A5972D

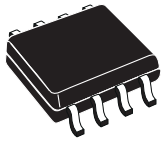
Up to 1.5 A step down switching regulator for automotive applications

Features

- Qualified following the AEC-Q100 requirements (temperature grade 3), see PPAP for more details.
- 1.5 A DC output current
- Operating input voltage from 4 V to 36 V
- Output voltage adjustable from 1.235 V to 35 V
- Low dropout operation: 100 % duty cycle
- 250 kHz Internally fixed frequency
- Voltage feedforward
- Zero load current operation
- Internal current limiting
- Protection against feedback disconnection
- Thermal shutdown

Applications

- Automotive applications



SO-8

Description

The A5972D is a step down monolithic power switching regulator with a minimum switch current limit of 1.8 A so it is able to deliver more than 1.5 A DC current to the load depending on the application conditions.

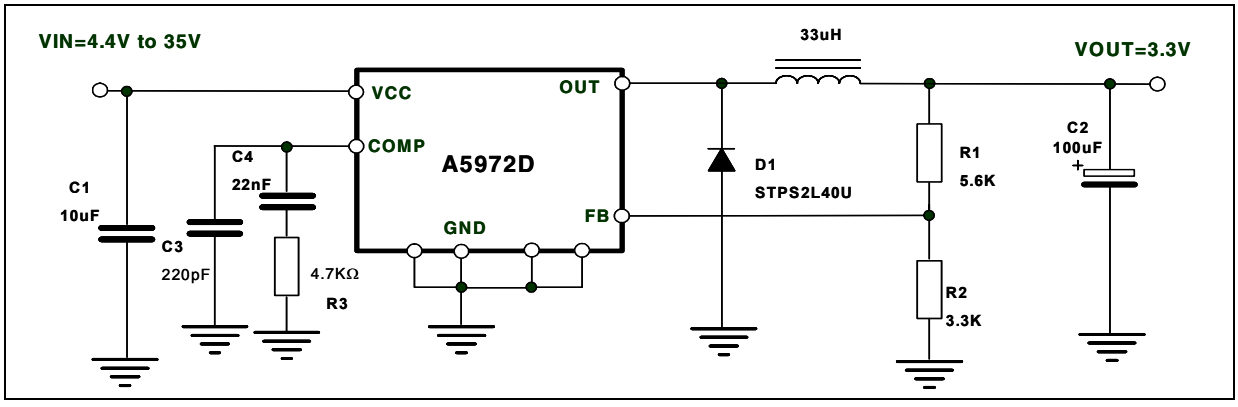
The output voltage can be set from 1.235V to 35V. The device uses an internal P-channel D-MOS transistor (with a typical $R_{DS(on)}$ of 250 mΩ) as switching element to minimize the size of the external components.

An internal oscillator fixes the switching frequency at 250 kHz.

Having a minimum input voltage of 4 V only, it is particularly suitable for 5 V bus.

Pulse by pulse current limit with the internal frequency modulation offers an effective constant current short circuit protection.

Figure 1. Application schematic

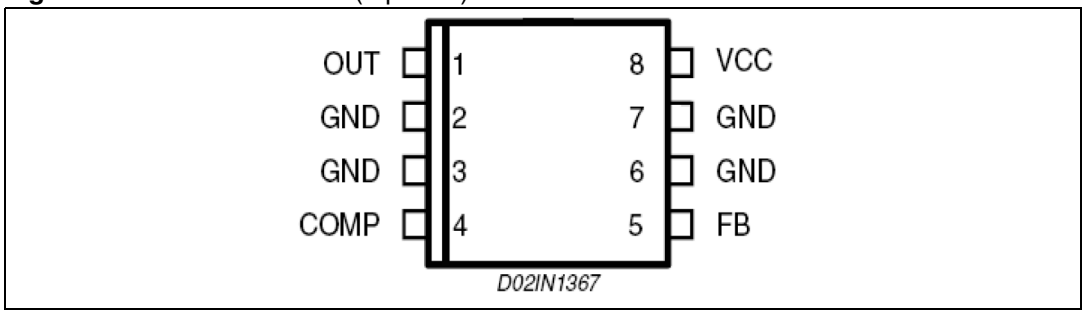


Contents

1 Pin settings

1.1 Pin connection

Figure 1. Pin connection (top view)



1.2 Pin description

Table 1. Pin description

N°	Pin	Description
1	OUT	Regulator output.
2,3,6,7	GND	Ground.
4	COMP	E/A output for frequency compensation.
5	FB	Feedback input. Connecting directly to this pin results in an output voltage of 1.23 V. An extenal resistive divider is required for higher output voltages.
8	VCC	Unregulated DC input voltage.

2 Electrical data

2.1 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_8	Input voltage	40	V
V_1	OUT pin DC voltage OUT pin peak voltage at Δt = 0.1 µs	-1 to 40 -5 to 40	V V
I_1	Maximum output current	int. limit.	
V_4 , V_5	Analog pins	4	V
P_{TOT}	Power dissipation at $T_A \leq 70$ °C	1.2	W
T_J	Operating junction temperature range	-40 to 150	°C
T_{STG}	Storage temperature range	-55 to 150	°C

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	SO8	Unit
R_{thJA}	Maximum thermal resistance junction-ambient	65 (1)	°C/W

1. Package mounted on board

3 Electrical characteristics

Table 4. Electrical characteristics
(T_J = -40 to 125 °C, V_{CC} = 12 V, unless otherwise specified)

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
V_{CC}	Operating input voltage range	V_0 = 1.235 V; I_0 = 2 A	4		36	V
$R_{DS(on)}$	Mosfet on resistance			0.250	0.5	Ω
I_L	Maximum limiting current (1)	V_{CC} = 5 V	1.8	2.5	3	A
		V_{CC} = 5 V, T_J = 25 °C	2	2.5	3	
f_{SW}	Switching frequency		212	250	280	kHz
	Duty cycle		0		100	%
Dynamic characteristics (see test circuit)						
V_5	Voltage feedback	4.4 V < V_{CC} < 36 V, 20 mA < I_0 < 2 A	1.198	1.235	1.272	V
η	Efficiency	V_0 = 5 V, V_{CC} = 12 V		90		%
DC characteristics						
I_{qop}	Total operating quiescent current			3	5	mA
I_q	Quiescent current	Duty cycle = 0; V_{FB}= 1.5 V			2.5	mA
Error amplifier						
V_{OH}	High level output voltage	V_{FB} = 1 V	3.5			V
V_{OL}	Low level output voltage	V_{FB} = 1.5 V			0.4	V
$I_{o\ source}$	Source output current	V_{COMP} = 1.9 V; V_{FB} = 1 V	190	300		µA
$I_{o\ sink}$	Sink output current	V_{COMP} = 1.9 V; V_{FB} = 1.5 V	1	1.5		mA
Ib	Source bias current			2.5	4	µA
	DC open loop gain	RL= ∞	50	65		dB
gm	Transconductance	I_{COMP} = -0.1 mA to 0.1 mA; V_{COMP} = 1.9 V		2.3		mS

1. With T_J = 85 °C, I_{lim_min} = 2 A, assured by design, characterization and statistical correlation.

4 Typical characteristics

Figure 2. Output voltage vs junction temperature

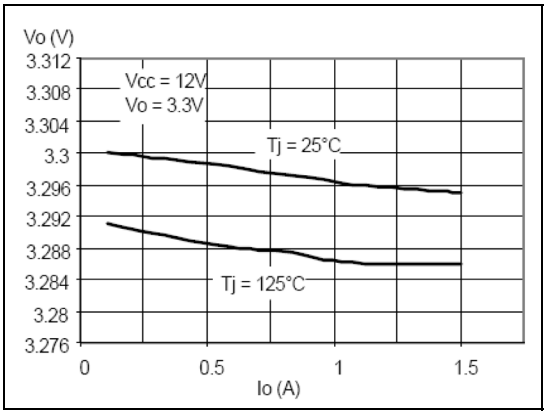


Figure 3. Quiescent current vs junction temperature

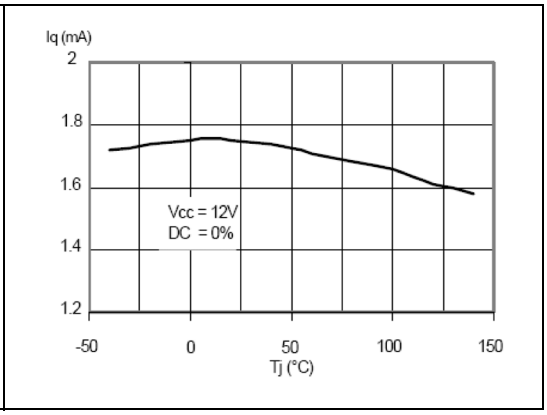


Figure 4. Line regulatior

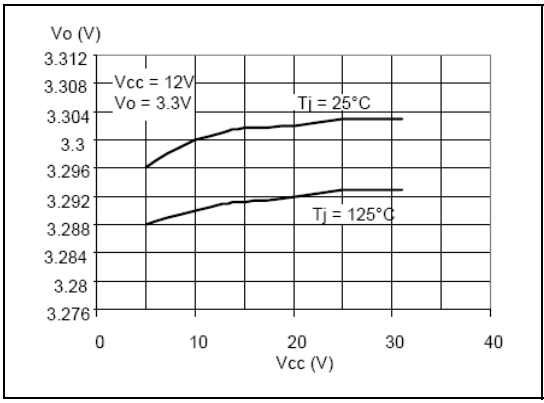


Figure 5. Shutdown current vs junction temperature

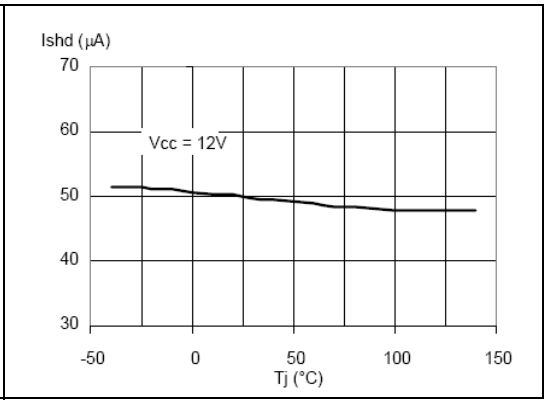


Figure 6. Output voltage vs junction temperature

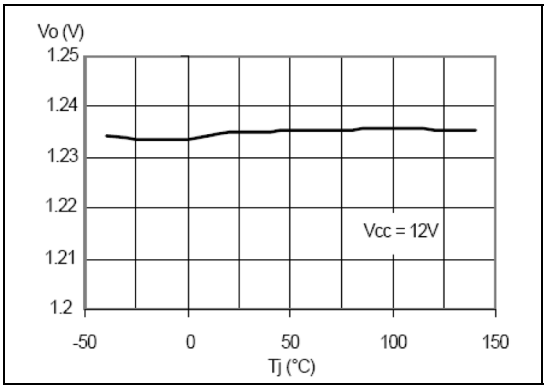


Figure 7. Junction temperature vs output current

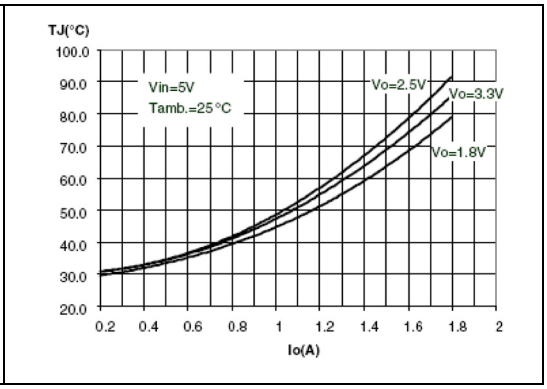


Figure 8. Junction temperature vs output current

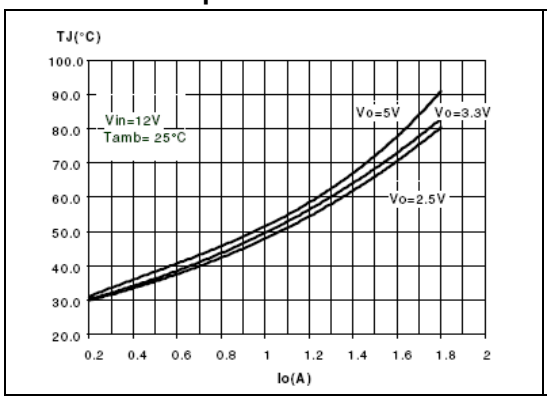


Figure 9. Efficiency vs output current

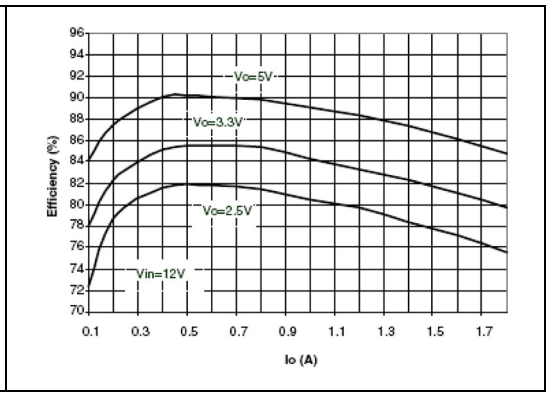
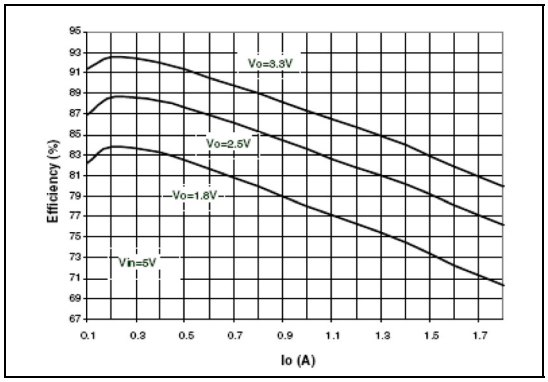


Figure 10. Efficiency vs output current



5 Package mechanical data

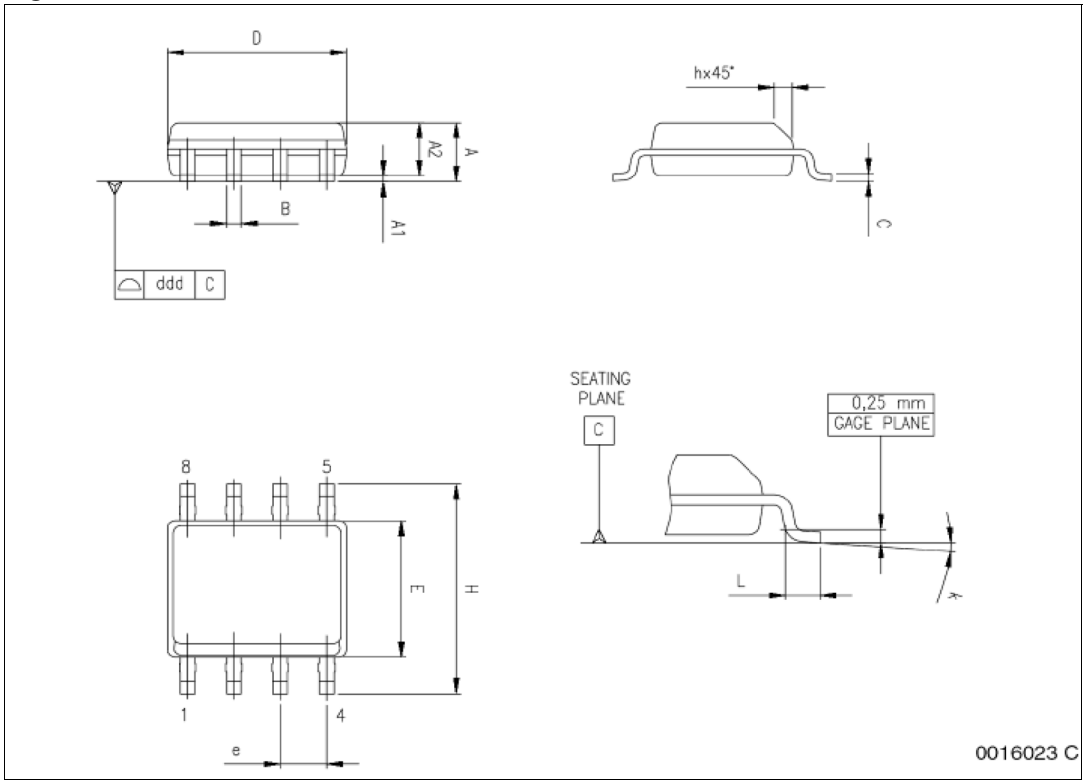
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

Table 5. SO-8 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.004		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D (1)	4.80		5.00	0.189		0.197
E	3.80		4.00	0.15		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	0° (min), 8° (max)					
ddd			0.10			0.004

1. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15mm (0.006 inch) in total (both side).

Figure 11. SO-8 mechanical data



6 Revision history

Table 6. Document revision history

Date	Revision	Changes
06-Aug-2007	1	Initial release
5-Nov-2007	2	Updated: *Table 4 on page 5*
2-May-2008	3	Updated: Cover page, *Table 4 on page 5*
27-Aug-2008	4	Updated: Coverpage and *Table 4 on page 5*

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