

### Product Overview

The NSI6801 is a single-channel isolated gate driver which is pin-compatible for popular opto-coupled gate driver. It can source and sink 5A peak current. System robustness is supported by 150kV/us minimum common-mode transient immunity (CMTI).

The driver operates with a maximum supply voltage of 32V. While the input circuit imitates the characters of LEDs, it has performance advantages compared to standard opto isolated gate drivers, including better reliability and aging performance, higher working temperature, shorter propagation delay and smaller pulse width distortion.

As a result, the NSI6801 is suitable to replace opto-isolated driver in high reliability, power density and efficiency switching power system.

### Key Features

- Isolated single-channel driver
- Pin compatible, drop in upgrade for opto isolated gate drivers
- Driver side supply voltage: up to 32V with UVLO
- 5A peak source and sink output current
- High CMTI:  $\pm 150\text{kV/us}$
- 75ns typical propagation delay
- 30ns maximum pulse width distortion
- Operation ambient temperature:  $-40^\circ\text{C} \sim 125^\circ\text{C}$
- Lead-free component, suitable for lead-free soldering profile:  $260^\circ\text{C}$ , MSL3
- RoHS& REACH Qualified

### Safety Regulatory Approvals

- UL recognition:  $5700V_{\text{RMS}}$  SOW6,  $5000V_{\text{RMS}}$  DUB8 and  $5000V_{\text{RMS}}$  SOP8 for 1 minute per UL1577
- DIN VDE V 0884-11:2017-01
- CSA component notice 5A
- CQC certification per GB4943.1-2011

### Applications

- DC-to-AC solar inverters
- Motor drives
- UPS and battery chargers
- Isolated DC/DC and AC/DC power supplies

### Device Information

Part Number	Spec difference	Package	Body Size
NSI6801B-DSWFR	9V	SOW6	7.5×4.68×2.30mm
NSI6801B-DSPR	9V	SOP8	4.9×3.9×1.35mm
NSI6801C-DSWFR	13V	SOW6	7.5×4.68×2.30mm
NSI6801C-DSPR	13V	SOP8	4.9×3.9×1.35mm
NSI6801TB-DDBR	9V	DUB8	9.32×6.4×3.40mm
NSI6801TC-DDBR	13V	DUB8	9.32×6.4×3.40mm
NSI6801LC-DDBR	13V	DUB8	9.32×6.4×3.40mm

### Functional Block Diagram

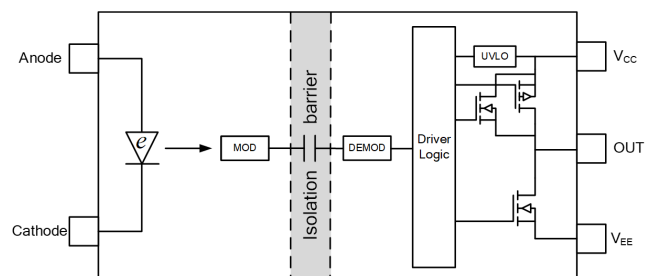


Figure 1. NSI6801 Block Diagram

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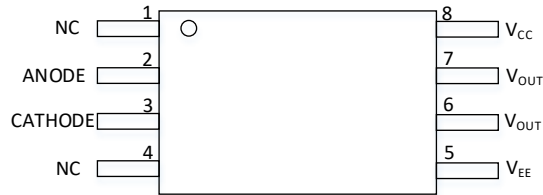
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# 1. Pin Configuration and Functions

NSI6801 SOW6 Top View



NSI6801T DUB8 and SOP8 Top View



NSI6801L DUB8 Top View

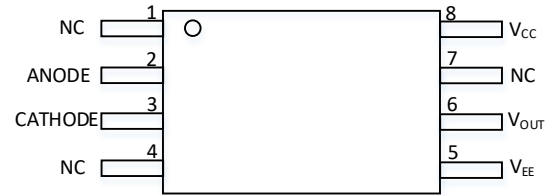


Table 1.1 NSI6801 Pin Configuration and Description

SYMBOL	PIN NO.			FUNCTION
	NSI6801 SOW6	NSI6801T DUB8 and NSI6801 SOP8	NSI6801L DUB8	
ANODE	1	2	2	Anode of LED emulator
CATHODE	3	3	3	Cathode of LED emulator
V <sub>EE</sub>	4	5	5	Negative output supply rail
V <sub>OUT</sub>	5	6, 7	6	Gate-drive output
V <sub>CC</sub>	6	8	8	Positive output supply rail
NC	2	1, 4	1, 4, 7	No Connection

## 2. Absolute Maximum Ratings

Parameters	Symbol	Min	Max	Unit
Average Input Current	$I_{F\_AVG}$		25	mA
Peak Transient Input Current	$I_{F\_PEAK}$		0.2	A
Reverse Input Voltage	$V_{R\_MAX}$		6.5	V
Driver Side Supply Voltage	$V_{CC-V_{EE}}$	-0.3	35	V
Output Signal Voltage	$V_{OUT}$	$V_{EE}-0.3$	$V_{CC}+0.3$	V
Operating Junction Temperature	$T_J$	-40	150	°C
Storage Temperature	$T_{stg}$	-65	150	°C

## 3. ESD Ratings

Ratings		Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD ● All pins	±2000	V
	Charged device model (CDM), per AEC-Q100-011-RevB ● All pins	±1000	V

## 4. Recommended Operating Conditions

Parameters	Symbol	Min	Max	Unit
Input Current (ON)	$I_{F(ON)}$	7	16	mA
Input Voltage (OFF)	$V_{F(off)}$	-5.5	0.9	V
Driver Side Supply Voltage (NSI6801C)	$V_{CC-V_{EE}}$	14	32	V
Driver Side Supply Voltage (NSI6801B)	$V_{CC-V_{EE}}$	10	32	V
Ambient Temperature	$T_A$	-40	125	°C

## 5. Thermal Information

Parameters	Symbol	NSI6801			Unit
		SOW6	DUB8	SOP8	
Junction-to-ambient thermal resistance	$R_{\theta JA}$	125	110	110	°C/W
Junction-to-top characterization parameter	$\Psi_{JT}$	30	30	18	°C/W

## 6. Specifications

### 6.1. DC Electrical Characteristics

(Unless otherwise noted, Typical values are at  $V_{CC}=15V$ ,  $V_{EE}=GND$ ,  $T_A=25^{\circ}C$ . All min and max specifications are at  $T_J=-40^{\circ}C$  to  $150^{\circ}C$ ,  $V_{CC}=14V$  to  $32V$ ,  $V_{EE}=GND$ ,  $I_{F(ON)}=7mA$  to  $16mA$ ,  $V_{F(off)}=-5.5V$  to  $0.9V$ )

Parameter	Symbol	Min	Typ	Max	Unit	Condition
<b>Driver Side Supply</b>						
High Level Supply Current	$I_{CCH}$		1.7	3	mA	$I_F=10mA$ , $I_{OUT}=0mA$
Low Level Supply Current	$I_{CCL}$		1.6	3	mA	$V_F=0V$ , $I_{OUT}=0mA$
<b>Driver Side Supply UVLO Threshold (NSI6801C, 13V UVLO Level)</b>						
VCC UVLO Rising Threshold	$V_{CC\_ON}$	12.6	13.2	13.7	V	$I_F=10mA$
VCC UVLO Falling Threshold	$V_{CC\_OFF}$	11.7	12.3	12.7	V	
VCC UVLO Hysteresis	$V_{CC\_HYS}$		0.9		V	
<b>Driver Side Supply UVLO Threshold (NSI6801B, 9V UVLO Level)</b>						
VCC2 UVLO Rising Threshold	$V_{CC2\_ON}$	8.7	9.2	9.7	V	$I_F=10mA$
VCC2 UVLO Falling Threshold	$V_{CC2\_OFF}$	8	8.5	9	V	
VCC2 UVLO Hysteresis	$V_{CC2\_HYS}$		0.7		V	
<b>Input Pin Characteristic</b>						
Input Forward Threshold Current Low to High	$I_{FLH}$	1.5	2.7	4	mA	$V_{OUT}>5V$ , $C_g=1nF$
Threshold Input Voltage High to Low	$V_{FHL}$	0.9			V	$V_{OUT}<5V$ , $C_g=1nF$
Input Forward Voltage	$V_F$	1.8	2.1	2.4	V	$I_F=10mA$
Temp Coefficient of Input Forward Voltage	$\Delta V_F/\Delta T$		0.34		mV/ $^{\circ}C$	$I_F=10mA$
Input Reverse Breakdown Voltage	$V_R$	6.5			V	$I_R=10\mu A$
Input Capacitance	$C_{IN}$		17		pF	$f=1MHz$
<b>Output Pin Characteristic</b>						
High Level Output Voltage	$V_{OH}$	$V_{CC}-0.3$	$V_{CC}-0.15$		V	$I_{OUT}=-50mA$ , $I_F=10mA$
			$V_{CC}$			$I_{OUT}=0mA$ , $I_F=10mA$
Low Level Output Voltage	$V_{OL}$		30	65	mV	$I_{OUT}=50mA$ , $V_F=0V$
High Level Peak Output Current	$I_{OH}$		5.2		A	$V_{CC}=15V$ , pulse width $<10\mu s$
Low Level Peak Output Current	$I_{OL}$		5.4		A	$V_{CC}=15V$ , pulse width $<10\mu s$

## 6.2. Switching Electrical Characteristics

(Unless otherwise noted, Typical values are at  $V_{CC}=15V$ ,  $V_{EE}=GND$ ,  $T_A=25^{\circ}C$ . All min and max specifications are at  $T_J=-40^{\circ}C$  to  $150^{\circ}C$ ,  $V_{CC}=14V$  to  $32V$ ,  $V_{EE}=GND$ ,  $I_{F(ON)}=7mA$  to  $16mA$ ,  $V_{F(off)}=-5.5V$  to  $0.9V$ )

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Propagation Delay	$t_{PLH}$	50	75	100	ns	$C_{LOAD}=1nF$ , $f=20kHz$ (50% Duty Cycle)
Propagation Delay	$t_{PHL}$	50	69	100	ns	
Pulse Width Distortion $ t_{PLH}-t_{PHL} $	$t_{PWD}$		6	30	ns	
Propagation Delay Difference Between Any Two Parts ( $t_{PHL}-t_{PLH}$ ) <sup>(1)</sup>	PDD	-35		35	ns	
Output Rise Time (20% to 80%)	$t_R$		6	20	ns	
Output Fall Time (80% to 20%)	$t_F$		6	20	ns	
Common Mode Transient Immunity	CMTI	150			kV/us	

(1) The difference between  $t_{PHL}$  and  $t_{PLH}$  between any two parts under the same test condition, ensured by characterization.

### 6.3. Typical Performance characteristics

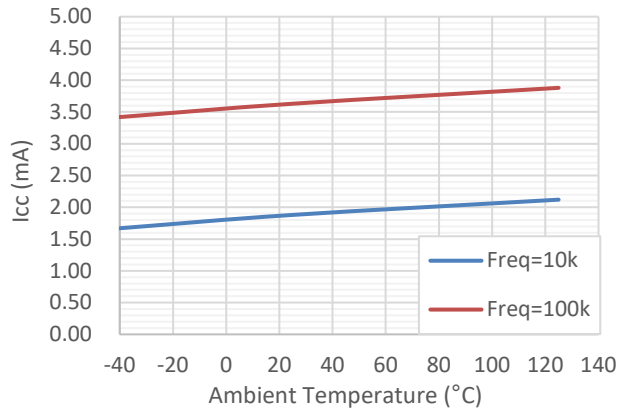


Figure 6.1 Supply currents versus Temperature

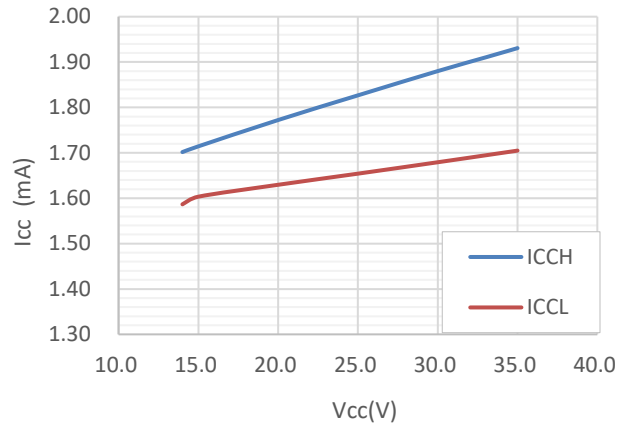


Figure 6.2 Supply current versus Supply Voltage

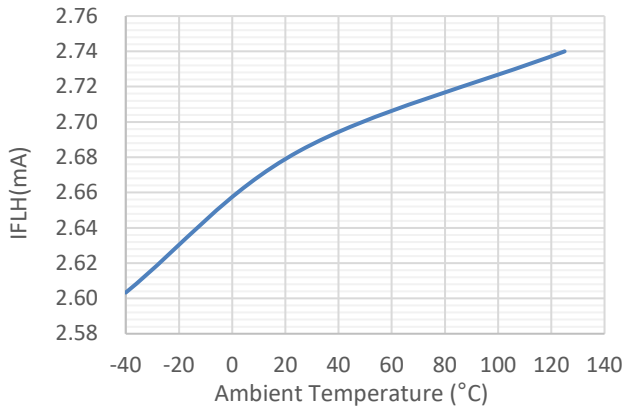


Figure 6.3 Forward threshold current versus Temperature

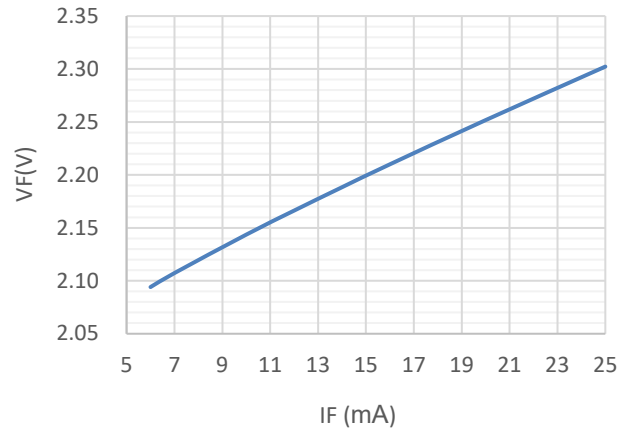


Figure 6.4 Forward current versus Forward voltage drop

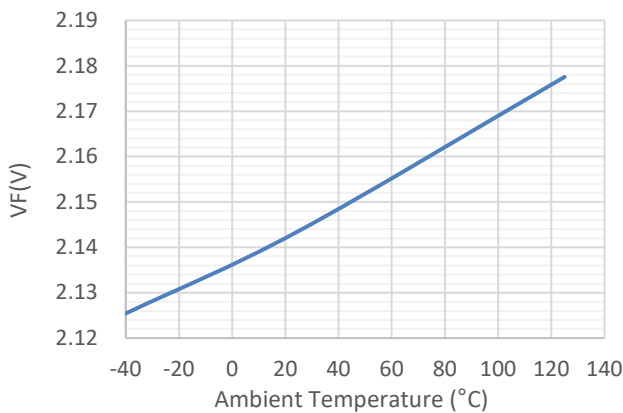


Figure 6.5 Forward voltage drop versus Temperature

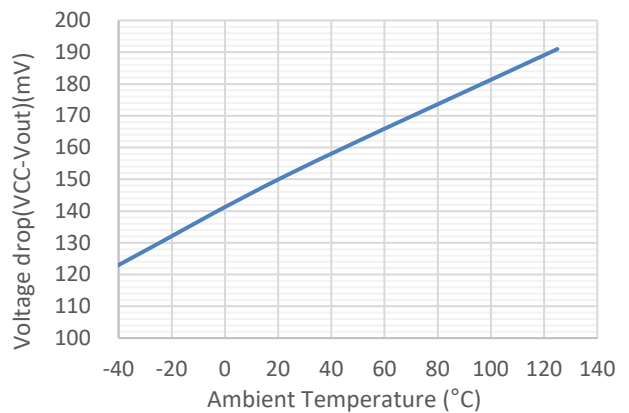


Figure 6.6 V<sub>OH</sub> (50mA Load) versus Temperature

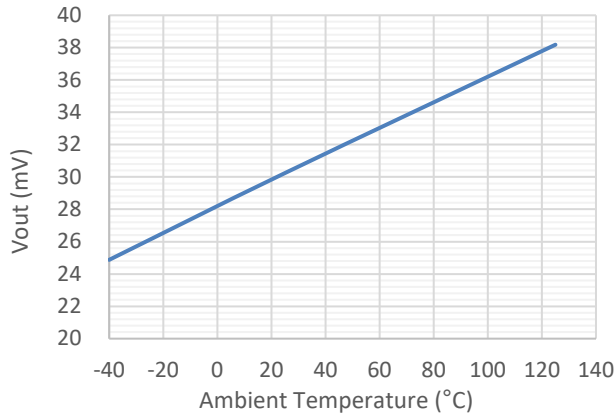


Figure 6.7 V<sub>OL</sub> versus Temperature

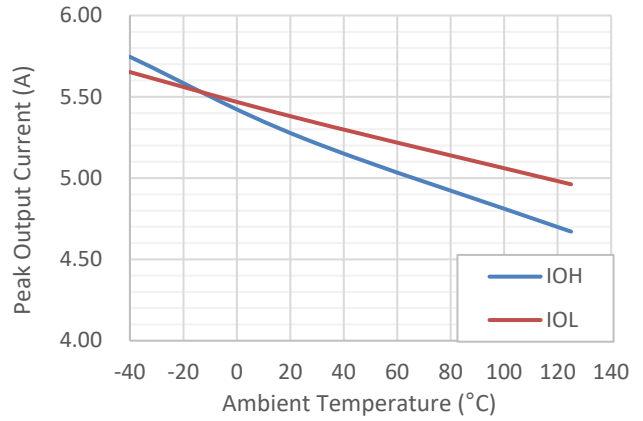


Figure 6.8 Output drive currents versus Temperature

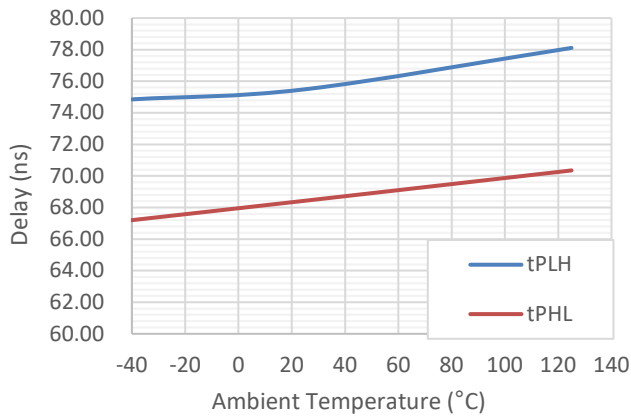


Figure 6.9 Propagation delay versus Temperature

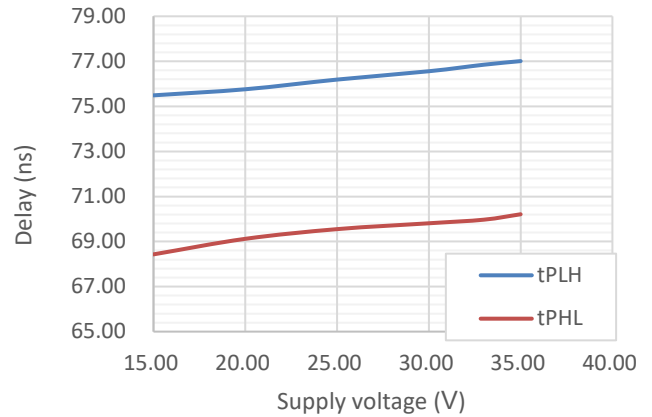


Figure 6.10 Propagation delay versus Supply voltage

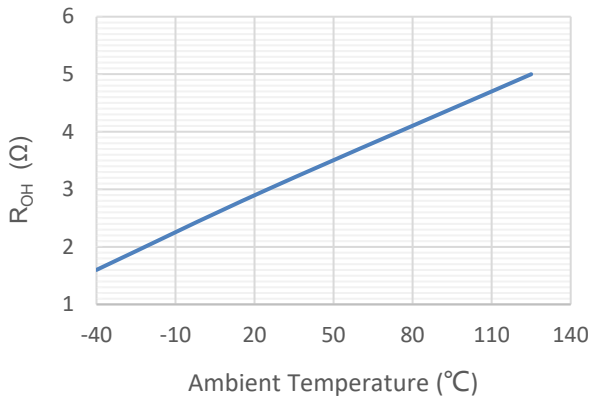


Figure 6.11 R<sub>OH</sub> versus Temperature

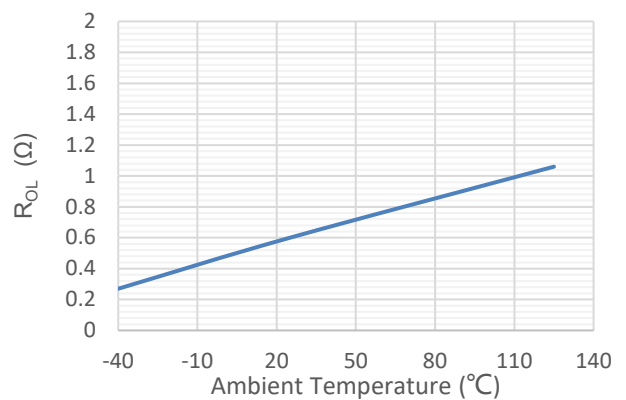


Figure 6.12 R<sub>OL</sub> versus Supply voltage



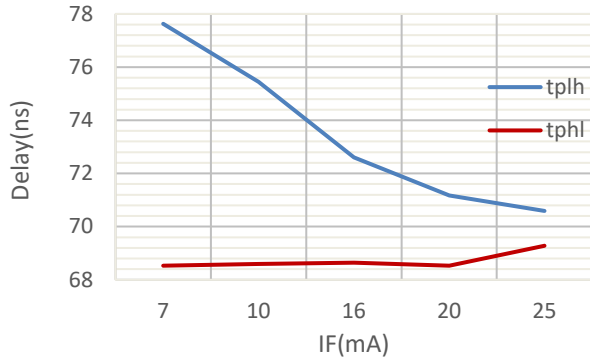


Figure 6.13 Propagation delay versus Forward current

### 6.4. Parameter Measurement Information

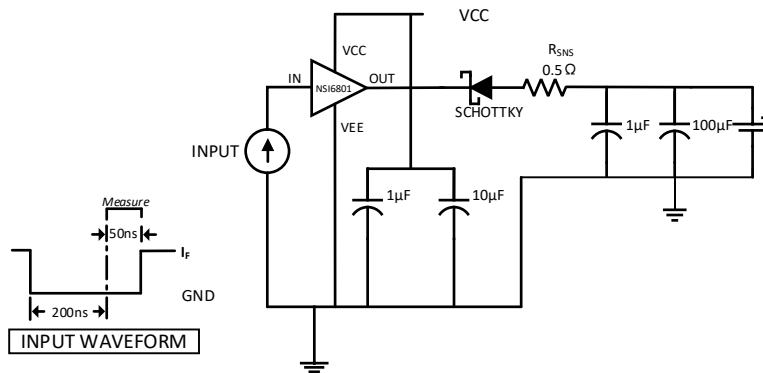


Figure 6.14 I<sub>OL</sub> Sink Current Test Circuit

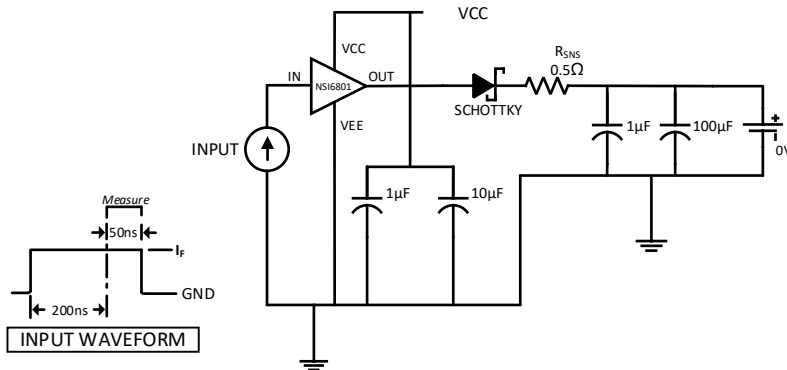


Figure 6.15 I<sub>OH</sub> Source Current Test Circuit

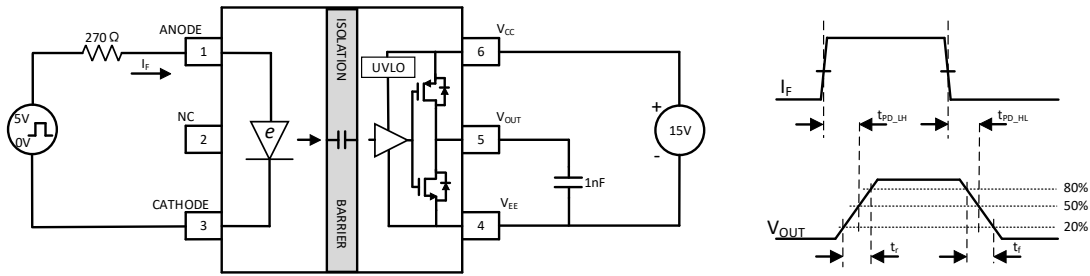


Figure 6.16 I<sub>F</sub> to V<sub>OUT</sub> Propagation Delay, Rise Time and Fall Time

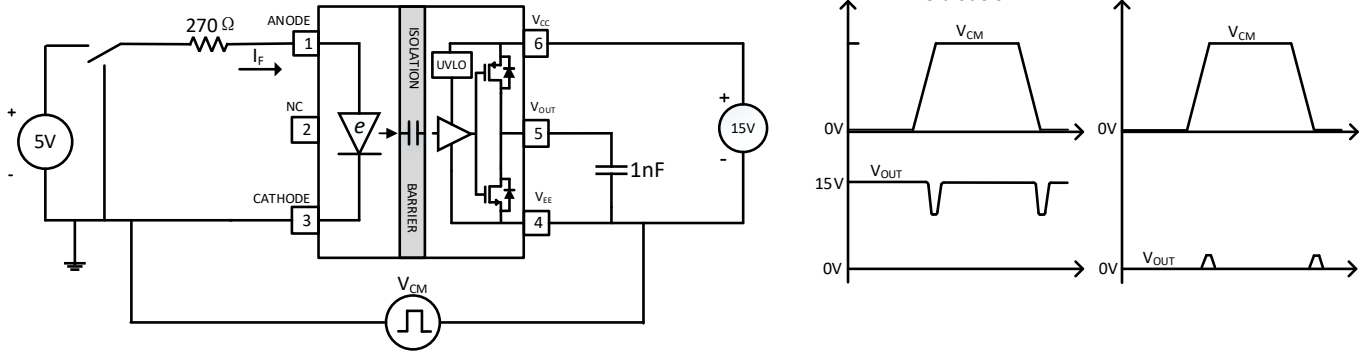


Figure 6.17 Common Mode Transient Immunity Test Circuit

## 7. High Voltage Feature Description

### 7.1. Insulation and Safety Related Specifications

<i>Parameters</i>	<i>Symbol</i>	<i>Value</i>			<i>Unit</i>	<i>Comments</i>
		<i>SOW6</i>	<i>DUB8</i>	<i>SOP8</i>		
Minimum External Air Gap (Clearance)	CLR	8	6.5	4.0	mm	Shortest terminal-to-terminal distance through air
Minimum External Tracking (Creepage)	CPG	8	6.5	4.0	mm	Shortest terminal-to-terminal distance across the package surface
Distance Through Insulation	DTI	20			um	internal gap
Tracking Resistance (Comparative Tracking Index)	CTI	>600	>600	>600	V	DIN EN 60112 (VDE 0303-11); IEC 60112
Material Group		I	I	I		IEC 60664-1

**7.2. Insulation Characteristics for SOW6 Package**

Description	Test Condition	Symbol	Value	Unit
Overvoltage Category per IEC60664-1	For Rated Mains Voltage $\leq 600V_{RMS}$		I to IV	
	For Rated Mains Voltage $\leq 1000V_{RMS}$		I to III	
Climatic Category			40/125/21	
Pollution Degree	per DIN VDE 0110, Table 1		2	
Maximum Working Isolation Voltage	AC voltage	$V_{IOWM}$	1500	$V_{RMS}$
	DC voltage		2121	$V_{DC}$
Maximum Repetitive Peak Isolation Voltage		$V_{IORM}$	2121	$V_{PEAK}$
Apparent Charge	Method B ,routine test(100% production) and preconditioning (type test); $V_{ini}=1.2*V_{IOTM}$ , $V_{pd(m)}=V_{IORM}\times 1.875$ , $t_{ini}=t_m=1s$	$q_{pd}$	<5	pC
	Method A, after Environmental Tests Subgroup 1, $V_{pd(m)}=V_{IORM}\times 1.6$ , $t_{ini}=60s$ , $t_m=10s$			pC
	Method A,after Input and Output Safety Test Subgroup 2 and Subgroup 3, $V_{pd(m)}=V_{IORM}\times 1.2$ , $t_{ini}=60s$ , $t_m=10s$			pC
Maximum Transient Isolation Voltage	$t = 60s$	$V_{IOTM}$	8000	$V_{PEAK}$
Maximum Withstanding Isolation Voltage	$V_{TEST}= V_{ISO}$ , $t = 60s$ (qualification); $V_{TEST}= 1.2\times V_{ISO}$ , $t = 1s$ (100%production)	$V_{ISO}$	5700	$V_{RMS}$
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50us waveform, $V_{TEST}=V_{IOSM}\times 1.6$	$V_{IOSM}$	6250	$V_{PEAK}$
Isolation Resistance	$V_{IO}=500V$ at $T_A=T_S=25^\circ C$	$R_{IO}$	$>10^{12}$	$\Omega$
	$V_{IO}=500V$ at $T_A=T_S=150^\circ C$		$>10^9$	$\Omega$
	$V_{IO}=500V$ at $100^\circ C\leq T_A\leq 125^\circ C$		$>10^{11}$	$\Omega$
Isolation Capacitance	$f = 1MHz$	$C_{IO}$	1	pF

### 7.3. Safety-Limiting Values for SOW6 Package

Description	Test Condition	Symbol	Value	Unit
Maximum Safety Temperature		$T_s$	150	°C
Safety Input, Output, or Total Power	$R_{\theta JA}=125^{\circ}\text{C/W}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$P_s$	750	mW
Safety Input, Output, or Supply Current	$R_{\theta JA}=125^{\circ}\text{C/W}$ , $V_{CC}=15\text{V}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$I_s$	50	mA
	$R_{\theta JA}=125^{\circ}\text{C/W}$ , $V_{CC}=30\text{V}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$I_s$	25	mA

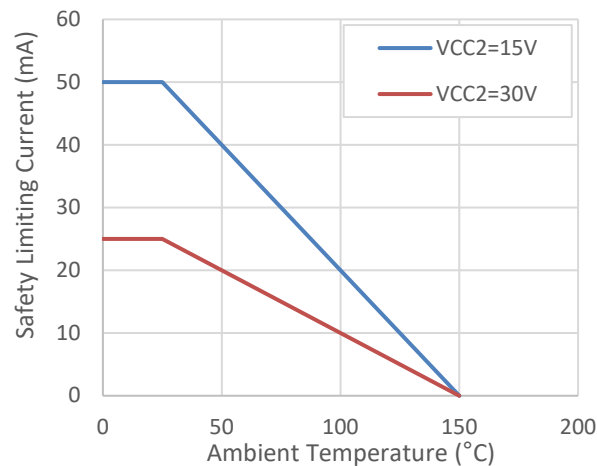


Figure 7.1 Thermal Derating Curve for Limiting Current per DIN VDE V 0884-11 for SOW6 Package

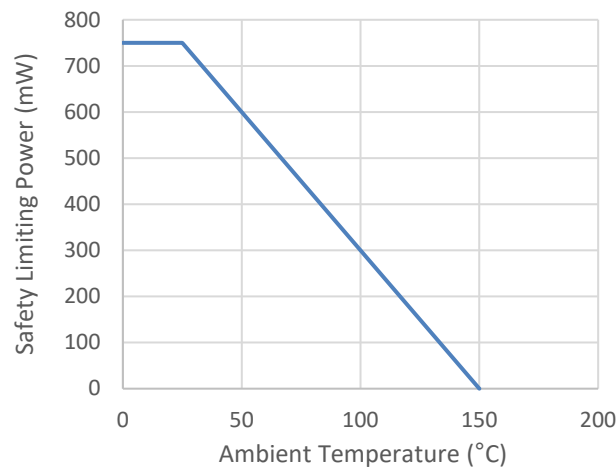


Figure 7.2 Thermal Derating Curve for Limiting Power per DIN VDE V 0884-11 for SOW6 Package

**7.4. Regulatory Information for SOW6 Package**

<i>UL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	Certified according to DIN EN IEC 60747-17(VDE 0884-17)	Certified by CQC11-471543-2012 GB4943.1-2022
Single Protection, 5700V <sub>RMS</sub> Isolation Voltage	Single Protection, 5700V <sub>RMS</sub> Isolation voltage	Reinforced Insulation V <sub>IORM</sub> =2121V <sub>PEAK</sub> , V <sub>IOTM</sub> =8000V <sub>PEAK</sub> , V <sub>IOSM</sub> =6250V <sub>PEAK</sub>	Reinforced Insulation
E500602		40052820	CQC21001289930

7.5. Insulation Characteristics for DUB8 Package

Description	Test Condition	Symbol	Value	Unit
Overvoltage Category	For Rated Mains Voltage $\leq 600V_{RMS}$		I to IV	
	For Rated Mains Voltage $\leq 1000V_{RMS}$		I to III	
Climatic Category			40/125/21	
Pollution Degree	per DIN VDE 0110, Table 1		2	
Maximum Working Isolation Voltage	AC voltage	$V_{IOWM}$	1000	$V_{RMS}$
	DC voltage		1414	$V_{DC}$
Maximum Repetitive Peak Isolation Voltage		$V_{IORM}$	1414	$V_{PEAK}$
Apparent Charge	Method B ,routine test(100% production) and preconditioning (type test); $V_{ini}=1.2*V_{IOTM}$ , $V_{pd(m)}=V_{IORM}\times 1.875$ , $t_{ini}=t_m=1s$	$q_{pd}$	<5	pC
	Method A, after Environmental Tests Subgroup 1, $V_{pd(m)}=V_{IORM}\times 1.6$ , $t_{ini}=60s$ , $t_m=10s$			pC
	Method A,after Input and Output Safety Test Subgroup 2 and Subgroup 3, $V_{pd(m)}=V_{IORM}\times 1.2$ , $t_{ini}=60s$ , $t_m=10s$			pC
Maximum Transient Isolation Voltage	$t = 60s$	$V_{IOTM}$	8000	$V_{PEAK}$
Maximum Withstanding Isolation Voltage	$V_{TEST}= V_{ISO}$ , $t = 60 s$ (qualification); $V_{TEST}= 1.2\times V_{ISO}$ , $t = 1s$ (100%production)	$V_{ISO}$	5000	$V_{RMS}$
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50us waveform, $V_{TEST}=V_{IOSM}\times 1.6$	$V_{IOSM}$	6250	$V_{PEAK}$
Isolation Resistance	$V_{IO}=500V$ at $T_A=T_S=25^\circ C$	$R_{IO}$	$>10^{12}$	$\Omega$
	$V_{IO}=500V$ at $T_A=T_S=150^\circ C$		$>10^9$	$\Omega$
	$V_{IO}=500V$ at $100^\circ C\leq T_A\leq 125^\circ C$		$>10^{11}$	$\Omega$
Isolation Capacitance	$f = 1MHz$	$C_{IO}$	1	pF

**7.6. Safety Limiting Values for DUB8 Package**

Description	Test Condition	Symbol	Value	Unit
Maximum Safety Temperature		$T_s$	150	°C
Safety Input, Output, or Total Power	$R_{\theta JA}=125^{\circ}\text{C}/\text{W}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$P_s$	750	mW
Safety Input, Output, or Supply Current	$R_{\theta JA}=125^{\circ}\text{C}/\text{W}$ , $V_{CC}=15\text{V}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$I_s$	50	mA
	$R_{\theta JA}=125^{\circ}\text{C}/\text{W}$ , $V_{CC}=30\text{V}$ , $T_J=150^{\circ}\text{C}$ , $T_A=25^{\circ}\text{C}$	$I_s$	25	mA

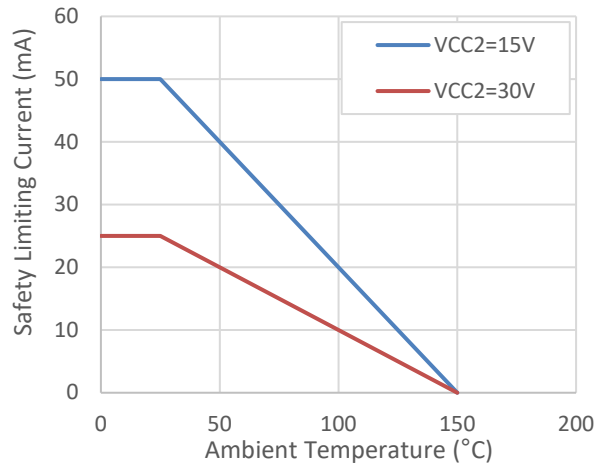


Figure 7.3 Thermal Derating Curve for Limiting Current per DIN VDE V 0884-11 for DUB8 Package

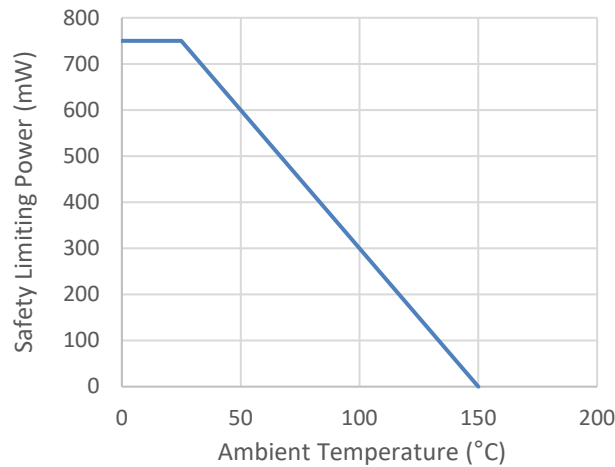


Figure 7.4 Thermal Derating Curve for Limiting Power per DIN VDE V 0884-11 for DUB8 Package



**7.7. Regulatory Information for DUB8 Package**

<i>UL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	Certified according to DIN EN IEC 60747-17(VDE 0884-17)	Certified by CQC11-471543-2012 GB4943.1-2022
Single Protection, 5000V <sub>RMS</sub> Isolation Voltage	Single Protection, 5000V <sub>RMS</sub> Isolation voltage	Reinforced Insulation V <sub>IORM</sub> =1414V <sub>PEAK</sub> , V <sub>IOTM</sub> =8000V <sub>PEAK</sub> , V <sub>IOSM</sub> =6250V <sub>PEAK</sub>	Reinforced Insulation
E500602		40052820	CQC20001263786

**7.8. Insulation Characteristics for SOP8 Package**

Description	Test Condition	Symbol	Value	Unit
Installation Classification per DIN VDE 0110				
Overvoltage Category	For Rated Mains Voltage $\leq 150V_{RMS}$		I to IV	
	For Rated Mains Voltage $\leq 300V_{RMS}$		I to III	
Climatic Category			40/125/21	
Pollution Degree	per DIN VDE 0110, Table 1		2	
Maximum Working Isolation Voltage	AC voltage	$V_{IOWM}$	700	$V_{RMS}$
	DC voltage		990	$V_{DC}$
Maximum Repetitive Peak Isolation Voltage		$V_{IORM}$	990	$V_{PEAK}$
Apparent Charge	Method B ,routine test(100% production) and preconditioning (type test); $V_{ini}=1.2*V_{IOTM}$ , $V_{pd(m)}=V_{IORM}\times 1.875$ , $t_{ini}=t_m=1s$	$q_{pd}$	<5	pC
	Method A, after Environmental Tests Subgroup 1, $V_{pd(m)}=V_{IORM}\times 1.3$ , $t_{ini}=60s$ , $t_m=10s$			pC
	Method A,after Input and Output Safety Test Subgroup 2 and Subgroup 3, $V_{pd(m)}=V_{IORM}\times 1.2$ , $t_{ini}=60s$ , $t_m=10s$			pC
Maximum Transient Isolation Voltage	$t = 60s$	$V_{IOTM}$	4242	$V_{PEAK}$
Maximum Withstanding Isolation Voltage	$V_{TEST}= V_{ISO}$ , $t = 60s$ (qualification); $V_{TEST}= 1.2\times V_{ISO}$ , $t = 1s$ (100%production)	$V_{ISO}$	3000	$V_{RMS}$
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50us waveform, $V_{TEST}=V_{IOSM}\times 1.3$	$V_{IOSM}$	4242	$V_{PEAK}$
Isolation Resistance	$V_{IO} = 500V$ at $T_A=T_S=25^\circ C$	$R_{IO}$	$>10^{12}$	$\Omega$
	$V_{IO} = 500V$ at $T_A=T_S=150^\circ C$		$>10^9$	$\Omega$
	$V_{IO} = 500V$ at $100^\circ C \leq T_A \leq 125^\circ C$		$>10^{11}$	$\Omega$
Isolation Capacitance	$f = 1MHz$	$C_{IO}$	1	pF

**7.9. Safety Limiting Values for SOP8 Package**

Description	Test Condition	Symbol	Value	Unit	
Maximum Safety Temperature		$T_s$	150	°C	
Maximum Safety Power Dissipation	$R_{\theta JA}=110^{\circ}\text{C}/\text{W}, T_J=150^{\circ}\text{C}, T_A=25^{\circ}\text{C}$	$P_s$	Total	1.14	W
			Input Side	0.05	
			Output Side	1.09	
Maximum Safety Current	$R_{\theta JA}=110^{\circ}\text{C}/\text{W}, V_{CC2}=15\text{V}, T_J=150^{\circ}\text{C}, T_A=25^{\circ}\text{C}$	$I_s$	Output Side	73	mA
	$R_{\theta JA}=110^{\circ}\text{C}/\text{W}, V_{CC2}=30\text{V}, T_J=150^{\circ}\text{C}, T_A=25^{\circ}\text{C}$		Output Side	36	

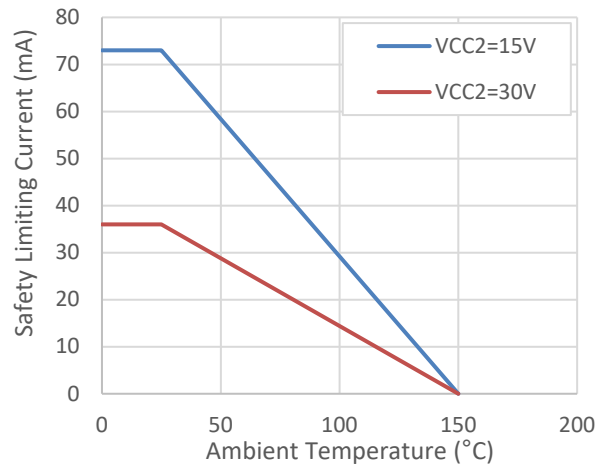


Figure 7.5 Thermal Derating Curve for Limiting Current per DIN VDE V 0884-11 for SOP8 Package

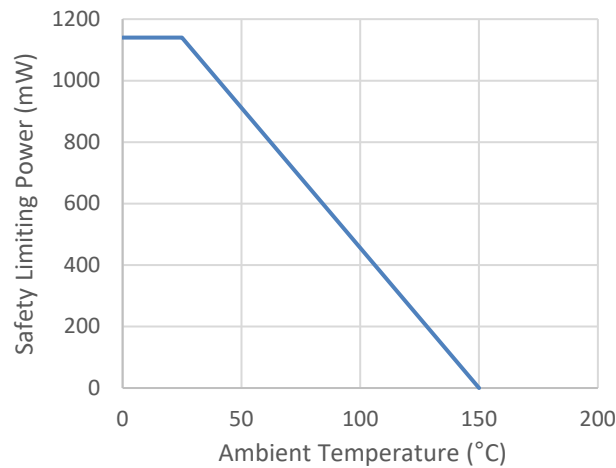


Figure 7.6 Thermal Derating Curve for Limiting Power per DIN VDE V 0884-11 for SOP8 Package

**7.10. Regulatory Information for SOP8 Package**

<i>UL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	Certified according to DIN EN IEC 60747-17(VDE 0884-17)	Certified by CQC11-471543-2012 GB4943.1-2022
Single Protection, 3000V <sub>RMS</sub> Isolation Voltage	Single Protection, 3000V <sub>RMS</sub> Isolation voltage	Basic Insulation V <sub>IORM</sub> =990V <sub>PEAK</sub> , V <sub>IOTM</sub> =4242V <sub>PEAK</sub> , V <sub>IOSM</sub> =4242V <sub>PEAK</sub>	Basic Insulation at 700V <sub>RMS</sub> (990V <sub>PEAK</sub> )
E500602		40050121	CQC20001264940

## 8. Function Description

The NSI6801 is a single-channel isolated gate driver which is pin-compatible for popular opto-coupled gate driver. The integrated galvanic isolation between control input logic and driving output stage grants additional safety. The device can source 5A and sink 5A peak current, which can drive IGBTs, power MOSFETs and SiC MOSFETs in many applications such as motor control systems, solar inverters and power supplies.

### 8.1. Functional Block Diagram

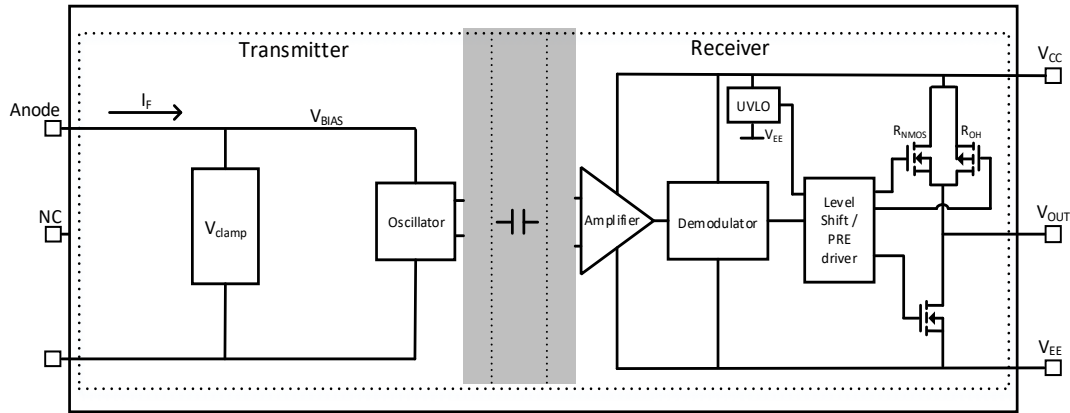


Figure 8.1 NSI6801 Functional Block Diagram

### 8.2. Truth Tables

Table 8.1 Driver Function Table <sup>(1)</sup>

<i>e</i> -diode	V <sub>CC</sub> status	Outputs
X	Powered Down	L
I <sub>F</sub> > I <sub>FLH</sub>	Powered Up	H
V <sub>F</sub> < V <sub>FHL</sub>	Powered Up	L

(1) H= Logic High; L= Logic Low; X= Irrelevant

### 8.3. Output Stage

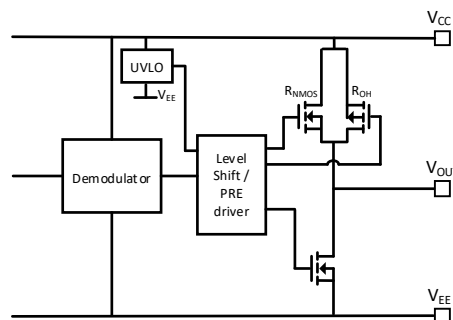


Figure 8.2 NSI6801 Output Stage

Table 8.2 NSI6801 Output Stage On-Resistance

R <sub>NMOS</sub>	R <sub>OH</sub>	R <sub>OL</sub>	Unit
0.8	3	0.6	Ω

The NSI6801 has P-channel and N-channel MOSFET in parallel to pull up the OUT pin when turning on external power transistor. During DC measurement, only the P-channel MOSFET is conducting. The measurement result  $R_{OH}$  represents the on-resistance of P-channel MOSFET.

The voltage and current of external power transistor drain to source or collector to emitter change during turn on. At that time, the NSI6801 N-channel MOSFET turns on to pull up OUT more quickly. It results external power transistor faster turn on time, lower turn on power loss, also leads to smaller temperature increase of NSI6801. The equivalent pull-up resistance of NSI6801 is the parallel combination  $R_{OH} || R_{NMOS}$ . The result is quite small, indicating the strong driving capability of NSI6801.

The pull-down structure of NSI6801 is simply composed of an N-channel MOSFET with on-resistance of  $R_{OL}$ . The result is quite small, indicating the strong driving capability of NSI6801.

#### 8.4. $V_{CC}$ and Under Voltage Lock Out (UVLO)

The lower limit of driver side supply voltage ( $V_{CC}$ ) is determined by the internal UVLO protection feature of the device.  $V_{CC}$  voltage should not fall below the UVLO threshold for normal operation, or else the gate-driver outputs can become clamped low.

A local bypass capacitor should be placed between the  $V_{CC}$  and  $V_{EE}$  pins, with a value of 220nF to 10 $\mu$ F for device biasing. An additional 100nF capacitor in parallel with the device biasing capacitor is recommended for high frequency filtering. Both capacitors should be positioned as close to the device as possible. Low-ESR, ceramic surface-mount capacitors are recommended.

#### 8.5. Active Pull-Down

The Active Pull-Down feature ensures a safe IGBT or MOSFET off-state if  $V_{CC}$  is not connected to the power supply. When  $V_{CC}$  is floating, the driver output is held low and clamping  $V_{OUT}$  pin to approximately 1.9V higher than  $V_{EE}$ .

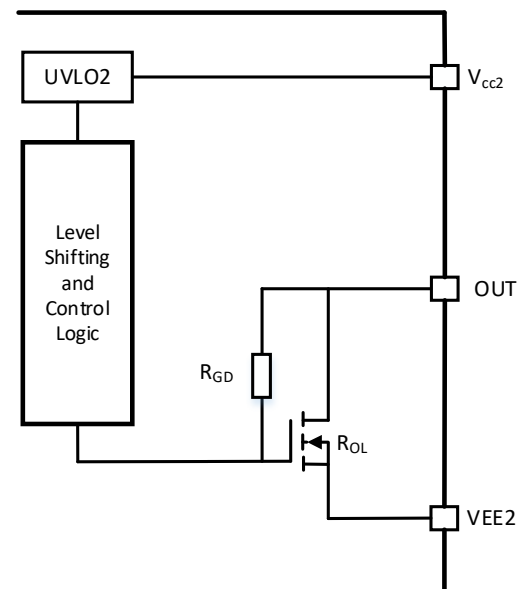


Figure 8.3 Active pulldown

#### 8.6. Short Circuit Clamping

During short circuit the gate voltage of IGBT or MOSFET tends to rise because of the feedback via the Miller capacitance. The diode between  $V_{OUT}$  and  $V_{CC}$  pins inside the driver limits this voltage to a value slightly higher than the supply voltage. A maximum current of 500mA may be fed back to the supply through this path for 10 $\mu$ s. If higher currents are expected or tighter clamping is desired external Schottky diodes may be added.

## 9. Application Note

### 9.1. Typical Application

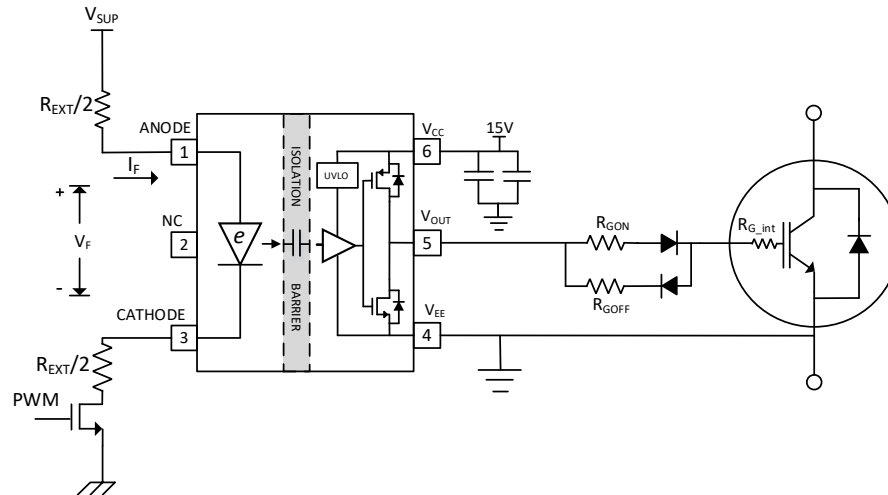


Figure 9.1 NSI6801 typical application circuit with NMOS driving input stage

Bypassing capacitors connecting between  $V_{CC}$  and  $V_{EE}$  are needed to achieve reliable performance. To filter noise, 0.1 $\mu$ F/50V ceramic capacitor is recommended to place as close as possible to NSI6801. To support high peak currents when turning on external power transistor, additional 10 $\mu$ F/50V ceramic capacitor is recommended. If the  $V_{CC}$  power supply is located long distance from the IC, bigger capacitance is needed.

NSI6801 requires 7mA to 16mA bias current that flows into the e-diode for normal operation. The PWM from MCU is not suitable to provide such current directly and external circuit is needed. In Figure 8.1, one NMOS is used with split input resistors. Another input drive method is using one buffer, as shown in Figure 8.2. The details to calculate input drive parameters are in Chapter 8.3.

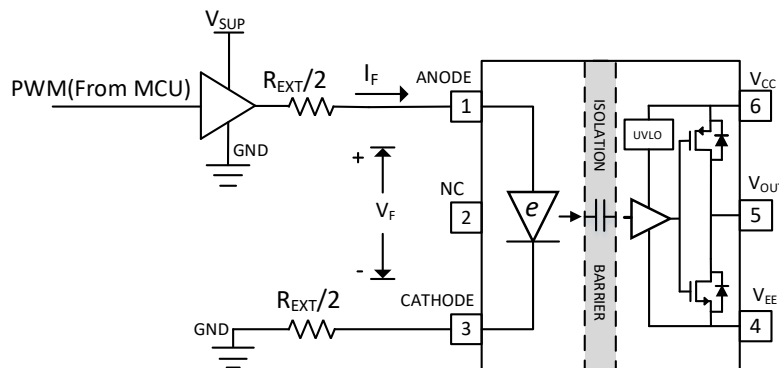


Figure 9.2 NSI6801 typical application circuit with one buffer driving input stage

### 9.2. Interlock Protection

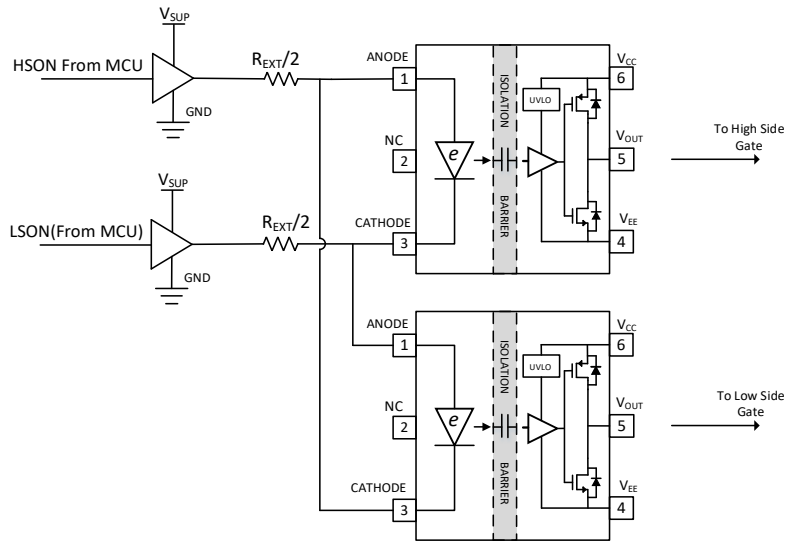


Figure 9.3 Interlock Protection using NSI6801

For applications to drive power transistors in half bridge configuration, two NSI6801 can be used. Interlock protection is possible as shown in Figure 8.3. If the controller has some mistake, leading to negative dead time, the output PWM of NSI6801 is adjusted to avoid power transistor shoot through. The input side reverse breakdown voltage of NSI6801 is greater than 6.5V, which supports interlock protection of 3.3V or 5V PWM signal source.

### 9.3. Selecting Input Resistor

The recommended forward current range for NSI6801 is 7mA to 16mA. The value of input resistor, buffer supply voltage and buffer internal resistance influence the forward current, as shown in Equation (1). In Figure 8.1,  $R_{Buffer}$  is the on-resistance of the external NMOS. In Figure 8.2,  $R_{Buffer}$  is the buffer output impedance in output “High” state. In Figure 8.3,  $R_{Buffer}$  is the summary of buffer output impedance in “High” and “Low” state.

$$R_{EXT} = \frac{V_{SUP} - V_F}{I_F} - R_{Buffer} \tag{1}$$

The parameter variation needs to be taken into consideration when selecting input resistor. Table 8.1 lists parameter variation in this example. The corresponding external resistor calculation result is 196Ω min, 262Ω typ and 300Ω max.

Table 9.1 External parameters range when calculating input resistor

Parameters	Min	Typ	Max
NSI6801 forward current $I_F$	7mA	10mA	16mA
NSI6801 forward voltage $V_F$	1.8V	2.1V	2.4V
Buffer supply voltage $V_{SUP}$	5V*95%	5V	5V*105%
Buffer internal resistance $R_{Buffer}$	13Ω	18Ω	22Ω

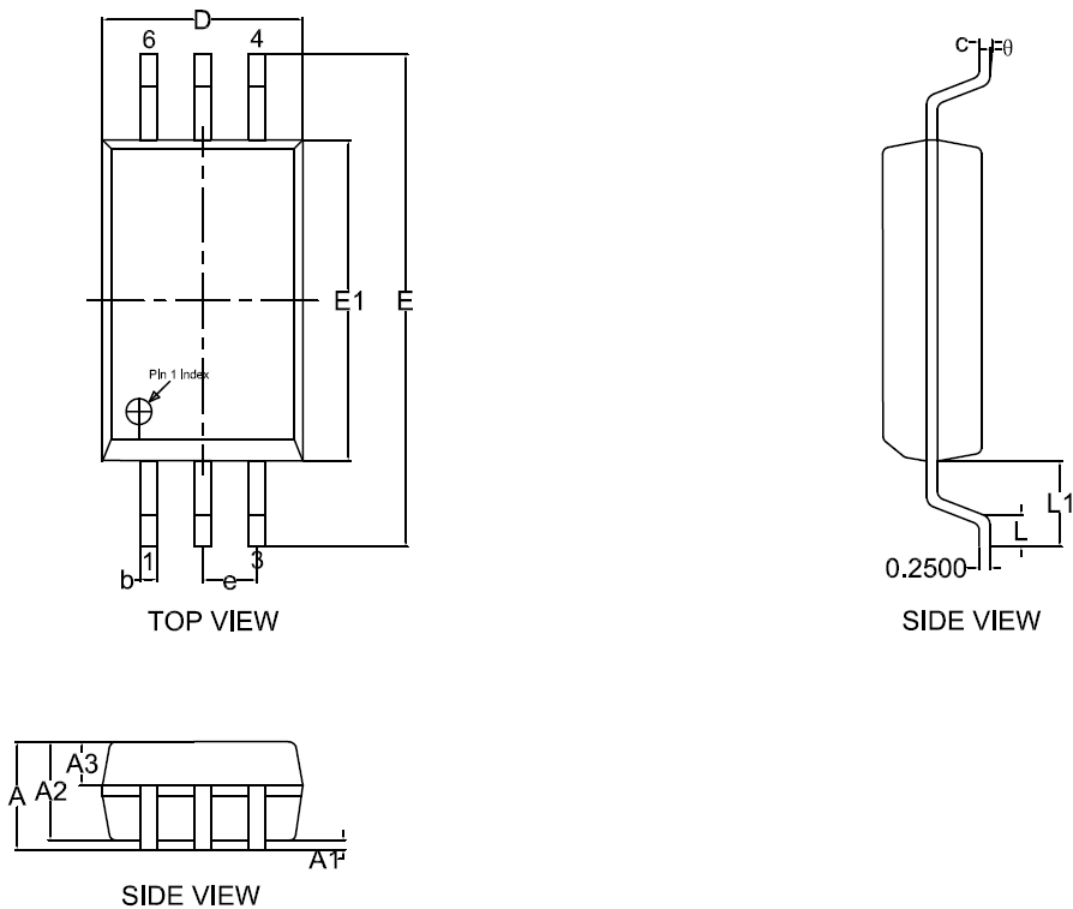


#### 9.4. PCB Layout

Careful PCB layout is essential for optimal performance. Some key guidelines are:

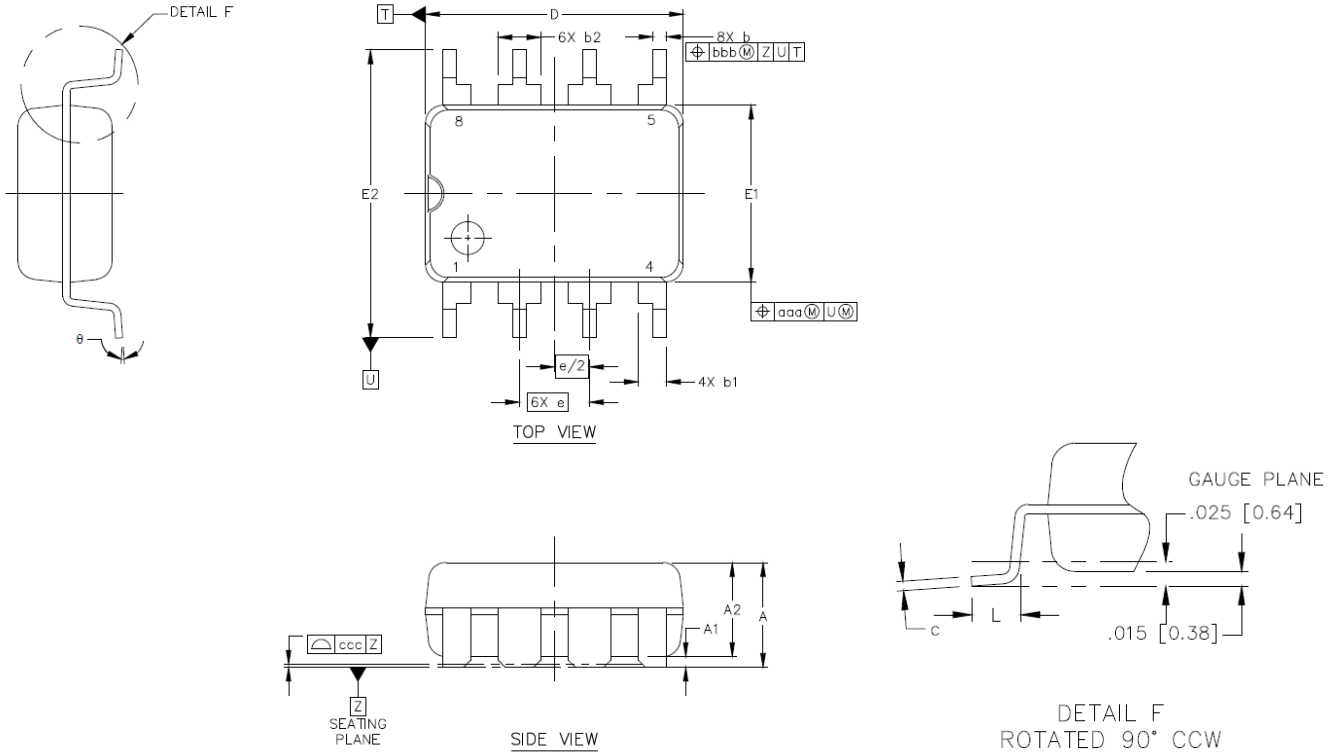
- The bypass capacitors should be placed close to NSI6801, between  $V_{CC}$  to  $V_{EE}$ .
- There is high switching current that charges and discharges the gate of external power transistor, leading to EMI and ring issues. The parasitic inductance of this loop should be minimized, by decreasing loop area and place NSI6801 close to power transistor.
- Place large amount of copper connecting to  $V_{EE}$  pin and  $V_{CC}$  pin for thermal dissipation, with priority on  $V_{EE}$  pin. If the system has multi  $V_{EE}$  or  $V_{CC}$  layers, use multiple vias of adequate size for connection.
- To ensure isolation performance between primary and secondary side, the space under the chip should keep free from planes, traces, pads or via.

### 10. Package Information



REF.	DIMENSIONS IN MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	2.65
A1	0.10	---	0.30
A2	2.25	2.30	2.35
A3	0.97	1.02	1.07
E	11.25	11.50	11.75
E1	7.40	7.50	7.60
D	4.58	4.68	4.78
L	0.50	---	1.00
b	0.28	---	0.51
c	0.25	---	0.29
$\theta$	0°	---	8°
e	1.27 BSC		
L1	2.00 BSC		

Figure 10.1 SOW6 Package Shape and Dimension in millimeters



	SYMBOL	MIN	NOM	MAX
TOTAL THICKNESS	A	3.58	---	4.19
STAND OFF	A1	0.38	---	0.58
MOLD THICKNESS	A2	3.20	---	3.61
LEAD WIDTH	b	0.36	---	0.56
	b1	---	0.99 REF	---
	b2	---	1.524 REF	--
L/F THICKNESS	c	0.20	---	0.36
BODY SIZE	D	9.27	---	9.37
	E1	6.20	---	6.60
	E2	10.11	---	10.69
LEAD PITCH	e	2.54 BSC		
LEAD LENGTH	L	1.15	---	1.45
	$\theta$	0°	---	8°
LEAD OFFSET	aaa	0.254		

Figure 10.2 DUB8 Package Shape and Dimension in millimeters

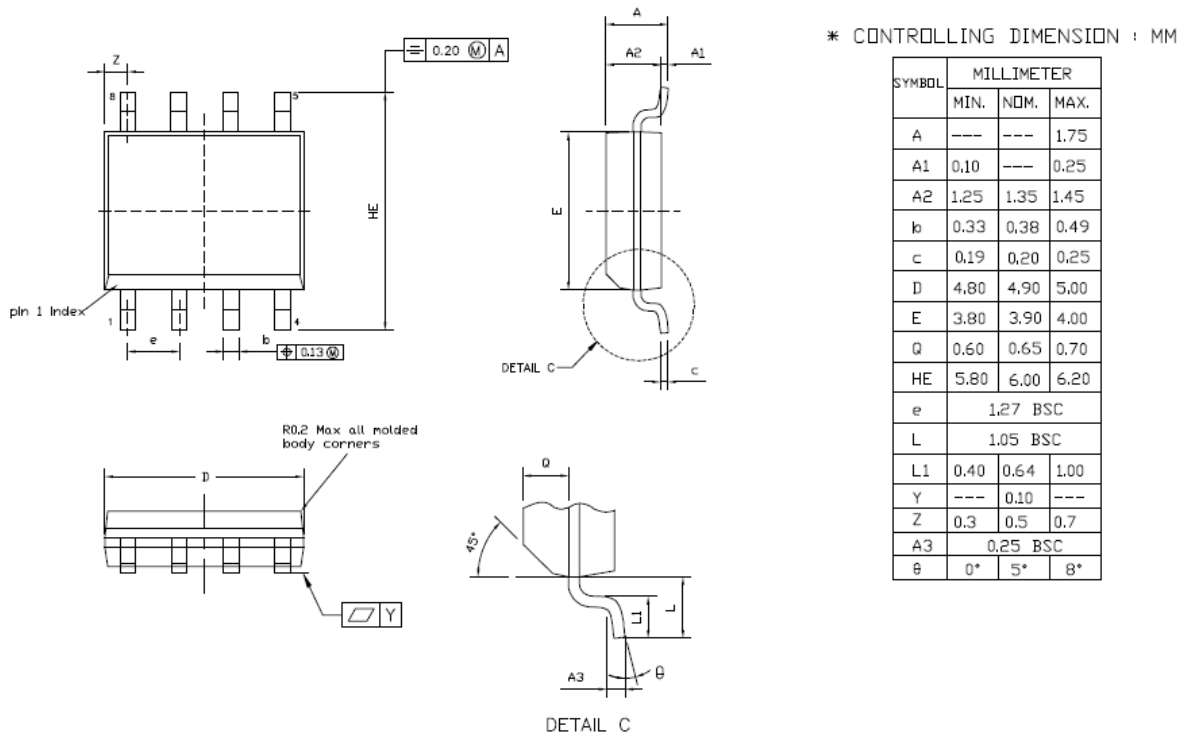


Figure 10.3 SOP8 Package Shape and Dimension in millimeters

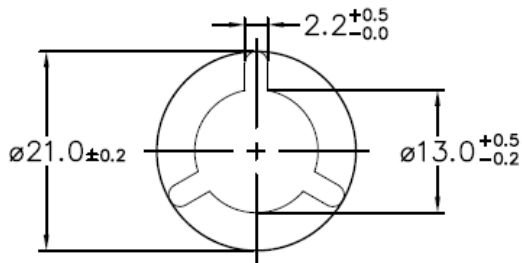
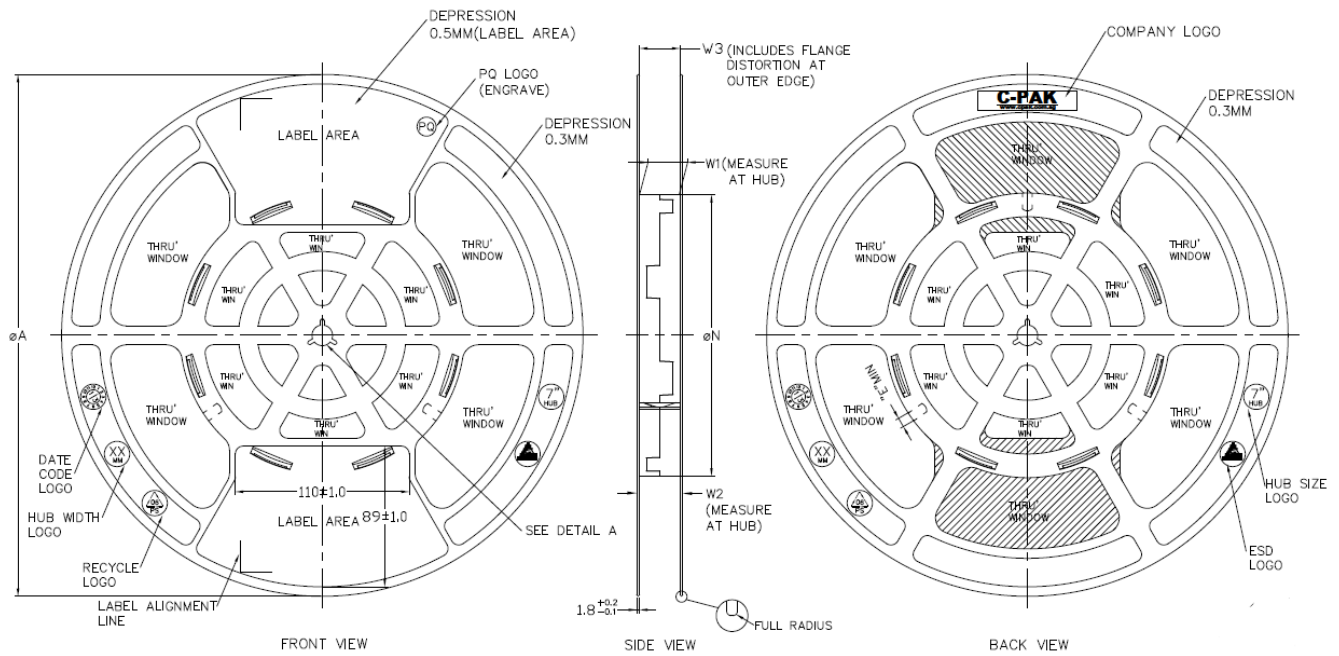
## 11. Ordering Information

<i>Part Number</i>	<i>Isolation Rating (kV)</i>	<i>UVLO Level</i>	<i>Vout Connection</i>	<i>Temperature</i>	<i>MSL</i>	<i>Package Drawing</i>	<i>SPQ</i>	<i>Category</i>
NSI6801B-DSWFR	5.7	9V	Pin 5	-40 to 125°C	3	SOW6	1000	Industrial
NSI6801C-DSWFR	5.7	13V	Pin 5	-40 to 125°C	3	SOW6	1000	Industrial
NSI6801TB-DDBR	5	9V	Pin 6, 7	-40 to 125°C	3	DUB8	800	Industrial
NSI6801TC-DDBR	5	13V	Pin 6, 7	-40 to 125°C	3	DUB8	800	Industrial
NSI6801LC-DDBR	5	13V	Pin 6	-40 to 125°C	3	DUB8	800	Industrial
NSI6801B-DSPR	3	9V	Pin 6, 7	-40 to 125°C	3	SOP8	2500	Industrial
NSI6801C-DSPR	3	13V	Pin 6, 7	-40 to 125°C	3	SOP8	2500	Industrial

## 12. Documentation Support

<i>Part Number</i>	<i>Product Folder</i>	<i>Datasheet</i>	<i>Technical Documents</i>	<i>Isolated Driver Selection Guide</i>
NSI6801	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

### 13. Tape and Reel Information



ARBOR HOLE  
DETAIL A  
SCALE : 3:1

PRODUCT SPECIFICATION						
TAPE WIDTH	øA ±2.0	øN ±2.0	W1	W2 (MAX)	W3	E (MIN)
08MM	330	178	8.4 <sup>+0.5</sup> <sub>-0.0</sub>	14.4	SHALL ACCOMMODATE TAPE WIDTH WITHOUT INTERFERENCE	5.5
12MM	330	178	12.4 <sup>+2.0</sup> <sub>-0.0</sub>	18.4		5.5
16MM	330	178	16.4 <sup>+2.0</sup> <sub>-0.0</sub>	22.4		5.5
24MM	330	178	24.4 <sup>+2.0</sup> <sub>-0.0</sub>	30.4		5.5
32MM	330	178	32.4 <sup>+2.0</sup> <sub>-0.0</sub>	38.4		5.5

SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW 10 <sup>12</sup>	ANTISTATIC	ALL TYPES
B	10 <sup>8</sup> TO 10 <sup>11</sup>	STATIC DISSIPATIVE	BLACK ONLY
C	10 <sup>5</sup> & BELOW 10 <sup>5</sup>	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10 <sup>8</sup> TO 10 <sup>11</sup>	ANTISTATIC (COATED)	ALL TYPES

Figure 13.1 Reel Information

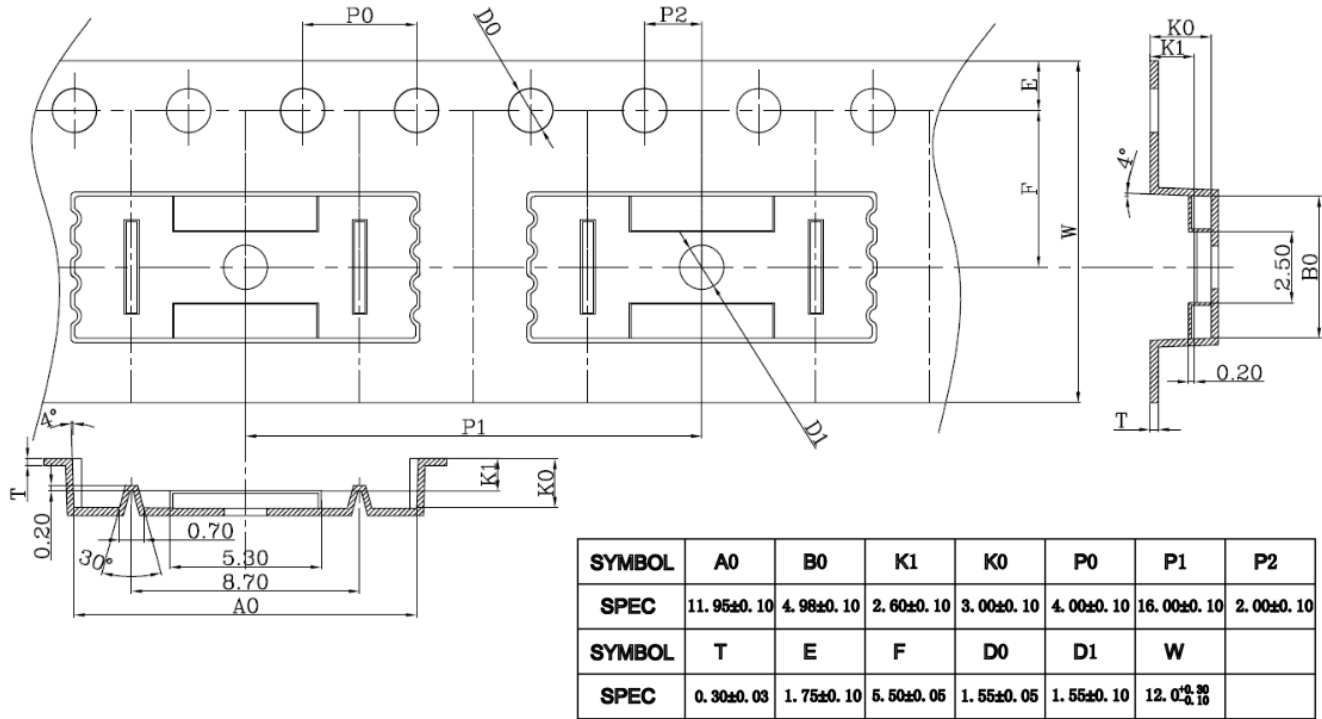


Figure 13.2 Tape Information of SOW6

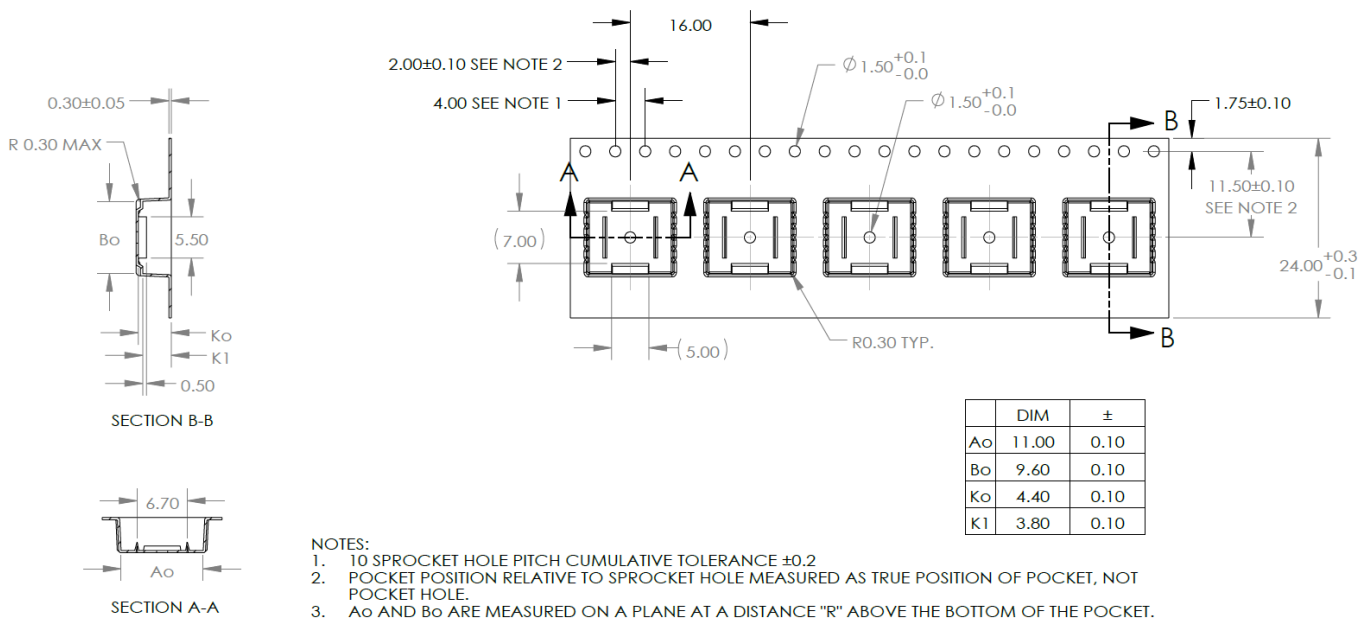


Figure 13.3 Tape Information of DUB8

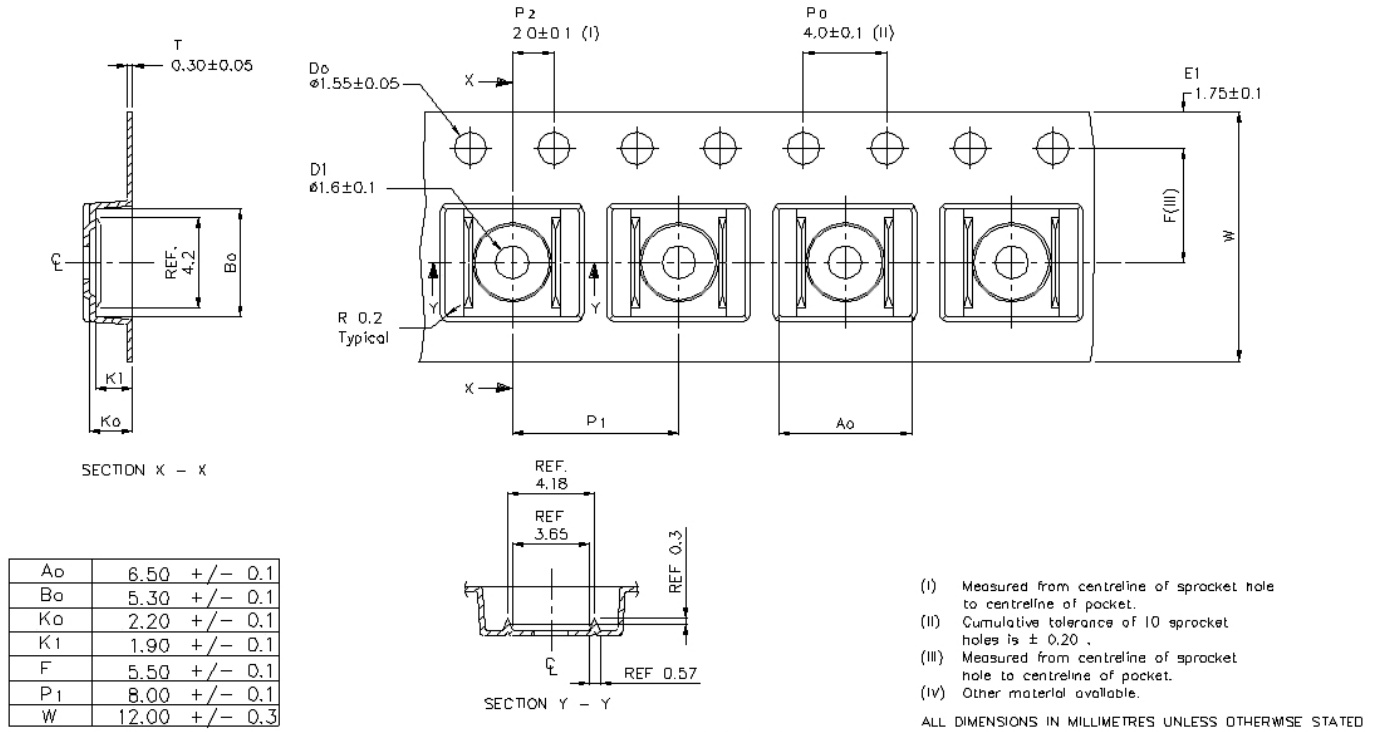


Figure 13.4 Reel Information of SOP8

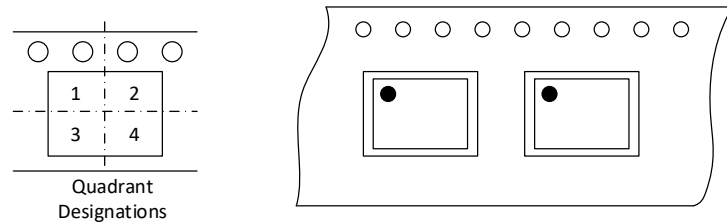


Figure 13.5 Quadrant Designation for Pin1 Orientation in Tape



## 14. Reversion History

Revision	Description	Date
1.0	Initial version	2021/4/16
1.1	Modified Regulatory Information for SOW6 Package	2021/11/6
1.2	Modified Tape and Reel information	2022/4/12
1.3	Add ROH versus temperature and ROL versus temperature	2022/9/26
1.4	1.Add SOP8 package 2. Modified Device Information 3.Modified Function Block Diagram 4. Modified Characteristics Annotation from VCC=15-30V to VCC=14-32V 5. Update Tracking Resistance and Material Group 6. Modified High Voltage Feature Description 7.Update Regulation Information for SOW6 and DUB8 Package 8.Add Propagation delay versus Forward current figure	2023/8/14

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