-	5	Ω
T_{amb}	ambient temperature		-40	-	125	°C
T_j	junction temperature		-40	-	150	°C

[1] Maximum output current when device is not thermal shutdown.
[2] The minimum valid output capacitance should be larger than 1.4 µF in worse cases.
[3] ESR shall be measured at 10 kHz. For capacitors with larger ESR, like ESR > 1 Ω, decouple with a 100 nF ceramic capacitor to improve transient response.

12. Electrical characteristics

Table 10. Electrical characteristics

At recommended operating conditions; T_j = -40 °C to 150 °C; V_{IN} = 13.5 V; C_{IN} = 1 µF; C_{OUT} = 4.7 µF; and V_{EN} = 2 V; unless otherwise noted, voltages are referenced to GND (ground = 0 V).

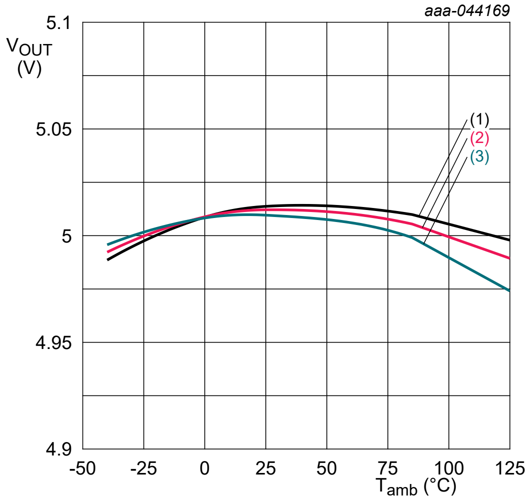
Symbol	Parameter	Conditions		T_{amb} = -40 °C to 125 °C		Unit
			Min	Typ[1]	Max	
Power supply						
$V_{IN(UVLO)}$	under voltage lockout threshold	V_{IN} rising		3.4	3.6	3.9	V
		V_{IN} falling		3.0	3.2	3.4	V
		hysteresis		-	400	-	mV
I_Q	quiescent current	V_{IN} = V_{OUT} + 500 mV (V_{IN} ≥ 4 V) to 40 V		-	40	70	µA
I_{GND}	ground current	I_{OUT} = 150 mA		-	-	1	mA
I_{SHUT}	shutdown current	V_{IN} = 4 V to 40 V; V_{EN} = 0 V; T_j = -40 °C to 125 °C		-	0.65	3	µA
		V_{IN} = 4 V to 40 V; V_{EN} = 0 V; T_j = -40 °C to 150 °C		-	0.65	6	µA
$I_{R(IN)}$	reverse current at V_{IN}	V_{IN} = 0 V; V_{OUT} = 20 V; V_{EN} = 5 V		-1	-	0	µA
$I_{R(-IN)}$	reverse current at negative input voltage	V_{IN} = -20 V; V_{OUT} = 0 V; V_{EN} = 5 V		-5	-	0	µA
Enable input (EN)						
V_{EN_L}	logic input low level			-	-	0.7	V
V_{EN_H}	logic input high level			2	-	-	V
I_{EN}	EN pin current	V_{EN} = 5 V		-	-	5	µA
Output						
V_{OUT}	output accuracy	V_{IN} = 4.5 V to 40 V (V_{OUT} = 3.3 V); V_{IN} = 6 V to 40 V (V_{OUT} = 5 V); I_{OUT} = 100 µA to 150 mA		-1.5	-	1.5	%
$\Delta V_{OUT(\Delta V_{IN})}$	line regulation	V_{IN} = 4.5 V to 40 V (V_{OUT} = 3.3 V); V_{IN} = 6 V to 40 V (V_{OUT} = 5 V)		-	-	10	mV
$\Delta V_{OUT(\Delta I_{OUT})}$	load regulation	V_{IN} = 13.5 V; I_{OUT} = 100 µA to 150 mA		-	-	1	%
V_{DO}	dropout voltage	V_{OUT} = 3.3 V; I_{OUT} = 150 mA		-	380	620	mV
		V_{OUT} = 5 V; I_{OUT} = 150 mA		-	320	530	
I_{OUT}	output current	V_{IN} = V_{OUT} + 1 V		-	-	150	mA
I_{DIS}	discharge current	V_{IN} = 13.5 V; V_{OUT} = 5 V		-	800	-	µA
I_{CL}	output current limit	V_{IN} = V_{OUT} + 1 V; V_{OUT} short to 90% x V_{OUT}		180	240	300	mA
PSRR	power-supply ripple rejection	V_{IN} = 13.5 V; I_{OUT} = 10 mA; C_{OUT} = 4.7 µF; frequency = 100 Hz	[2]	-	85	-	dB
Operating temperature range						
T_{SD}	junction thermal shutdown temperature	rising junction temperature	[2]	-	175	-	°C
T_{HYS}	thermal shutdown hysteresis		[2]	-	20	-	°C

[1] All typical values are measured at T_{amb} = 25 °C.
[2] Guaranteed by design and bench test, not fully tested in production.

13. Typical characteristics

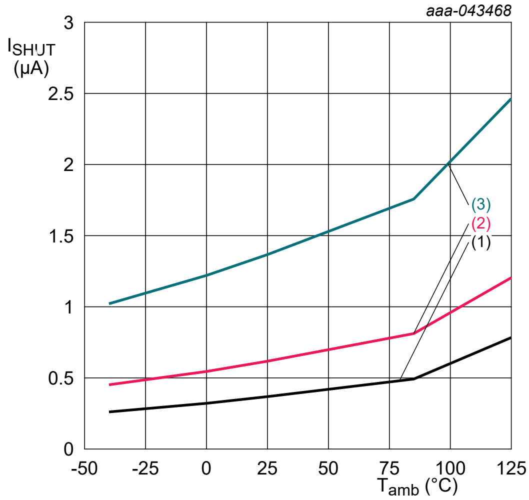
At recommended operating conditions, voltages are referenced to GND (ground = 0 V); typical values are at 25°C (unless otherwise noted).

V_{IN} = 13.5 V, V_{EN} ≥ 2 V, C_{IN} = 1 µF, C_{OUT} = 4.7 µF, V_{OUT} = 5 V, T_{amb} = -40 °C to 125 °C, T_j = -40 °C to 150 °C, unless otherwise specified.



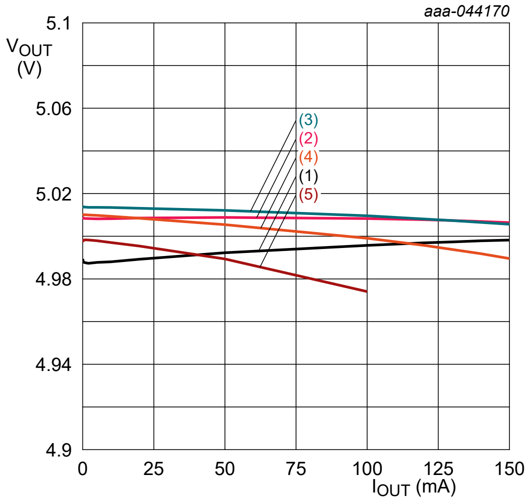
V_{OUT} = 5 V
(1) I_{OUT} = 100 µA
(2) I_{OUT} = 50 mA
(3) I_{OUT} = 100 mA

Fig. 1. Output voltage vs ambient temperature



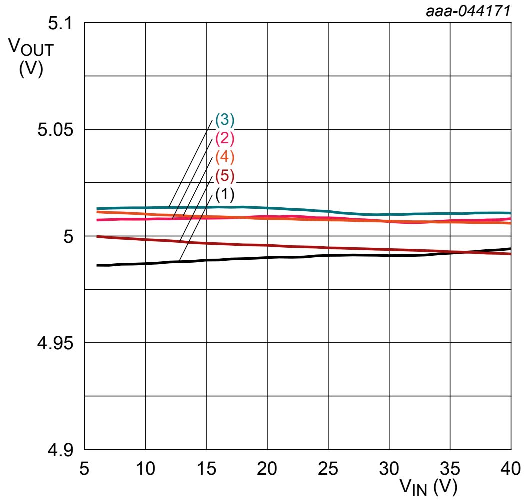
(1) V_{IN} = 4 V
(2) V_{IN} = 13.5 V
(3) V_{IN} = 40 V

Fig. 2. Shutdown current vs ambient temperature



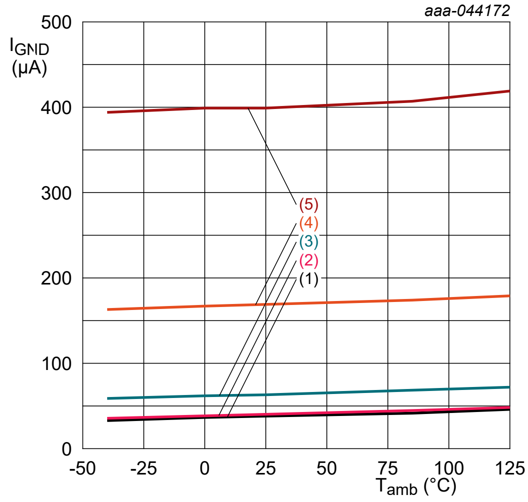
V_{IN} = 13.5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 0 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = 85 °C
(5) T_{amb} = 125 °C

Fig. 3. Load regulation



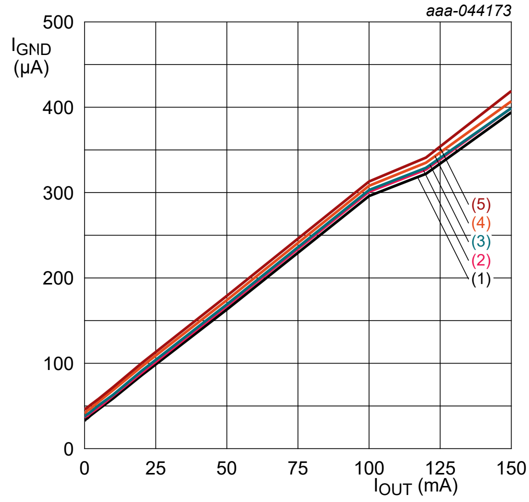
I_{OUT} = 10 mA
(1) T_{amb} = -40 °C
(2) T_{amb} = 0 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = 85 °C
(5) T_{amb} = 125 °C

Fig. 4. Line regulation



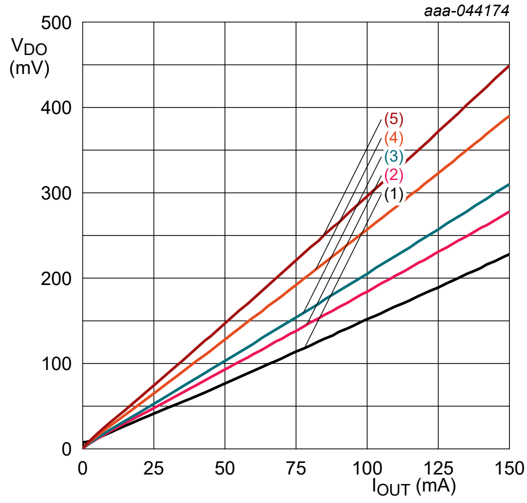
(1) I_{OUT} = 100 µA
(2) I_{OUT} = 1 mA
(3) I_{OUT} = 10 mA
(4) I_{OUT} = 50 mA
(5) I_{OUT} = 150 mA

Fig. 5. Ground current vs ambient temperature



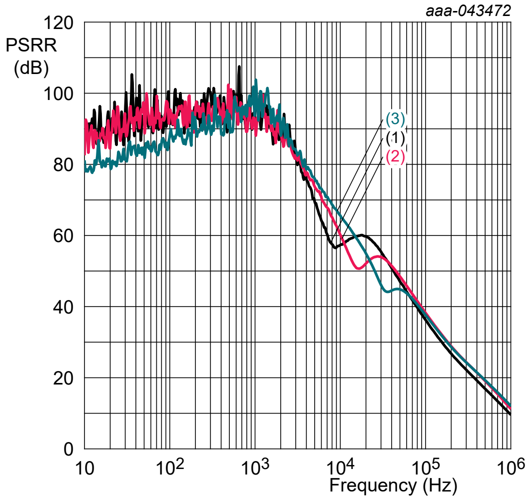
(1) T_{amb} = -40 °C
(2) T_{amb} = 0 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = 85 °C
(5) T_{amb} = 125 °C

Fig. 6. Ground current vs output current



V_{OUT} = 5 V
(1) T_{amb} = -40 °C
(2) T_{amb} = 0 °C
(3) T_{amb} = 25 °C
(4) T_{amb} = 85 °C
(5) T_{amb} = 125 °C

Fig. 7. Dropout voltage vs output current



V_{IN} = 13.5 V; C_{OUT} = 4.7 µF
(1) I_{OUT} = 1 mA
(2) I_{OUT} = 10 mA
(3) I_{OUT} = 100 mA

Fig. 8. PSRR vs frequency

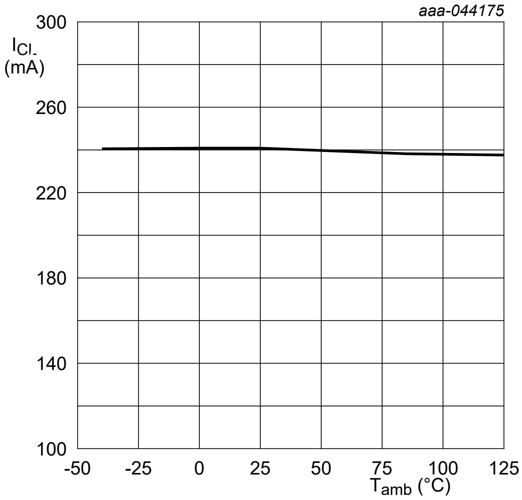
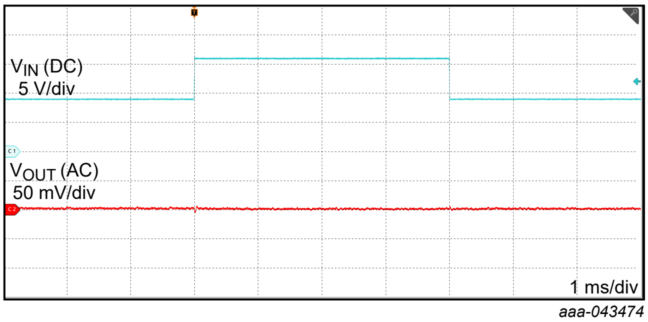
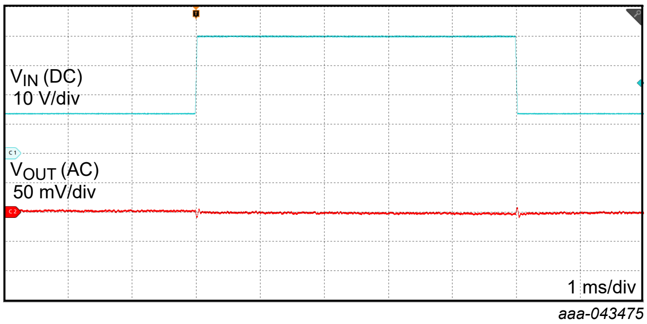


Fig. 9. Current limit vs ambient temperature



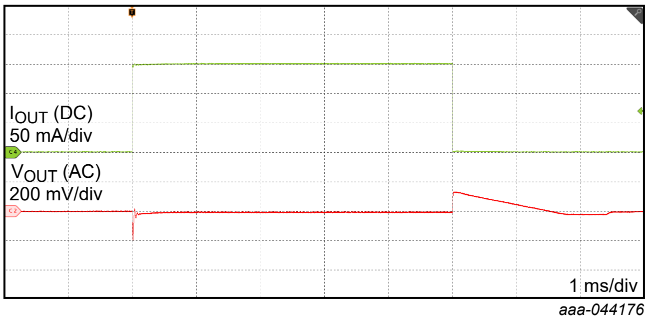
V_{IN} = 9 V to 16 V; slew rate = 1 V/μs;
V_{OUT} = 5 V; I_{OUT} = 150 mA; C_{OUT} = 10 μF

Fig. 10. Line transient



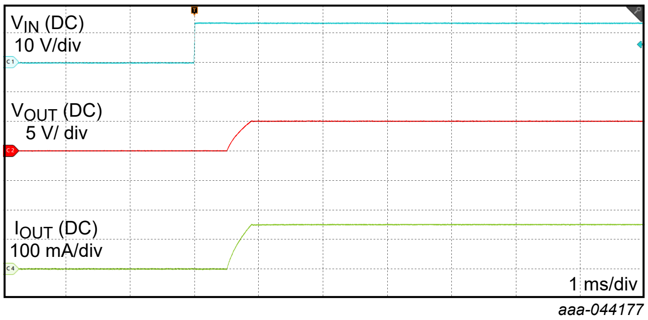
V_{IN} = 13.5 V to 40 V; slew rate = 1 V/μs;
V_{OUT} = 5 V; I_{OUT} = 150 mA; C_{OUT} = 10 μF

Fig. 11. Line transient



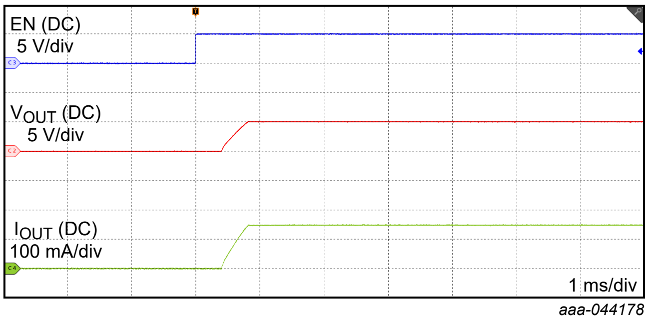
V_{IN} = 13.5 V; I_{OUT} = 0 mA to 150 mA;
slew rate = 1 A/μs; V_{OUT} = 5 V; C_{OUT} = 10 μF

Fig. 12. Load transient



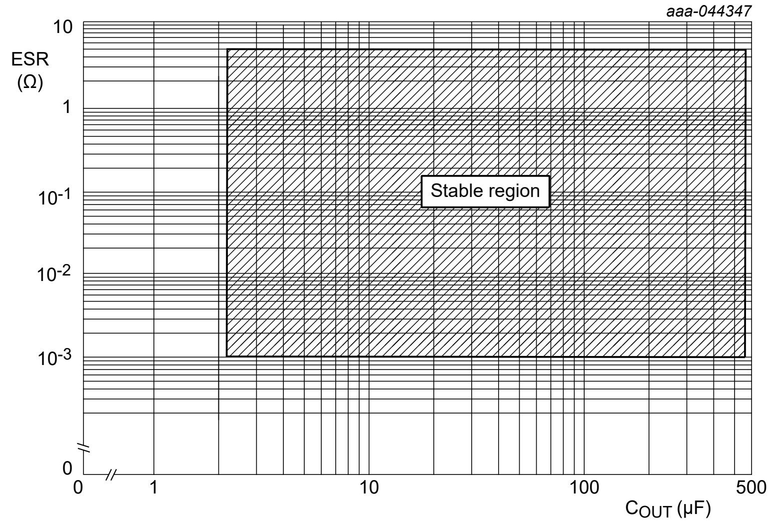
V_{EN} = 5 V; V_{IN} from 0 V to 13.5 V;
V_{OUT} = 5 V; I_{OUT} = 150 mA; C_{OUT} = 10 μF

Fig. 13. Start up by VIN



V_{IN} = 13.5 V; V_{EN} from 0 V to 5 V;
V_{OUT} = 5 V; I_{OUT} = 150 mA; C_{OUT} = 10 μF

Fig. 14. Start up by EN



1 mΩ ≤ ESR ≤ 5 Ω; 2.2 µF ≤ C_{OUT} ≤ 470 µF

Fig. 15. Stability, ESR vs C_{OUT}

14. Detailed description

14.1. Overview

The NEX94215-Q100 is a Low-Dropout (LDO) linear regulator designed to connect to batteries in automotive applications. The device has an input voltage range extending to 40 V (45 V max), which allows the device to withstand transients (such as load dump) that are anticipated in automotive systems.

The device has only a 40 µA typical quiescent current at light load and 0.65 µA typical shutdown current under disabled mode. The device offers multiple protection features, including reverse polarity protection and safeguarding against shorting to the battery and ground.

14.2. Function block diagram

The NEX94215-Q100 function block diagram is shown in Fig. 16.

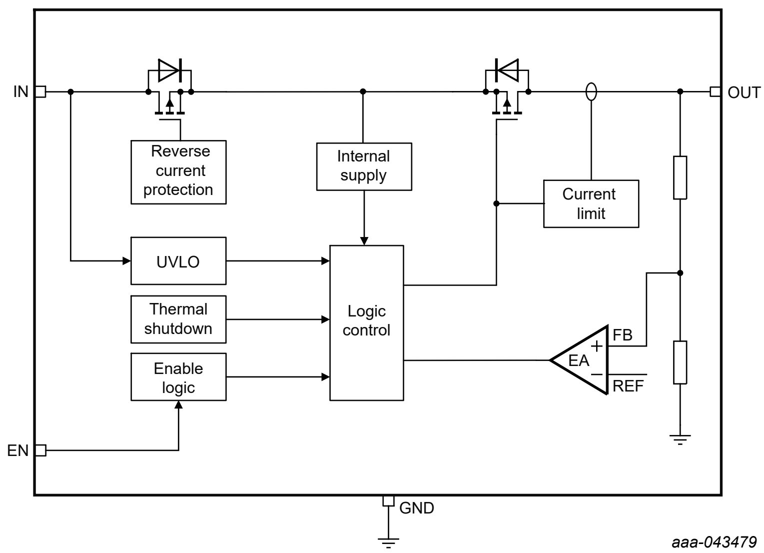


Fig. 16. NEX94215-Q100 function block diagram

14.3. Feature description

14.3.1. Device enable (EN)

The enable pin is a high-voltage-tolerant pin. A high input on EN activates the device and turns on the regulator. Connect this pin to an external Microcontroller Unit (MCU) or a digital circuit to enable and disable the device or connect it to the IN pin for self-bias applications.

14.3.2. Undervoltage lockout (UVLO)

An undervoltage lockout (UVLO) circuit is to stop the operation of the device when the input voltage drops below the typical falling threshold $V_{IN\ (UVLO)}$.

To prevent the device from turning off when the input drops during turn-on, check the hysteresis values of UVLO specified in the Electrical Characteristics table beforehand.

If the input voltage has a negative transient that drops below the UVLO threshold and recovers, the regulator shuts down and powers up with a normal power-up sequence when the input voltage is above the required level.

14.3.3. Current limit operation

The device has an internal current limit circuit that protects the regulator during transient high-load current faults or shorting events.

When a current limit event occurs, the device begins to heat up because of the increase in power dissipation. When the device achieves the current limit I_{CL}, the pass transistor dissipates power [(V_{IN} – V_{OUT}) x I_{CL}].

If a thermal shutdown is triggered, the device turns off. After the device cools down, the internal thermal shutdown circuit turns the device back on. If the output current fault continues, the device cycles between the current limit and thermal shutdown.

14.3.4. Thermal protection

The NEX94215-Q100 is integrated with an internal temperature sensor to monitor internal junction temperature (T_j). If T_j exceeds the thermal shutdown temperature T_{SD} at 175 °C, the device stops working. When T_j drops below the hysteresis level of typical 20 °C, the device starts operating again.

Thermal shutdown might be triggered during start-up due to large inrush current charging large output capacitance, or high (V_{IN} – V_{OUT}) regulations under heavy loads due to large power dissipation across the die. Proper heat sinking needs to be considered under these high power dissipation conditions.

14.3.5. Output short-to-battery and reverse protection

The NEX94215-Q100 employs a back-to-back PMOS topology to protect the device from damage during fault conditions where V_{OUT} exceeds V_{IN}, effectively blocking reverse current flow. The device remains undamaged as long as it operates within the range described in Limiting values. This integrated protection eliminates the requirement for an external diode.

The NEX94215-Q100 survives, and no damage occurs to the device when the output is shorted to the battery as shown in Fig. 17. And a shorting to battery might also occur when the device is powered by a lower separated input voltage supply as shown in Fig. 18. In this case, the NEX94215-Q100 input supply is set at 9 V when a shorting to battery (13.5 V typical) occurs on output, which typically runs at 5 V. The continuous reverse current that flows out through the input pin is less than 5 µA.

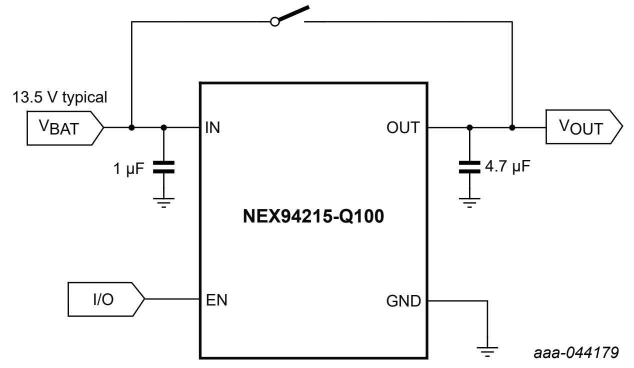


Fig. 17. Output short-to-battery

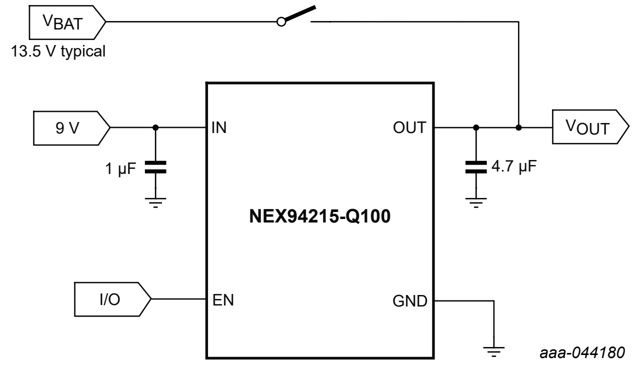


Fig. 18. Output short-to-battery with lower input voltage

14.3.6. Active output discharge

The device incorporates an active output discharge function when enabled, ensuring that the output voltage rapidly returns to its nominal level during overvoltage fluctuations. This is particularly effective during load transients such as heavy-to-light load transitions.

When the output voltage exceeds the nominal level, the device activates a FET that connects a resistor with the resistance value of several thousands of ohms and the ground to achieve active discharge. Under these conditions, the output sources a typical current of 800 µA (at output voltage of 5 V) through this resistance network, even without an external load.

14.4. Device functional modes

14.4.1. Device functional mode comparison

Table 11 shows the conditions that lead to the different modes of operation. See Table 10 for recommended operating conditions.

Table 11. Device functional mode comparison

Operating mode	V_{IN}	V_{EN}	I_{OUT}	T_j
Normal operation	$V_{IN} \geq V_{OUT(nom)} + V_{DO}$ and $V_{IN} \geq V_{IN(min)}$ [1]	$V_{EN} > V_{EN\_H}$	$I_{OUT} \leq I_{OUT(max)}$	$T_j < T_{SD}$
Dropout operation	$V_{IN(min)} \leq V_{IN} < V_{OUT(nom)} + V_{DO}$	$V_{EN} > V_{EN\_H}$	$I_{OUT} \leq I_{OUT(max)}$	$T_j < T_{SD}$
Disabled mode	$V_{IN} < V_{UVLO}$	$V_{EN} < V_{EN\_L}$	Not applicable	$T_j > T_{SD}$

[1] $V_{OUT(nom)}$ is nominal output voltage; $V_{IN(min)}$ is minimum input voltage.

14.4.2. Normal operation

The device works at nominal voltage when all the following conditions are met:

- The output current is less than the current limit.
- The device's junction temperature is less than thermal shutdown temperature.
- The enable pin voltage has previously exceeded the enable rising threshold voltage and has not yet decreased to less than the enable falling threshold.

14.4.3. Dropout operation

The device operates in dropout mode when the input voltage is less than the sum of target output voltage plus the dropout voltage and all other conditions are met for normal operation.

In this mode, the output voltage tracks the input voltage. The transient performance of the device becomes significantly degraded because the pass element is in the ohmic or triode region and acts as a switch. Line or load transients in dropout can result in large output-voltage deviations.

When the input voltage returns to a value greater than or equal to the sum of nominal output voltage plus the dropout voltage [$V_{OUT(nom)}$ + V_{DO}], the output voltage can overshoot for a short period of time while the device pulls the pass element back into the linear region.

14.5. Application implementation

14.5.1. Application information

The following section is a reference to simplify the system design with the NEX94215-Q100 typical application for external components calculation and selection.

14.5.2. Typical application

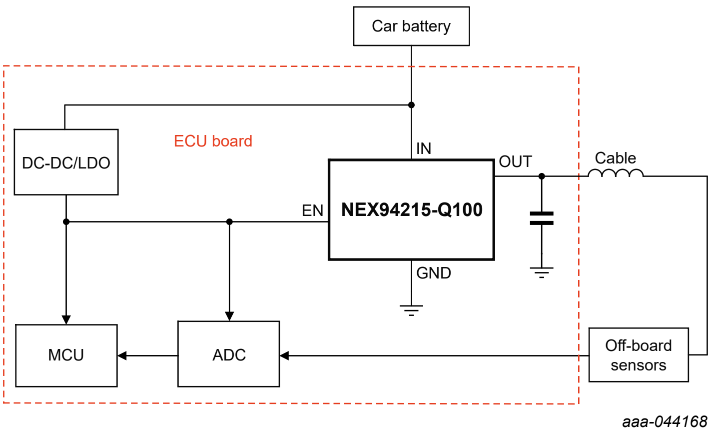


Fig. 19. NEX94215-Q100 typical application

14.5.2.1. Design requirements

A typical application is applied to automotives and power supply for off-board sensors, which normally requires 5 V output. The design parameters are listed in Table 12.

Table 12. Design parameters

Parameters	Values
Input voltage range	6 V to 40 V
Output voltage	5 V
Output current	150 mA max
Input capacitance	10 µF
Output capacitance	10 µF

14.5.2.2. Detailed design procedure

14.5.2.2.1. Input capacitor

The device requires an input decoupling capacitor, the value of which depends on the application. The typical recommended value for the decoupling capacitor is 1 µF. The voltage rating must be greater than the maximum input voltage.

14.5.2.2.2. Output capacitor

To ensure the stability of the NEX94215-Q100, the device requires an output capacitor with a value of 4.7 µF to 470 µF from OUT to GND and the ESR range between 0.001 Ω and 5 Ω. It is recommended to select a ceramic capacitor with low ESR to improve the load transient response and ripple performance.

15. Layout

15.1. Layout guidelines

For best overall performance, the following guidelines are recommended for the LDO layout:

- Place all circuit components on the same side of the circuit board and as near as practical to the respective LDO pin connections.
- Place ground return connections to the input and output capacitor, and to the LDO ground pin as close as possible to each other, connected by a wide, component-side, copper surface.
- The use of vias and long traces to the input and output capacitors is strongly discouraged and negatively affects system performance.
- In most applications, the ground plane is necessary to meet thermal requirements.

A ground reference plane should either be embedded in the PCB itself or located on the bottom side of the PCB opposite the components. This reference plane serves to assure accuracy of the output voltage, shield noise, and behaves similarly to a thermal plane to spread (or sink) the heat from the LDO device when connected to the thermal pad.

15.2. Layout examples

Fig. 20 shows a layout example of NEX94215-Q100 (SOT223) device.

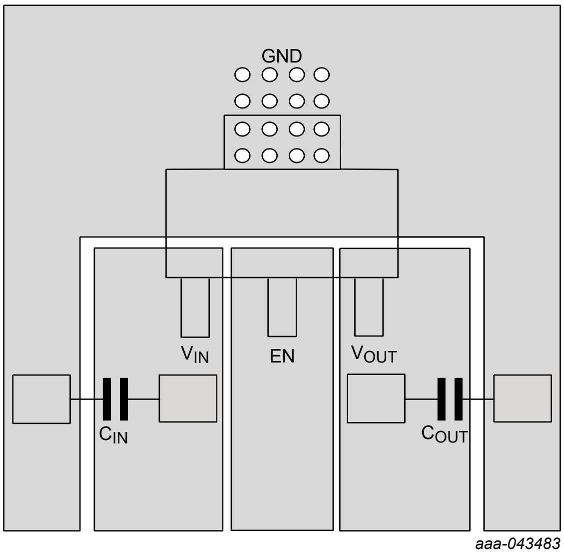
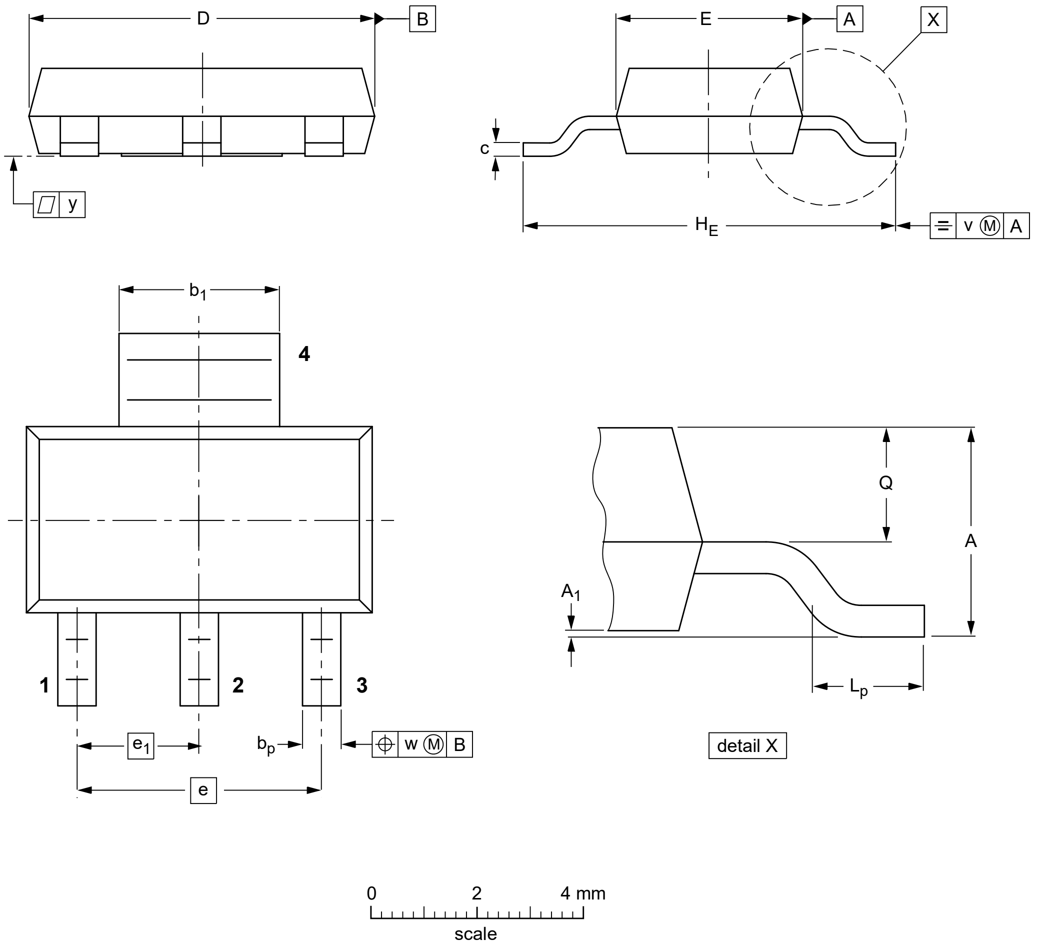


Fig. 20. NEX94215-Q100 layout example

16. Package outline

Plastic surface-mounted package with increased heatsink; 4 leads **SOT223**



DIMENSIONS (mm are the original dimensions)

UNIT	A	A_1	b_p	b_1	c	D	E	e	e_1	H_E	L_p	Q	v	w	y
mm	1.8 1.5	0.10 0.01	0.80 0.60	3.1 2.9	0.32 0.22	6.7 6.3	3.7 3.3	4.6	2.3	7.3 6.7	1.1 0.7	0.95 0.85	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT223			SC-73			~~04-11-10~~ 06-03-16

Fig. 21. Package outline SOT223 (SC-73)

17. Abbreviations

Table 13. Abbreviations

Acronym	Description
AEC	Automotive Electronics Council
ANSI	American National Standards Institute
BCM	Body Control Module
CDM	Charge Device Model
ESD	Electrostatic Discharge
ESDA	ElectroStatic Discharge Association
ESR	Equivalent Series Resistance
EV	Electric Vehicle
FET	Field-Effect Transistor
HBM	Human Body Model
HEV	Hybrid Electric Vehicle
JEDEC	Joint Electron Device Engineering Council
LDO	Low-Dropout
MCU	Microcontroller Unit
PCB	Printed Circuit Board
PG	Power-good
PMOS	P-channel Metal-Oxide-Semiconductor
UVLO	Undervoltage Lockout

18. Revision history

Table 14. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
NEX94215_Q100 v. 1	20251015	Product data sheet	-	-

19. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.
[2] The term 'short data sheet' is explained in section "Definitions".
[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the internet at https://www.nexperia.com.

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