

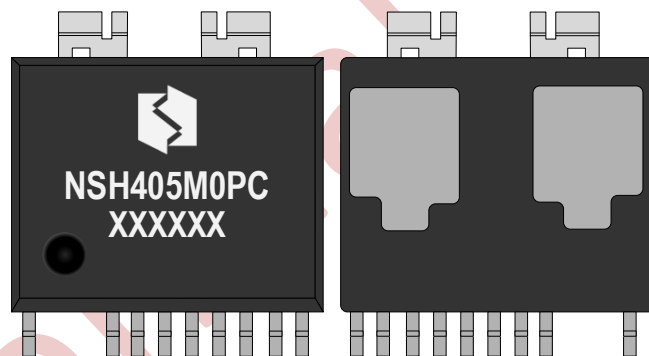


NSH405M0PC 4A, 500V Half-Bridge IPM

1. Features

- Under-voltage lockout for both channels
- High-level effective, supported 3.3V, 5V and 15V input
- Integrated gate drivers and bootstrap functionality
- Temperature detected output for MCU control
- Cross-conduction prevention logic
- Isolation 1500 VRMS min
- 500V maximum operating voltage
- 4A Peak pulse current @25°C
- Maximum Power Dissipation for each MOSFET
--14.2W
- High-Side Under-Voltage Protection
--Trigger level=7.7V
--Reset level= 8.7V

NSH405M0PC is a 4A, 500V half-bridge intelligence power module designed for motor drive applications, integrated 4A/500V MOSFET gate driver and bootstrap functionality in a small ESOP13 package. It can be flexibly applied to single-phase and three-phase DC brushless motor drive.



Device Information

Part Number	Package	Body size
NSH405M0PC	ESOP13	7.5mm x 9mm

2. Applications

- BLDC Motor control

3. Description

Internal Electrical Schematic

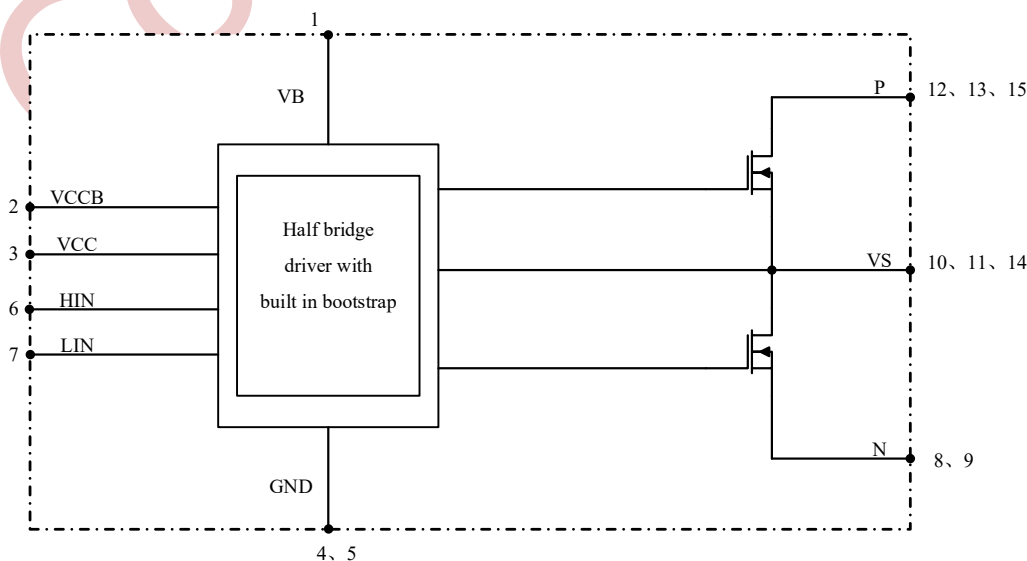


Fig.1 Internal Electrical Schematic

4. Selection Guide

PART No.	Input signal	UVLO	Built in BSD	BV _{DSS}	Pulse Current
NSH405M0PC	HIN, LIN	7.7/8.7V	YES	500V	4A

5. Order Information

PART No.	Marking	Package Type	packing of products	SPQ
NSH405M0PC	 NSH405M0PC XXXXX	ESOP13	Tape and reel	2.5K

6. Revision History

Version	Items	Time
V1.0	Created	2023.04.01
V1.1	Advanced EMI performance	2024.05.29



目录

1. FEATURES.....	1
2. APPLICATIONS	1
3. DESCRIPTION	1
4. SELECTION GUIDE	2
5. ORDER INFORMATION	2
6. REVISION HISTORY	2
7. PIN-OUT DESCRIPTION	4
8. ABSOLUTE MAXIMUM RATINGS.....	5
8.1 INVERTER PART.....	5
8.2 CONTROL PART	5
8.3 BOOTSTRAP FUNCTIONALITY	5
8.4 TOTAL SYSTEM.....	5
8.5 THERMAL AND MECHANICAL CHARACTERISTICS	5
9. RECOMMENDED OPERATING CONDITIONS	6
10. ELECTRICAL CHARACTERISTICS	7
10.1 CONVERT PART.....	7
10.2 CONTROL PART.....	7
11. FUNCTION DESCRIPTION	8
11.1 BASIC FUNCTION DESCRIPTION	8
11.2 TIME CHARTS OF PROTECTIVE FUNCTION	8
12. NSH405M0PC TYPICAL APPLICATION CIRCUIT	9
13. DETAILED PACKAGE OUTLINE DRAWING	10
14. ATTENTION	11

7. Pin-Out Description

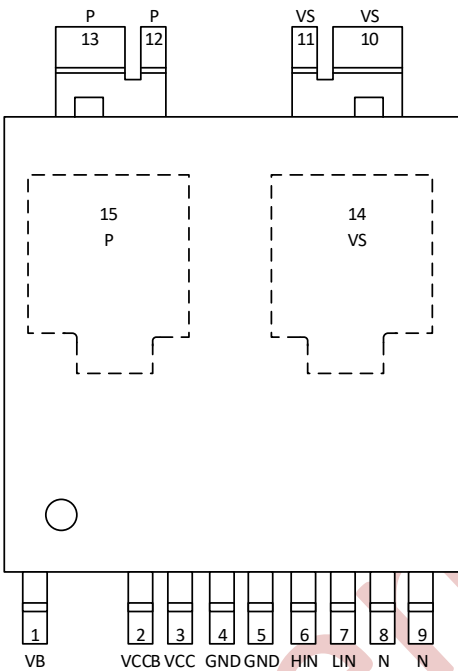


Fig2 Footprint Description

Table7-1 Pin description

PIN	Name	Description
1	VB	High Side Floating Supply
2	VCCB	Internal Diode Input
3	VCC	Gate Drive Supply
4-5	GND	Low Side Gate Drive Return
6	HIN	Logic Input for High Side
7	LIN	Logic Input for Low Side
8-9	N	Low Side Source Connection
10-11,14	VS	Phase Output
12-13,15	P	DC Bus

8. Absolute Maximum Ratings

T_j = 25°C, Unless Otherwise Specified

8.1 Inverter Part

Symbol	Parameter	Conditions	Ratings	Unit
V _{DSS}	Drain-Source Voltage of Each MOSFET	T _C = 25°C	500	V
I _D	Each MOSFET Current, Continuous	T _C = 25°C	2	A
		T _C = 75°C	1.5	A
I _{DM}	Each MOSFET Pulse Current, Peak	T _C = 25°C, less than 100us	4	A
		T _C = 75°C	3	A
I _{Drms}	Each MOSFET Current, Rms	T _C = 25°C, F _{PWM} < 20KHz	0.85	Arms
P _D	Maximum Power Dissipation	T _C = 25°C, For Each MOSFET	14.2	W

8.2 Control Part

Symbol	Parameter	Conditions	Ratings	Unit
V _{CC}	Control Supply Voltage	Applied between V _{CC} and COM	20	V
V _{BS}	High-side Bias Voltage	Applied between V _B and V _S	20	V
V _{IN}	Input Signal Voltage	Applied between V _{IN} and COM	-0.3~V _{CC} +0.3	V

8.3 Bootstrap Functionality

Symbol	Description	Conditions	Rating	Unit
V _{RRMB}	Maximum Repetitive Reverse Voltage	T _C = 25°C	500	V
I _{FB}	Forward Current	T _C = 25°C	0.25	A
I _{FPB}	Forward Peak Current, Peak	T _C = 25°C, Less than 1mS	0.5	A

8.4 Total System

Symbol	Parameter	Conditions	Ratings	Unit
T _j	Operating Junction Temperature		-40~150	°C
T _{STG}	Storage Temperature	T _C = 25°C	-40~125	°C
V _{ISO}	Isolation Voltage	60Hz, Sinusoidal, AC 1 min, between pins and heat-sink plate	1500	Vrms

NOTE1: To insure safe operation of the IPM, the average junction temperature should be limited to T_J ≤ 150°C (@T_C ≤ 100°C).

8.5 Thermal and Mechanical Characteristics

Symbol	Parameter	Conditions	Ratings	Unit
R _{th} (J-B)	Thermal resistance, junction to mounting pad, each MOSFET	For Each MOSFET	1.0	°C/W
R _{th} (J-A)	Thermal resistance, junction to ambient, each MOSFET	For Each MOSFET	40	°C/W

9. Recommended Operating Conditions

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V _{PN}	Supply Voltage	Applied between P and N	-	300	400	V
V _{CC}	Control Supply Voltage	Applied between VCC and COM	13.5	-	18.5	V
V _{BS}	High-Side Bias Voltage	Applied between VB and VS	13.5	-	18.5	V
V _{IN(ON)}	Input ON Threshold Voltage	Applied between VIN and COM	3.0	-	V _{CC}	V
V _{IN(OFF)}	Input OFF Threshold Voltage		0	-	0.6	V
t _{dead}	Blanking Time for Preventing Arm-Shor	V _{CC} = V _{BS} = 13.5 ~ 16.5 V, T _j <150°C	1.0	-	-	μs
F _{PWM}	PWM Switching Frequency	T _j <150°C	-	15	-	kHz

10. Electrical Characteristics

TJ= 25°C, Unless Otherwise Specified

10.1 Convert Part

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
BV _{DSS}	Drain - Source Breakdown Voltage	V _{IN} = 0 V, I _D = 250μA (NOTE 2)	500	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{IN} = 0 V, V _{DS} = 500 V	-	-	0.5	μA
V _{SD}	Drain - Source Diode Forward Voltage	V _{CC} = V _{BS} = 15V, V _{IN} = 0 V, I _D = -4 A	-	-	1.2	V
R _{DS(on)}	Drain-Source Turn-On Resistance	V _{CC} = V _{BS} = 15 V, V _{IN} = 5 V, I _D = 2 A	-	2.7	3.5	ohm
t _{ON}	Switching Times	V _{PN} = 300 V, V _{CC} = V _{BS} = 15 V, I _D = 0.5 A V _{IN} = 0/5 V, Inductive Load L = 3 mH (NOTE 3)	-	920	-	ns
t _{OFF}			-	520	-	ns
t _{tr}			-	210	-	ns
E _{ON}			-	40	-	μJ
E _{OFF}			-	10	-	μJ
R _{BSOA}	Reverse Bias Safe Operating Area	V _{PN} = 400 V, V _{CC} = V _{BS} = 15 V, I _D = I _{DP} , V _{DS} = BV _{DSS} , T = 150°C	Full Square			

NOTE 2: BV_{DSS} is the absolute maximum voltage rating between drain and source terminal of each FRFET inside IPM. V_{PN} should be sufficiently less than this value considering the effect of the stray inductance so that V_{DS} should not exceed BV_{DSS} in any case.

NOTE 3: t_{ON} and t_{OFF} include the propagation delay time of the internal drive IC. Listed values are measured at the laboratory test condition, and they can be different according to the field applications due to the effect of different printed circuit boards and wirings.

Please see Fig 3 for the switching time definition.

10.2 Control Part

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
I _{QCC}	Quiescent VCC Supply Current	V _{CC} = 15V V _{IN} = 5V Applied between VCC and COM	-	100	220	μA
I _{QB}	Quiescent VBS Supply Current	V _{DB} = 15V V _{IN} = 5V Applied between VB -VS	-	50	100	μA
UV _{CCD}	Low-Side Under-Voltage Protection	VCC Under-Voltage Protection Detection Level	-	7.7	-	V
UV _{CCR}		VCC Under-Voltage Protection Reset Level	-	8.7	-	V
UV _{BSD}	High-Side Under-Voltage Protection	VBS Under-Voltage Protection Detection Level	-	7.7	-	V
UV _{BSR}		VBS Under-Voltage Protection Reset Level	-	8.7	-	V
V _{IH}	ON Threshold Voltage	Logic HIGH Level, Applied between VIN and COM	-	-	2.6	V
V _{IL}	OFF Threshold Voltage	Logic Low Level, Applied between VIN and COM	-	-	0.8	V

11. Function Description

11.1 Basic Function description

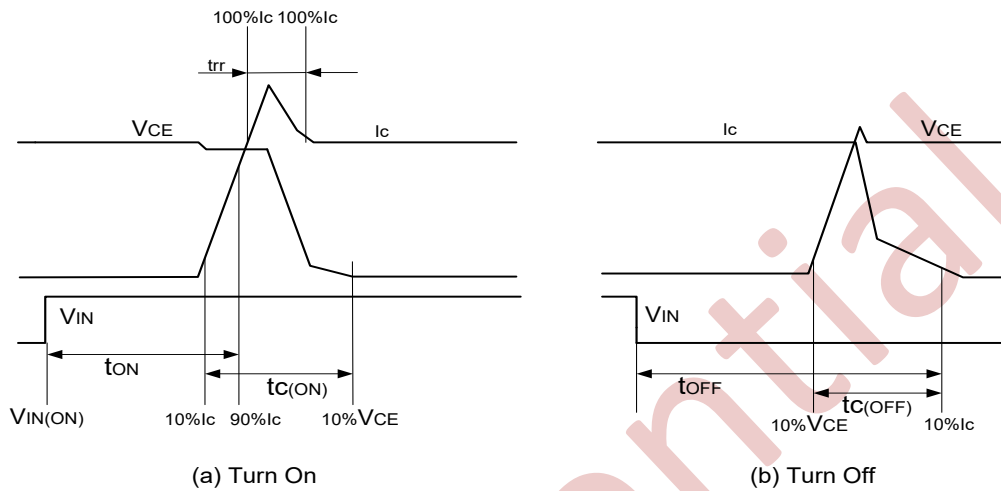


Fig. 3 Switching Time Definitions

11.2 Time Charts of Protective Function

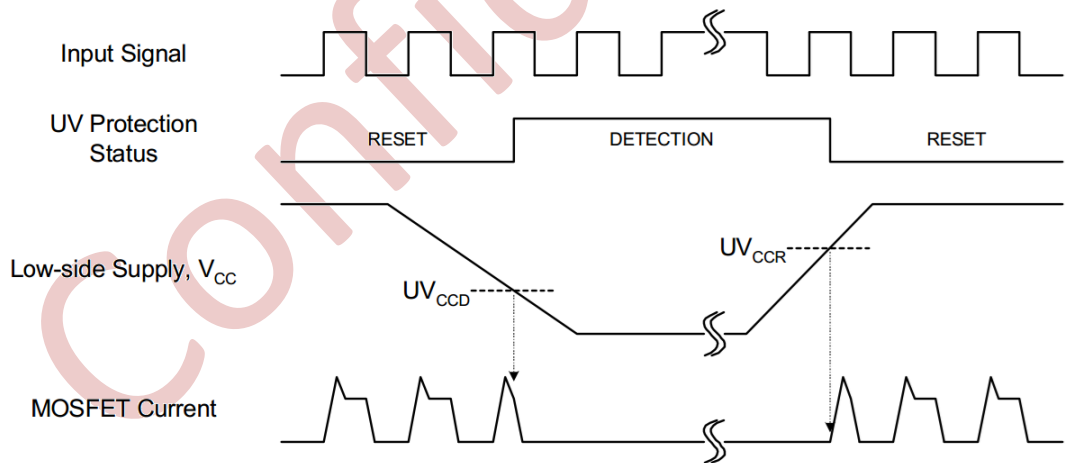


Fig. 4 Under voltage Protection (Low-side)

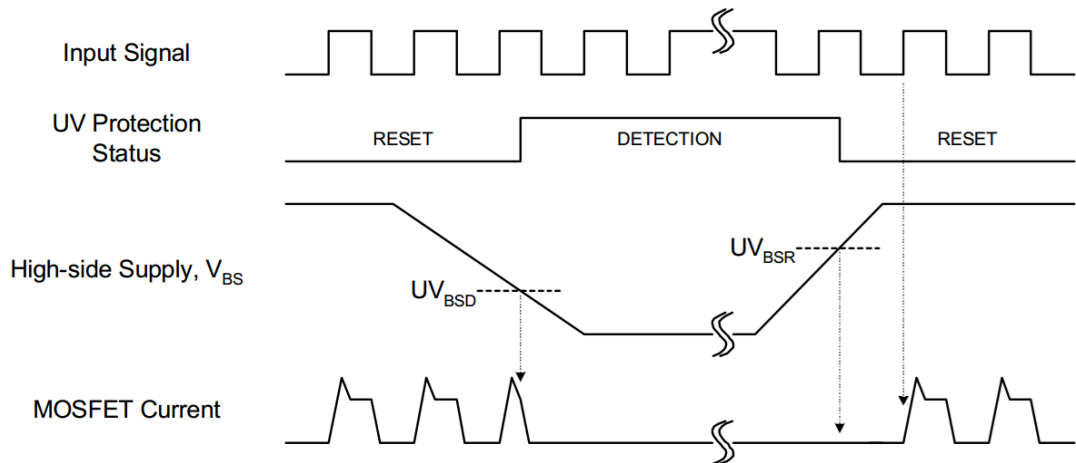


Fig. 5 Under voltage Protection (High-side)



12. NSH405M0PC Typical Application Circuit

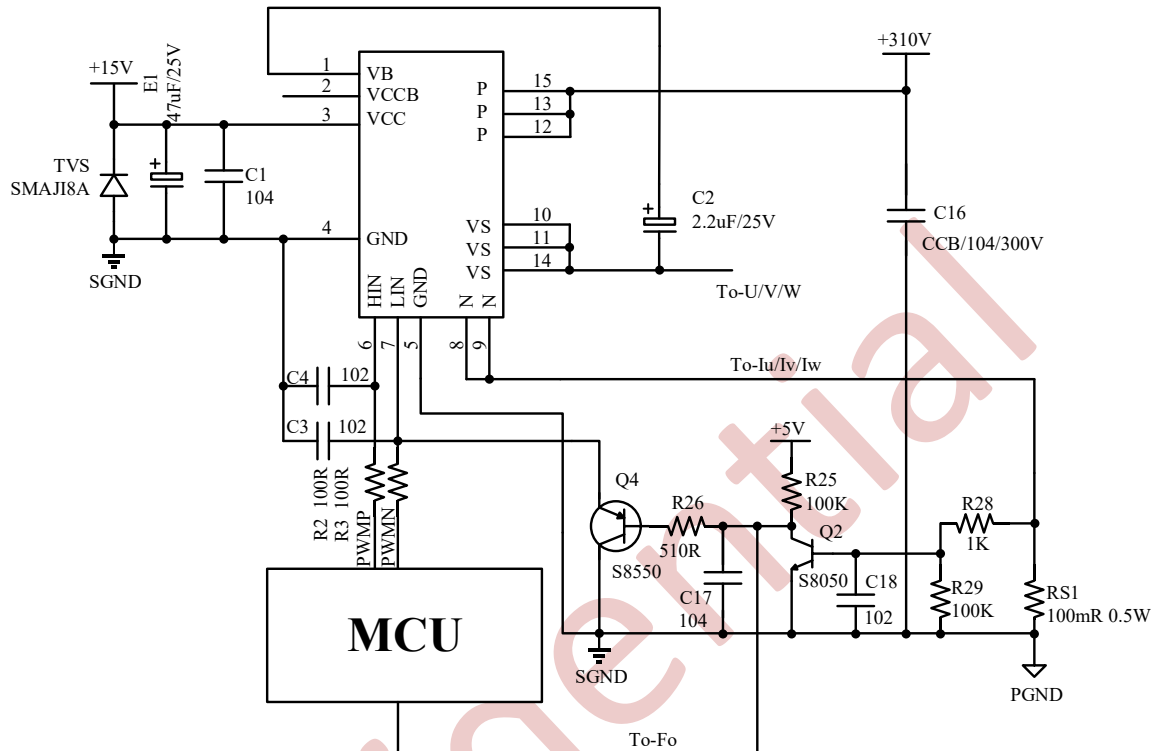


Fig.6 Typical Application Connection NSH405M0PC

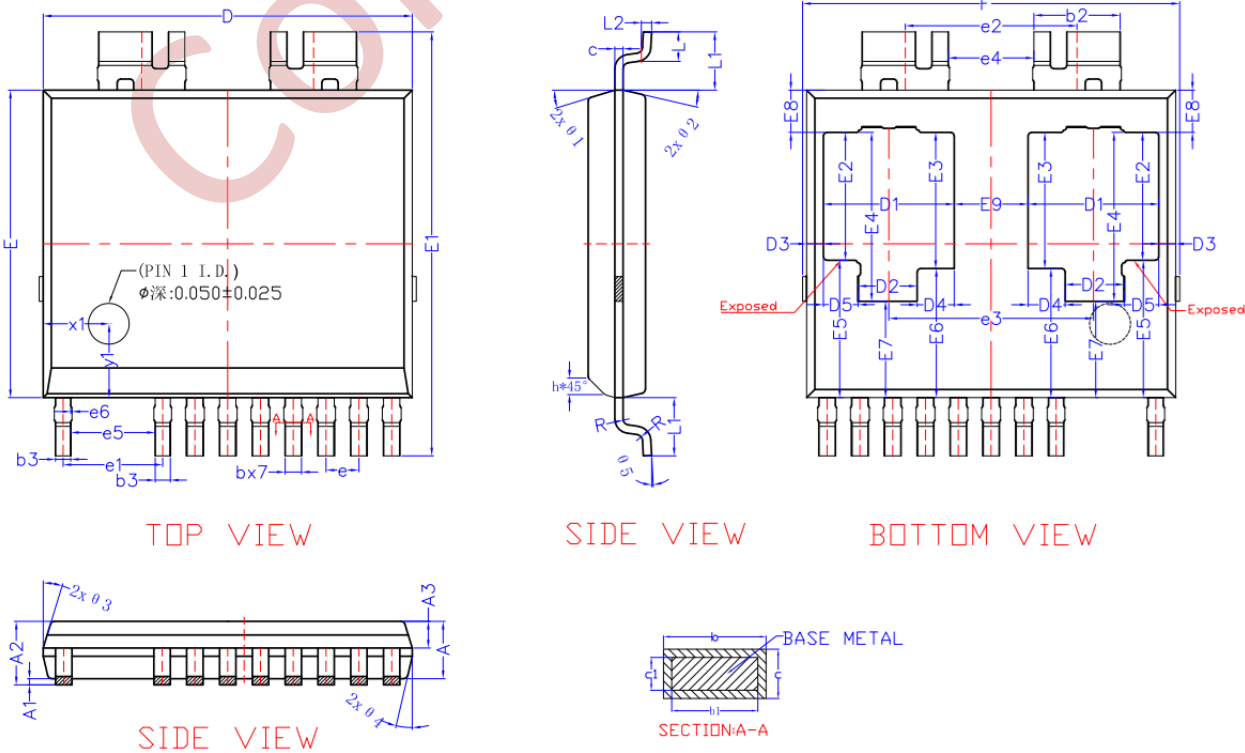
HIN	LIN	Output	Note
0	0	High Resistance	Both MOSFET Off
0	1	0	Low side MOSFET On
1	0	VDC	High side MOSFET On
1	1	Forbidden	Shoot through
open	open	High Resistance	Both MOSFET Off

13. Detailed Package Outline Drawing

ESOP13 Package Dimensions

Size Symbol	MIN(mm)	TYP(mm)	MAX(mm)	Size Symbol	MIN(mm)	TYP(mm)	MAX(mm)
A	1.350	1.400	1.450	E8	0.932	1.032	1.132
A1	0.020	/	0.120	E9	1.750	1.800	1.850
A2	1.370	/	1.570	e	0.750	0.800	0.850
A3	0.600	0.650	0.700	e1	2.380	2.430	2.480
b	0.380	/	0.460	e2	4.140	4.190	4.240
b1	0.370	0.400	0.430	e3	4.940	4.990	5.040
b2	2.050	2.100	2.150	e4	2.040	2.090	2.140
b3	0.320	0.370	0.420	e5	1.910	2.060	2.110
c	0.193	/	0.253	e6	-0.02	0.030	0.080
c1	0.170	0.203	0.230	F	9.000	-	9.400
D	8.900	9.000	9.100	L	0.620	0.720	0.820
D1	3.090	3.190	3.290	L1	1.320	1.420	1.520
D2	1.340	1.440	1.540		两边 L1 差值: 0.15 MAX		
D3	0.310	0.410	0.510	L2	0.25 BSC		
D4	0.805	0.905	1.005	R	0.10	/	/
D5	0.745	0.845	0.945	h	0.35	0.40	0.45
E	7.400	7.500	7.600	θ1	15°	17°	19°
E1	10.240	10.340	10.440	θ2	11°	13°	15°
E2	3.018	3.118	3.218	θ3	15°	17°	19°
E3	3.218	3.318	3.418	θ4	11°	13°	15°
E4	4.018	4.118	4.218	θ5	0°	3°	6°
E5	3.250	3.350	3.450	ø	0.90	1.00	1.10
E6	3.050	3.150	3.250	x1	1.50	1.60	1.70
E7	2.250	2.350	2.450	yl	1.70	1.80	1.90

Package Outlines





14. Attention

- Any and all NSIC products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your NSIC representative nearest you before using any NSIC products described or contained herein in such applications.
- NSIC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all NSIC products described or contained herein.
- Specifications of any and all NSIC products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- NSIC Technology (Wuxi) CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all NSIC products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of NSIC Technology (Wuxi) CO.,LTD.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. NSIC believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the NSIC product that you intend to use.
- This catalog provides information as of May 2024. Specifications and information herein are subject to change without notice.