

## Product Overview

The NSI7258 is a single-channel solid-state relay (SSR), which is pin-compatible for popular photo MOSFET. The SSR turns ON with a minimum input current of 5.5mA. It can conduct 30mA current at ON state, with resistance less than 250Ω. The SSR turns off with an input voltage of 0.5V or less. It can withstand 1000V voltage at OFF state, with less than 1uA leakage current.

The NSI7258 uses NOVOSENSE's high reliability isolation technology. While the input circuit imitates the characters of LEDs, it has performance advantages compared to standard photo MOSFET, including better reliability and aging performance, higher working temperature, shorter turn-on and turn-off delay. As a result, the NSI7258 is suitable to replace photo MOSFET in high reliability system.

## Key Features

- Normally open (1-Form-A) solid state relay
- Up to 5000Vrms Insulation voltage
- Breakdown voltage: 1700V
- OFF state leakage current: <1uA at 1000V
- ON state resistance: <250Ω at 10mA load current
- Input forward threshold current: <5.5mA
- Turn on time: <0.3ms
- Turn off time: <0.05ms
- Integrated MOSFETs with 0.6 mA avalanche rating
- RoHS-compliant Packages: SOW12
- Creepage and clearance ≥ 8mm (input-output)
- Creepage and clearance ≥ 5.91mm (between drain pins of MOSFETs)
- Meets CISPR32 Class B and CISPR 25 Class 5 EMI limits without ferrite beads on a 2-layer PCB

## Safety Regulatory Approvals

- UL recognition: 5000V<sub>rms</sub> for 1 minute per UL1577
- CQC certification per GB4943.1
- CSA component notice 5A
- DIN EN IEC 60747-17 (VDE 0884-17)

## Applications

- Solid-state Relay
- EV Charging Station
- Energy Storage System
- Solar Energy System

## Device Information

Part Number	Package	Body Size
NSI7258-DSWLR	SOW12	10.30 × 7.50mm

## Functional Block Diagrams

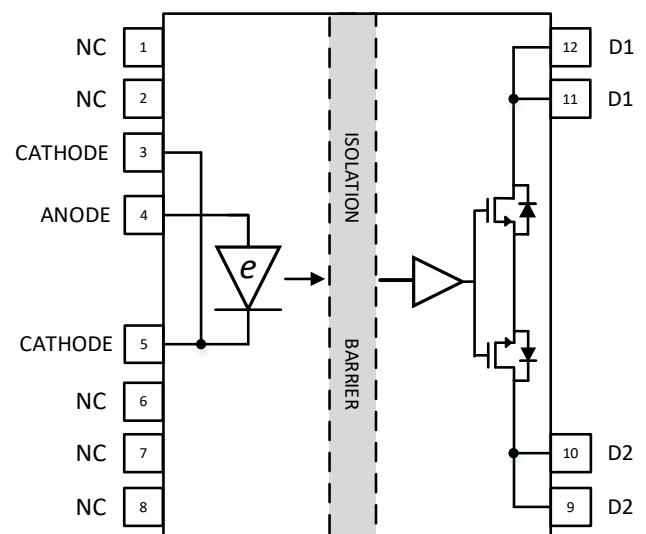


Figure 1. NSI7258 Block Diagram

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# 1. Pin Configuration and Functions

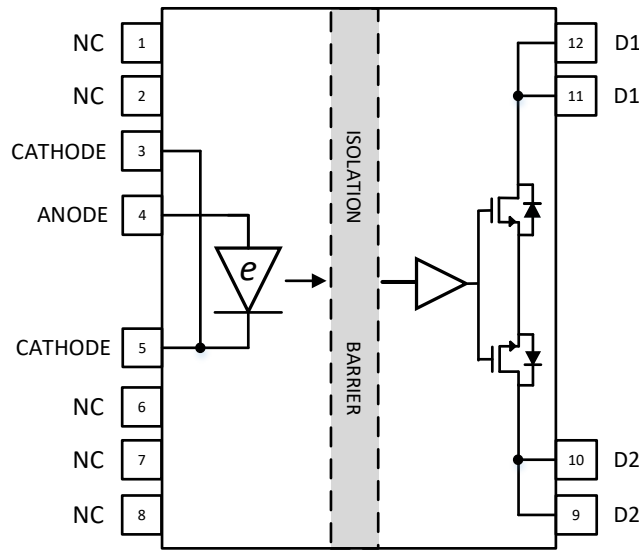


Figure 1.1 NSI7258 Package

Table 1.1 NSI7258 Pin Configuration and Description

<b>NSI7258 PIN NO.</b>	<b>SYMBOL</b>	<b>FUNCTION</b>
1, 2, 6, 7, 8	NC	No Connection
3, 5	CATHODE	Cathode of LED Emulator (Internally connected)
4	ANODE	Anode of LED Emulator
9, 10	D2	Drain 2 (Internally connected)
11, 12	D1	Drain 1 (Internally connected)

Note a: NSI7258 can work properly as long as either one of Pin3 and Pin5 is connected to external circuit.

## 2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Input Current	$I_F$			30	mA	
Reverse Input Voltage	$V_R$			6.5	V	
Output Withstand Voltage	$V_O$			1700	V	
Output Load Current	$I_o$			50	mA	
Ambient Temperature	$T_A$	-40		125	°C	
Operating Junction Temperature	$T_J$	-40		150	°C	
Storage Temperature	$T_{stg}$	-55		150	°C	

## 3. ESD Ratings

		Ratings	Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD	<ul style="list-style-type: none"> <li>All pins</li> </ul>	±2.0	kV
	Charged device model (CDM), per AEC-Q100-011-RevB	<ul style="list-style-type: none"> <li>All pins</li> </ul>	±1.0	kV

## 4. Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Input current (ON)	$I_{Fon}$	7		20	mA	
Input voltage (OFF)	$V_{Foff}$	-5		0.5	V	
Operating Temperature	$T_A$	-40		125	°C	
Output withstand voltage	$V_o$			1000	V	
Output load current	$I_o$			30	mA	

## 5. Thermal Information

Parameters	Symbol	SOW12	Unit
Junction-to-ambient thermal resistance	$R_{\theta JA}$	70	$^{\circ}\text{C} / \text{W}$
Junction-to-case (top) thermal resistance	$R_{\theta JC(\text{top})}$	36.1	$^{\circ}\text{C} / \text{W}$
Junction-to-board thermal resistance	$R_{\theta JB}$	24.7	$^{\circ}\text{C} / \text{W}$
Junction-to-top characterization parameter	$\Psi_{JT}$	10.3	$^{\circ}\text{C} / \text{W}$
Junction-to-board characterization parameter	$\Psi_{JB}$	23.3	$^{\circ}\text{C} / \text{W}$

## 6. Specifications

### 6.1. Electrical Characteristics (DC)

( $I_{Fon}=7\text{mA}$  to  $20\text{mA}$ ,  $V_{Foff}=-5\text{V}$  to  $0.5\text{V}$ ,  $T_A=-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . Unless otherwise noted, Typical values are at  $T_A=25^{\circ}\text{C}$ )

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Input Forward Threshold Current Low to High	$I_{FON}$		3.9	5.5	mA	$I_o=2\text{mA}$
Input Forward Voltage	$V_F$	1.6	1.8	2.1	V	$I_F=10\text{mA}$
Output Withstand Voltage	$V_{O\_OFF}$	1700			V	$I_o=100\mu\text{A}$
Output Leakage Current	$I_{O\_OFF}$			1	$\mu\text{A}$	$V_o=1000\text{V}$
Output Resistance	$R_{ON}$		80	250	$\Omega$	$I_o=10\text{mA}$
Common Mode Transient Immunity	CMTI		100		kV/ $\mu\text{s}$	(Ref Fig 6.9)

### 6.2. Switching Specifications (AC)

( $I_{Fon}=7\text{mA}$  to  $20\text{mA}$ ,  $V_{Foff}=-5\text{V}$  to  $0.5\text{V}$ ,  $T_A=-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ . Unless otherwise noted, Typical values are at  $T_A=25^{\circ}\text{C}$ )

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Turn-On Time	$t_{ON}$		0.106	0.3	ms	$V_{DD}=40\text{V}$ , $R_{LOAD}=20\text{k}$ (Ref Fig 6.10)
Turn-Off Time	$t_{OFF}$		0.006	0.05	ms	$V_{DD}=40\text{V}$ , $R_{LOAD}=20\text{k}$ (Ref Fig 6.10)

### 6.3. Typical Performance Characteristics

(Unless otherwise noted,  $T_A=25^\circ\text{C}$ )

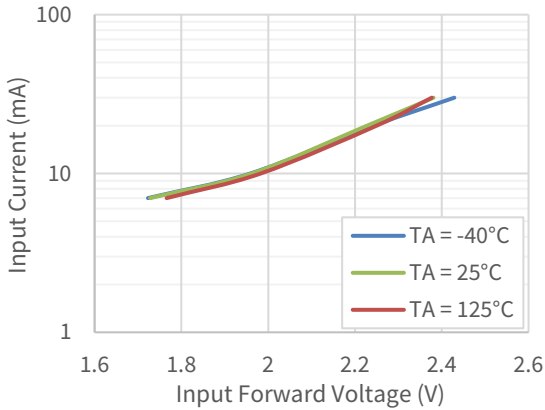


Fig 6.1 Input Current vs. Input Forward Voltage

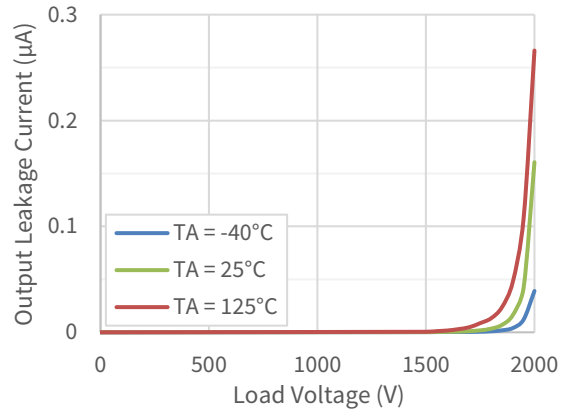


Fig 6.2 Output Leakage Current vs. Load Voltage

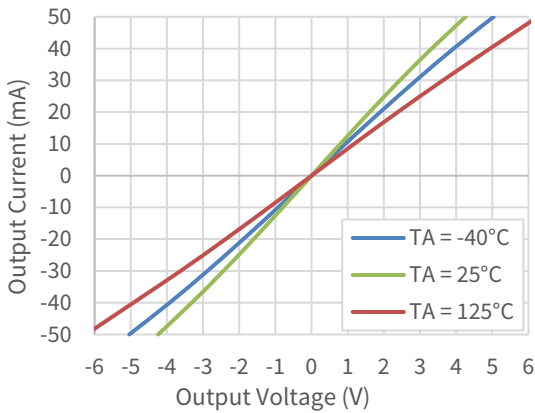


Fig 6.3 Output Current vs. Ambient Temperature

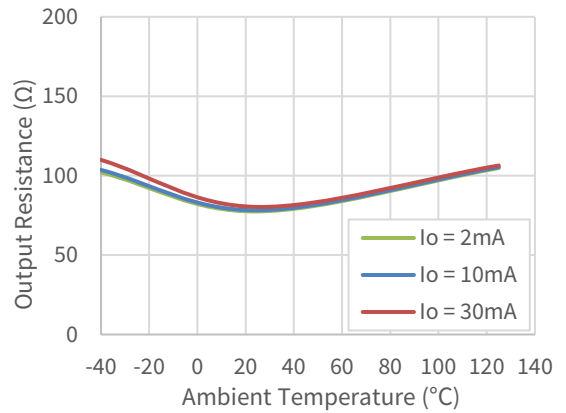


Fig 6.4 Typical On-Resistance vs. Ambient Temperature

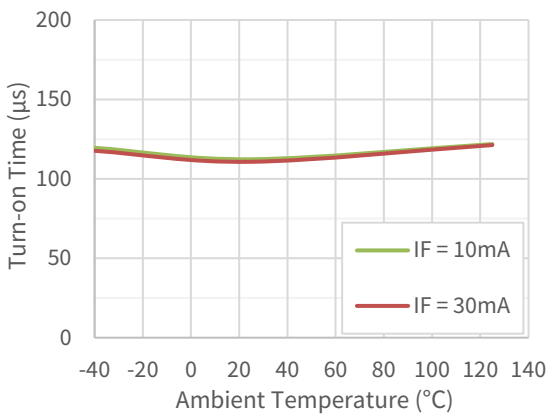


Fig 6.5 Turn-on Time vs. Ambient Temperature  
(Test Condition:  $V_{DD} = 40\text{V}$ ,  $R_{LOAD} = 20\text{k}\Omega$ )

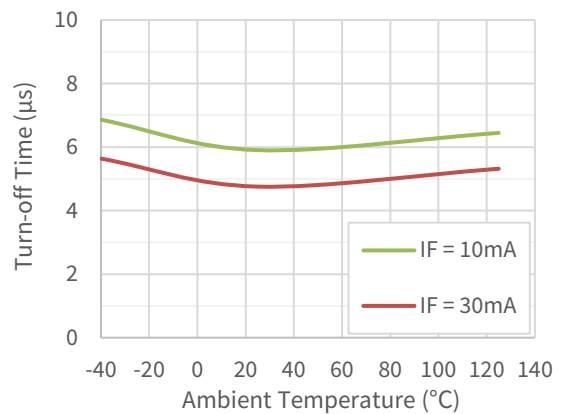


Fig 6.6 Turn-off Time vs. Ambient Temperature  
(Test Condition:  $V_{DD} = 40\text{V}$ ,  $R_{LOAD} = 20\text{k}\Omega$ )

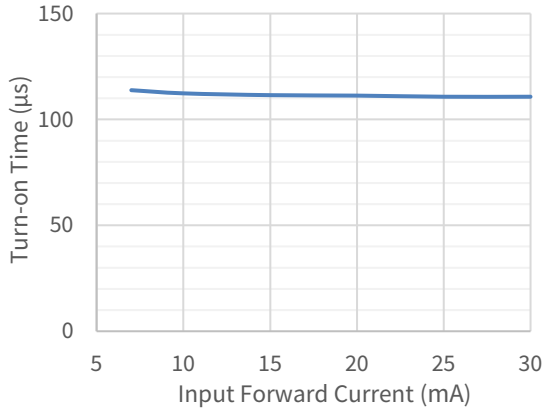


Fig 6.7 Turn-on Time vs. Input Forward Current  
(Test Condition:  $V_{DD} = 40V$ ,  $R_{LOAD} = 20k\Omega$ )

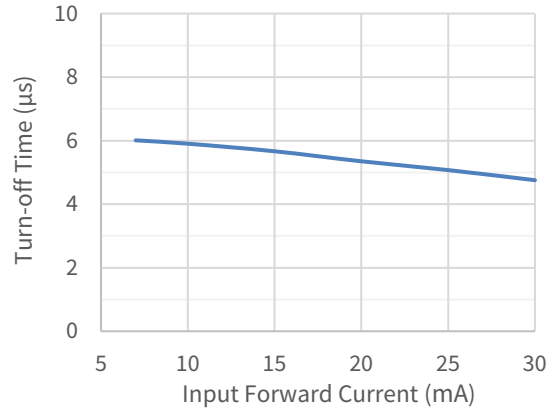


Fig 6.8 Turn-off Time vs. Input Forward Current  
(Test Condition:  $V_{DD} = 40V$ ,  $R_{LOAD} = 20k\Omega$ )

### 6.4. Parameter Measurement Information

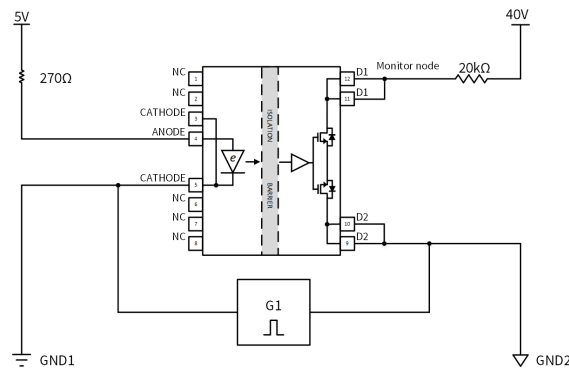


Figure 6.9 Common Mode Transient Immunity Test Circuit

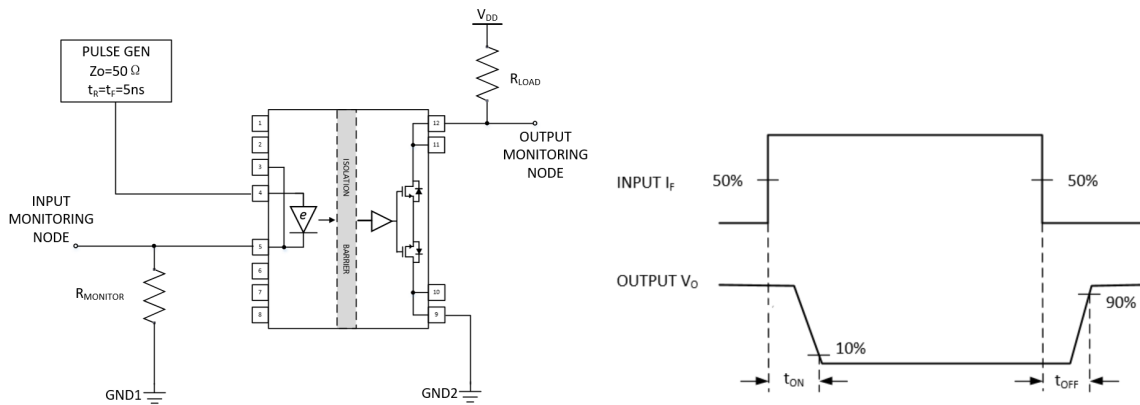


Figure 6.10 Switching Characteristics Test Circuit and Waveform

## 7. High Voltage Feature Description

### 7.1. Insulation and Safety Related Specifications

Parameters	Symbol	Value	Unit	Comments
		SOW12		
Minimum External Clearance	CLR	8	mm	IEC 60664-1:2007
Minimum External Creepage	CPG	8	mm	IEC 60664-1:2007
Distance Through Insulation	DTI	13	um	Distance through insulation
Tracking Resistance (Comparative Tracking Index)	CTI	>600	V	DIN EN 60112 (VDE 0303-11); IEC 60112
Material Group		I		IEC 60664-1

### 7.2. Insulation Characteristics

Description	Test Condition	Symbol	Value	Unit
Overvoltage Category per IEC60664-1	For Rated Mains Voltage $\leq 150\text{Vrms}$		I to IV	
	For Rated Mains Voltage $\leq 300\text{Vrms}$		I to IV	
	For Rated Mains Voltage $\leq 600\text{Vrms}$		I to IV	
	For Rated Mains Voltage $\leq 1000\text{Vrms}$		I to III	
Climatic Classification			40/125/21	
Pollution Degree per DIN VDE 0110			2	
Maximum repetitive isolation voltage		$V_{IORM}$	1414	$V_{PEAK}$
Maximum working isolation voltage	AC voltage	$V_{IOWM}$	1000	$V_{RMS}$
	DC voltage		1414	$V_{DC}$
Apparent Charge	Method a, after Input/output safety test subgroup 2/3, $V_{ini} = V_{IOTM}$ , $t_{ini} = 60\text{ s}$ , $V_{pd(m)} = 1.2 * V_{IORM}$ , $t_m = 10\text{ s}$ .	$q_{pd}$	<5	pC
	Method a, after environmental tests subgroup 1, $V_{ini} = V_{IOTM}$ , $t_{ini} = 60\text{ s}$ , $V_{pd(m)} = 1.3 * V_{IORM}$ , $t_m = 10\text{ s}$			
	Method b, routine test (100% production) and preconditioning (type test); $V_{ini} = 1.2 * V_{IOTM}$ , $t_{ini} = 1\text{ s}$ $V_{pd(m)} = 1.5 * V_{IORM}$ , $t_m = 1\text{ s}$ (method b1) or $V_{pd(m)} = V_{ini}$ , $t_m = t_{ini}$ (method b2)			
Maximum transient isolation voltage	$t = 60\text{ sec}$	$V_{IOTM}$	7071	$V_{PEAK}$
Maximum impulse voltage	Tested in air, 1.2/50-us waveform per IEC62368-1	$V_{IMP}$	5439	$V_{PEAK}$



Description	Test Condition	Symbol	Value	Unit
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50us waveform, $V_{IOSM} \geq V_{IMP} \times 1.3$	$V_{IOSM}$	7071	$V_{PEAK}$
Isolation resistance	$V_{IO} = 500V, T_{amb} = 25^{\circ}C$	$R_{IO}$	$>10^{12}$	$\Omega$
	$V_{IO} = 500V, 100^{\circ}C \leq T_{amb} \leq 125^{\circ}C$	$R_{IO}$	$>10^{11}$	$\Omega$
	$V_{IO} = 500V, T_{amb} = T_s$	$R_{IO}$	$>10^9$	$\Omega$
Isolation capacitance	$f = 1MHz$	$C_{IO}$	1.6	pF
Maximum safety temperature		$T_s$	150	$^{\circ}C$
<b>UL1577</b>				
Insulation voltage per UL	$V_{TEST} = V_{ISO}, t = 60 s$ (qualification), $V_{TEST} = 1.2 \times V_{ISO}, t = 1 s$ (100% production test)	$V_{ISO}$	5000	$V_{RMS}$

### 7.3. Regulatory Information

The NSI7258 is approved by the organizations listed in table.

UL		TUV	CQC
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	DIN EN IEC 60747-17 (VDE 0884-17)	Certified according to GB4943.1
Single Protection, 5000V <sub>rms</sub> Isolation voltage	Single Protection, 5000V <sub>rms</sub> Isolation voltage	Basic Insulation $V_{IORM} = 1414V_{peak}$ $V_{IOTM} = 7071V_{peak}$ $V_{IOSM} = 7071V_{peak}$	Basic insulation
E500602	E500602	R 50632636	CQC24001426160

## 8. Application Note

### 8.1. Typical Application Circuit

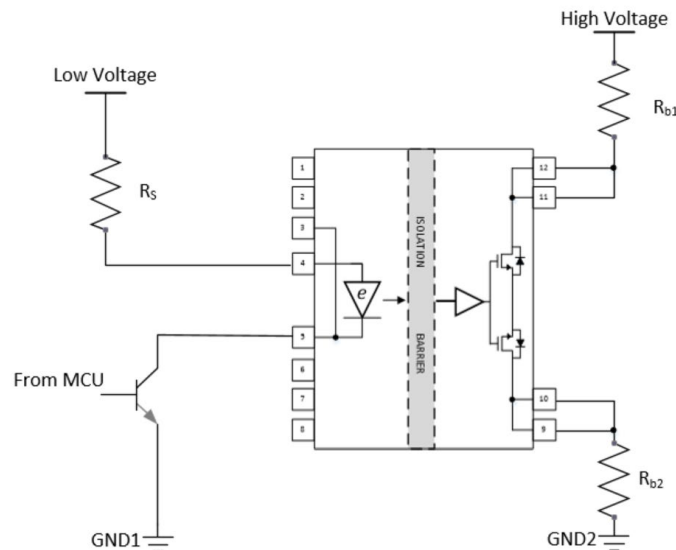


Figure 8.1 Typical application circuit

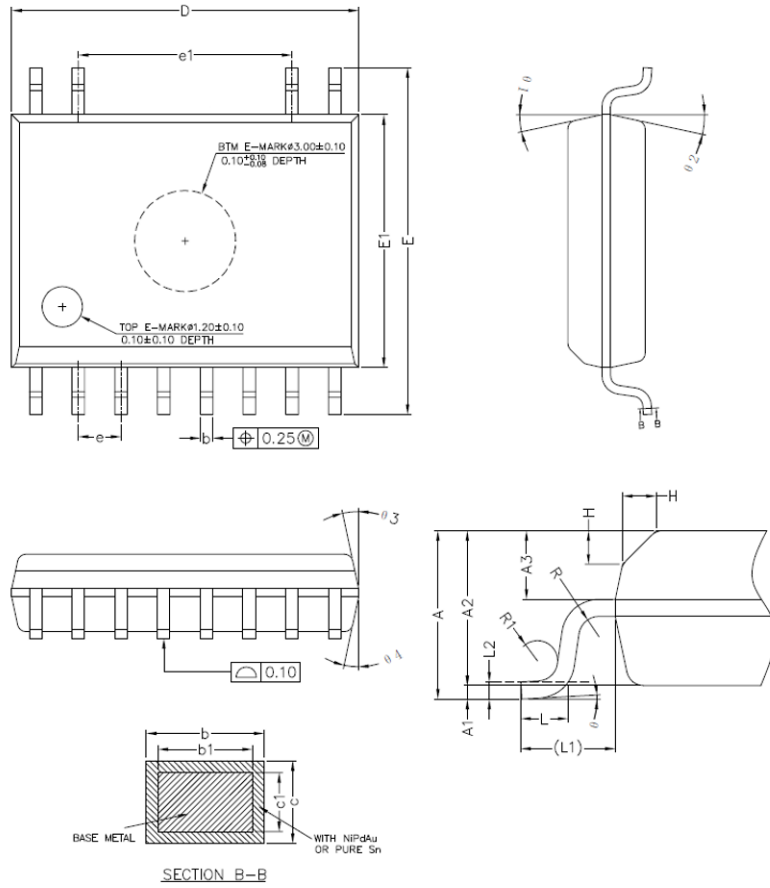
The NSI7258 is a single-channel solid-state relay, which is pin-compatible for popular photo MOSFET. It uses NOVOSENSE's high reliability isolation technology, which has performance advantages compared to standard photo MOSFET including better reliability and aging performance, higher working temperature, shorter turn-on and turn-off delay. The SOW12 Package allows the NSI7258 to support 0.6 mA output avalanche current (AC sinusoidal wave,  $T_m=1\text{min}$ , duty cycle  $<10\%$ , cumulative of 5 minutes over lifetime,  $T_A=25^\circ\text{C}$ ), with voltage clamped at more than 2000V.

The input circuit of NSI7258 imitates the characters of photodiode and delivers energy through the on-chip power transfer block to drive two inner back-to-back high-voltage SiC MOSFETs. When current is driven into the input side, the gate of the MOSFETs is charged and switches MOSFETs on.

A typical application circuit (Figure 8.1) shows NSI7258's input side (low voltage side) being controlled by the MCU to switch the output (high voltage side).  $R_S$  is used as current limiting resistor to control the input forward current. NOVOSENSE's high reliability isolation technology protects the low voltage side of the circuit from the high voltage side.

Pins 3 to 5, 8 to 9 and 15 to 16 are internally connected. In routing the PCB layout, using either of the internally-connected pins or shorting the pins is acceptable.

### 9. Package Information



COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	—	—	2.65
A1	0.10	0.20	0.30
A2	2.20	2.30	2.40
A3	0.97	1.02	1.07
b	PURE Sn 0.33	—	0.47
	NiPdAu 0.33	—	0.44
b1	0.33	0.38	0.43
c	PURE Sn 0.22	—	0.32
	NiPdAu 0.22	—	0.29
c1	0.22	0.25	0.28
D	10.20	10.30	10.40
E	10.10	10.30	10.50
E1	7.40	7.50	7.60
e	1.17	1.27	1.37
e1	6.25	6.35	6.45
H	0.40	0.50	0.60
L	0.55	0.70	0.85
L1	1.40REF		
L2	0.25BSC		
R	0.07	—	—
R1	0.07	—	—
θ	0°	—	8°
θ 1	10°	12°	14°
θ 2	10°	12°	14°
θ 3	10°	12°	14°
θ 4	10°	12°	14°

NOTES:  
ALL DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

Figure 9.1 SOW12 Package Shape and Dimension in millimeters

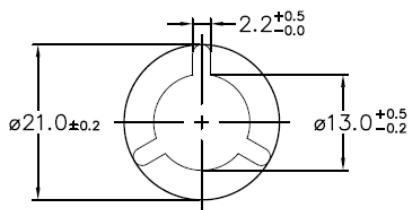
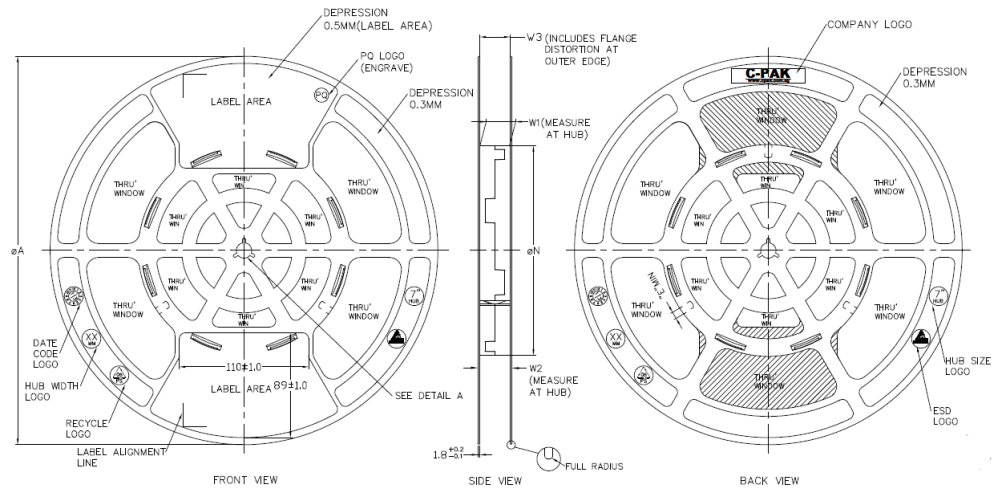
## 10. Ordering Information

<i>Part Number</i>	<i>Isolation Rating (kV)</i>	<i>Number of Channels</i>	<i>Recommended withstand voltage (V)</i>	<i>Temperature</i>	<i>MSL</i>	<i>Package Type</i>	<i>Package Drawing</i>	<i>SPQ</i>
NSI7258-DSWLR	5	1	1000	-40 to 125°C	3	SOIC12	SOW12	1000

## 11. Documentation Support

<i>Part Number</i>	<i>Product Folder</i>	<i>Datasheet</i>	<i>Technical Documents</i>
NSI7258	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

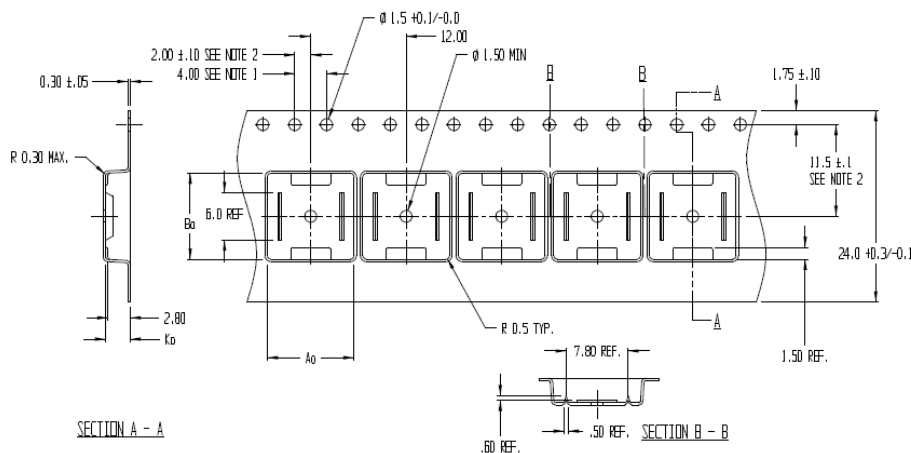
## 12. Tape and Reel Information



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 ±0.5 / -0.0	14.4	SHALL ACCOMMODATE TAPE WIDTH WITHOUT INTERFERENCE	5.5
12MM	330	178	12.4 ±0.5 / -0.0	18.4		5.5
16MM	330	178	16.4 ±0.5 / -0.0	22.4		5.5
24MM	330	178	24.4 ±0.5 / -0.0	30.4		5.5
32MM	330	178	32.4 ±0.5 / -0.0	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>9</sup> & BELOW 10 <sup>8</sup>	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10 <sup>9</sup> TO 10 <sup>11</sup>	ANTISTATIC (COATED)	ALL TYPES



NOTES:

1. 10.0 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE
3. A<sub>0</sub> AND B<sub>0</sub> ARE CALCULATED ON A PLANE AT A DISTANCE "R" ABOVE THE BOTTOM OF THE POCKET.

A<sub>0</sub> = 10.90  
B<sub>0</sub> = 10.80  
K<sub>0</sub> = 3.1

Figure 12.1 Tape and Reel Information of SOW12

### 13. Revision History

Revision	Description	Date
1.0	Initial Version.	2024/7/15

## IMPORTANT NOTICE

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