NOVOSENSE

NSI7117-Q1
1700-V 50mA Solid-State Relay
Datasheet (EN) 1.0

Product Overview

NSI7117-Q1 is an automotive single-channel solid-state relay (SSR), which is pin-compatible with popular photo MOSFETs. The SSR can conduct 30mA current and the resistance is less than 250Ω in the on state with a minimum input current of 6mA. It turns off with an input voltage of 0.5V or less and can withstand 1000V voltage in the off state, with less than 1μA leakage current.

NSI7117-Q1 uses NOVOSENSE's high reliability isolation technology. While the input circuit emulates the characteristics of LEDs, it offers performance advantages over conventional photo-MOSFETs, including better reliability and aging performance, higher working temperature, reduced turn-on and turn-off delay. Consequently, the NSI7117-Q1 serves as an ideal replacement for photo-MOSFETs in high reliability system.

Key Features

- AEC Q-100 Qualified for Grade 1: TA from –40 °C to 125 °C
- Normally open (1-Form-A) solid state relay
- Insulation voltage: Up to 5000 V_{rms}
- Breakdown voltage: 1700V
- OFF state leakage current: <1μA at 1000V
- ON state resistance: <250Ω at 10mA load current
- Input forward threshold current: <6mA
- Turn on time: <0.8ms
- Turn off time: <0.2ms
- 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 CISPR 25 Class 5 EMI limits
- Enhanced performance during BCI immunity tests

Safety Regulatory Approvals

- UL recognition: up to 5000 V_{rms} for 1 minute per UL1577
- CQC certification per GB4943.1 pending
- CSA component notice 5A approval IEC60950-1 standard pending
- DIN VDE V 0884-17 pending

Applications

- Automotive BMS
- OBC
- Traction Inverter
- PDU

Device Information

Part Number	*Package*	*Body Size*
NSI7117-Q1SWLR	SOW12	10.30 × 7.50mm

Functional Block Diagrams

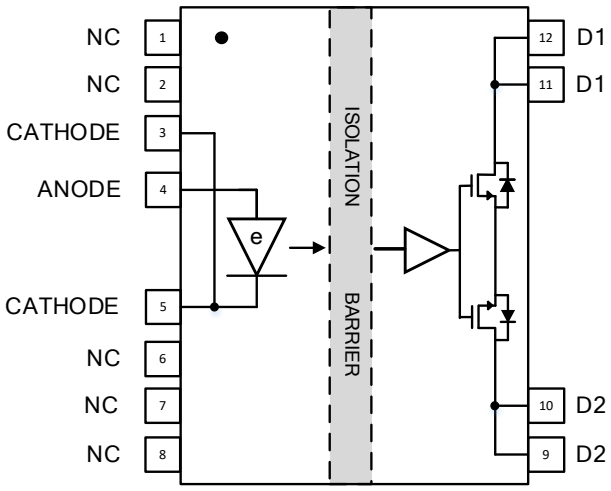

Figure 1. NSI7117-Q1 Block Diagram

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1. Pin Configuration and Functions

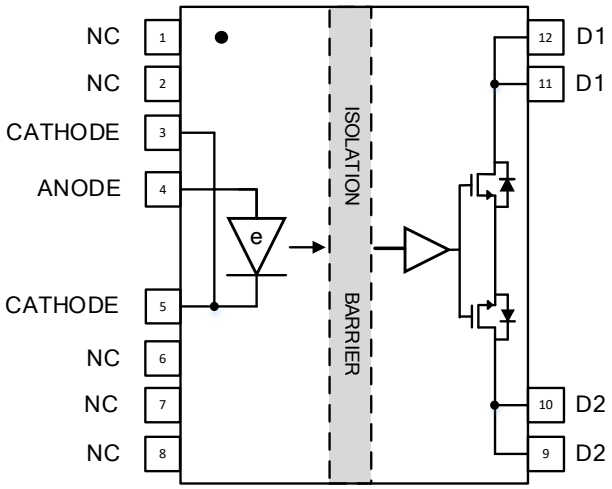


Figure 1.1 NSI7117-Q1 Package

Table 1.1 NSI7117-Q1 Pin Configuration and Description

NSI7117 Pin No.	*Symbol*	*Function*
1, 2, 6, 7, 8	NC	No Connection
3, 5	CATHODE	Cathode of LED Emulator (Internally connected) [a]
4	ANODE	Anode of LED Emulator
9, 10	D2	Drain 2 (Internally connected)
11, 12	D1	Drain 1 (Internally connected)

Note a: NSI7117-Q1 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	
Avalanche Current(1)				0.6	mA	
Ambient Temperature	T_A	-40		125	°C	
Operating Junction Temperature	T_J	-40		150	°C	
Storage Temperature	T_{stg}	-55		150	°C	

(1) t_m=1min, duty cycle=0.1%, cumulative of 5 minutes over lifetime, guaranteed by bench characterization.

3. ESD Ratings

	Ratings	Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD ● All pins	±2.0	kV
	Charged device model (CDM), per AEC-Q100-011-RevB ● All pins	±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	SOW-16	Unit
Junction–to-ambient thermal resistance	$R_{\theta JA}$	70	°C /W
Junction-to-case (top) thermal resistance	$R_{\theta JC(top)}$	36.1	°C /W
Junction-to-board thermal resistance	$R_{\theta JB}$	24.7	°C /W
Junction–to-top characterization parameter	Ψ_{JT}	10.3	°C /W
Junction-to-board characterization parameter	Ψ_{JB}	23.3	°C /W

6. Specifications

6.1. Electrical Characteristics (DC)

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

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Input Forward Threshold Current Low to High	I_{FON}		4.5	6	mA	IO=2mA
Input Forward Voltage	V_F	1.8	2.1	2.5	V	IF=10mA
Output Withstand Voltage	V_{O_OFF}	1700			V	IO=100μA
Output Leakage Current	I_{O_OFF}			1	μA	VO=1000V
Output Resistance	R_{ON}		72	250	Ω	IO=10mA
Common Mode Transient Immunity	CMTI		100		kV/μs	(Ref Fig 6.7)

6.2. Switching Specification (AC)

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

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Turn-On Time	t_{ON}		0.38	0.8	ms	VDD=40V, RLOAD=20k (Ref Fig 6.8)
Turn-Off Time	t_{OFF}		0.03	0.2	ms	VDD=40V, RLOAD=20k (Ref Fig 6.8)

6.3. Typical Performance Characteristics

(Unless otherwise noted, TA=25°C)

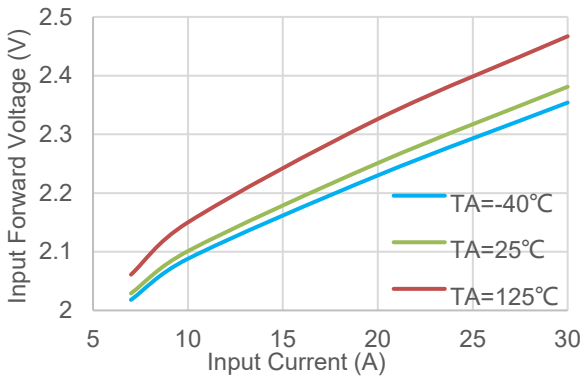


Figure 6.1 Input Current vs. Input Forward Voltage

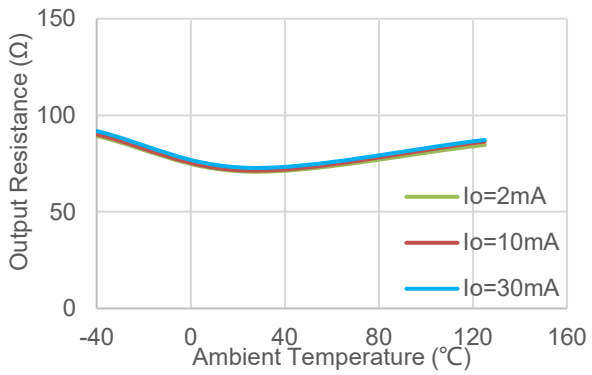


Figure 6.2 Typical On-Resistance vs. Ambient Temperature

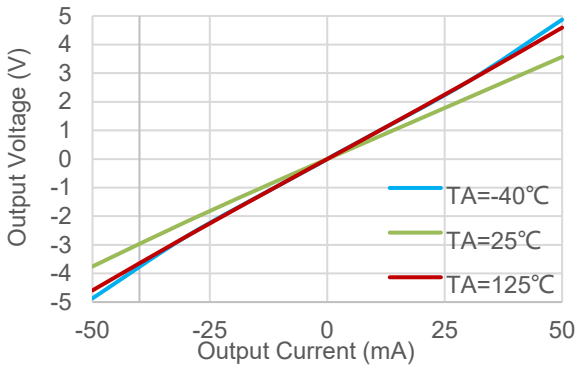


Figure 6.3 On-state Output Voltage vs. Output Current

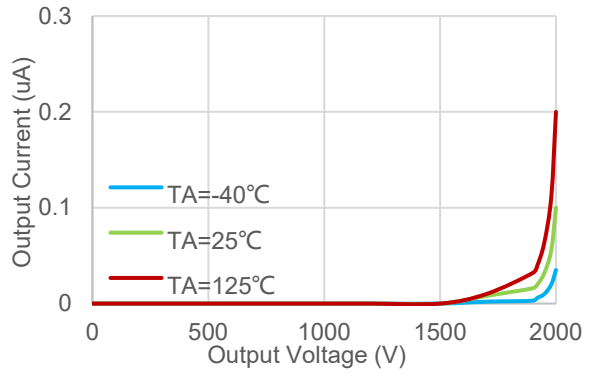


Figure 6.4 Off-state Output Current vs. Output Voltage

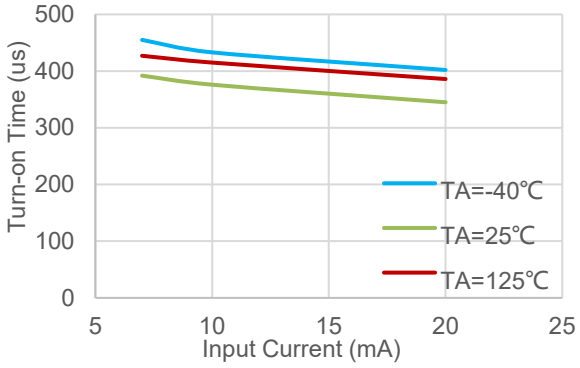


Figure 6.5 Turn-on Time vs. Input Current
(Test Condition: V_{DD} = 40V, R_{LOAD} = 20kΩ)

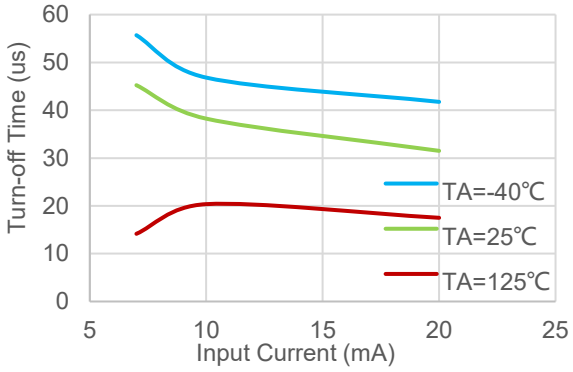


Figure 6.6 Turn-off Time vs. Input Current
(Test Condition: V_{DD} = 40V, R_{LOAD} = 20kΩ)

6.4. Parameter Measurement Information

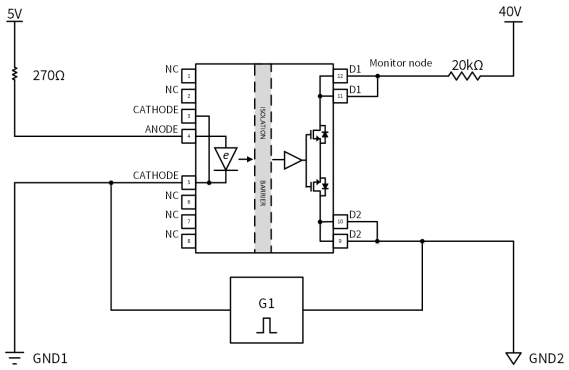


Figure 6.7 Common Mode Transient Immunity Test Circuit

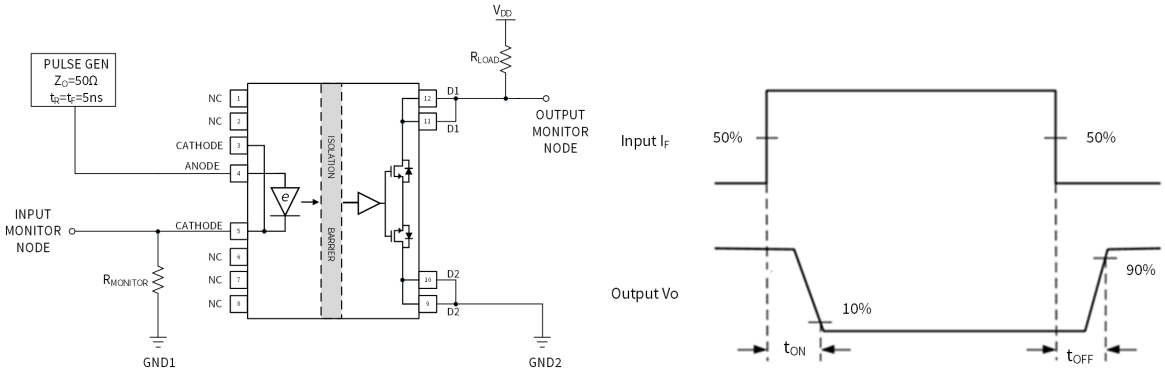


Figure 6.8 Switching Characteristics Test Circuit and Waveform

7. High Voltage Feature Description

7.1. Insulation and Safety Related Specifications

Parameters	*Symbol*	*Value* *WB-SOIC-16*	*Unit*	*Comments*
Minimum External Clearance	CLR	8	mm	IEC 60664-1
Minimum External Creepage	CPG	8	mm	IEC 60664-1
Distance Through Insulation	DTI	13	μm	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 ≤ 150Vrms		I to IV	
	For Rated Mains Voltage ≤ 300Vrms		I to IV	

Description	Test Condition	Symbol	Value	Unit
	For Rated Mains Voltage ≤ 600Vrms		I to IV	
	For Rated Mains Voltage ≤ 1000Vrms		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} = VIOTM, t_{ini} = 60 s, $V_{pd(m)}$ = 1.2*V_{IORM}, t_m = 10s.	q pd	<5	pC
	Method a, after environmental tests subgroup 1, V_{ini} = V_{IOTM}, t_{ini} = 60s, $V_{pd(m)}$ = 1.3*V_{IORM}, t_m=10s			
	Method b, routine test (100% production) and preconditioning (type test); V_{ini} = 1.2*V_{IOTM}, t_{ini} = 1s $V_{pd(m)}$=1.5*V_{IORM}, t_m=1s(method b1)or $V_{pd(m)}$=V_{ini}, t_m=t_{ini}(method b2)			
Maximum transient isolation voltage	t = 60 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}
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50us waveform, V_{IOSM} ≥ V_{IMP} × 1.3	V_{IOSM}	7071	V_{PEAK}
Isolation resistance	V_{IO} =500V, T_{amb}=25°C	R_{IO}	>10^{12}	Ω
	V_{IO} =500V, 100°C ≤ T_{amb} ≤ 125°C	R_{IO}	>10^{11}	Ω
	V_{IO} =500V, T_{amb}=Ts	R_{IO}	>10^{9}	Ω
Isolation capacitance	f = 1MHz	C_{IO}	1.2	pF
Maximum safety temperature		T_s	150	°C
UL1577				
Insulation voltage per UL	V_{TEST} = V_{ISO}, t = 60 s (qualification), V_{TEST} = 1.2 × V_{ISO}, t = 1 s (100% production test)	V_{ISO}	5000	V_{RMS}

7.3. Regulatory Information

The NSI7117- is approved or pending approval 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_{rms} Isolation voltage	Single Protection, 5000V_{rms} Isolation voltage	Basic Insulation V_{IORM}=1414V_{peak} V_{IOTM}=7071V_{peak} V_{IOSM}=7071V_{peak}	Basic insulation
E500602	E500602	File (pending)	File (pending)

8. Application Information

8.1. Typical Application Circuit

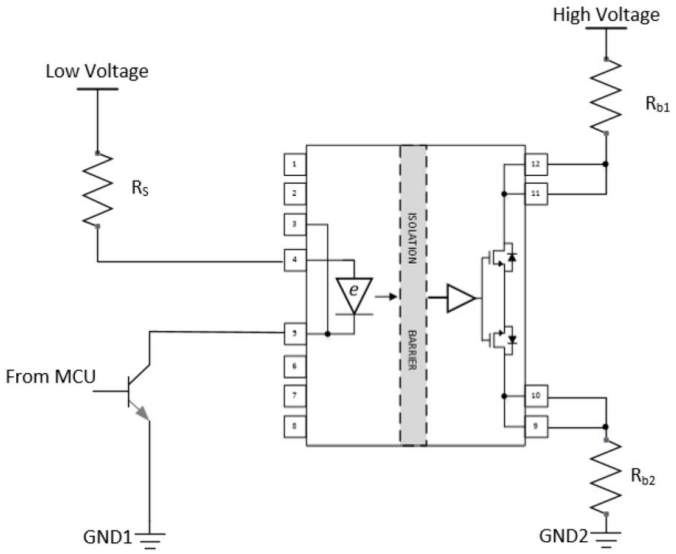


Figure 8.1 Typical application circuit

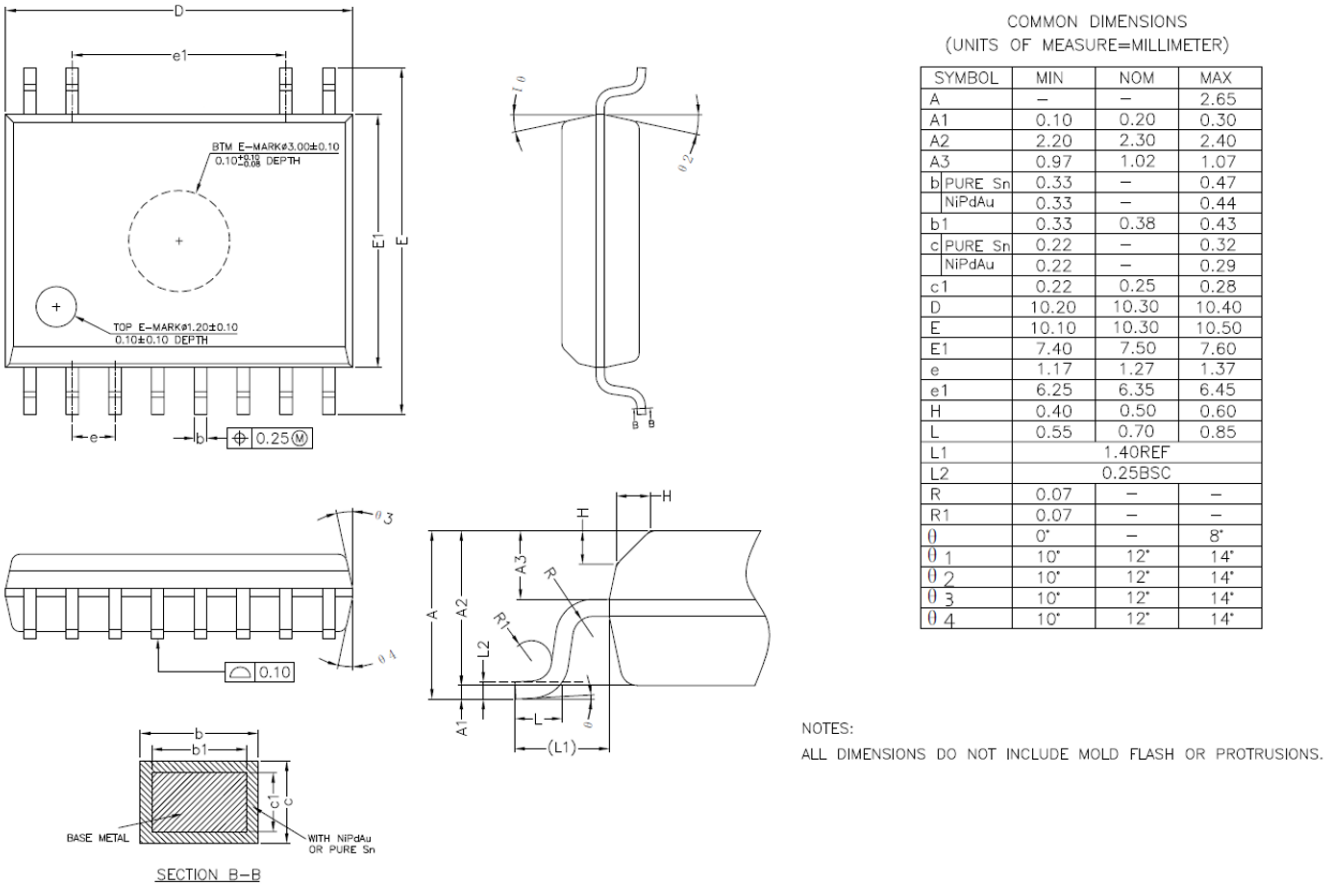
NSI7117-Q1 is an automotive-grade, 1700V, 30mA single-channel solid-state relay. It is pin-compatible with popular photo MOSFETs. With NOVOSENSE's high-reliability isolation technology, the NSI7117-Q1 offers significant advantages over standard photo MOSFETs, including better reliability and aging performance, higher operating temperature, and shorter turn-on and turn-off delay. The SOW12 package enables NSI7117-Q1 to support 0.6 mA output avalanche current (RMS value, Tm=1min, duty cycle <0.1%, cumulative of 5 minutes over lifetime, TA=25°C) while clamping voltage at over 2000V.

The primary side of NSI7117-Q1 imitates the characteristics of a photodiode, delivering energy through the isolation barrier to drive two integrated secondary side back-to-back high-withstand voltage SiC MOSFETs without requiring an additional secondary side power supply. With an input current of 7-20mA, the secondary side can conduct with a resistance less than 250Ω and withstands 1000V voltage with less than 1μA leakage current in the off-state.

As shown in the typical application circuit (Figure 8.1), NSI7117-Q1 is usually controlled by an MCU combined with a BJT to switch the internal MOSFETs, along with a series resistor R_s to limit 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 & 5, 9 & 10 and 11 & 12 are internally connected. In the PCB layout, using either of the internally-connected pins or shorting them together 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°
θ1	10°	12°	14°
θ2	10°	12°	14°
θ3	10°	12°	14°
θ4	10°	12°	14°

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

Figure 9.1 SOW12 Package Shape and Dimension in millimeters

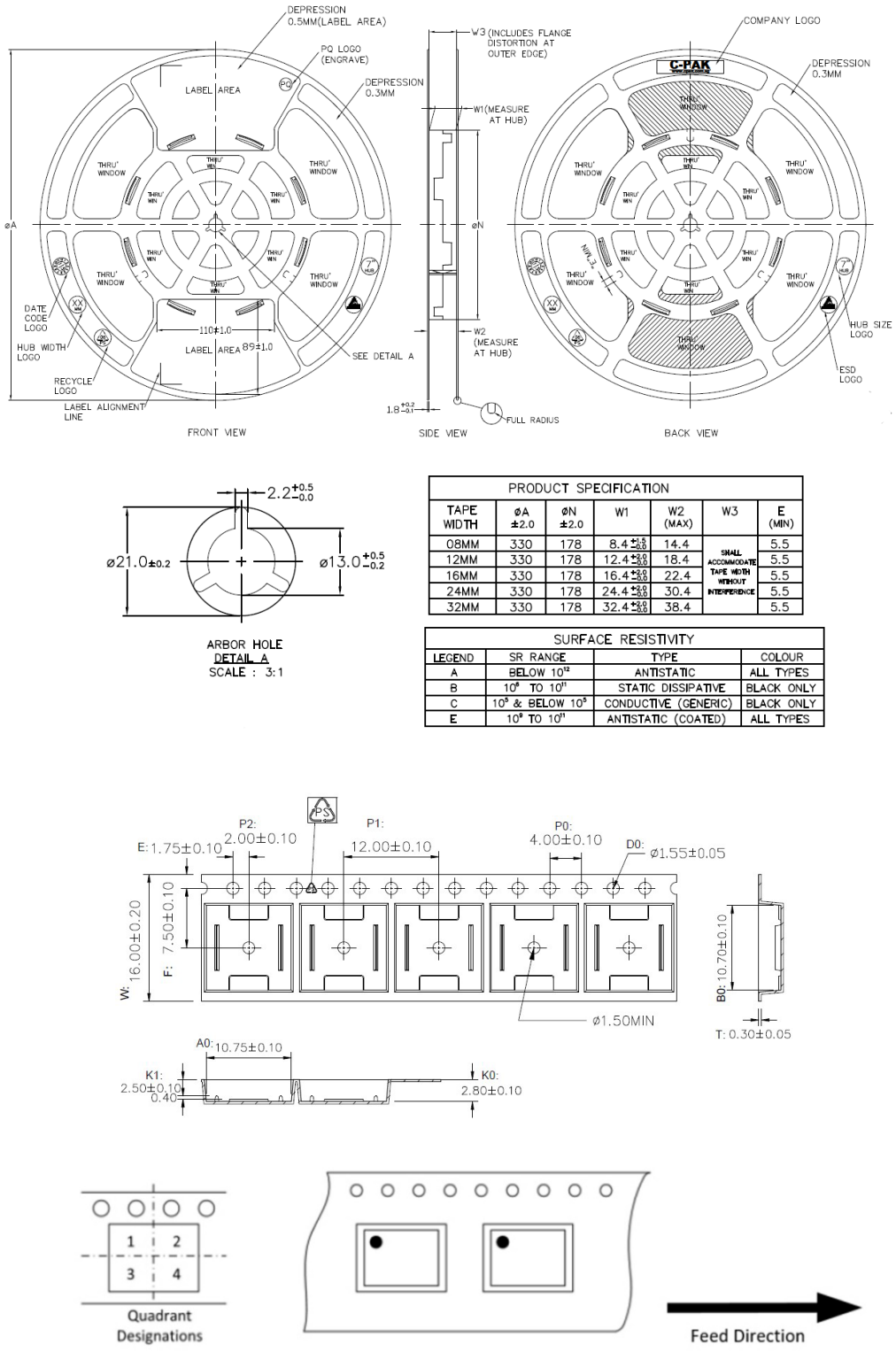
10. Ordering Information

Part Number	Isolation Rating (kV)	Number of Channels	Recommended withstand voltage (V)	Temperature	MSL	Device Marking	Package Type	Package Drawing	SPQ	MPQ
NSI7117-Q1SWLR	5	1	1000	-40 to 125°C	3	NSi7117Q	SOIC12	SOW12	1000	1000

11. Documentation Support

Part Number	Product Folder	Datasheet	Technical Documents
NSI7117-Q1	Click here	Click here	Click here

12. Tape and Reel Information



PRODUCT SPECIFICATION						
TAPE WIDTH	øA ±2.0	øN ±2.0	W1	W2 (MAX)	W3	E (MIN)
08MM	330	178	8.4 +1.5 -0.0	14.4	SHALL ACCOMMODATE TAPE WIDTH WITHOUT INTERFERENCE	5.5
12MM	330	178	12.4 +2.0 -0.0	18.4		5.5
16MM	330	178	16.4 +2.0 -0.0	22.4		5.5
24MM	330	178	24.4 +2.0 -0.0	30.4		5.5
32MM	330	178	32.4 +2.0 -0.0	38.4		5.5

SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW 10^{12}	ANTISTATIC	ALL TYPES
B	10^{8} TO 10^{11}	STATIC DISSIPATIVE	BLACK ONLY
C	10^{5} & BELOW 10^{5}	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10^{9} TO 10^{11}	ANTISTATIC (COATED)	ALL TYPES

Figure 12.1 Tape and Reel Information of SOW12

13. Revision History

Revision	Description	Date
1.0	Initial version.	2026/4/22

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