Nuvoton
1.6 Times Linear Fan Driver
NCT3940S/ NCT3940S-A

新唐科技 NUVOTON INTELLECTUAL PROPERTY

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1. GENERAL DESCRIPTION

The NCT3940S/ NCT3940S-A is a simply linear fan driver. It is designed for noise-sensitive or power-sensitive applications that require system cooling. The NCT3940S/ NCT3940S-A is a low quiescent current, low dropout linear regulator which is designed with a P-channel MOSFET to power a DC fan and delivers output current up to 500mA. The output voltage follows the 1.6 times on the voltage of V_{SET} pin to dynamic adjust the DC fan speed. NCT3940S supports enable pin to control the output voltage. NCT3940S-A is power-on by the VSET pin voltage threshold and supports fully turn-on function. The internal power MOSFET can be fully turned on directly when FON# is at low level. NCT3940S/ NCT3940S-A is available in SOP-8 package.

2. FEATURES

2.1. General

- VOUT Follows 1.6 Times of VSET
- 150mV Dropout @ 0.5A Output Current
- 5uA Quiescent Current is Shutdown Mode
- UVLO Function
- Full On Function
- Over Current, Short Circuit and Over Temperature Protections
- Low External Component Count
- Low Cost and Easy to Use

2.2. Package

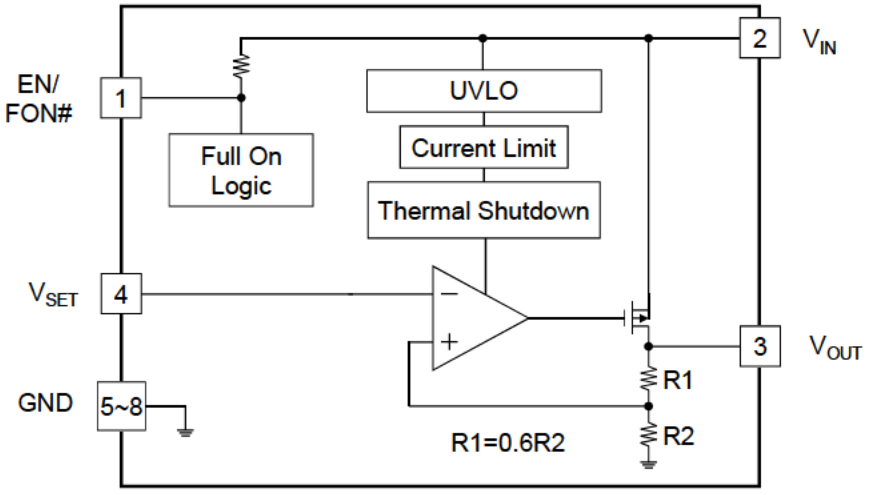
- SOP-8 150mil with Exposed Pad Package
- Lead Free (ROHS Compliant) and Halogen Free

2.3. Application

- Notebook/ Netbook Fan Driver
- Peripheral Add-in Cards
- Motherboards
- Battery Powered Systems

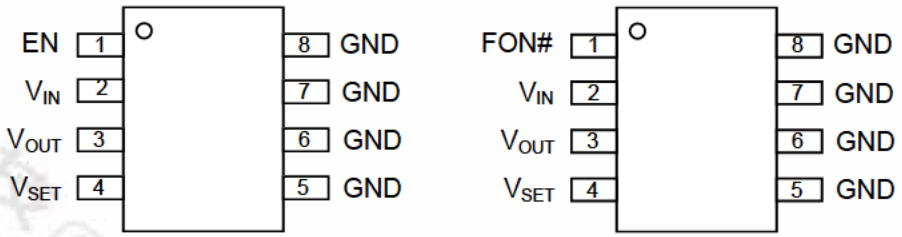
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3. BLOCK DIAGRAM



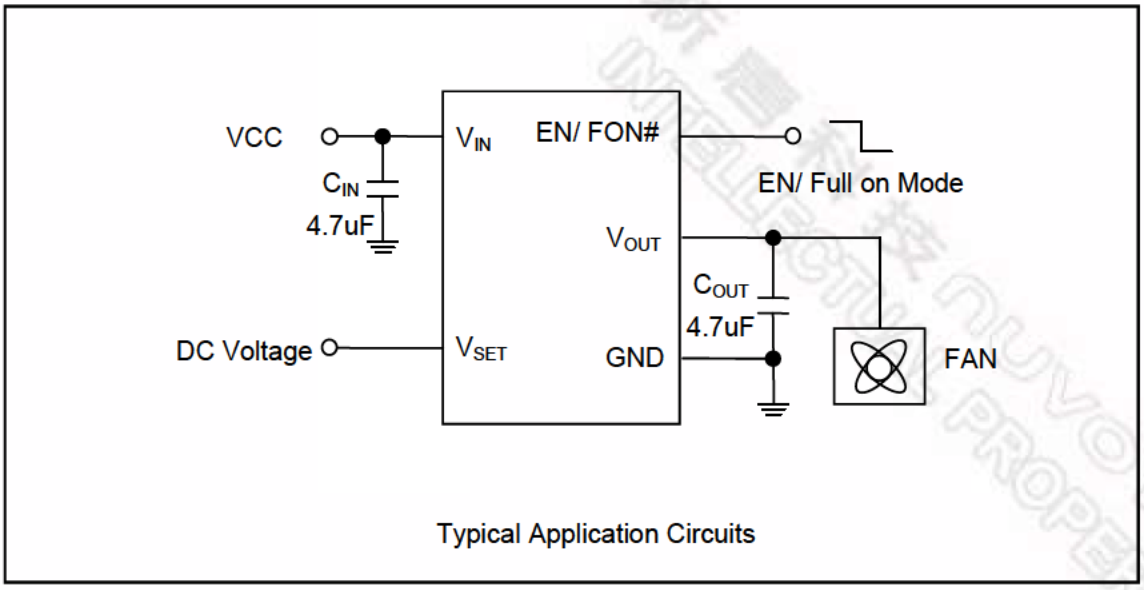
Note: FON# function was supported by NCT3940S-A only.

4. PIN CONFIGURATION AND TYPICAL APPLICATION CIRCUIT



NCT3940S
(Top View)

NCT3940S-A
(Top View)



Typical Application Circuits

5. PIN DESCRIPTION

PIN NAME	NO		PIN TYPE	DESCRIPTION
	NCT3940S	NCT3940S-A		
FON#	N/A	1	I	Only for NCT3940S-A device. Full On mode selection pin. Output voltage follows 1.6 times of V_{SET} pin voltage when FON# pin at high level. The internal power MOSFET full turns on when FON# pin at low level. Internal pull up resistor connected to V_{IN}.
EN	1	N/A	I	Only for NCT3940S device. Enable pin. Output voltage follows 1.6 times of V_{SET} pin voltage when Enable pin at high level.
V_{IN}	2		POWER	DC power supply input. Connect a bypass capacitor (4.7uF, typically) is recommended.
V_{OUT}	3		AO	Voltage output pin. Connect a low ESR ceramic capacitor (4.7uF, typically) to ground to assure stability.
V_{SET}	4		AIN	Output voltage setting pin. The inputs could be DC voltage. The input voltage must be larger that 1V.

GND	5~8	GROUND	Power supply ground.

PIN TYPE	PIN Attribute
AO	Output pin (Analog)
AIN	Input pin (Analog)
I	Input pin (Digital)
POWER	Positive power supply input
GROUND	Power supply ground

6. FUNCTIONAL DESCRIPTION

6.1 General Description

The NCT3940S/ NCT3940S-A is a low quiescent current, low dropout linear regulator which is designed with a P-channel MOSFET to power a DC fan. It can deliver output current up to 500mA. The output voltage follows the 1.6 times on the voltage of V_{SET} pin to dynamic adjust the DC fan speed. NCT3940S supports enable pin to control the output voltage. NCT3940S-A is power-on by the VSET pin and supports fully turn-on function.

6.2 Under Voltage Lockout, UVLO

The NCT3940S/ NCT3940S-A was built-in a UVLO protection to keep the output off until the internal circuitry is operating properly. Typical UVLO threshold is 2.5V with 0.15V hysteresis.

6.3 Full On Function

The function is for NCT3940S-A only. The input voltage level of FON# can control the internal regulator fully turn on or following 1.6 times of V_{SET} voltage. When pulling this pin below 0.4V, the regulator will be fully turned on. When pulling this pin above 1.6V, the output voltage will follow 1.6 times of V_{SET} voltage.

6.4 VSET Setting

The output voltage is 1.6 times of V_{SET} pin voltage. If the input voltage of V_{SET} is under 1V, the internal regulator will be turned off. When the V_{SET} voltage exceeds 1V, the output voltage will follow 1.6 times of V_{SET} voltage.

6.5 Current Limit

The NCT3940S/ NCT3940S-A provides a current limit circuitry, which monitors the output current and controls PMOS gate voltage to limit the output current at a specific value.

6.6 Thermal Shutdown

The NCT3940S/ NCT3940S-A has a thermal shutdown circuitry to limit the junction temperature. When the junction temperature exceeds 150° C, the thermal shutdown circuits disable the output, allowing the device to cool down. The output circuitry is enabled again after the junction temperature cools down by 30° C, resulting in a pulsed output during continuous thermal overload conditions. The thermal protection is designed to protect the IC in the event of over temperature conditions. For reliabile operation, the junction temperature cannot exceed 125° C.

6.7 VIN Decoupling

To achieve the best results when using the NCT3940S/ NCT3940S-A, decouple the power supply with a 4.7uF capacitor. Use a high quality ceramic surface mount capacitor if possible. Surface mount components minimize lead inductance, which improves performance, and ceramic capacitors tend to have adequate high frequency response for decoupling applications.

6.8 VOUT Stability

To maintain circuit stability and improve transient response over temperature and current, the NCT3940S/ NCT3940S-A needs a suitable output capacitor. In order to insure the circuit stability, the suitable output capacitor should be larger than 4.7uF.

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7. ELECTRICAL CHARACTERISTIC

7.1 Absolute Maximum Ratings

PARAMETER		RATING	UNIT
Power Supply Voltage		-0.3 to 7V	V
Voltage on Other Pins		-0.3 to 7V	V
Storage Temperature		-50 to 150	° C
Soldering Temperature		Refer to IPC/JEDEC J-STD-020 Specification	
ESD Protection	Human Body Mode	2	kV
	Machine Mode	200	V
	Latch-up	100	mA

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

7.2 Thermal Information

ITEM	RATING	UNIT
Power Dissipation, P_D @ T_A=25℃	Internal Limited	W
Package Thermal Resistance, SOP8, θ_{JA}	160	℃/W

7.3 Recommended operating conditions

PARAMETER	RATING	UNIT
Operating Temperature	0 to 70	° C
Junction Temperature	-40 to 125	° C
Supply Voltage, VCC	5 ± 10%	V

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7.4 Electrical CHARACTERISTICS

V_{IN}=5V, V_{SET}=2V, C_{IN}=C_{OUT}=2.2uF, Ta=25° C

PARAMETER	SYM.	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Supply Input Voltage						
Supply Input Voltage	V_{IN}	4.5		5.5	V	
Under Voltage Lockout (UVLO)						
V_{IN} UVLO Threshold		2.1	2.5	2.9	V	V_{IN} rising
V_{IN} UVLO Hysteresis			0.15		V	
EN Pin						
EN Voltage High		2.0			V	
EN Voltage Low				0.4	V	
EN Pin Bias Current			1.5	10	uA	EN=0V
FON# Pin						
Low Voltage	V_{IL}			0.4	V	
High Voltage	V_{IH}	1.6			V	
FON# Pin Bias Current	$I_{FON\#}$		1.5	10	uA	FON#=0V
Supply Input Current						
Quiescent Current	I_Q		0.5	1	mA	V_{OUT} = 5V
Output Voltage						
V_{OUT} Voltage / V_{SET} Voltage		1.552	1.6	1.648	V/V	V_{IN}=5.5V, V_{SET}=1V~3.2V
Load Regulation			30	40	mV	10mA≦I_{OUT}≦500mA
Line Regulation			0.2	0.5	%	Vin=4.5V to 5.5V
Output Resistance			0.3	0.4	Ω	I_{OUT}=500mA, V_{SET}=3.4V
Output Leakage			0	1	uA	V_{SET} < 1V
V_{SET} Pin						
Minimum V_{SET} Voltage			1		V	
Current Limit Protection						
Current Limit	I_{LIMIT}	0.7	1.0		A	
Over Temperature Protection						
Thermal Shutdown Temperature		145	150	160	° C	
Thermal Shutdown Hysteresis		20	30	40	° C	

8. TYPICAL OPERATING WAVEFORMS

V_{SET} = 2V, V_{EN}=V_{IN}, V_{IN} = 5V, I_O = 0.5A, C_{IN} = C_{OUT} = 4.7uF, T_A = T_J = 25℃, unless otherwise specified

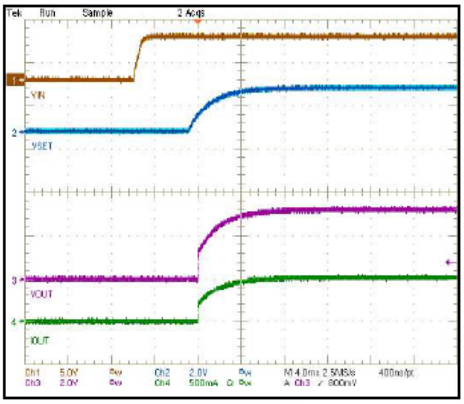


Figure 01. Power on

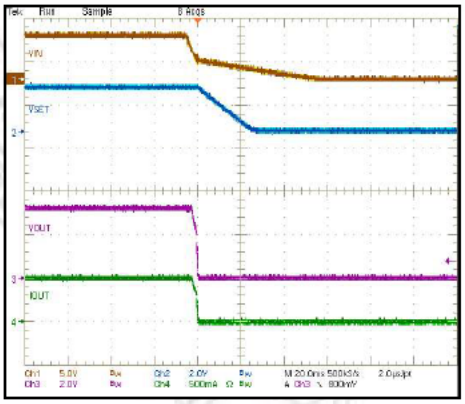


Figure 02. Power off

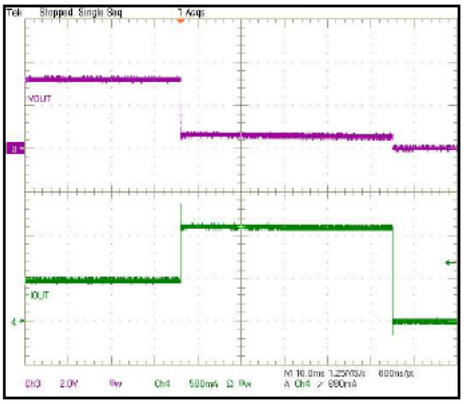


Figure 03. Current Limit, OTP

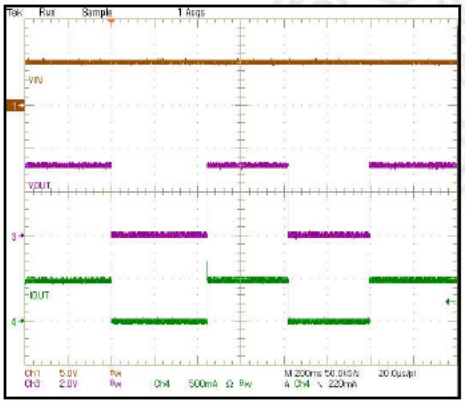


Figure 04. OTP

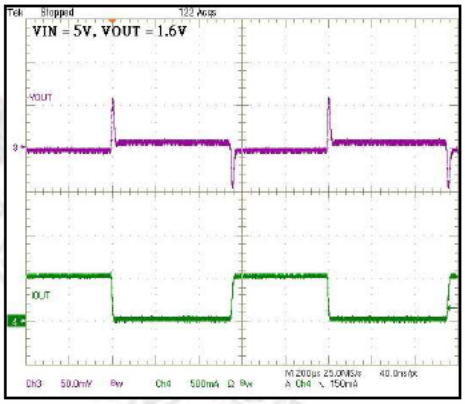


Figure 05. Load Transient

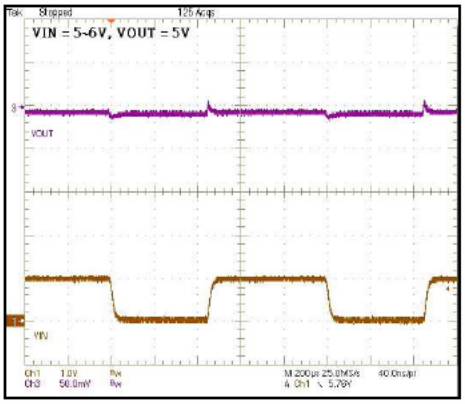


Figure 06. Line Transient

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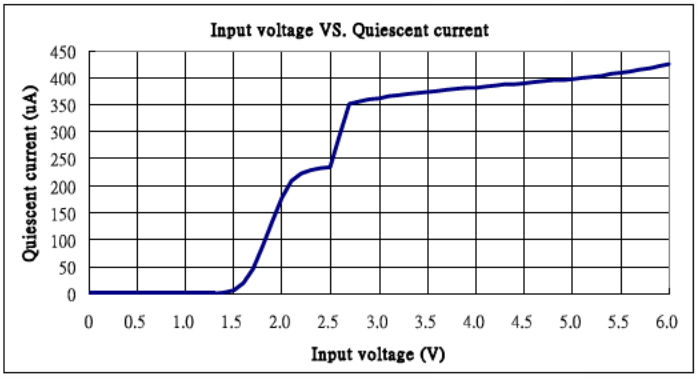


Figure 07. Input Voltage vs. Quiescent Current

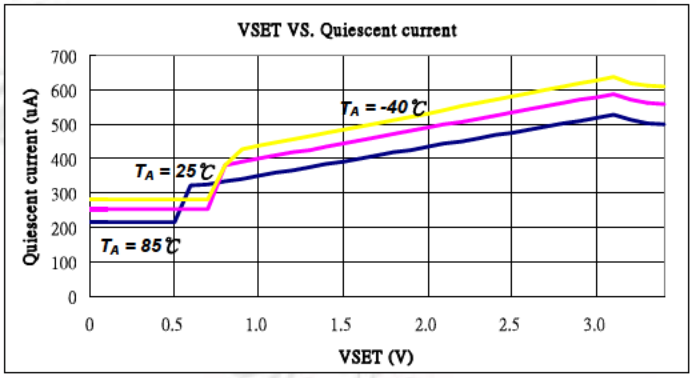


Figure 08. V_{SET} vs. Quiescent Current

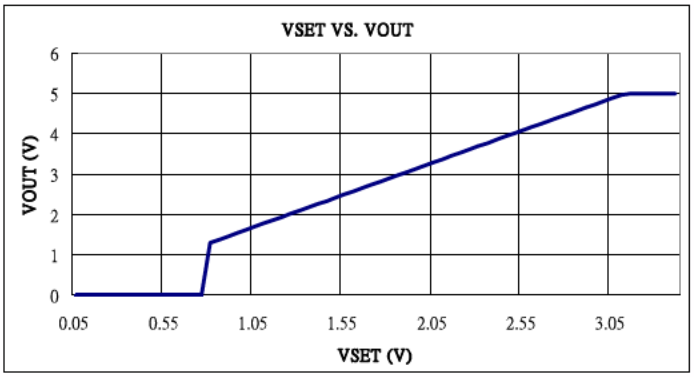


Figure 09. V_{SET} vs. V_{OUT}

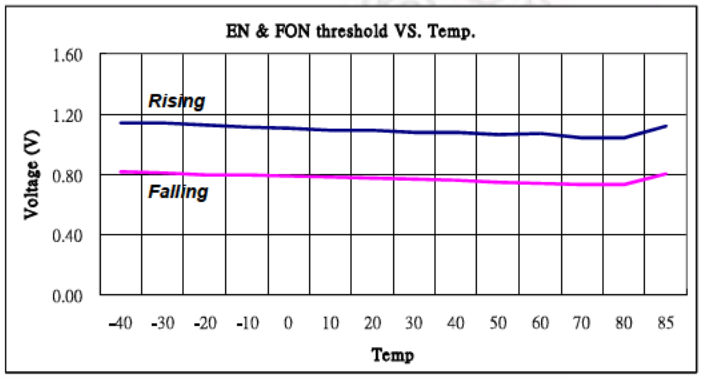


Figure 10. EN & FON Threshold vs. Temperature

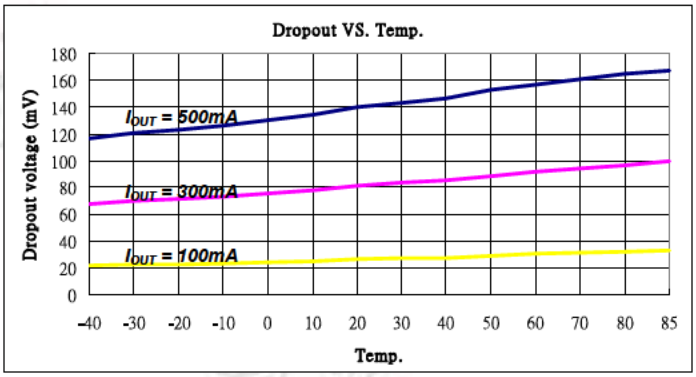
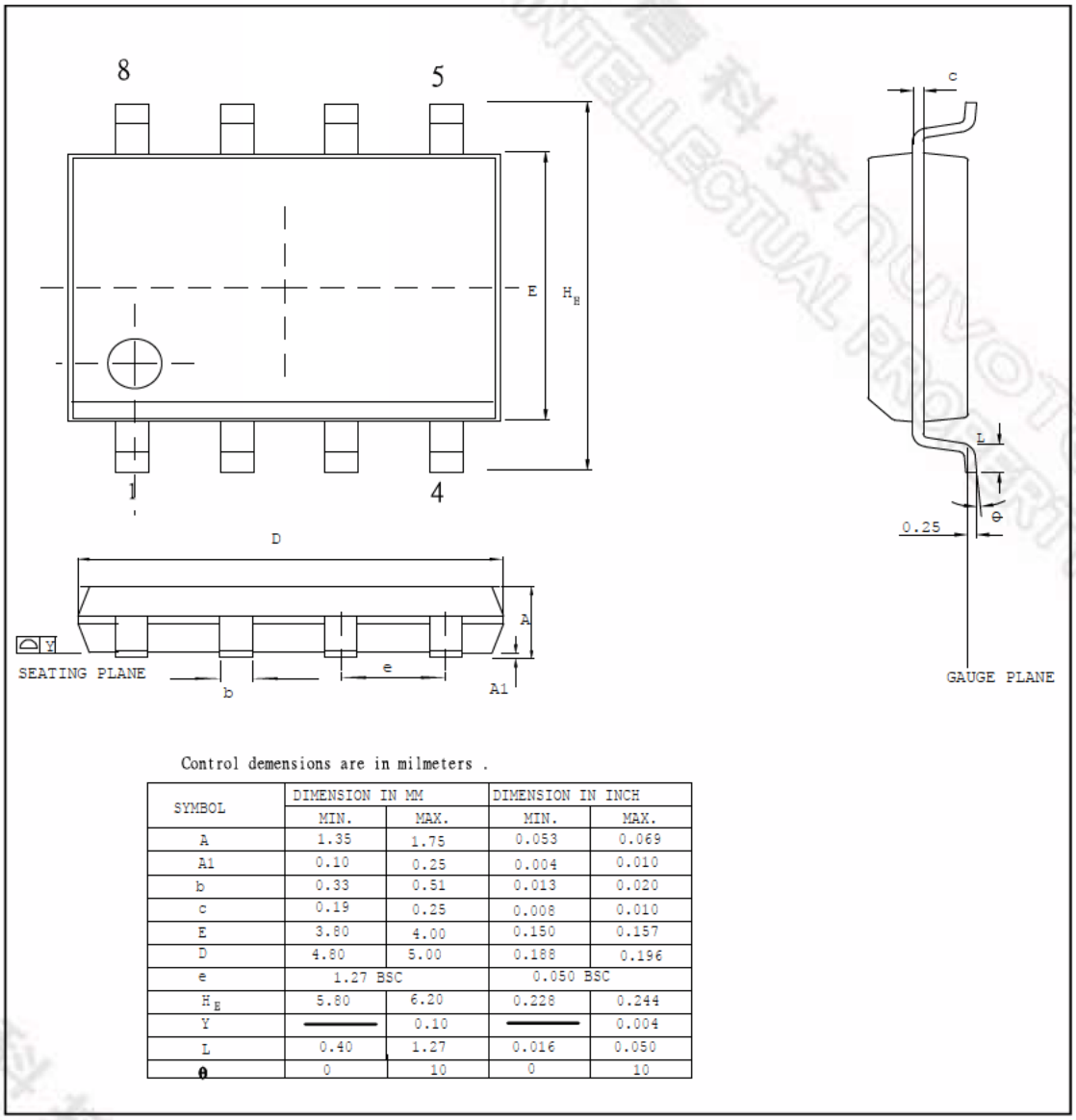


Figure 11. Dropout Voltage vs. Temperature

9. PACKAGE DIMENSION

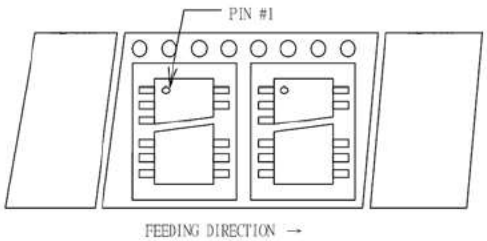
SOP-8 (150mil)



Control demensions are in milmeters .

SYMBOL	DIMENSION IN MM		DIMENSION IN INCH	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
b	0.33	0.51	0.013	0.020
c	0.19	0.25	0.008	0.010
E	3.80	4.00	0.150	0.157
D	4.80	5.00	0.188	0.196
e	1.27 BSC		0.050 BSC	
H_E	5.80	6.20	0.228	0.244
Y	—	0.10	—	0.004
L	0.40	1.27	0.016	0.050
θ	0	10	0	10

9.1 Taping Specification



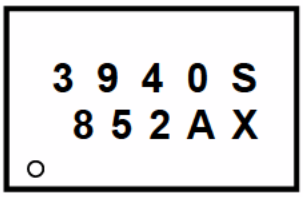
8 Pin SOP Package

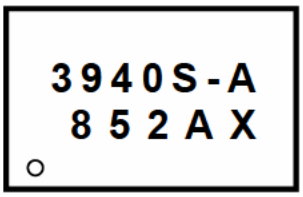
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10. ORDERING INFORMATION

Part Number	Package Type	Supplied as	Production Flow
NCT3940S	8PIN SOP (Green Package)	E Shape: 100 units/Tube T Shape: 2,500 units/T&R	Commercial, 0℃ to +70℃
NCT3940S-A			

11. TOP MARKING SPECIFICATION





1st Line: 3940S/ 3940S-A

2nd Line: Tracking code

- 852: packages assembled in Year 2008, week 52
- A: assembly house ID.
- X: IC version. (A means A; B means B and C means C…etc.)

12. REVISION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A1	11/28/2008	All	New Create
A2	11/28/2008	P8, P9	Added waveforms, fixed some description
A3	03/07/2011	All	Fixed some description

Important Notice

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