High-side Power Distribution Switch
NCT3521U

新唐科技 NUVOTON INTELLECTUAL PROPERTY

nuvoTon

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1. GENERAL DESCRIPTION

The NCT3521 power switch is an integrated 80mΩ power switch IC designed for high-side load switching applications.

The NCT3521 power switch operates with an input voltage range from 3.0 to 5.5V, making it ideal for both 3V and 5V systems. The NCT3521 Power Switch also features an under-voltage lock out which turns the switch off when an input under-voltage condition exists. The NCT3521 also have several protection that include current limiting, and thermal shutdown to prevent catastrophic switch failure caused by increasing power dissipation when continuous heavy loads or short circuit occurs. And a built-in charge pump is used to drive the N-channel MOSFET that is free of parasitic body diode to eliminate any reversed current flow across the switch when it is powered off. The NCT3521 features shutdown discharge function and soft-start function, this makes the NCT3521 has slowly turn on and fast turn off features.

Its low quiescent current and small package is particularly suitable in battery-powered equipment. In shutdown mode, the quiescent current decrease to less than 1uA.

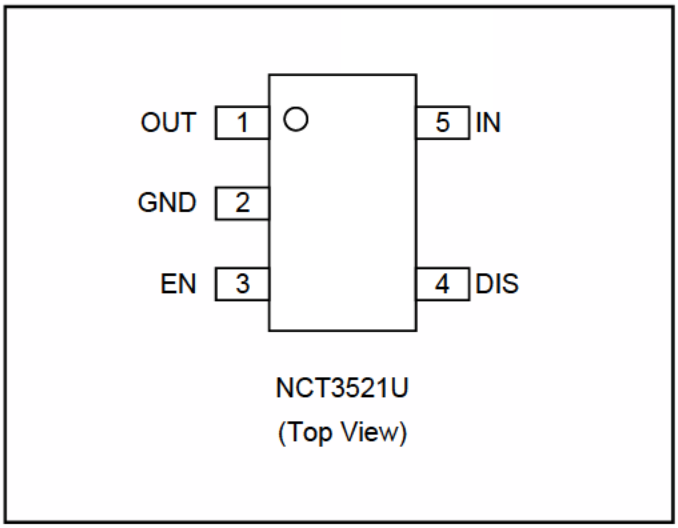
2. FEATURES

- 80mΩ High-Side MOSFET
- Continues current up to 2A, Current trip threshold 2.5A
- Operating Range from 2.7 to 5.5V
- 1.9mS Typical VOUT Turn-On Rise Time
- Under Voltage Lockout
- 70uA Quiescent Supply Current
- 1uA Shutdown Current
- Active-High Enable Pin
- Fast response time at OCP
- Reverse Input-Output Voltage Protection
- Adjustable Shutdown Discharge
- Slowly turn on and Fast turn off
- SOT-23-5 Lead Free (ROHS Compliant) and Halogen Free Package
- UL Approved file number: E346668

3. APPLICATIONS

- High-Side Power Protection Switch
- Hot Plug-Powered Hubs
- Battery-Charger Circuits

4. PIN CONFIGURATION AND DESCRIPTION

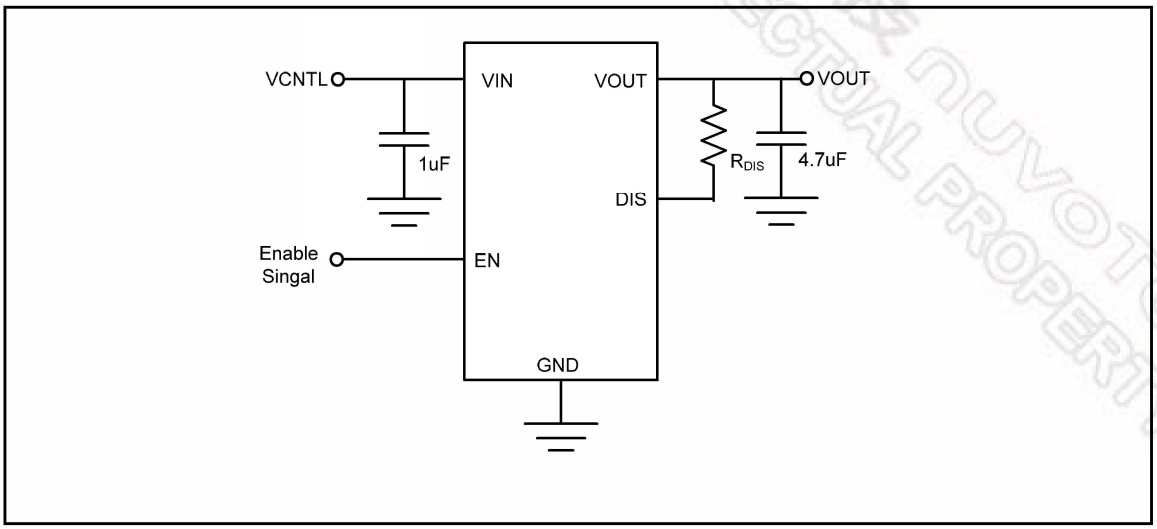


NCT3521U
(Top View)

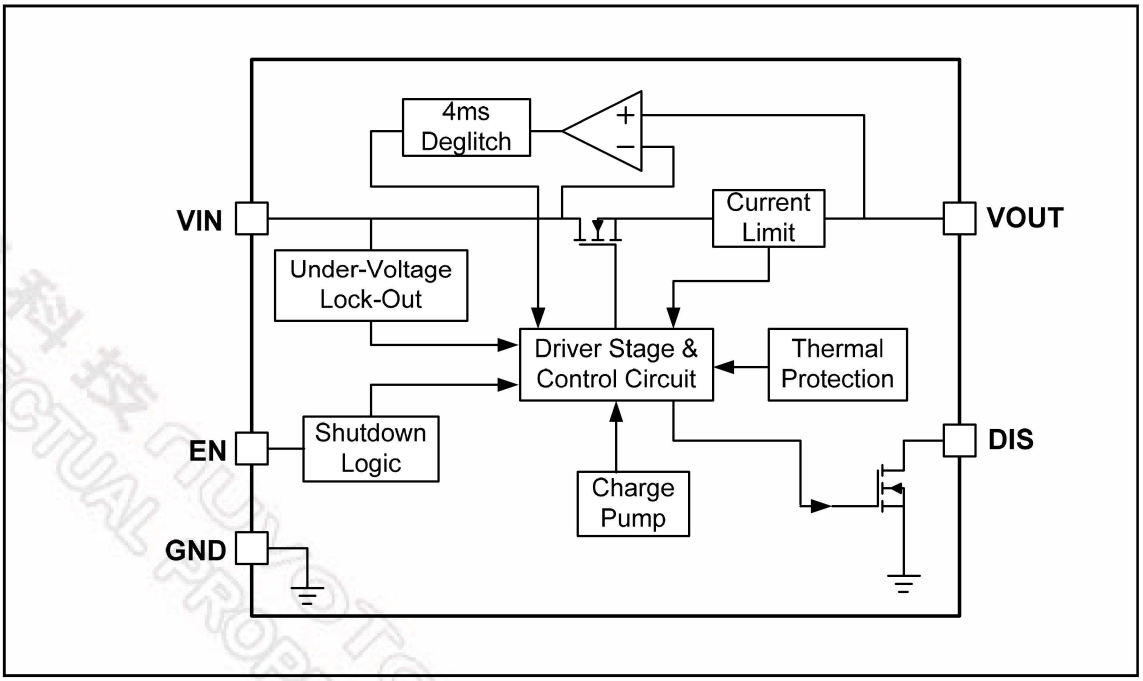
PIN#	PIN NAME	I/O	FUNCTION
1	OUT	O	**Output Voltage.** This pin is the N-MOSFET Source that delivers the voltage to output. Connecting a 0.1uF or greater ceramic capacitor from this pin to GND as close to the chip as possible.
2	GND		**GND.**
3	EN	I	**Enable.** High enable. Pulling this pin to the logic low will disable the chip.
4	DIS	I	**Discharge.** Drain of internal N-MOSFET. This pin will active when chip is disabled. By connecting a resistor from DIS to OUT pin, the voltage of OUT can be sink from this pin when chip is disabled.

5	IN	I	**Input Voltage.** This pin is the N-MOSFET Drain that supplies output current and also supplies operating current for the chip. Connecting a 0.1uF or greater ceramic capacitor from this pin to GND as close to the chip as possible.

5. TYPICAL APPLICATION CIRCUIT



6. BLOCK DIAGRAM



7. FUNCTIONAL DESCRIPTION

7.1 Product Introduction

The NCT3521 power switch is a N-Channel MOSFET power switches designed for high-side load switching applications.

Once turned on, the soft-start circuitry is activated and the output current is ramped up with linear until it reaches the level required for the output load condition. The typical soft-start time is 1.9ms.

7.2 Soft-start

The NCT3521 built-in soft-start function to reduce the inrush current and eliminate the voltage drop at Vin supply voltage when enabling. The soft-start interval is typically 1.9ms.

7.3 Under Voltage Lockout

UVLO (under voltage lockout) prevents the output MOSFET from turning on until VIN exceeds 2.6V typically. After the switch turns on, if the voltage drops below 2.3V typically, UVLO shuts off the output MOSFET. Built-in hysteresis prevents unwanted turn on/off due to input voltage drop from large current surges.

7.4 Enable

The NCT3521 is disabled when the EN pin is in the logic low condition. During disabled, the supply current reduces to below 1uA typically. The voltage level of enable pin is also compatible with both TTL and CMOS logic voltage levels. This pin can't floating, please connect logic high or logic low.

7.5 Over Current Limit

The NCT3521 contains an independent current limit and the short circuit current protection to prevent unexpected applications. The current limit monitors and controls the Internal MOSFET gate voltage, limiting the output current to higher than 2A typical. The output can be shorted to ground indefinitely without damaging the part.

7.6 Thermal-Shutdown Protection

Thermal protection limits power dissipation to prevent IC over temperature exceeds 150℃, the over-temperature protection circuit starts the thermal shutdown function and turns the pass transistor off. The pass transistor turns on again after the junction temperature is falling 50℃ (junction temperature ≦100℃).

7.7 Application information

- **Input Capacitor and Output Capacitor**

A minimum of 1uF ceramic capacitor is recommended to be placed directly next to the VIN pin. The Bypass capacitor should be placed as close as possible to the VIN pin to be effective in minimizing transients on the input.

- **Noise Immunity**

In very electrically noisy environments, it is recommended that 0.1uF ceramic capacitors be placed from IN to GND and OUT to GND as close to device pins as possible.

8. ELECTRICAL CHARACTERISTICS

8.1 Absolute Maximum Ratings

PARAMETER		RATING	UNIT
Input Supply Voltage		-0.3 to 6V	V
Other Pins		-0.3 to 6V	V
Power Dissipation, PD @ TA=25℃		Internal Limited	W
Package Thermal Resistance, SOT23-5, θ_{JA}		240	℃/W
Storage Temperature		-50 to 150	℃
Junction Temperature		150	℃
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.

8.2 Recommended Operating Conditions

PARAMETER	RATING	UNIT
Supply Voltage VIN	2.7 to 5.5	V
Ambient Operating Temperature	-40 to 85	℃
Junction Temperature	-40 to 125	℃

Note: Limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods.

8.3 DC Electrical Characteristics

(VEN = VIN = 5V, CIN = COUT = 10uF, TA = TJ = 25° C, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply voltage						
Supply Input Voltage	V_{IN}		2.7		5.5	V
V_{IN} Under Voltage Lockout			1.6	2.3	2.6	V
V_{IN} Under Voltage Hysteresis				0.2		V
Output MOS $R_{DS(ON)}$		I_{OUT} = 0.5A		80	115	mΩ
Input Supply Current	I_{IN}			70	80	uA
Shutdown Supply Current					1	uA
Softstart current	I_{SS}			55		uA
Enable						
Enable High Level	V_{EN}		1.6			V
Enable Low Level	V_{SD}				0.8	V
Supply Current					1	uA
Output Turn-on Rising Time		R_L = 10Ω, 90 % Setting	1.3	1.9	2.7	ms
Shutdown Discharge Resistance				30	60	Ω
Over Current Protection						
Current Limit Threshold	I_{LIMIT}	V_{OUT} = 4V	2.4	3	3.6	A
Output Short-circuit Current		V_{OUT} = 0V, 2.7V < VIN < 5.5V	0.2	1.3	1.9	A
Reverse Voltage Protection						
Reverse voltage trip level	V_{OUT-IN}		95	135	190	mV
Time from reverse voltage condition to MOSFET turn off		V_{IN} = 5V	2	4	8	ms
Thermal Protection						
Thermal Shutdown Temperature	T_{SD}			150		℃
Thermal Shutdown Hysteresis	T_{SDHYS}			50		℃

9. TYPICAL OPERATING WAVEFORMS

(VIN = VEN = 5V, C_{OUT} = 1uF, C_{IN} = 1uF, T_A = 25℃, unless otherwise specified)

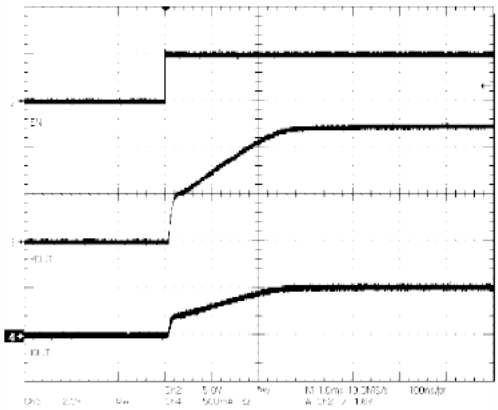


Figure 1. Turn-on and Rising-time

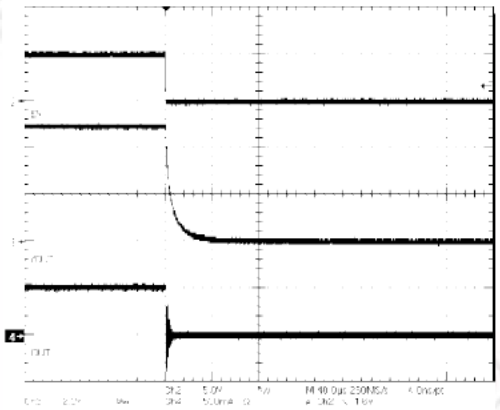


Figure 2. Turn-off and Falling-time

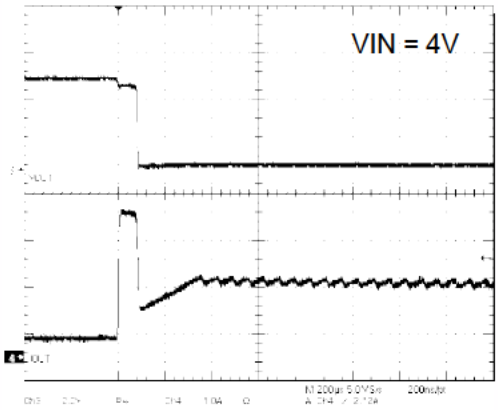


Figure 3. Current Limit Trip and Current Limit

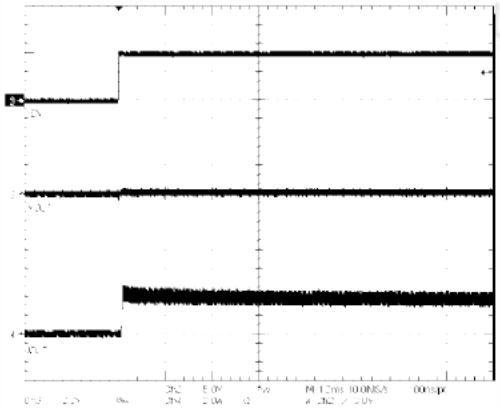


Figure 4. Short-circuit, device enable into short

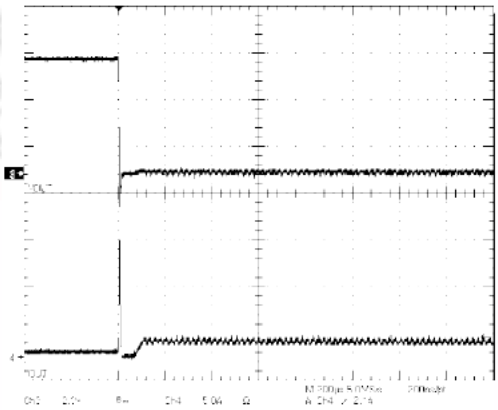


Figure 5. Short-circuit, Normal operation

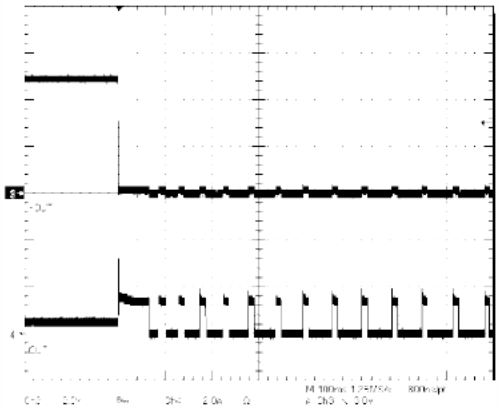


Figure 6. Over-temperature Protection

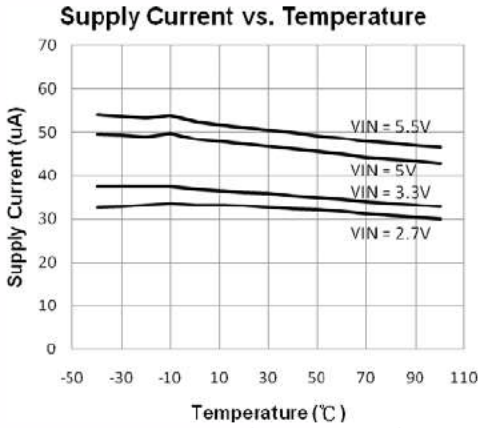


Figure 7. Supply current vs. Temperature

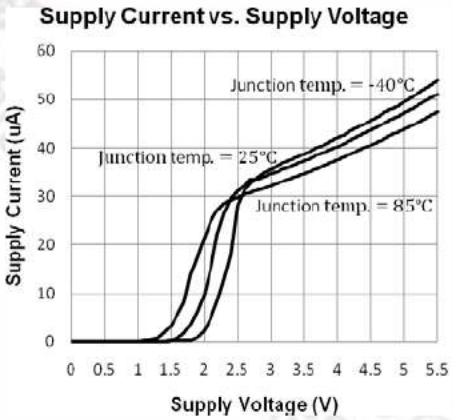


Figure 8. Over-temperature Protection

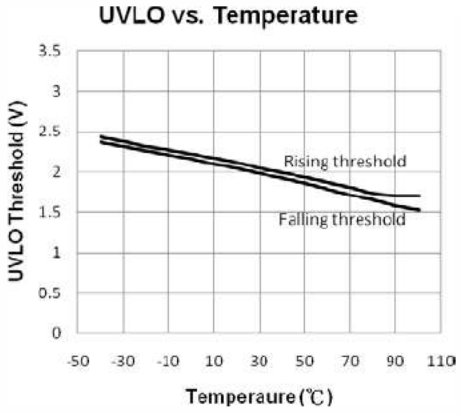


Figure 9 UVLO Threshold vs. Temperature

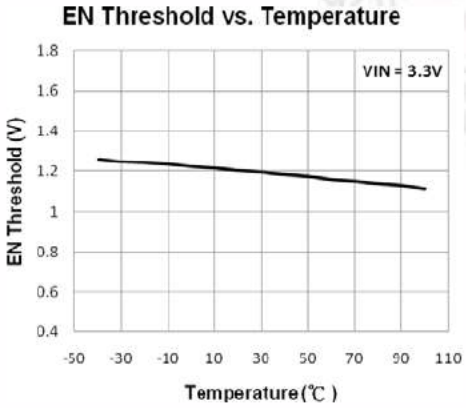


Figure 10. EN Threshold vs. Temperature

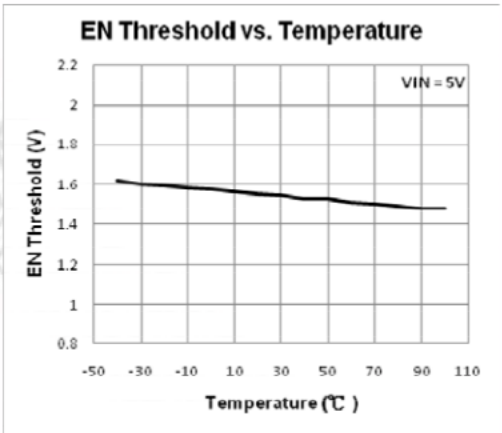


Figure 11 MOSFET $R_{DS(ON)}$ vs. Temperature

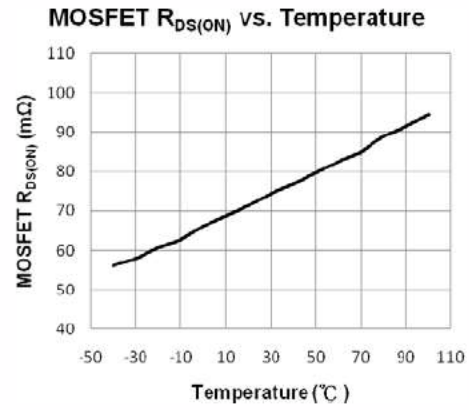
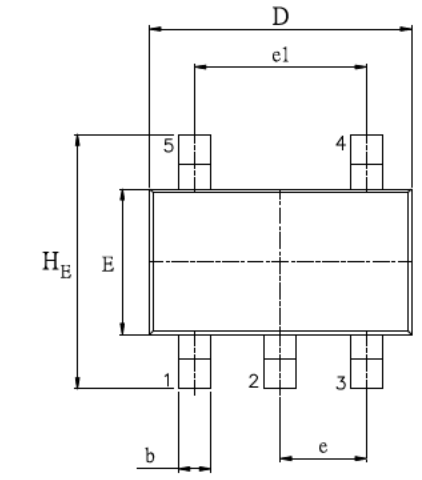
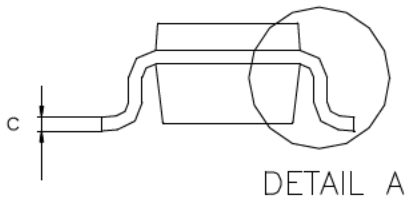


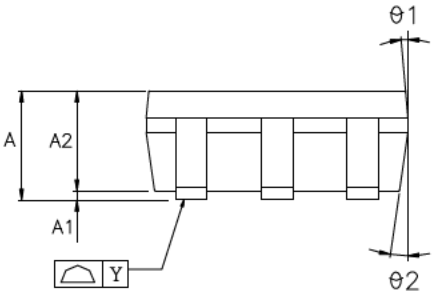
Figure 12. EN Threshold vs. Temperature

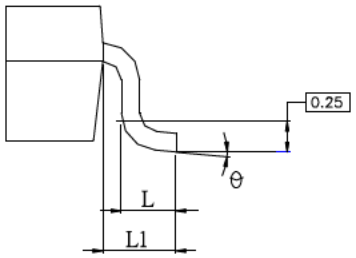
10. PACKAGE DIMENSION

- **NCT3521U SOT23-5 Package Outline**







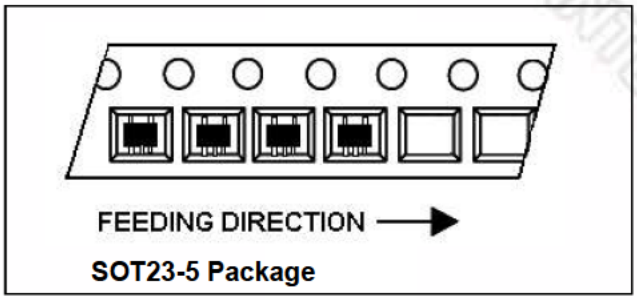


DETAIL A

COTROL DIMENSIONS ARE IN MILLIMETERS

SYMBOL	MILLIMETERS			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.05	1.20	1.35	0.041	0.047	0.053
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	1.00	1.10	1.2	0.039	0.043	0.047
b	0.25	–	0.50	0.010	–	0.020
c	0.08	–	0.20	0.003	–	0.008
D	2.70	2.90	3.00	0.106	0.114	0.118
H_E	2.60	2.80	3.00	0.102	0.110	0.118
E	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC.			0.075 BSC.		
L	0.35	0.45	0.55	0.014	0.018	0.022
L1	0.60 REF.			0.024 REF.		
θ	0°	5°	10°	0°	5°	10°
θ1	3°	5°	7°	3°	5°	7°
θ2	6°	8°	10°	6°	8°	10°
Y	–	–	0.10	–	–	0.004

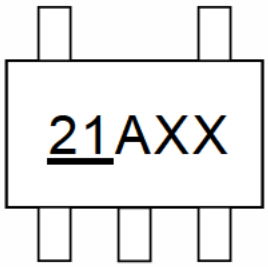
➢ **TAPING SPECIFICATION**



11. ORDERING INFORMATION

PART NUMBER	SUPPLIED AS	PACKAGE TYPE	OPERATING TEMPERATURE, TA
NCT3521U	T Shape: 3,000 units/T&R	SOT23-5 (Green package)	-40°C to +85°C

12. TOP MARKING SPECIFICATION



SOT23-5

1st Line: 21AXX

- 21: NCT3521U
- A : Internal Use Only
- XX: Assembly Date Code (Week)

13. REVISION HISTORY

VERSION	DATE	PAGE	DESCRIPTION
A0	05/27/2010	All	New Create
A1	06/30/2010	7,8	Updated waveform measurement
A2	11/24/2010	2,3	Correct the typo error
A3	01/06/2011	4	Correct some function description.
A4	06/20/2011	6,8	Correct EN threshold
A5	11/04/2011	All	Keep the NCT3521U information only. Added UL Approved number.

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

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