



NSH505PQ 5A, 500V Half-Bridge IPM

1. Features

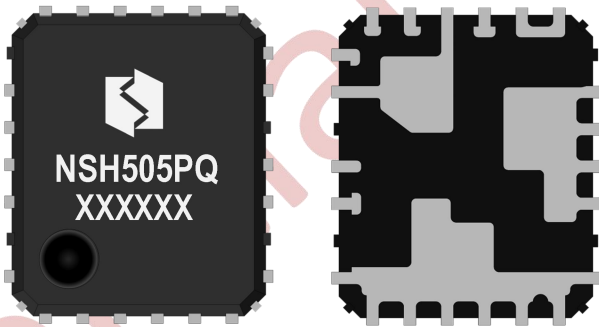
- Under-voltage lockout for both channels
- High-level effective, supported 3.3V, 5V and 15V input
- Integrated gate drivers and bootstrap functionality
- Temperature detected output for MCU control
- Cross-conduction prevention logic
- Isolation 1500 VRMS min
- 500V maximum operating voltage
- 5A Peak pulse current @25℃
- Maximum Power Dissipation for each MOSFET --14.2W
- High-Side Under-Voltage Protection --Trigger level=8.2V --Reset level= 8.9V

2. Applications

- BLDC Motor control

3. Description

NSH505PQ is a 5A,500V half-bridge intelligence power module designed for motor drive applications, integrated 5A/500V MOSFET gate driver and bootstrap functionality in a small PQFN 5×6mm package. It can be flexibly applied to single-phase and three-phase DC brushless motor drive.



Device Information

Part Number	Package	Body size
NSH505PQ	PQFN5x6	5mm x 6mm

Internal Electrical Schematic

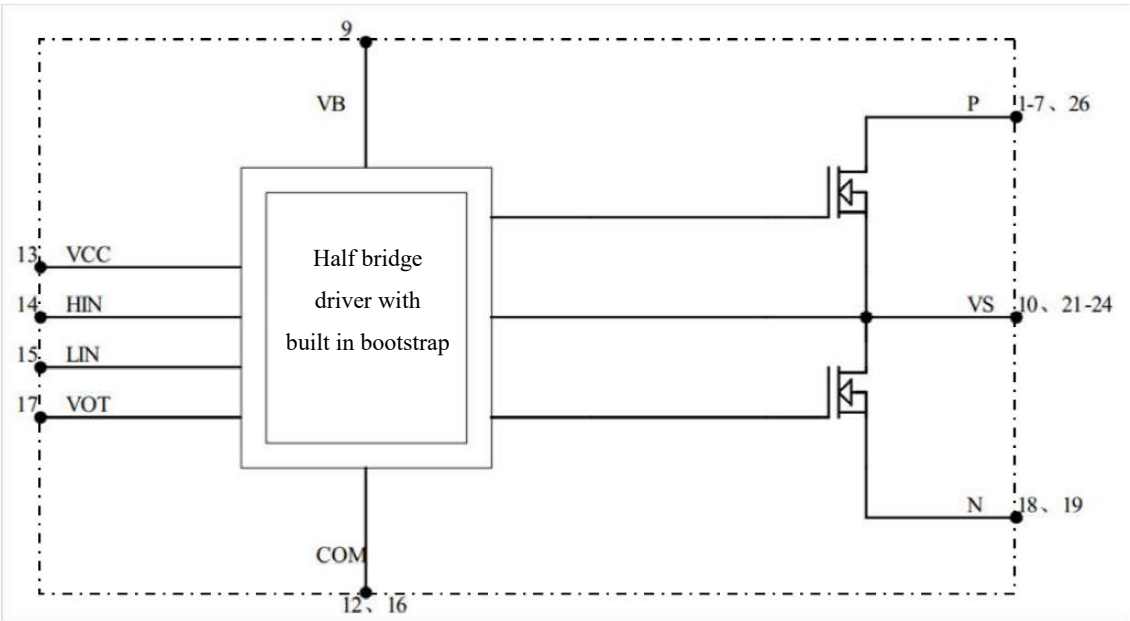


Fig.1 Internal Electrical Schematic

4. Selection Guide

PART No.	Input signal	Deadtime	UVLO	Built in BSD	BV _{DSS}	Pulse Current
NSH505PQ	HIN, LIN	540ns	8.2/8.9V	YES	500V	5A

5. Order Information

PART No.	Marking	Package Type	packing of products	SPQ
NSH505PQ	 NSH505PQ XXXXXX	PQFN5x6	Tape and reel	6 K

6. Revision History

Version	Items	Time
V1.0	Created	2022.04.01
V1.1	Advanced EMI performance	2023.05.29



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	9
12. NSH505PQ TYPICAL APPLICATION CIRCUIT	10
13. DETAILED PACKAGE OUTLINE DRAWINGS	11

7. Pin-Out Description

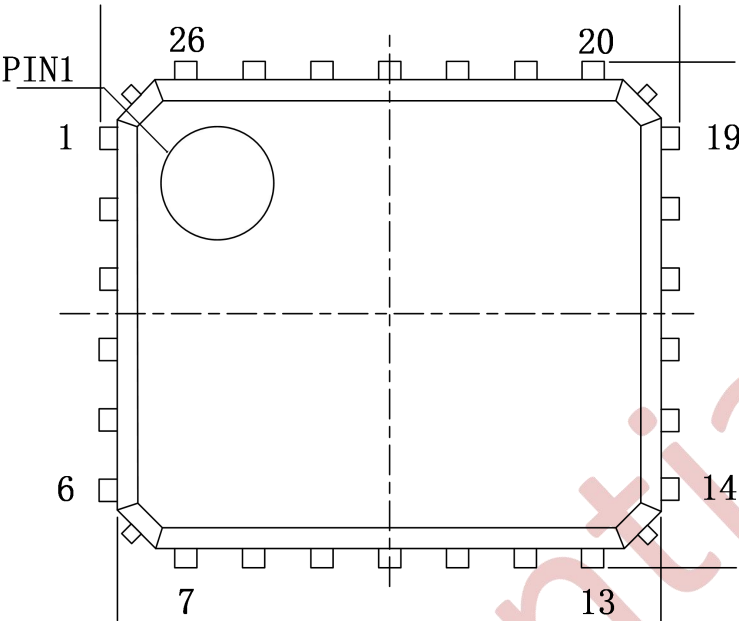


Fig2 Footprint Description

Table7-1 Pin description

PIN	Name	Description
13	VCC	Gate Drive Supply
14	HIN	Logic Input for High Side
15	LIN	Logic Input for Low Side
17	VOT	Temperature Signal Out
12、16	COM	Low Side Gate Drive Return
18,19	N	Low Side Source Connection
10、21-24	VS	Phase Output
1-7、26	P	DC Bus
9	VB	High Side Floating Supply (Bootstrap Cap Connection)

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 (T _C refer to Fig:5)	2.5	A
		T _C = 75°C	1.75	A
I _{DM}	Each MOSFET Pulse Current, Peak	T _C = 25°C, less than 100us	5	A
		T _C = 75°C	3.5	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	450	V
V_{CC}	Control Supply Voltage	Applied between VCC and COM	13.5	15.0	16.5	V
V_{BS}	High-Side Bias Voltage	Applied between VB and VS	13.5	15.0	16.5	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	$V_{CC} = V_{BS} = 13.5 \sim 16.5 \text{ V}$, $T_j < 150^\circ\text{C}$	1.0	-	-	μs
F_{PWM}	PWM Switching Frequency	$T_j < 150^\circ\text{C}$	-	15	20	kHz



10. Electrical Characteristics

T_J = 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 = 1 mA (NOTE 2)	500	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{IN} = 0 V, V _{DS} = 500 V	-	-	1	mA
V _{SD}	Drain - Source Diode Forward Voltage	V _{CC} = V _{BS} = 15V, V _{IN} = 0 V, I _D = -0.5 A	-	0.9	-	V
R _{DS(on)}	Drain-Source Turn-On Resistance	V _{CC} = V _{BS} = 15 V, V _{IN} = 5 V, I _D = 0.5 A	-	2	2.5	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 _r			-	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 Current VCC Supply	V _{CC} = 15V V _{IN} = 5V Applied between VCC and COM	-	360	500	μA
I _{QB}	Quiescent Current VBS Supply	V _{DB} = 15V V _{IN} = 5V Applied between VB -VS	-	70	210	μA
UV _{CCD}	Low-Side Under-Voltage Protection	VCC Under-Voltage Protection Detection Level	7.4	8.2	9.0	V
UV _{CCR}		VCC Under-Voltage Protection Reset Level	8.0	8.9	9.8	V
UV _{BSD}	High-Side Under-Voltage Protection	VBS Under-Voltage Protection Detection Level	7.4	8.2	9.0	V
UV _{BSR}		VBS Under-Voltage Protection Reset Level	8.0	8.9	9.8	V
V _{TS}	HVIC Temperature Sensing Voltage Output	V _{CC} = 15 V, T _{HVIC} = 25°C (Fig:4)	0.6	0.75	0.90	V
V _{IH}	ON Threshold Voltage	Logic HIGH Level, Applied between VIN and COM	2.5	-	-	V
V _{IL}	OFF Threshold Voltage	Logic Low Level, Applied between VIN and COM	-	-	0.8	V
DT	Deadtime	T _c = 25°C, V _{CC} = 15V	400	540	680	ns

11. Function Description

11.1 Basic Function description

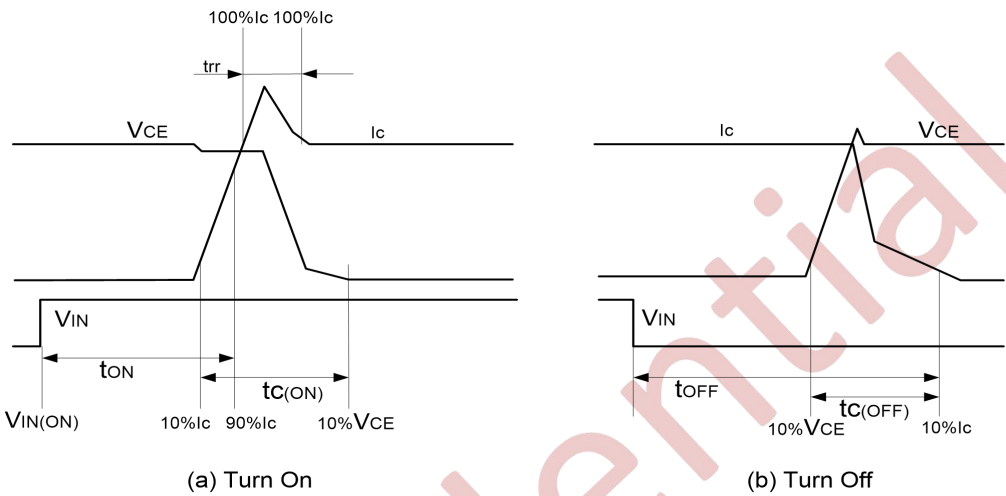


Fig. 3 Switching Time Definitions

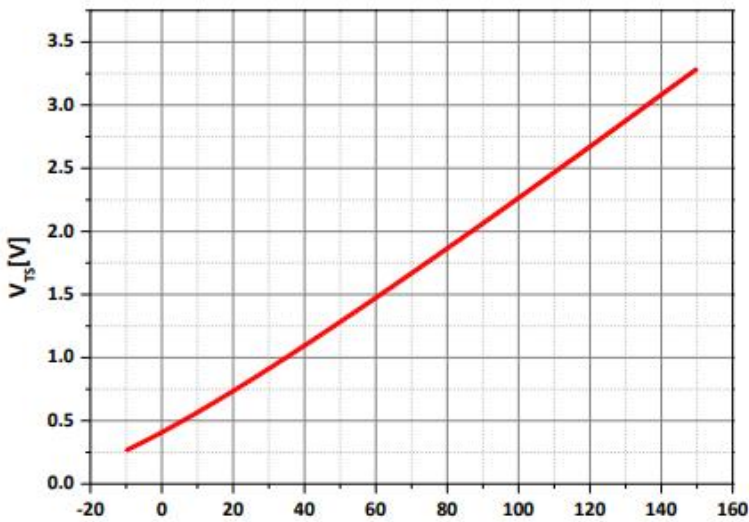


Fig. 4 Curves of HVIC Temperature detection—voltage curve

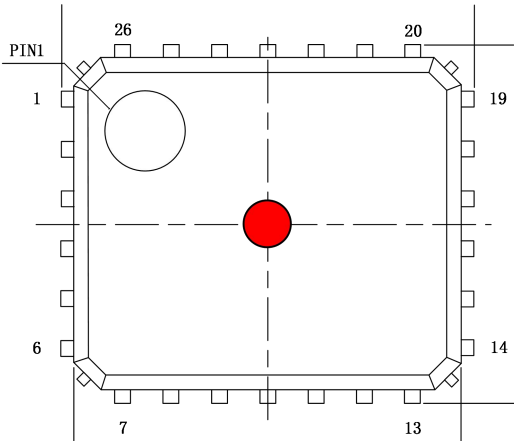


Fig. 5 Case Temperature Measurement



11.2 Time Charts of Protective Function

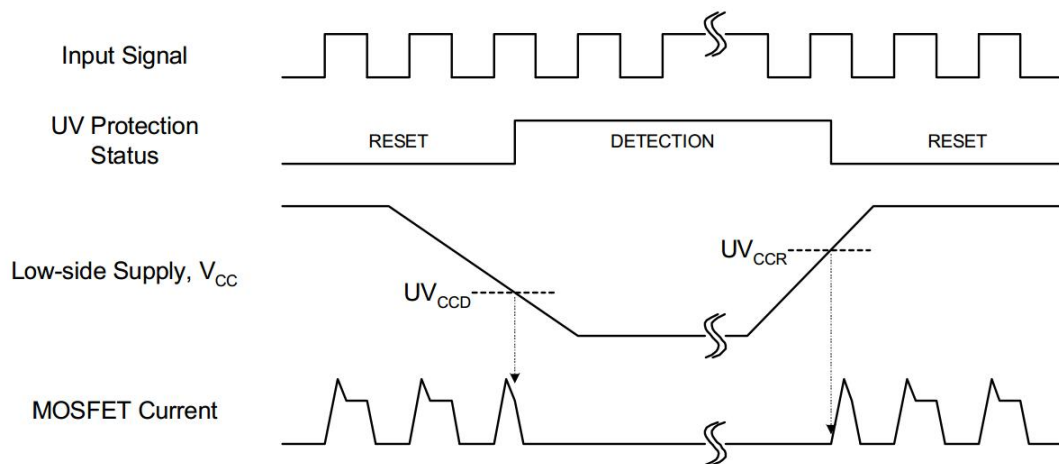


Fig. 6 Under voltage Protection (Low-side)

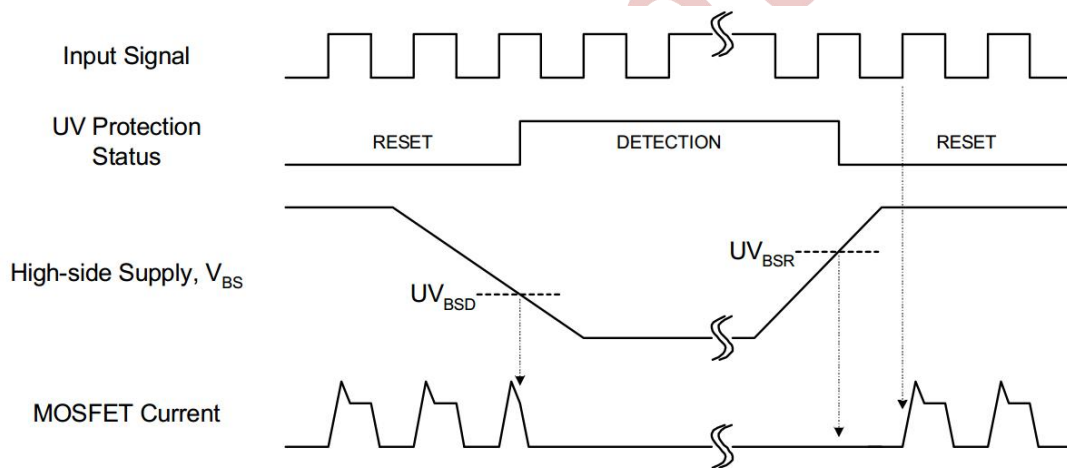


Fig. 7 Under voltage Protection (High-side)

12. NSH505PQ Typical Application Circuit

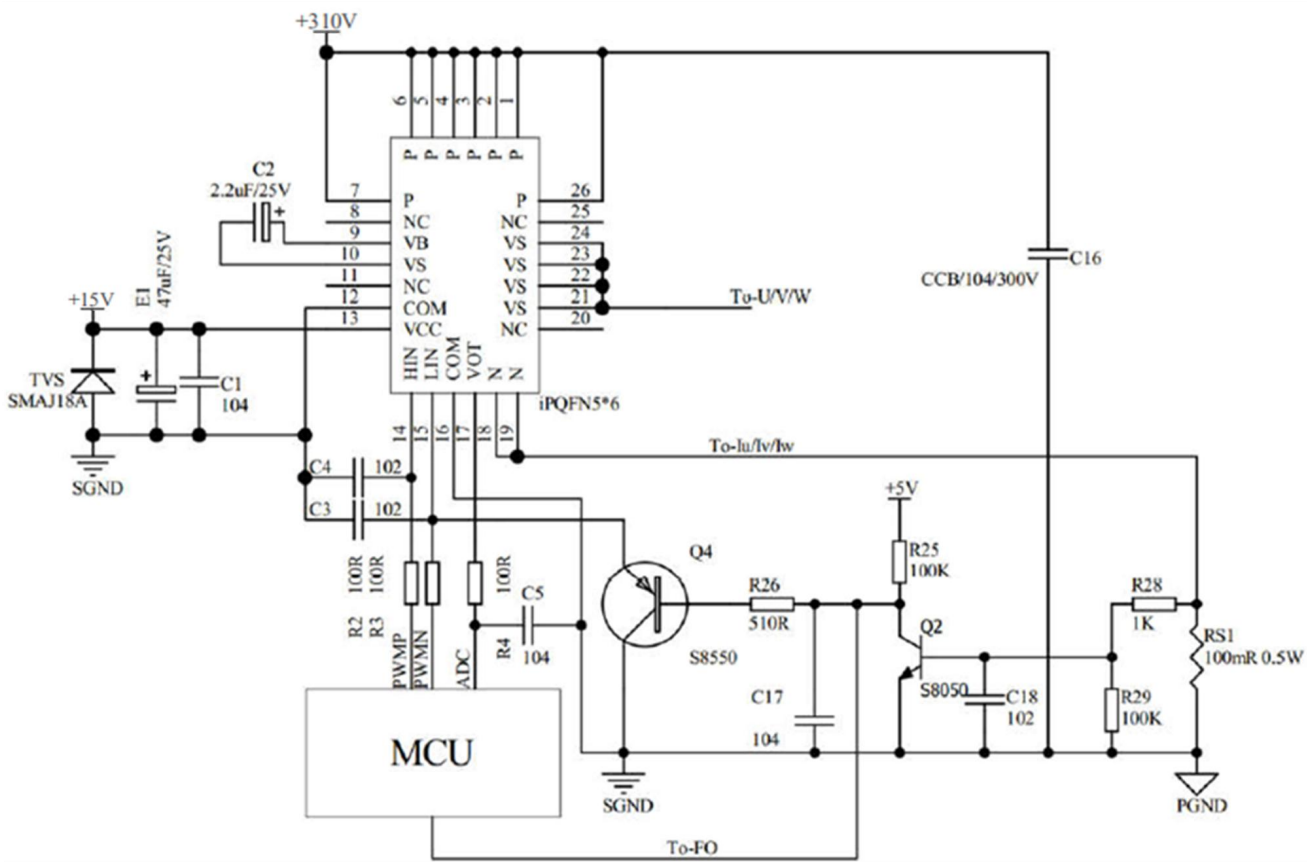


Fig.8 Typical Application Connection NSH505PQ

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

- 1、使用时，模块要做好防潮处理，建议刷三防漆或者外部点绝缘胶
- 2、使用时，建议检测模块17脚温度信号，增加过温保护或者降功率，最高保护温度120℃（VOT=2.5V）。
- 3、使用时，尽量做好散热处理，可以参考加绝缘垫片或者陶瓷片，粘合到散热器上。



13. Detailed Package Outline Drawing

PQFN5x6 Package Dimensions

Size Symbol	MIN(mm)	TYP(mm)	MAX(mm)	Size Symbol	MIN(mm)	TYP(mm)	MAX(mm)
A	0.950	1.100	1.250	E3	1.325	1.475	1.625
b	0.150	0.250	0.380	E4	1.325	1.475	1.625
c	0.154	0.254	0.354	E5	0.850	1.000	1.150
D	5.958	6.108	6.258	E6	0.300	0.450	0.600
D1	6.250	6.400	6.550	e	0.650	0.750	0.850
D2	1.935	2.085	2.325	i	/	/	0.200
D3	1.400	1.550	1.700	k	1.000	/	/
D4	2.575	2.725	2.875	L	0.050	0.200	0.350
E	4.958	5.108	5.258	L1	0.450	0.600	0.750
E1	5.250	5.400	5.550	θ	9°	12°	15°
E2	1.515	1.665	1.815	ϕ	1.000	1.200	1.400

Package Outlines

