1 A LDO with Power-Good for Automotive Application

Features

- AEC-Q100 qualified:
  - Device ambient temperature: -40°C ≤ T_A ≤ 125°C
  - Device junction temperature: -40°C ≤ T_J ≤ 150°C
- Operating input voltage range: 1.7 V to 6.0 V
- Operating output voltage range:
  - Fixed options: 0.65 V to 5.0 V
  - Adjustable option: 0.55 V to 5.5 V
- High PSRR: 56 dB at 1 kHz
- Open-drain mode power-good output:
  - DIA7986AA/BA
- Adjustable soft-start time:
  - DIA7986AN/BN
- Output accuracy:
  - ±1% at T_A = 25°C
  - ±1.5% at -40°C ≤ T_A ≤ 85°C
  - ±2% at -40°C ≤ T_A ≤ 125°C
- Ultra-low dropout: 220 mV at 1 A, V_{OUT} = 3.3 V
- Low quiescent current:
  - 31 μA typical at no load
  - 100 nA shutdown mode typical current
- Active output discharge: DIA7986A
- Stable with a 1 μF or larger capacitor

Applications

- Telematics control units
- Automotive cluster displays
- Front and rear cameras
- Automotive head units

Package Information

Part Number	Package	Body Size
DIA7986	DFN6	2 mm × 2 mm
	DFN8	3 mm × 3 mm

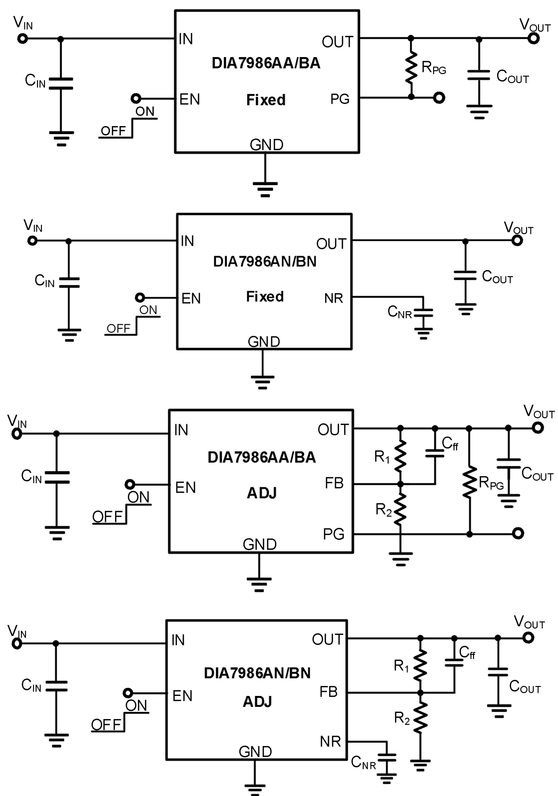
Description

The DIA7986 is a 1 A ultra-low-dropout regulator with power-good function. The DIA7986 is designed for applications requiring low quiescent current and provides fast line and load transient performance. Additionally, DIA7986 features high Power Supply Ripple Rejection (PSRR) at up to 1 A.

The DIA7986 operates with an input voltage range from 1.7 V to 6.0 V and the output voltage is adjustable from 0.55 V to 5.5 V.

The DIA7986 is stable with small ceramic output capacitors, allowing for a small overall solution size. An error amplifier and precision band-gap provide an accuracy of ±2% over temperature. The DIA7986 helps reduce the thermal dissipation during short-circuit events with internal foldback current limit. The device also contains integrated thermal shutdown, current limit, and undervoltage lockout (UVLO) features.

Simplified Schematic



Ordering Information

Ordering Part No.	Top Marking	MSL	Description	RoHS	T_A	Package	
DIA7986AAaaCD6	YWXZ H6AAX	1	Active Discharge	Green	-40 to 125°C	DFN2*2-6	Tape & Reel, 3000
DIA7986ANaaCD8	YWXZ H6ANX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986AAaaCD8	YWXZ H6AAX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986AAADJCD6	YWXZ H6AAX	1		Green	-40 to 125°C	DFN2*2-6	Tape & Reel, 3000
DIA7986ANADJCD8	YWXZ H6ANX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986AAADJCD8	YWXZ H6AAX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986BAaaCD6	YWXZ H6BAX	1	Non-Active Discharge	Green	-40 to 125°C	DFN2*2-6	Tape & Reel, 3000
DIA7986BNaaCD8	YWXZ H6BNX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986BAaaCD8	YWXZ H6BAX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986BAADJCD6	YWXZ H6BAX	1		Green	-40 to 125°C	DFN2*2-6	Tape & Reel, 3000
DIA7986BNADJCD8	YWXZ H6BNX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000
DIA7986BAADJCD8	YWXZ H6BAX	1		Green	-40 to 125°C	DFN3*3-8	Tape & Reel, 3000

Output Voltage Options

Option Code "**aa**"	**08**	**10**	**11**	**12**	**15**	**25**	**28**	**30**	**33**
Voltage	0.8 V	1.0 V	1.1 V	1.2 V	1.5 V	2.5 V	2.8 V	3 V	3.3 V

Marking Definition

H6AAX	H6: Product code; AA: A 150-μs delay open-drain version with discharge feature; X: Voltage code.
H6ANX	H6: Product code; AN: Adjustable soft-start version with discharge feature; X: Voltage code.
H6BAX	H6: Product code; BA: A 150-μs delay open-drain version without discharge feature; X: Voltage code.
H6BNX	H6: Product code; BN: Adjustable soft-start version without discharge feature; X: Voltage code.

Voltage Code

Option Code "X"	C	D	E	F	G	J	K	L	M	Q
Voltage	0.8 V	1.0 V	1.1 V	1.2 V	1.5 V	2.5 V	2.8 V	3 V	3.3 V	ADJ

If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

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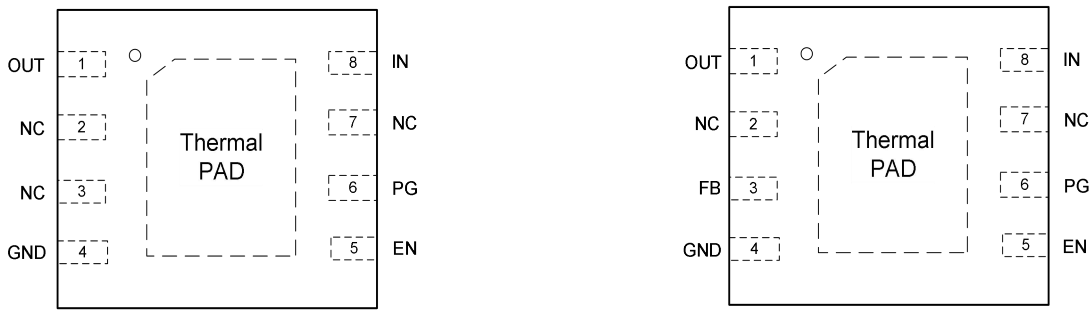
1. Pin Assignment and Functions

Fixed

Adjustable

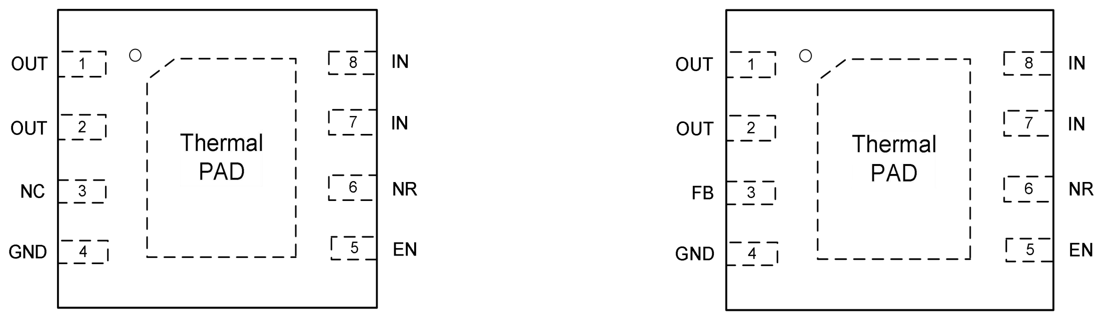
*Figure 1. DFN2*2-6 (Top view)*



Fixed

Adjustable

*Figure 2. DFN3*3-8 (Top view)*



Fixed

Adjustable

*Figure 3. DFN3*3-8 (Top view)* (1)

Note:

(1) Only for adjustable soft-start version (DIA7986AN/BN).

Table 1. Pin description

Pin Name	Description
EN	Enable pin. Drive EN greater than $V_{EN(HI)}$ to turn on the regulator. Drive EN less than $V_{EN(LO)}$ to put the low-dropout regulator (LDO) into shutdown mode.
FB	This pin is used as an input to the control loop error amplifier and is used to set the output voltage of the LDO.
GND	Ground pin.
IN	Input pin. For best transient response and to minimize input impedance, use the recommended value or larger ceramic capacitor from IN to ground as listed in the Recommended Operating Conditions table. Place the input capacitor as close to the output of the device as possible.
NC	No internal connection. Ground this pin for better thermal performance.
OUT	Regulated output voltage pin. A capacitor is required from OUT to ground for stability. For best transient response, use the nominal recommended value or larger ceramic capacitor from OUT to ground; Place the output capacitor as close to the output of the device as possible.
PG	Power-good output. Available in open-drain topologies. A pull-up resistor is only required for the open-drain type. For the open-drain version (DIA7986AA/BA), if the power-good functionality is not being used, ground this pin or leave floating.
NR	Connect an external capacitor between this pin and ground to reduce the output noise to very low levels. The capacitor slows down the V_{OUT} ramp as well (soft -start). Max recommended C_{NR} value is 0.47 μF.
Thermal Pad	The thermal pad is left floating. Connect to the GND plane for improved thermal performance.

2. Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Rating” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maxim rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Rating	Unit
V_{IN}	Supply voltage	-0.3 to 6.6	V
V_{EN}	Enable voltage	-0.3 to 6.6	
V_{FB}	Feedback voltage	-0.3 to 2	
V_{PG}	Power-good voltage	-0.3 to 6.6	
V_{OUT}	Output voltage	-0.3 to V_{IN} + 0.3 (1)	
I_{OUT}	Output current	Internally limited	
I_{PG}	Power-good current	-10 to 10	mA
T_J	Operating junction temperature	-40 to 150	°C
T_{STG}	Storage temperature	-65 to 150	

Note:

(1) The absolute maximum rating is V_{IN} + 0.3 V or 6.0 V, whichever is smaller.

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter		Rating	Unit
V_{IN}	Input voltage		1.7 to 6	V
V_{OUT}	Output voltage	Adjustable only	0.55 to 5.5	V
		Fixed only	0.65 to 5	V
I_{OUT}	Output current		0 to 1	A
C_{IN}	Input capacitor		≥1	μF
C_{OUT}	Output capacitor (1)		1 to 220	μF
C_{FF}	Feed-forward capacitor		10	nF
V_{EN}	Enable voltage		0 to 6	V
V_{PG}	PG voltage		0 to 6	V
T_J	Junction operating temperature		-40 to 150	°C

Note:

(1) Minimum derated capacitance of 0.47 μF is required for stability.

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition	Value	Unit
Human-body model	ANSI/ESDA/JEDECJS-001	±4000	V
Charged-device model	ANSI/ESDA/JEDECJS-002	±2000	V

5. Electrical Characteristics

At operating temperature range (T_A = -40°C to 125°C), $V_{IN} = V_{OUT(NOM)} + V_{DO}$ or 1.7 V (whichever is greater), I_{OUT} = 1 mA, $V_{EN} = V_{IN}$, and $C_{IN} = C_{OUT}$ = 1 µF, unless otherwise noted; all typical values are at T_A = 25°C.

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_{FB}	Feedback voltage	Adjustable only			0.55		V
	Output accuracy (1)	T_A = 25°C		-1		1	%
		-40°C ≤ T_A ≤ 85°C		-1.5		1.5	%
		-40°C ≤ T_A ≤ 125°C		-2.0		2.0	%
	Line regulation	$V_{OUT(NOM)} + V_{DO} \le V_{IN}$ (2) ≤ 6.0 V			2	7.5	mV
	Load regulation	0.1 mA ≤ I_{OUT} ≤ 1 A, V_{IN} ≥ 2.0 V			0.03		V/A
I_Q	Quiescent current	I_{OUT} = 0 mA	T_A = 25°C		31	40	µA
			-40°C ≤ T_A ≤ 125 °C		31	45	µA
I_{SHDN}	Shutdown current	V_{EN} ≤ 0.3 V, 1.7 V ≤ V_{IN} ≤ 6.0 V -40°C ≤ T_A ≤ 125°C			0.1	1	µA
I_{FB}	Feedback pin current	Adjustable only			0.01	0.1	µA
I_{CL}	Output current limit	$V_{OUT(NOM)}$ < 1.0 V, $V_{OUT} = V_{OUT(NOM)}$ - 0.2 V, V_{IN} = 2.0 V		1.2	1.5	1.8	A
		$V_{OUT(NOM)}$ ≥ 1.0 V, $V_{OUT} = V_{OUT(NOM)}$ × 0.85, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V					
I_{SC}	Short-circuit current limit	V_{OUT} = 0 V	$V_{OUT(NOM)}$ < 1.0 V, V_{IN} = 2.0 V	600	680	850	mA
			$V_{OUT(NOM)}$ ≥ 1.0 V, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V				
V_{DO}	Dropout voltage	I_{OUT} = 1 A, V_{OUT} = 0.95 × $V_{OUT(NOM)}$	V_{OUT} = 1 V		700		mV
			V_{OUT} = 1.2 V		560		
			V_{OUT} = 1.5 V		425		
			V_{OUT} = 1.8 V		350		
			V_{OUT} = 2.5 V		280		
			V_{OUT} = 3.3 V		220		
			V_{OUT} = 5.5 V		175		
PSRR	Power-supply rejection ratio	V_{OUT} = 1.8 V, V_{IN} = 2.8 V, I_{OUT} = 1 A, C_{OUT} = 2.2 µF	f = 1 kHz		56		dB
			f = 100 kHz		38		
			f = 1 MHz		28		
V_N	Output noise voltage	BW = 10 Hz to 100 kHz, V_{OUT} = 0.9 V, V_{IN} = 1.9 V			53		µVRMS
V_{UVLO}	Undervoltage lockout	V_{IN} falling		1.17	1.27	1.5	V

		V_{IN} rising		1.19	1.32	1.54	
$V_{UVLO,HYST}$	Undervoltage lockout hysteresis	V_{IN} hysteresis			50		mV
t_{STR}	Startup time	From EN low-to-high transition to $V_{OUT} = V_{OUT(NOM)} \times 0.95$		200	500	850	μs
			C_{NR} = 10 nF (3)		1.0		ms
			C_{NR} = 100 nF (3)		10		
$V_{EN(HI)}$	EN pin high voltage	Enabled		1			V
$V_{EN(LO)}$	EN pin low voltage	Disabled				0.3	V
I_{EN}	Enable pin current	$V_{IN} = V_{EN} = 6.0$ V			10		nA
$R_{PULLDOWN}$	Pulldown resistance	$V_{IN} = 6.0$ V		60	95	130	Ω
PG_{HTH}	PG high threshold (4)	V_{OUT} increasing		90	92	94	$\%V_{OUT}$
PG_{LTH}	PG low threshold (4)	V_{OUT} decreasing		88	90	92	$\%V_{OUT}$
PG_{HYST}	PG hysteresis (4)				2		$\%V_{OUT}$
$V_{OL(PG)}$	PG pin low-level output voltage (4)	$V_{IN} \geq 1.7$ V, $I_{SINK} = 1.0$ mA				300	mV
		$V_{IN} \geq 2.75$ V, $I_{SINK} = 2.0$ mA					
$I_{kg(PG)}$	PG pin leakage current (4)	$V_{OUT} > PG_{HTH}$, $V_{PG} = 6.0$ V			7	50	nA
T_{SD}	Thermal shutdown	Shutdown, temperature increasing		155	160	168	°C
		Reset, temperature decreasing		125	130	135	
t_{PGDH}	PG delay time rising	Time from 92% V_{OUT} to 20% of PG (5)		140	155	170	μs
t_{PGDL}	PG delay time falling	Time from 90% V_{OUT} to 80% of PG (5)		1.5	5	7	μs

Note:

(1) When the device is connected to external feedback resistors at the FB pin, external resistor tolerances are not included.

(2) $V_{IN} = 1.7$ V for $V_{OUT(NOM)} + V_{DO} < 1.7$ V.

(3) Only for DIA7986AN/BN version.

(4) Only for DIA7986AA/BA version (open-drain).

(5) Output overdrive = 10%.

(6) Specifications subject to change without notice.

6. Typical Characterisctics

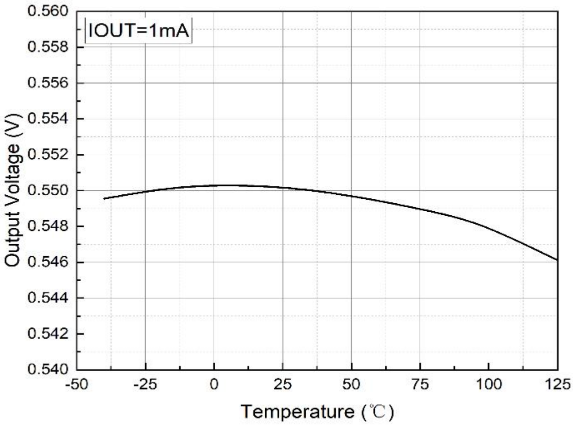
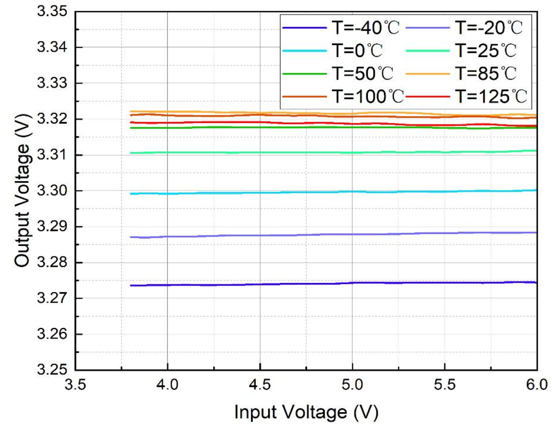


Figure 4. V_{OUT} vs. Temperature



V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Figure 5. V_{OUT} vs. V_{IN}

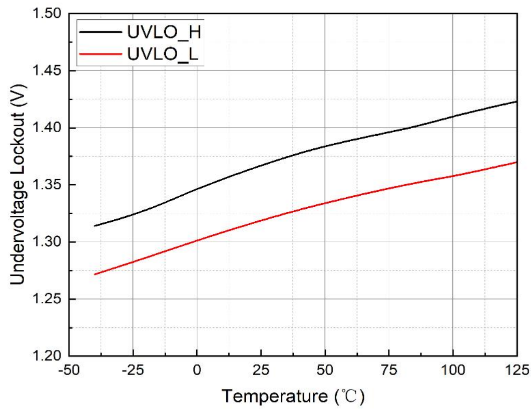


Figure 6. Undervoltage lockout vs. Temperature

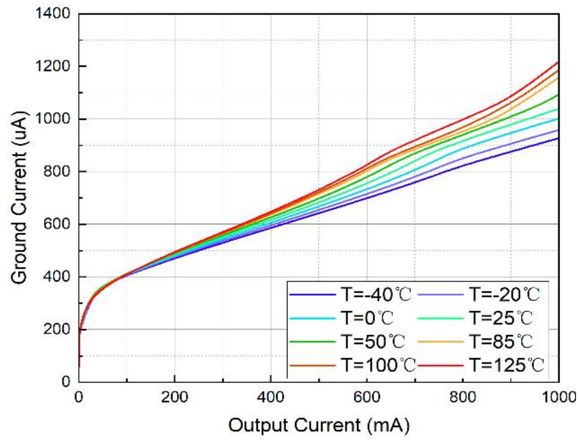
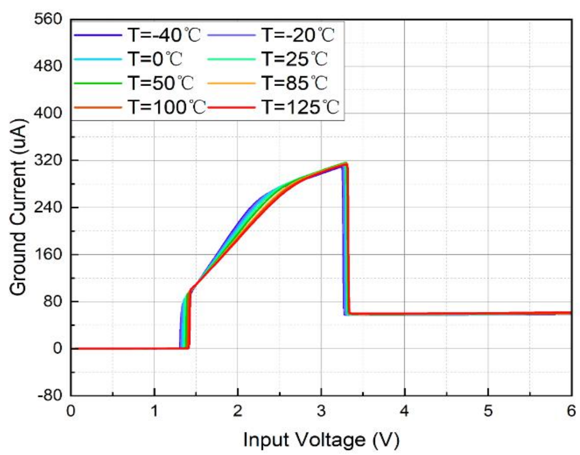
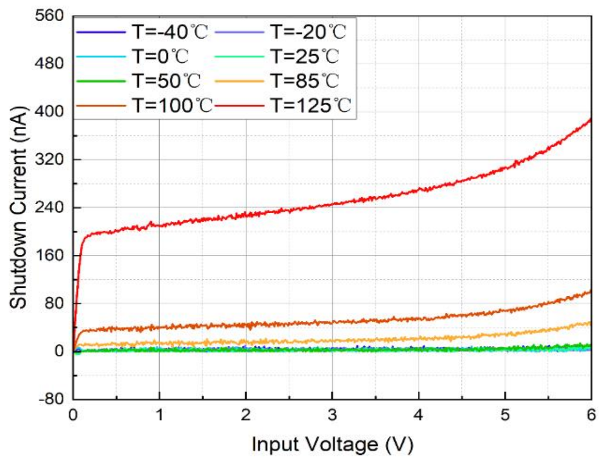


Figure 7. I_{GND} vs. I_{OUT} (V_{OUT} = 3.3 V)



V_{OUT} = 3.3 V, I_{OUT} = 0 mA

Figure 8. I_{GND} vs. V_{IN}



V_{EN} = 0 V

Figure 9. I_{SHDN} vs. V_{IN}

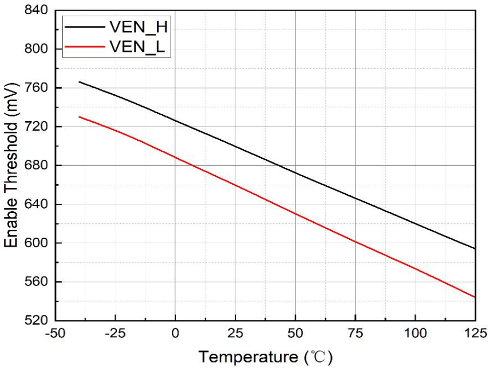


Figure 10. $V_{EN(HI)}$ and $V_{EN(LO)}$ vs. Temperature

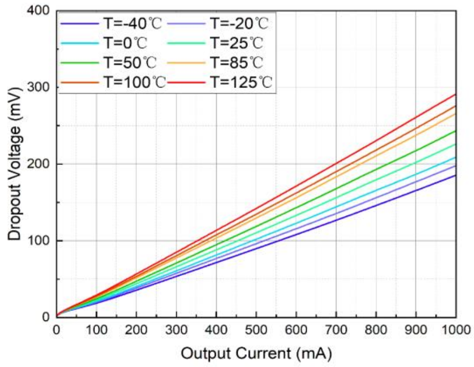
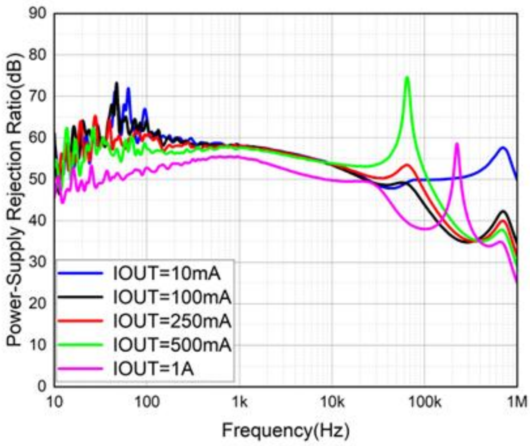
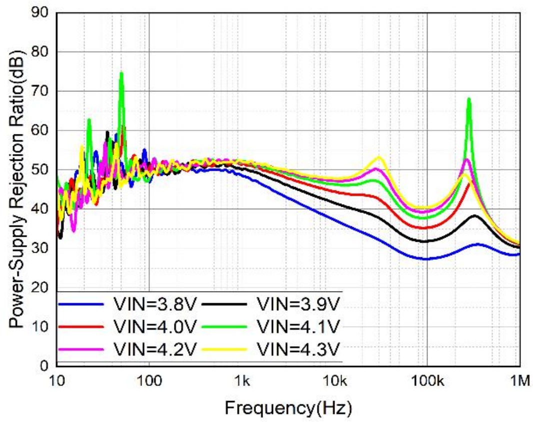


Figure 11. 3.3 V dropout voltage vs. I_{OUT}



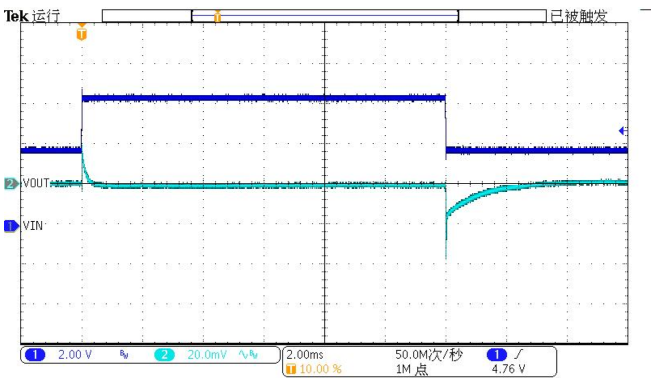
V_{IN} = 2.8 V, V_{OUT} = 1.8 V, C_{OUT} = 2.2 µF

Figure 12. PSRR vs. Frequency and I_{OUT}



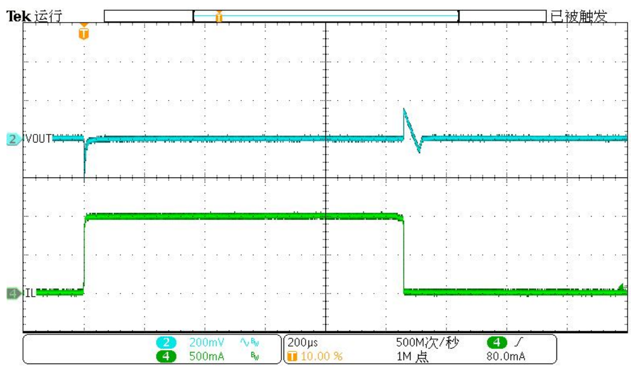
V_{OUT} = 3.3 V, I_{OUT} = 500 mA,C_{OUT} = 2.2 µF

Figure 13. PSRR vs. Frequency and V_{IN}



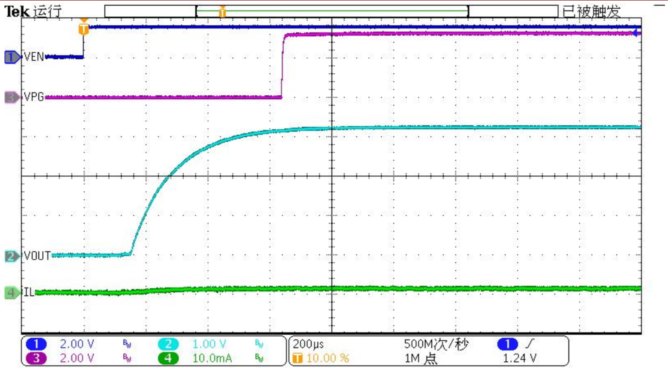
V_{OUT} = 3.3 V, I_{OUT} = 1 mA, VIN slew rate = 1 V/µs

Figure 14. 3.3 V Line transient



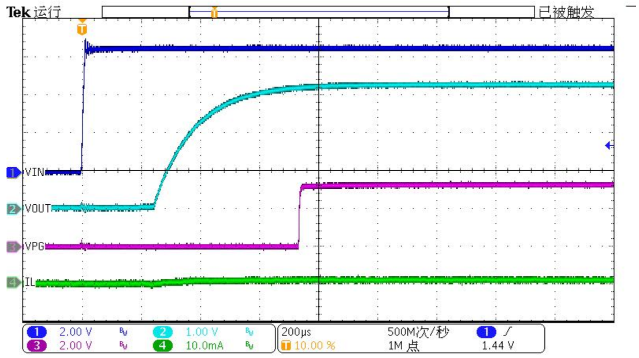
V_{OUT} = 3.3 V, V_{IN} = 3.8 V

Figure 15. 1 mA to 1 A Load transient



V_{IN} = 3.8 V, V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Figure 16. Startup with EN



V_{OUT} = 3.3 V, I_{OUT} = 1 mA

Figure 17. VIN power up

7. Block Diagram

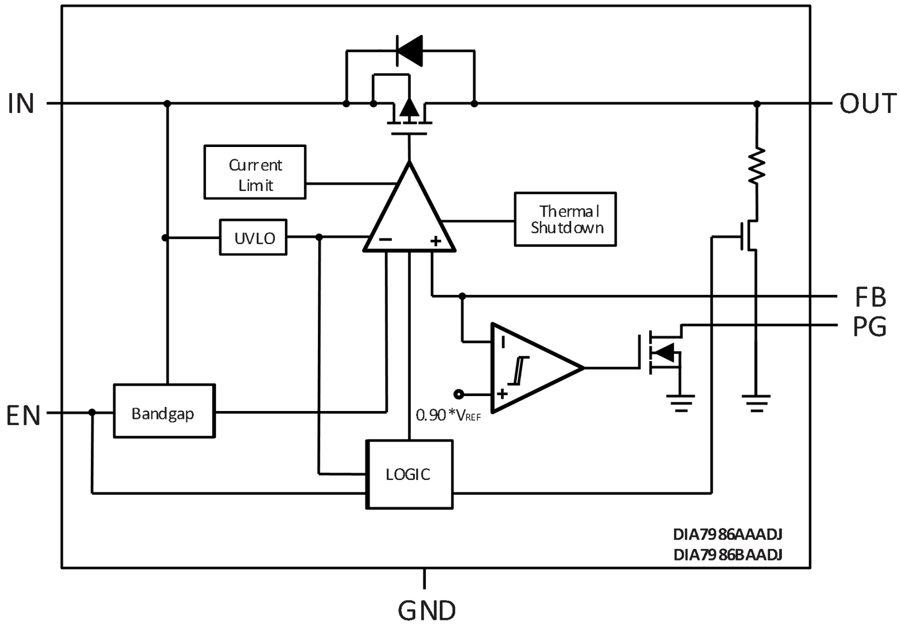


Figure 18. Adjustable version with open-drain power-good

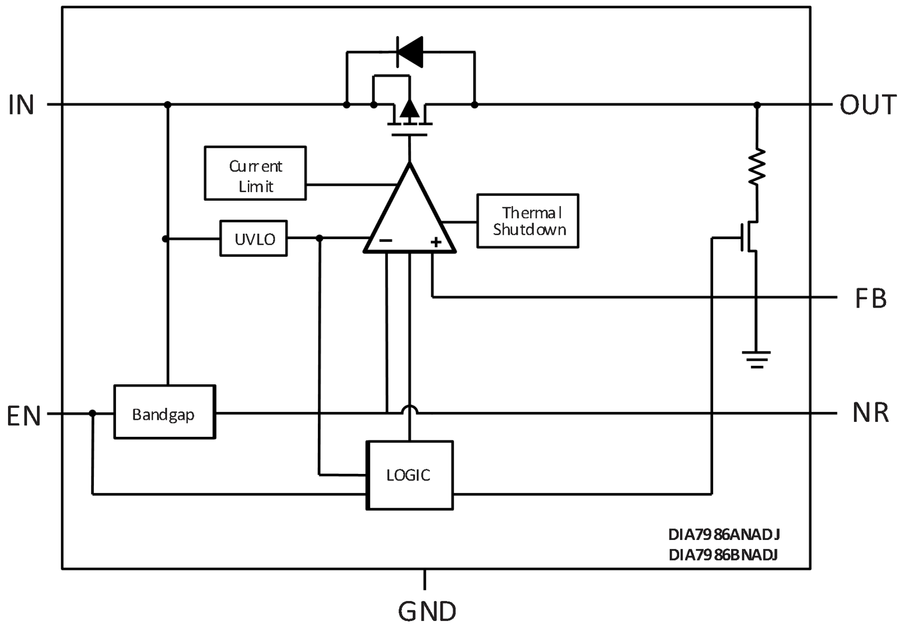


Figure 19. Adjustable version with adjustable soft-start

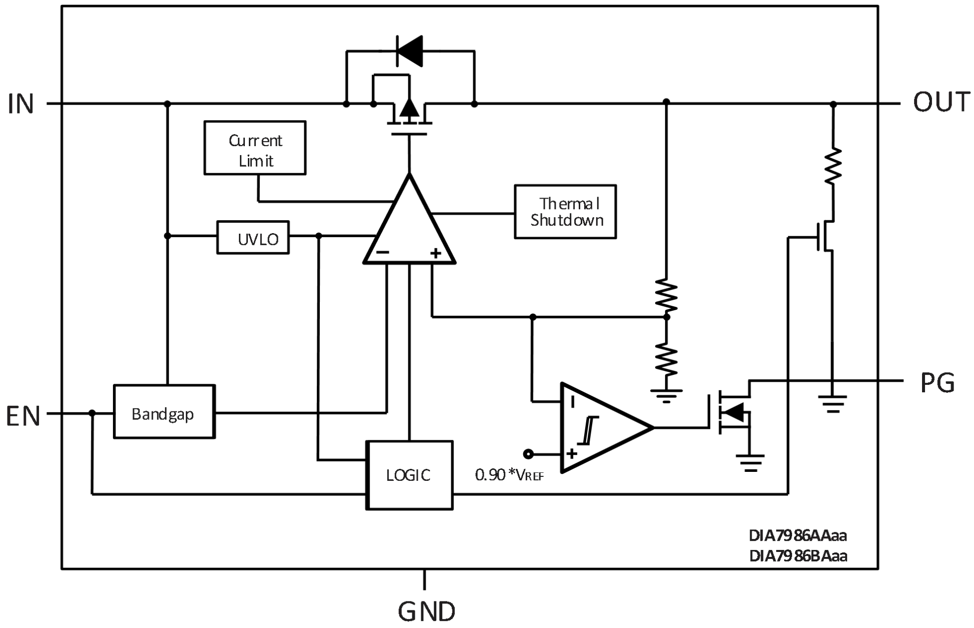


Figure 20. Fixed voltage version with open-drain power-good

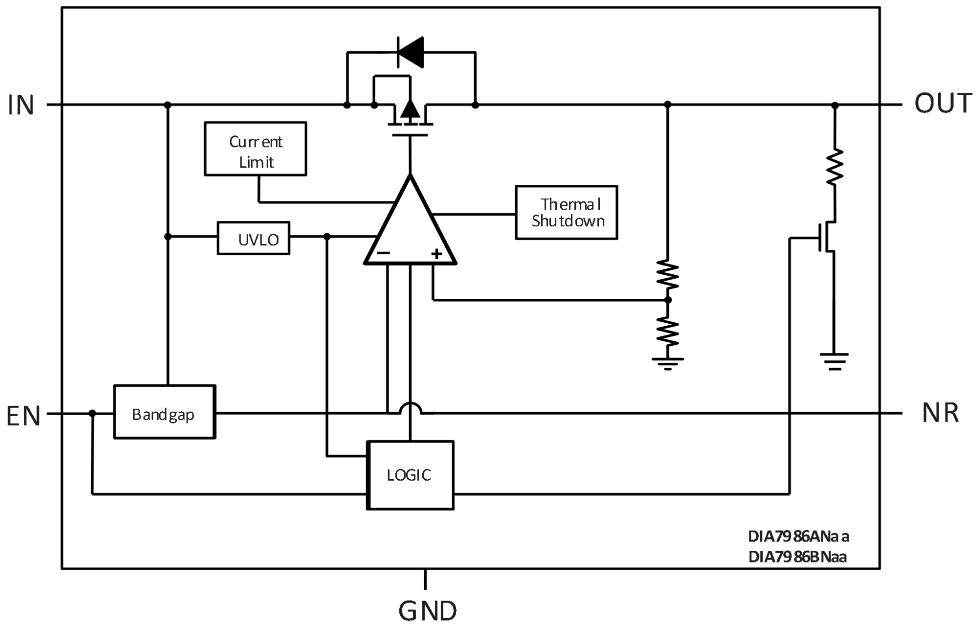


Figure 21. Fixed voltage version with adjustable soft-start

8. Function Description

8.1. Overview

The DIA7986 is a low-dropout regulator (LDO) that consumes a low quiescent current and delivers an excellent line and load transient performance. These characteristics, combined with low noise and high PSRR with low dropout voltage, make this device ideal for automotive applications.

This regulator offers short-current limit, shutdown, and thermal protection. The operating junction temperature for this device is -40°C to 150°C.

8.2. Undervoltage lockout (UVLO)

The DIA7986 contains an undervoltage lockout (UVLO) circuit that ensures that the device is functional when the supply voltage is lower than the operational range of the internal circuitry, which disables the output until the input voltage is greater than the rising UVLO voltage (V_{UVLO}). When V_{IN} is less than V_{UVLO}, the output is connected to the ground with a pulldown resistor ($R_{PULLDOWN}$). When the device enters UVLO, the PG output is pulled low.

8.3. Shutdown

The enable pin (EN) is active high. Forcing the EN pin to exceed $V_{EN(HI)}$ will enable the device. Forcing the EN pin to drop below $V_{EN(LO)}$ will turn off the device. Connect EN to IN when shutdown capability is not required. The PG output pin is pulled low when the device is disabled. The DIA7986 has an internal pulldown MOSFET that connects an $R_{PULLDOWN}$ resistor to the ground when the device is disabled. Output capacitance (C_{OUT}) and the load resistance (R_L) in parallel with the pulldown resistor ($R_{PULLDOWN}$) decide the discharge time after disabling. The equation below calculates the time constant:

$$t = (R_{PULLDOWN} \times R_L)/(R_{PULLDOWN} + R_L) \times C_{OUT} \quad (1)$$

8.4. Current limit

The device is protected during transient high-load current faults or shorting events by an internal current limit circuit. The current limit is a hybrid scheme that transitions from a current-limit scheme to a short-limit scheme at the foldback voltage ($V_{FOLDBACK}$). When the output is shorted, the device supplies a typical current called the short-circuit current limit (I_{SC}). In a high-load current fault with the output voltage above $V_{FOLDBACK}$, the current-limit scheme limits the output current to I_{CL}. When the voltage drops below $V_{FOLDBACK}$, a short-current limit activates that scales back the current as the output voltage approaches GND.

For this device, $V_{FOLDBACK} = 0.45 \times V_{OUT(NOM)}$.

When the device is within the current limit, the output voltage is not regulated. The device begins to heat up when a current limit event occurs, and if a thermal shutdown is triggered, the device turns off. When the device is in current-limit, the pass transistor dissipates power [(V_{IN} - V_{OUT}) × I_{CL}]. When the device output is shorted and the output is below $V_{FOLDBACK}$, the pass transistor dissipates power [(V_{IN} - V_{OUT}) × I_{SC}]. The internal thermal shutdown circuit turns the device back on after the device cools down. The device cycles between the current limit and thermal shutdown if the output current fault condition continues.

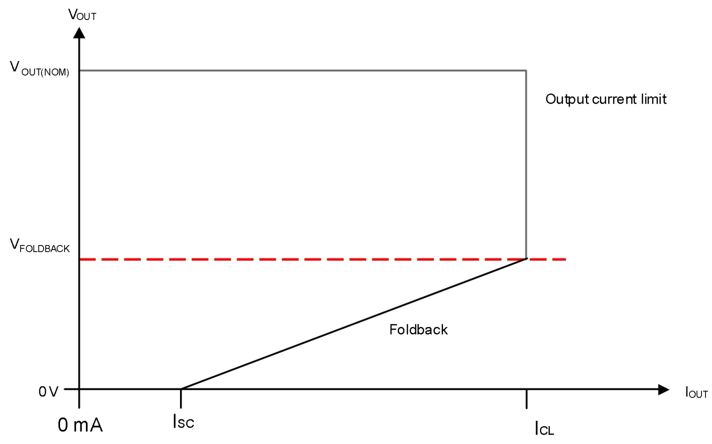


Figure 22. Current limit

8.5. Thermal shutdown

The DIA7986 has a thermal shutdown protection feature that disables the device when the junction temperature rises to approximately 160°C. This feature helps to reduce the power dissipated by the device, allowing it to cool down. When the temperature falls to approximately 130°C, the output circuitry is re-enabled. However, depending on various factors like power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may turn on and off repeatedly. This cycling helps to limit regulator dissipation and protect the regulator from overheating damage. Activating the thermal shutdown feature usually indicates excessive power dissipation as a result of the product of the (V_{IN} - V_{OUT}) voltage and the load current. For reliable operation, limit junction temperature to 150°C maximum. To estimate the margin of safety in a complete design, increase the ambient temperature until the thermal protection is triggered, use worst-case loads and signal conditions.

The DIA7986 has a built-in protection circuit that guards against overload conditions. However, it's not meant to be triggered during regular operation. Running the device continuously into thermal shutdown can harm the device's reliability.

8.6. Startup response

The DIA7986 is equipped with noise reduction pin (NR) for noise sensitive applications. A noise reduction capacitor (C_{NR}) at the NR pin bypasses noise generated by the bandgap reference. The C_{NR} serves not only for noise reduction. The C_{NR} works like the soft start timing capacitor during start-up. The controlled monotonic ramping of voltage reference (adjustable soft−start) is limiting the inrush current.

8.7. Device functional modes

The Device Functional Modes table shows the conditions that lead to the different modes of operation. See the Electrical Characteristics table for parameter values.

Table 2. Device functional modes

Operating Mode	V_{IN}	V_{EN}	I_{OUT}	T_J
Normal operation	$V_{IN} > V_{OUT(nom)} + V_{DO}$ and $V_{IN} > V_{IN(min)}$	$V_{EN} > V_{EN(HI)}$	$I_{OUT} < I_{OUT(max)}$	$T_J < T_{SD(shutdown)}$
Dropout operation	$V_{IN(min)} < V_{IN} < V_{OUT(nom)} + V_{DO}$	$V_{EN} > V_{EN(HI)}$	$I_{OUT} < I_{OUT(max)}$	$T_J < T_{SD(shutdown)}$
Disabled (any true condition disables the device)	$V_{IN} < V_{UVLO}$	$V_{EN} < V_{EN(LOW)}$	Not applicable	$T_J > T_{SD(shutdown)}$

8.8. Dropout operation

If all conditions are met for normal operation but the input voltage is lower than the nominal output voltage plus the specified dropout voltage, the device operates in dropout mode. During dropout mode, the output voltage tracks the input voltage and the transient performance of the device becomes significantly degraded and acts as a switch. Line or load transients in dropout can result in large output-voltage deviations.

When the device is in dropout, $V_{IN} < V_{OUT(NOM)} + V_{DO}$, directly after being in a normal regulation state, but not during startup, the pass transistor is driven into the ohmic or triode region. The output voltage can overshoot for a short period while the device pulls the pass transistor back into the linear region when the input voltage returns to a value greater than or equal to the nominal output voltage plus the dropout voltage ($V_{OUT(NOM)} + V_{DO}$).

8.9. Disabled

Shutting down the output of the device will require forcing the voltage of the enable pin to less than the maximum EN pin low-level input voltage. The pass transistor is turned off internal circuits are shutdown, and the output voltage is actively discharged to the ground by an internal discharge circuit from the output to the ground, when the device is disabled.

9. Application Information

Important notice: Validation and testing are the most reliable ways to confirm system functionality. The application information is not part of the specification and is for reference purposes only.

9.1. Application examples

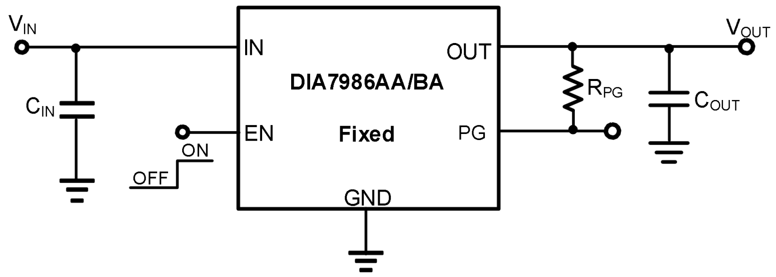


Figure 23. Typical application: fixed voltage (DIA7986AA/BA)

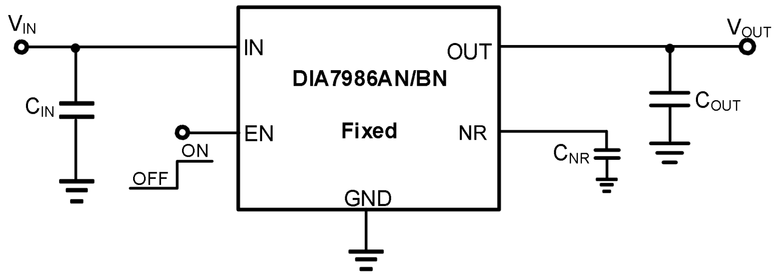


Figure 24. Typical application: fixed voltage (DIA7986AN/BN)

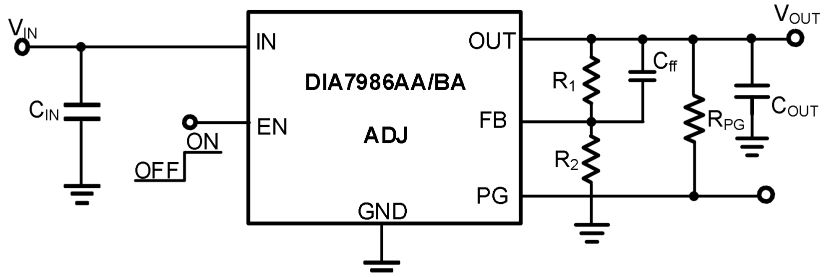


Figure 25. Typical application: adjustable voltage (DIA7986AA/BA)

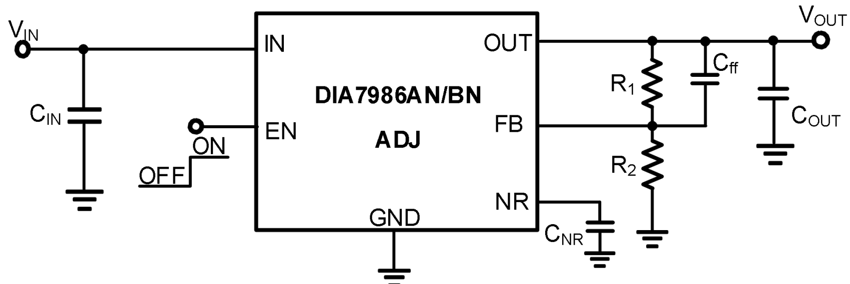


Figure 26. Typical application: adjustable voltage (DIA7986AN/BN)

9.2. Adjustable device feedback resistors

Figure 10 shows that the output voltage of the DIA7986 can be adjusted from 0.55 V to 5.5 V by using a resistor divider network.

The adjustable version DIA7986 requires external feedback divider resistors to set the output voltage. The feedback divider resistors, R_1 and R_2 set the V_{OUT}, according to the following equation:

$$V_{OUT} = V_{FB} \times (1 + R_1/R_2) \quad (2)$$

Setting the feedback divider current to 100 × the FB pin current listed in the Electrical Characteristics table can ignore the FB pin current error term in the V_{OUT} equation, which provides the maximum feedback divider series resistance, as shown in the following equation:

$$R_1 + R_2 \leq V_{OUT} / (I_{FB} \times 100) \quad (3)$$

9.3. Dropout voltage

A PMOS pass transistor is used to achieve low dropout. The PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element when (V_{IN} - V_{OUT}) is less than the dropout voltage (V_{DO}). The PMOS device behaves like a resistor in dropout mode therefore V_{DO} scales approximately with the output current. PSRR and transient response degrade as (V_{IN} - V_{OUT}) approaches dropout operation with any linear regulator.

9.4. Exiting dropout

A ramping input supply causes an LDO to overshoot on start-up, as shown in Figure 27 when the slew rate and voltage levels are in the correct range. Use an enable signal to avoid this condition.

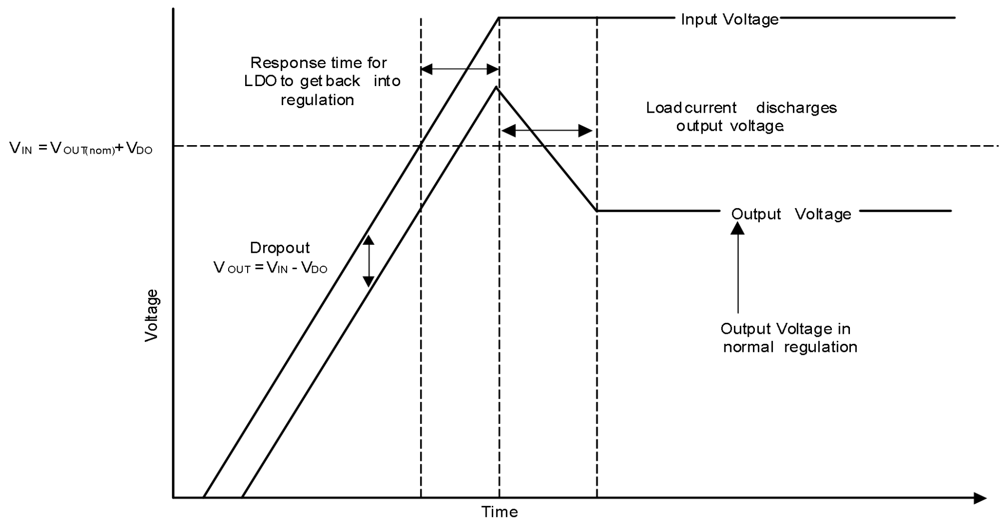
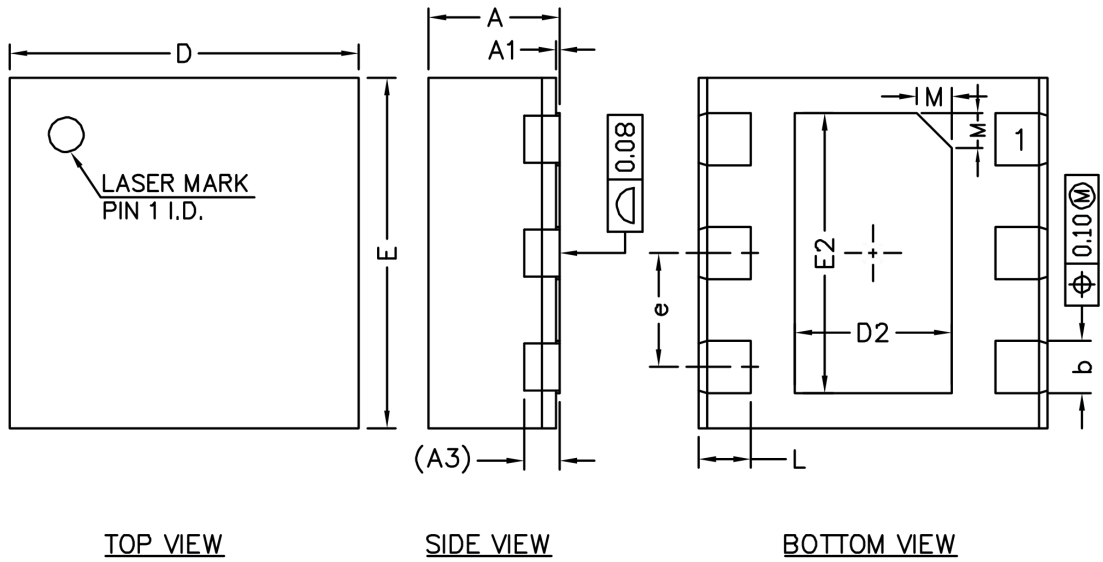


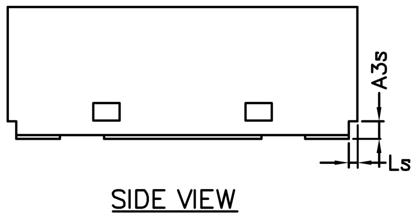
Figure 27. Start-up into dropout

Overshooting on the output of the regulator can be caused by the error amplifier having to drive the gate capacitance of the pass element and bring the gate back to the correct voltage for proper regulation. The gate voltage (V_{GS}) is pulled all the way down to the ground to give the pass device the lowest on-resistance possible when the LDO is placed in dropout. However, the output will overshoot until the loop responds and the output current pulls the output voltage back down into regulation if a line transient occurs when the device is in dropout. Continue to add input capacitance in the system until the transient is slow enough to reduce the overshoot if these transients are not acceptable.

10. Physical Dimensions

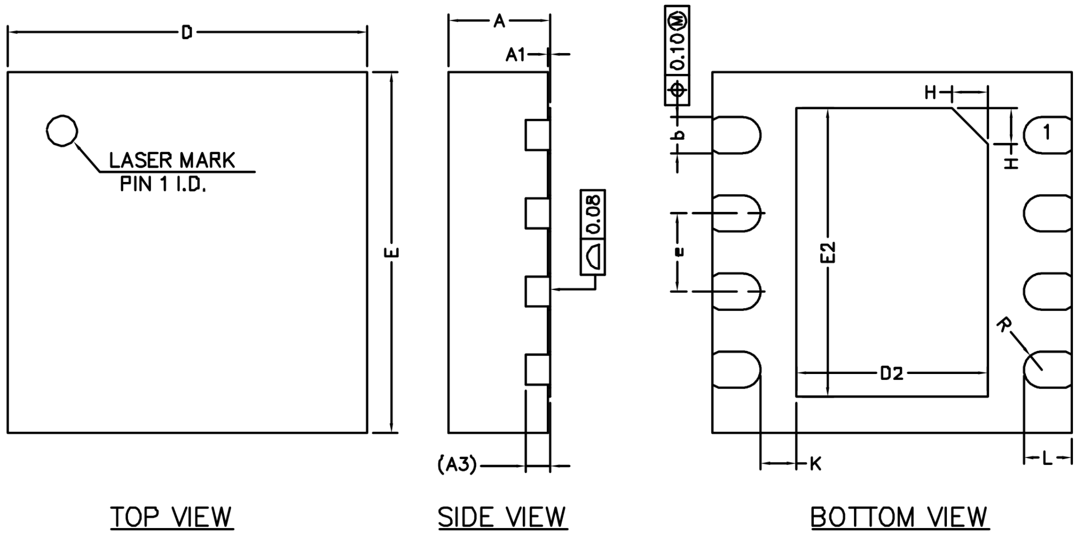
10.1. DFN2*2-6

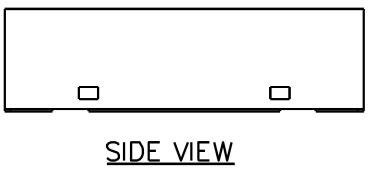




Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF		
A3s	0.10	-	-
b	0.25	0.30	0.35
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D2	0.80	0.90	1.00
E2	1.50	1.60	1.70
e	0.55	0.65	0.75
L	0.25	0.30	0.35
Ls	0.05 REF		
M	0.20 REF		

10.2. DFN3*3-8





Common Dimensions (Units of measure = Millimeter)			
Symbol	Min	Nom	Max
A	0.80	0.85	0.90
A1	0.00	0.02	0.05
A3	0.203 REF		
b	0.25	0.30	0.35
D	2.90	3.00	3.10
E	2.90	3.00	3.10
D2	1.50	1.60	1.70
E2	2.30	2.40	2.50
e	0.55	0.65	0.75
H	0.30 REF		
K	0.20	0.30	0.40
L	0.30	0.40	0.50
R	0.15 REF		

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