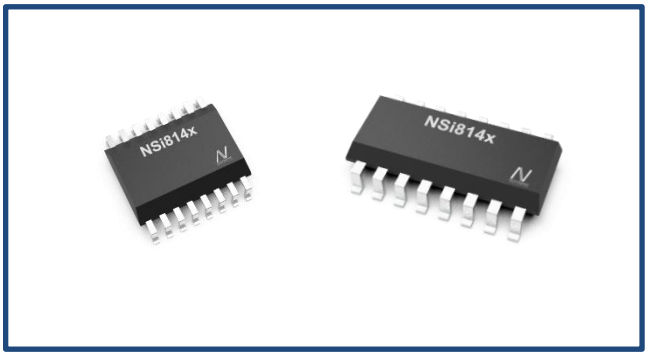
NSi8140/NSi8141/NSi8142: High Reliability Quad-Channel Digital Isolators

Datasheet (EN) 1.4

Product Overview

The NSi814x devices are high reliability quad-channel digital isolators. The NSi814x device is safety certified by UL1577 support several insulation withstand voltages (3.75kV$_{rms}$, 5kV$_{rms}$), while providing high electromagnetic immunity and low emissions at low power consumption. The data rate of the NSi814x is up to 150Mbps, and the common-mode transient immunity (CMTI) is up to 150kV/us. The NSi814x device provides digital channel direction configuration and the default output level configuration when the input power is lost. Wide supply voltage of the NSi814x device support to connect with most digital interface directly, easy to do the level shift. High system level EMC performance enhance reliability and stability of use. AEC-Q100 (Grade 1) option is provided for all devices.



Key Features

- Up to 5000V$_{rms}$ Insulation voltage
- Date rate: DC to 150Mbps
- Power supply voltage: 2.5V to 5.5V
- AEC-Q100 Grade 1 available for all devices
- High CMTI: 150kV/us
- Chip level ESD: HBM: ±6kV
- High system level EMC performance:
  - Enhanced system level ESD, EFT, Surge immunity
- Default output high level or low level option
- Isolation barrier life: >60 years
- Low power consumption: 1.5mA/ch (1 Mbps)
- Low propagation delay: <15ns
- Operation temperature: -40℃~125℃
- RoHS-compliant packages:
  - SOIC-16 narrow body
  - SOIC-16 wide body

Safety Regulatory Approvals

- UL recognition: up to 5000V$_{rms}$ for 1 minute per UL1577
- CQC certification per GB4943.1-2011
- CSA component notice 5A
- DIN VDE V 0884-11:2017-01

Applications

- Industrial automation system
- Isolated SPI, RS232, RS485
- General-purpose multichannel isolation
- Motor control

Functional Block Diagrams

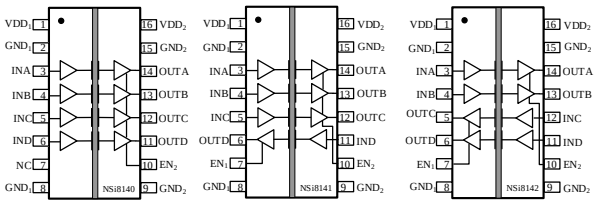


Figure 1. NSi814x Block Diagram

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1.0 ABSOLUTE MAXIMUM RATINGS

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Power Supply Voltage	VDD1, VDD2	-0.5		6.5	V	
Maximum Input Voltage	VINA,VINB, VINC, VIND	-0.4		VDD+0.4	V	
Maximum Output Voltage	VOUTA,VOUTB, VOUTC	-0.4		VDD+0.4	V	
Maximum Input/Output Pulse Voltage	VINA, VINB, VINC,VOUTA, VOUTB,VOUTC	-0.8		VDD+0.8	V	Pulse width should be less than 100ns, and the duty cycle should be less than 10%
Common-Mode Transients	CMTI			±150	kV/us	
Output current	Io	-15		15	mA	
Maximum Surge Isolation Voltage	V_{IOSM}			5.3	kV	
Operating Temperature	Topr	-40		125	℃	
Storage Temperature	Tstg	-40		150	℃	
Electrostatic discharge	HBM			±6000	V	
	CDM			±2000	V	

2.0 SPECIFICATIONS

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Power on Reset	VDD_{POR}		2.2		V	POR threshold as during power-up
	VDD_{HYS}		0.1		V	POR threshold Hysteresis
Input Threshold	V_{IT}		1.6		V	Input Threshold at rising edge
	V_{IT_HYS}		0.4		V	Input Threshold Hysteresis
High Level Input Voltage	V_{IH}	2			V	
Low Level Input Voltage	V_{IL}			0.8	V	
High Level Output Voltage	V_{OH}	VDD-0.3			V	I_{OH} =- 4mA
Low Level Output Voltage	V_{OL}			0.3	V	I_{OL} = 4mA
Output Impedance	R_{out}		50		ohm	
Input Pull high or low Current	I_{pull}		8	15	uA	
Start Up Time after POR	trbs		40		usec	

Common Mode Transient Immunity	CMTI	100		150	kV/us	

2.1. RECOMMENDED OPERATING CONDITIONS

Parameters	*Symbol*	*min*	*typ*	*max*	*unit*
Power Supply Voltage	VDD1, VDD2	2.5		5.5	V
Operating Temperature	Topr	-40		125	℃
High Level Input Voltage	VIH	2			V
Low Level Input Voltage	VIL			0.8	V
Data rate	DR			150	Mbps

2.2. THERMAL CHARACTERISTICS

Parameters	*Symbol*	*WB SOIC-16*	*NB-SOIC-16*	*Unit*
IC Junction-to-Air Thermal Resistance	θ_{JA}	78.9	78.9	° C/W
Junction-to-case (top) thermal resistance	$\theta_{JC(top)}$	41.6	41.1	° C/W
Junction-to-board thermal resistance	θ_{JB}	43.6	49.5	° C/W

2.3. ELECTRICAL CHARACTERISTICS

(VDD1=2.5V~5.5V, VDD2=2.5V~5.5V, Ta=-40℃ to 125℃. Unless otherwise noted, Typical values are at VDD1 = 5V, VDD2 = 5V, Ta = 25℃)

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Power on Reset	VDD_{POR}		2.2		V	POR threshold as during power-up
	VDD_{HYS}		0.1		V	POR threshold Hysteresis
Input Threshold	V_{IT}		1.6		V	Input Threshold at rising edge
	V_{IT_HYS}		0.4		V	Input Threshold Hysteresis
High Level Input Voltage	V_{IH}	2			V	
Low Level Input Voltage	V_{IL}			0.8	V	
High Level Output Voltage	V_{OH}	VDD-0.3			V	I_{OH} =- 4mA
Low Level Output Voltage	V_{OL}			0.3	V	I_{OL} = 4mA
Output Impedance	R_{out}		50		ohm	
Input Pull high or low Current	I_{pull}		8	15	uA	
Start Up Time after POR	trbs		40		usec	

Common Mode Transient Immunity	CMTI	100		150	kV/us	

(VDD1=5V± 10%, VDD2=5V± 10%, Ta=-40℃ to 125℃. Unless otherwise noted, Typical values are at VDD1 = 5V, VDD2 = 5V, Ta = 25℃)

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Supply current	**NSi8140**					
	I_{DD1}(Q0)		0.894	1.50	mA	All Input 0V for NSi8140x0 Or All Input at supply for NSi8140x1
	I_{DD2}(Q0)		2.326	3.5	mA	
	I_{DD1}(Q1)		5.316	7.8	mA	All Input at supply for NSi8140x0 Or All Input 0V for NSi8140x1
	I_{DD2}(Q1)		2.432	3.65	mA	
	I_{DD1}(1M)		3.087	4.63	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.728	4.09	mA	
	I_{DD1}(10M)		3.182	4.77	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		5.834	8.75	mA	
	I_{DD1}(100M)		3.918	5.88	mA	All Input with 100Mbps, C_L=15pF
	I_{DD2}(100M)		37.06	55.6	mA	
	NSi8141					
	I_{DD1}(Q0)		1.244	1.87	mA	All Input 0V for NSi8141x0 Or All Input at supply for NSi8141x1
	I_{DD2}(Q0)		2.164	3.25	mA	
	I_{DD1}(Q1)		4.658	7	mA	All Input at supply for NSi8141x0 Or All Input 0V for NSi8141x1
	I_{DD2}(Q1)		3.416	5	mA	
	I_{DD1}(1M)		3.07	4.6	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		3.064	4. 6	mA	
	I_{DD1}(10M)		3.82	5.7	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		5.496	8.2	mA	
	I_{DD1}(100M)		10.708	16.06	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		29.336	44	mA	
	NSi8142					
	I_{DD1}(Q0)		1.688	2.5	mA	All Input 0V for NSi8142x0 Or All Input at supply for NSi8142x1
	I_{DD2}(Q0)		1.704	2.56	mA	
	I_{DD1}(Q1)		4.038	6.06	mA	All Input at supply for NSi8142x0 Or All Input 0V for NSi8142x1
	I_{DD2}(Q1)		4.1	6.15	mA	

	I_{DD1}(1M)		3.06	4.6	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		3.108	4.7	mA	
	I_{DD1}(10M)		4.578	6.9	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		4.694	7	mA	
	I_{DD1}(100M)		19	28.5	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		20.868	31	mA	
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	t_{PLH}	5	8.20	15	ns	See Figure 2.9 , C_L = 15pF
	t_{PHL}	5	10.56	15	ns	See Figure 2.9 , C_L = 15pF
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH} \rvert$	PWD			5.0	ns	See Figure 2.9 , C_L = 15pF
Rising Time	t_r			5.0	ns	See Figure 2.9 , C_L = 15pF
Falling Time	t_f			5.0	ns	See Figure 2.9 , C_L = 15pF
Peak Eye Diagram Jitter	t_{JIT}(PK)		350		ps	
Channel-to-Channel Delay Skew	t_{SK}(c2c)			2.5	ns	
Part-to-Part Delay Skew	t_{SK}(p2p)			5.0	ns	
Disable high to Tri-State	t_{PHZ}		14.88		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZH}		10.00		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Disable low to Tri-State	t_{PLZ}		17.25		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZL}		10.85		ns	See Figure 2.10 , C_L = 15pF, R_L=1k

(VDD1=3.3V± 10%, VDD2=3.3V± 10%, Ta=-40℃ to 125℃. Unless otherwise noted, Typical values are at VDD1 = 3.3V, VDD2 = 3.3V, Ta = 25℃)

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Supply current	**NSi8140**					
	I_{DD1}(Q0)		0.832	1.25	mA	All Input 0V for NSi8140x0 Or All Input at supply for NSi8140x1
	I_{DD2}(Q0)		2.214	3.3	mA	
	I_{DD1}(Q1)		5.23	7.9	mA	All Input at supply for NSi8140x0 Or All Input 0V for NSi8140x1
	I_{DD2}(Q1)		2.32	3.48	mA	
	I_{DD1}(1M)		3.01	4.5	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.486	3.73	mA	

	I_{DD1}(10M)		3.106	4.66	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		4.476	6.7	mA	
	I_{DD1}(100M)		3.826	5.74	mA	All Input with 100Mbps, C_L=15pF
	I_{DD2}(100M)		25.5	38	mA	
	NSi8141					
	I_{DD1}(Q0)		1.165	1.75	mA	All Input 0V for NSi8141x0 Or All Input at supply for NSi8141x1
	I_{DD2}(Q0)		2.062	3.1	mA	
	I_{DD1}(Q1)		4.566	6.85	mA	All Input at supply for NSi8141x0 Or All Input 0V for NSi8141x1
	I_{DD2}(Q1)		3.306	5	mA	
	I_{DD1}(1M)		2.954	4.4	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.862	4.3	mA	
	I_{DD1}(10M)		3.452	5.2	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		4.368	6.5	mA	
	I_{DD1}(100M)		8.084	12	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		19.96	30	mA	
	NSi8142					
	I_{DD1}(Q0)		1.598	2.4	mA	All Input 0V for NSi8142x0 Or All Input at supply for NSi8142x1
	I_{DD2}(Q0)		1.618	2.43	mA	
	I_{DD1}(Q1)		3.942	5.9	mA	All Input at supply for NSi8142x0 Or All Input 0V for NSi8142x1
	I_{DD2}(Q1)		4.004	6	mA	
	I_{DD1}(1M)		2.901	4.3	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.9452	4.4	mA	
	I_{DD1}(10M)		3.898	5.85	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		3.976	6	mA	
	I_{DD1}(100M)		12.9	19	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		14.868	22	mA	
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	t_{PLH}	5	9.20	15	ns	See Figure 2.9 , C_L = 15pF
	t_{PHL}	5	10.40	15	ns	See Figure 2.9 , C_L = 15pF
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH} \rvert$	PWD			5.0	ns	See Figure 2.9 , C_L = 15pF

Rising Time	t_r			5.0	ns	See Figure 2.9 , C_L = 15pF
Falling Time	t_f			5.0	ns	See Figure 2.9 , C_L = 15pF
Peak Eye Diagram Jitter	t_{JIT}(PK)		350		ps	
Channel-to-Channel Delay Skew	t_{SK}(c2c)			2.5	ns	
Part-to-Part Delay Skew	t_{SK}(p2p)			5.0	ns	
Disable high to Tri-State	t_{PHZ}		17.85		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZH}		13.37		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Disable low to Tri-State	t_{PLZ}		20.6		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZL}		13.67		ns	See Figure 2.10 , C_L = 15pF, R_L=1k

(VDD1=2.5V± 10%, VDD2=2.5V± 10%, Ta=-40℃ to 125℃. Unless otherwise noted, Typical values are at VDD1 = 2.5V, VDD2 = 2.5V, Ta = 25℃)

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Supply current	**NSi8140**					
	I_{DD1}(Q0)		0.802	1.2	mA	All Input 0V for NSi8140x0 Or All Input at supply for NSi8140x1
	I_{DD2}(Q0)		2.161	3.24	mA	
	I_{DD1}(Q1)		5.17	7.8	mA	All Input at supply for NSi8140x0 Or All Input 0V for NSi8140x1
	I_{DD2}(Q1)		2.282	3.4	mA	
	I_{DD1}(1M)		2.968	4.45	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.384	3.58	mA	
	I_{DD1}(10M)		3.056	4.58	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		3.862	5.8	mA	
	I_{DD1}(100M)		3.772	5.67	mA	All Input with 100Mbps, C_L=15pF
	I_{DD2}(100M)		19.54	29.3	mA	
	NSi8141					
	I_{DD1}(Q0)		1.128	1.7	mA	All Input 0V for NSi8141x0 Or All Input at supply for NSi8141x1
	I_{DD2}(Q0)		2.012	3	mA	
	I_{DD1}(Q1)		4.51	6.8	mA	All Input at supply for NSi8141x0 Or All Input 0V for NSi8141x1
	I_{DD2}(Q1)		3.248	4.9	mA	
	I_{DD1}(1M)		2.894	4.3	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.766	4.15	mA	
	I_{DD1}(10M)		3.272	4.9	mA	All Input with 10Mbps,

	I_{DD2}(10M)		3.892	5.8	mA	C_L=15pF
	I_{DD1}(100M)		6.95	10.4	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		15.706	23.56	mA	
	NSi8142					
	I_{DD1}(Q0)		1.556	2.3	mA	All Input 0V for NSi8142x0 Or All Input at supply for NSi8142x1
	I_{DD2}(Q0)		1.574	2.4	mA	
	I_{DD1}(Q1)		3.884	5.8	mA	All Input at supply for NSi8142x0 Or All Input 0V for NSi8142x1
	I_{DD2}(Q1)		3.942	5.9	mA	
	I_{DD1}(1M)		2.824	4.3	mA	All Input with 1Mbps, C_L=15pF
	I_{DD2}(1M)		2.866	4.3	mA	
	I_{DD1}(10M)		3.574	5.36	mA	All Input with 10Mbps, C_L=15pF
	I_{DD2}(10M)		3.642	5.46	mA	
	I_{DD1}(100M)		10.678	16	mA	All Input with 100Mbps, C_L = 15pF
	I_{DD2}(100M)		11.618	17	mA	
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	t_{PLH}	5	10.0	15	ns	See Figure 2.9 , C_L = 15pF
	t_{PHL}	5	10.0	15	ns	See Figure 2.9 , C_L = 15pF
Pulse Width Distortion $\lvert t_{PHL} - t_{PLH} \rvert$	PWD			5.0	ns	See Figure 2.9 , C_L = 15pF
Rising Time	t_r			5.0	ns	See Figure 2.9 , C_L = 15pF
Falling Time	t_f			5.0	ns	See Figure 2.9 , C_L = 15pF
Peak Eye Diagram Jitter	t_{JIT}(PK)		350		ps	
Channel-to-Channel Delay Skew	t_{SK}(c2c)			2.5	ns	
Part-to-Part Delay Skew	t_{SK}(p2p)			5.0	ns	
Disable high to Tri-State	t_{PHZ}		20.6		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZH}		18.12		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Disable low to Tri-State	t_{PLZ}		21.85		ns	See Figure 2.10 , C_L = 15pF, R_L=1k
Enable to Data high Valid	t_{PZL}		20.02		ns	See Figure 2.10 , C_L = 15pF, R_L=1k

2.4. TYPICAL PERFORMANCE CHARACTERISTICS

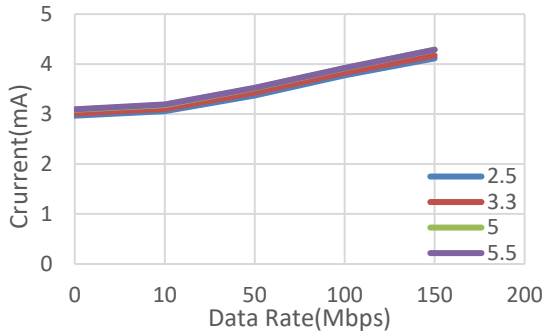


Figure 2.1 NSi8140 VDD1 Supply Current vs Data Rate

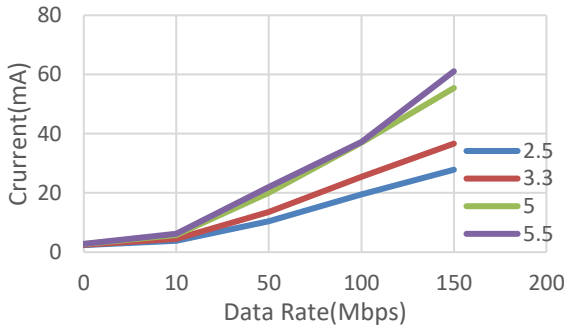


Figure 2.2 NSi8140 VDD2 Supply Current vs Data Rate

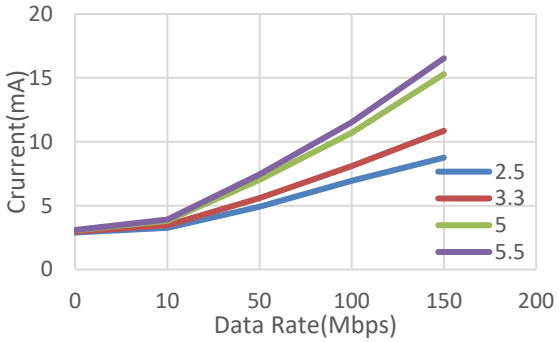


Figure 2.3 NSi8141 VDD1 Supply Current vs Data Rate

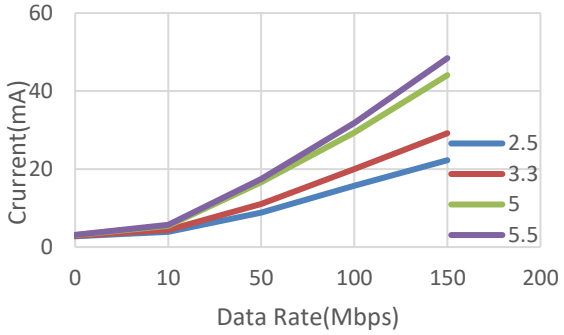


Figure 2.4 NSi8141 VDD2 Supply Current vs Data Rate

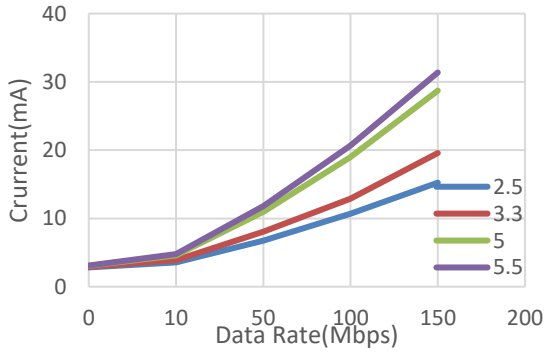


Figure 2.5 NSi8142 VDD1 Supply Current vs Data Rate

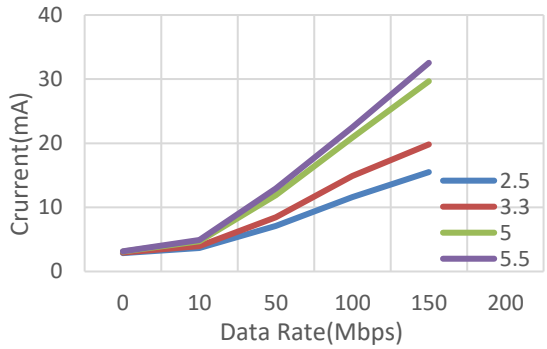
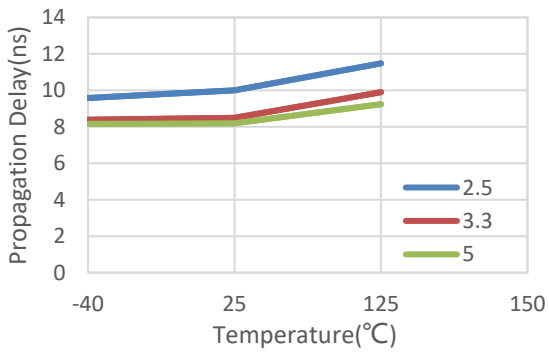


Figure 2.6 NSi8142 VDD2 Supply Current vs Data Rate



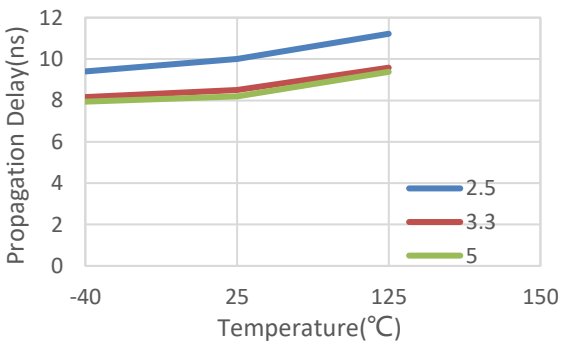


Figure 2.7 Rising Edge Propagation Delay Vs Temp

Figure 2.8 Falling Edge Propagation Delay Vs Temp

2.5. PARAMETER MEASUREMENT INFORMATION

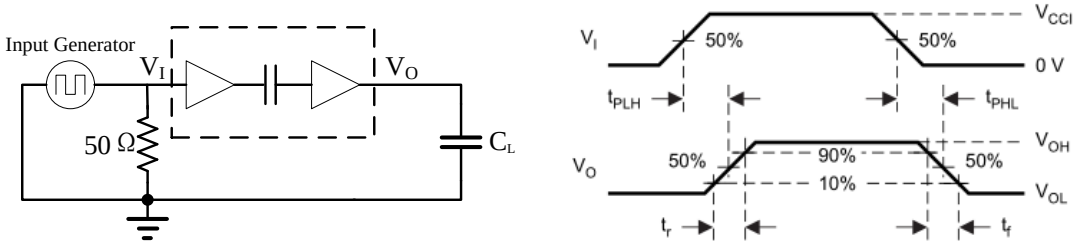


Figure 2.9 Switching Characteristics Test Circuit and Waveform

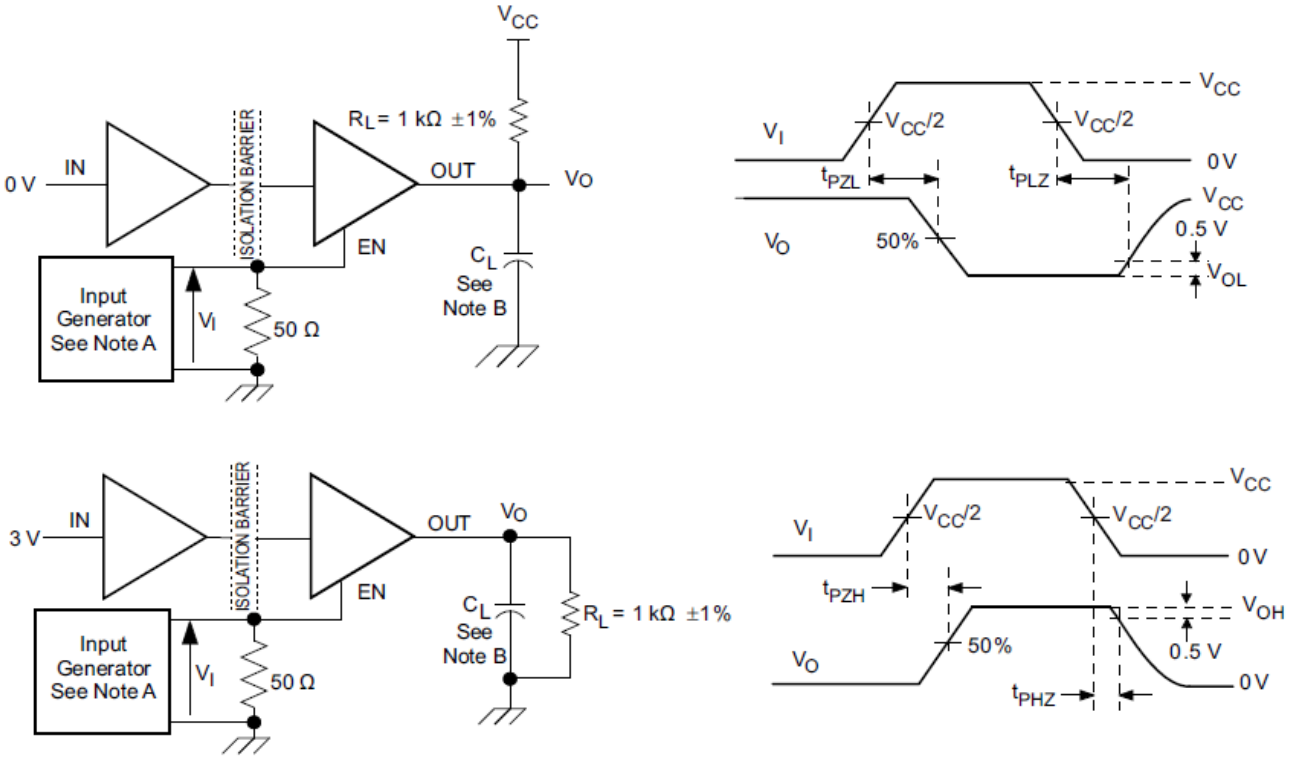


Figure 2.10 Enable/Disable Propagation Delay Time Test Circuit and Waveform

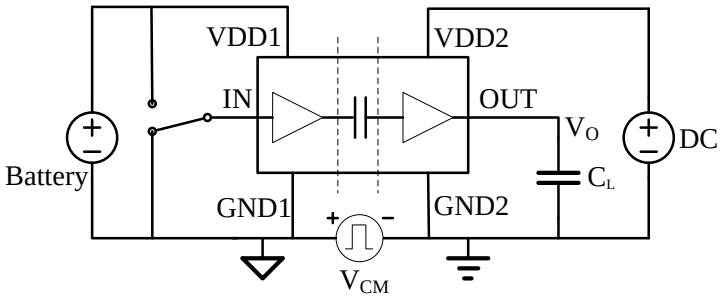


Figure 2.11 Common-Mode Transient Immunity Test Circuit

Note A :The input pulse is supplied by a generator having the following characteristics: PRR ≤ 50 kHz, 50% duty cycle, tr ≤ 3 ns, tf ≤ 3 ns, Z_O = 50 Ω. At the input, a 50-Ω resistor is required to terminate the Input Generator signal. It is not needed in actual application.

NoteB : C_L = 15 pF and includes instrumentation and fixture capacitance within ±20%.

3.0 HIGH VOLTAGE FEATURE DESCRIPTION

3.1. INSULATION AND SAFETY RELATED SPECIFICATIONS

Parameters	*Symbol*	*Value*		*Unit*	*Comments*
		NB-SOIC-16	*WB-SOIC-16*		
Minimum External Air Gap (Clearance)	L(I01)	4.0	8.0	mm	Shortest terminal-to-terminal distance through air
Minimum External Tracking (Creepage)	L(I02)	4.0	8.0	mm	Shortest terminal-to-terminal distance across the package surface
Minimum internal gap	DTI	20		um	Distance through insulation
Tracking Resistance(Comparative Tracking Index)	CTI	>400		V	DIN EN 60112 (VDE 0303-11); IEC 60112
Material Group		Ⅱ			

3.2. DIN VDE V 0884-11（VDE V 0884-11）:2017-01 INSULATION CHARATERISTICS

Description	*Test Condition*	*Symbol*	*Value*		*Unit*
			NB-SOIC-16	WB-SOIC-16	
Installation Classification per DIN VDE 0110					
For Rated Mains Voltage ≤ 150V_{rms}			Ⅰ to Ⅳ	Ⅰ to Ⅳ	
For Rated Mains Voltage ≤ 300V_{rms}			Ⅰ to Ⅲ	Ⅰ to Ⅳ	

For Rated Mains Voltage ≤ 400V_{rms}			Ⅰ to Ⅲ	Ⅰ to Ⅳ	
Climatic Classification			10/105/21	10/105/21	
Pollution Degree per DIN VDE 0110, Table 1			2	2	
Maximum repetitive peak isolation voltage		V_{IORM}	565	1166	Vpeak
Maximum working isolation voltage	AC voltage	V_{IOWM}	400	824	V_{RMS}
	DC voltage		565	1166	Vpeak
Input to Output Test Voltage, Method B1	$V_{IORM} \times 1.5 = V_{pd(m)}$, 100% production test, $t_{ini} = t_m = 1$ sec, partial discharge < 5 pC	$V_{pd(m)}$	847	1749	Vpeak
Input to Output Test Voltage, Method A					
After Environmental Tests Subgroup 1	$V_{IORM} \times 1.2 = V_{pd(m)}$, $t_{ini} = 60$ sec, $t_m = 10$ sec, partial discharge < 5 pC	$V_{pd(m)}$	678	1399	Vpeak
After Input and /or Safety Test Subgroup 2 and Subgroup 3	$V_{IORM} \times 1.2 = V_{pd(m)}$, $t_{ini} = 60$ sec, $t_m = 10$ sec, partial discharge < 5 pC	$V_{pd(m)}$	678	1399	Vpeak
Maximum transient isolation voltage	t = 60 sec	VIOTM	5300	7000	Vpeak
Maximum Surge Isolation Voltage	Test method per IEC60065,1.2/50us waveform, VTEST=VIOSM×1.3	VIOSM	5384	5384	Vpeak
Isolation resistance	VIO =500V	RIO	>10^9	>10^9	Ω
Isolation capacitance	f = 1MHz	CIO	0.6	0.6	pF
Input capacitance		CI	2	2	pF
Total Power Dissipation at 25℃		Ps		1499	W
Safety input, output, or supply current	θJA = 140 °C/W, V I = 5.5 V, T J = 150 °C, T A = 25 °C	Is	160		mA
	θJA = 84 °C/W, V I = 5.5 V, T J = 150 °C, T A = 25 °C			237	mA
Case Temperature		Ts	150	150	℃

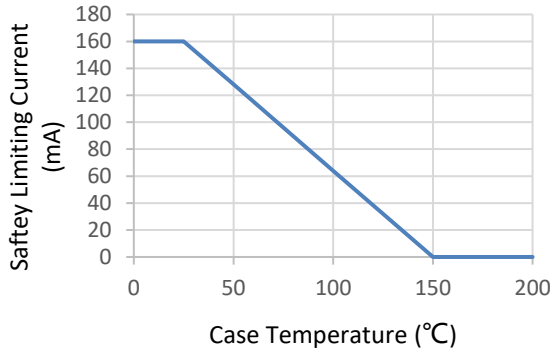


Figure 3.1 NSi8140N/NSi8141N/NSi8142N Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

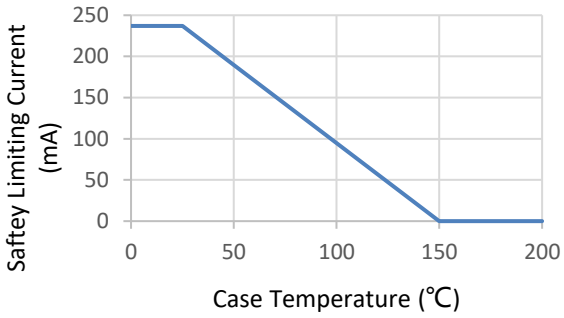


Figure 3.2 NSi8140W/NSi8141W/NSi8142W Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

3.3. REGULATORY INFORMATION

The NSi8140N/NSi8141N/NSi8142N are approved or pending approval by the organizations listed in table.

CUL		*VDE*	*CQC*
UL 1577 Component Recognition Program[1]	Approved under CSA Component Acceptance Notice 5A	DIN VDE V 0884-11(VDE V 0884-11):2017-01[2]	Certified by CQC11-471543-2012 GB4943.1-2011
Single Protection, 3750V_{rms} Isolation voltage	Single Protection, 3750V_{rms} Isolation voltage	Basic Insulation 565Vpeak, V_{IOSM}=5384Vpeak	Basic insulation at 400V_{rms} (565Vpeak)
File (E500602)	File (E500602)	File (5024579-4880-0001)	File (pending)

[1] In accordance with UL 1577, each NSi8140N/NSi8141N/NSi8142N is proof tested by applying an insulation test voltage ≥ 4500 V $_{rms}$ for 1 sec.

[2] In accordance with DIN VDE V 0884-11, each NSi8140N/NSi8141N/NSi8142N is proof tested by applying an insulation test voltage ≥ 847 V peak for 1 sec (partial discharge detection limit = 5 pC). The * marking branded on the component designates DIN VDE V 0884-11 approval.

The NSi8140W/NSi8141W/NSi8142W are approved or pending approval by the organizations listed in table.

CUL		*VDE*	*CQC*
UL 1577 Component Recognition Program[1]	Approved under CSA Component Acceptance Notice 5A	DIN VDE V 0884-11(VDE V 0884-11):2017-01[2]	Certified by CQC11-471543-2012 GB4943.1-2011

Single Protection, 5000V_{rms} Isolation voltage	Single Protection, 5000V_{rms} Isolation voltage	Basic Insulation 1166Vpeak, V_{IOSM}=5384Vpeak	Basic insulation at 824V_{RMS} (1166Vpeak) Reinforced insulation at 400V_{RMS} (565Vpeak)
File (E500602)	File (E500602)	File (5024579-4880-0001)	File (pending)

[1] In accordance with UL 1577, each NSi8140W/NSi8141W/NSi8142W is proof tested by applying an insulation test voltage ≥ 6000 V rms for 1 sec.

[2] In accordance with DIN VDE V 0884-11, each NSi8140W/NSi8141W/NSi8142W is proof tested by applying an insulation test voltage ≥ 1749 V peak for 1 sec (partial discharge detection limit = 5 pC). The * marking branded on the component designates DIN VDE V 0884-11 approval.

4.0 FUNCTION DESCRIPTION

The NSi814x is a Quad-channel digital isolator based on a capacitive isolation barrier technique. The digital signal is modulated with RF carrier generated by the internal oscillator at the Transmitter side. Then it is transferred through the capacitive isolation barrier and demodulated at the Receiver side.

The NSi814x devices are high reliability quad-channel digital isolator with AEC-Q100 qualified. The NSi814x device is safety certified by UL1577 support several insulation withstand voltages (3.75kV_{rms}, 5kV_{rms}), while providing high electromagnetic immunity and low emissions at low power consumption. The data rate of the NSi814x is up to 150Mbps, and the common-mode transient immunity (CMTI) is up to 150kV/us. The NSi814x device provides digital channel direction configuration and the default output level configuration when the input power is lost. Wide supply voltage of the NSi814x device support to connect with most digital interface directly, easy to do the level shift. High system level EMC performance enhance reliability and stability of use.

The NSi814x has a default output status when VDDIN is unready and VDDOUT is ready as shown in Table 4.1, which helps for diagnosis when power is missing at the transmitter side. The output B follows the same status with the input A within 60us after powering up.

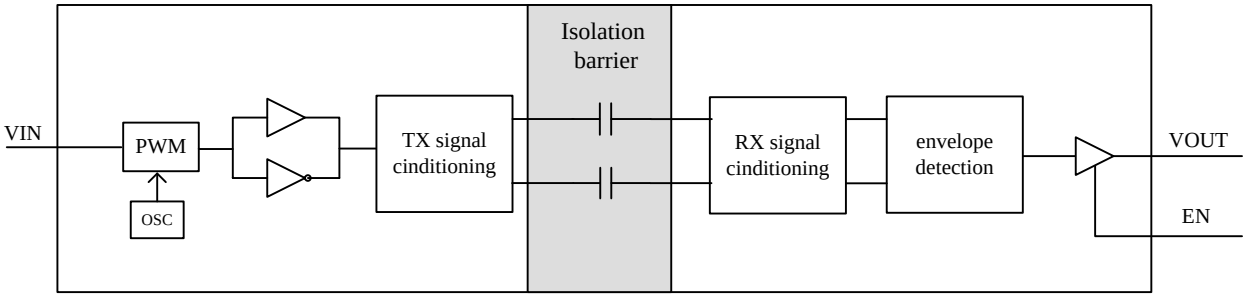


Figure 4.1 Simplified Channel Diagram

Table 4.1 Output status vs. power status

Input	*EN_x*	*VDD1 status*	*VDD2 status*	*Output*	*Comment*
H	H or NC	Ready	Ready	H	Normal operation.
L	H or NC	Ready	Ready	L	
X	L	Ready	Ready	Z	Output Disabled, the output is high impedance
X	H or NC	Unready	Ready	L H	The output follows the same status with the input within 60us after input side VDD1 is powered on.
X	L	Unready	Ready	Z	Output Disabled, the output is high impedance
X	X	Ready	Unready	X	The output follows the same status with the input within 60us after output side VDD2 is powered on.

5.0 APPLICATION NOTE

5.1. PCB LAYOUT

The NSi814x requires a 0.1 µF bypass capacitor between VDD1 and GND1, VDD2 and GND2. The capacitor should be placed as close as possible to the package. Figure 5.1 show the recommended schematic diagram , Figure 5.2 to Figure 5.3 show the recommended PCB layout, make sure the space under the chip should keep free from planes, traces, pads and via. To enhance the robustness of a design, the user may also include resistors (50–300 Ω) in series with the inputs and outputs if the system is excessively noisy. The series resistors also improve the system reliability such as latch-up immunity.

The typical output impedance of an isolator driver channel is approximately 50 Ω, ±40%. When driving loads where transmission line effects will be a factor, output pins should be appropriately terminated with controlled impedance PCB traces.

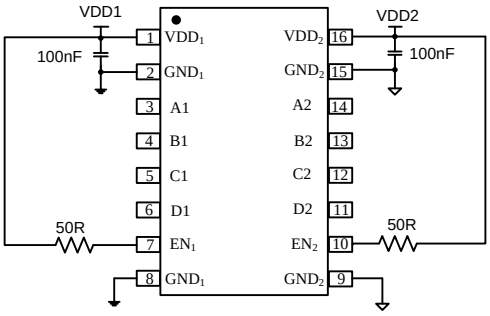


Figure5.1 Recommended schematic diagram

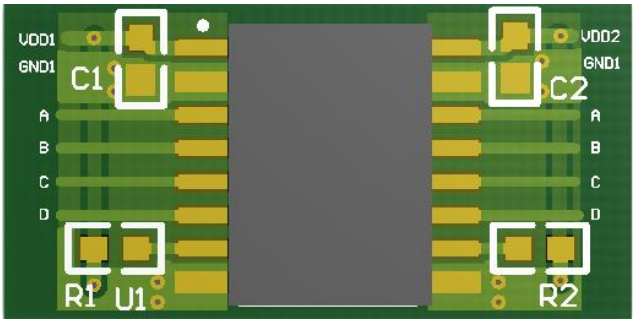


Figure5.2 Recommended PCB Layout — Top Layer

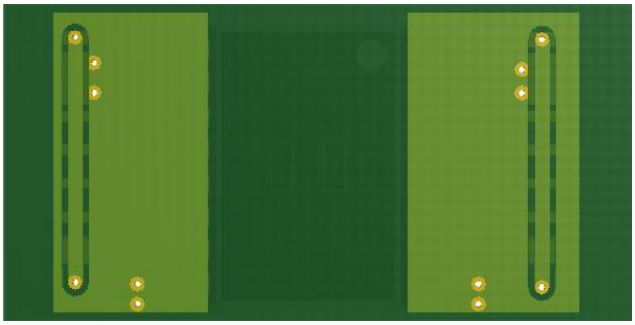


Figure5.3 Recommended PCB Layout — Bottom Layer

5.2. HIGH SPEED PERFORMANCE

Figure 5.4 shows the eye diagram of NSi814x at 200Mbps data rate output. The result shows a typical measurement on the NSi814x with 350ps p-p jitter.

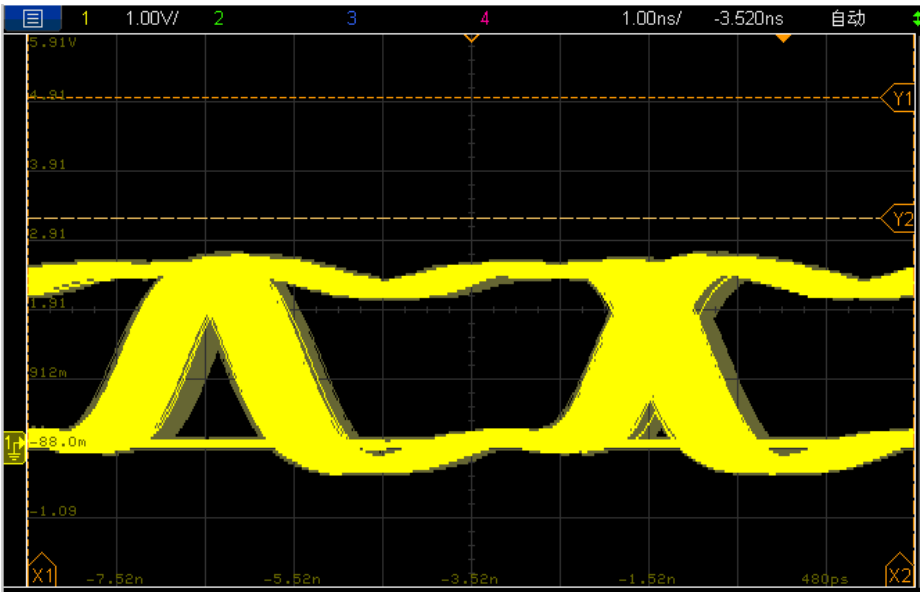


Figure5.4 NSi814x Eye Diagram

5.3. TYPICAL SUPPLY CURRENT EQUATIONS

The typical supply current of NSi814x can be calculated using below equations. I_{DD1} and I_{DD2} are typical supply currents measured in mA, f is data rate measured in Mbps, C_L is the capacitive load measured in pF

NSi8140:

I_{DD1} = 0.19 *a1+1.45*b1+0.82*c1.

I_{DD2} = 1.36+ VDD1*f* C_L *c1*10^{-9}

When a1 is the channel number of low input at side 1, b1 is the channel number of high input at side 1, c1 is the channel number of switch signal input at side 1.

NSi8141:

I_{DD1} = 0.87 +1.26*b1+0.63*c1+ VDD1*f* C_L *c2*10^{-9}

I_{DD2} = 0.87 +1.26*b2+0.63*c2+ VDD1*f* C_L *c1*10^{-9}

When b1 is the channel number of high input at side 1, c1 is the channel number of switch signal input at side 1, b2 is the channel number of high input at side 2, c2 is the channel number of switch signal input at side 2.

NSi8142:

I_{DD1} = 0.87 +1.26*b1+0.63*c1+ VDD1*f* C_L *c2*10^{-9}

I_{DD2} = 0.87 +1.26*b2+0.63*c2+ VDD1*f* C_L *c1*10^{-9}

When b1 is the channel number of high input at side 1, c1 is the channel number of switch signal input at side 1, b2 is the channel number of high input at side 2, c2 is the channel number of switch signal input at side 2.

6.0 PACKAGE INFORMATION

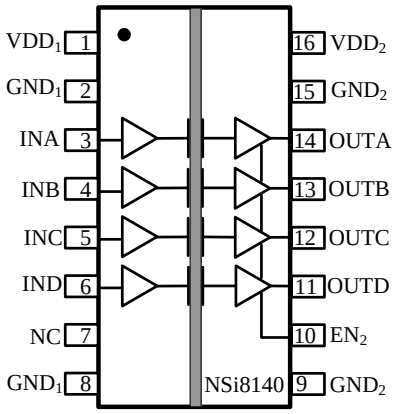


Figure 6.1 NSi8140N Package

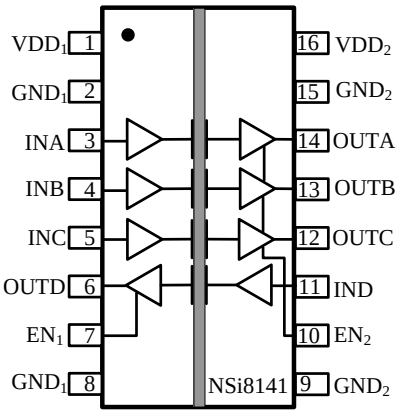


Figure 6.2 NSi8141N Package

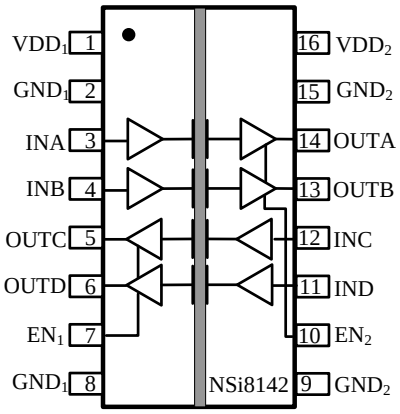
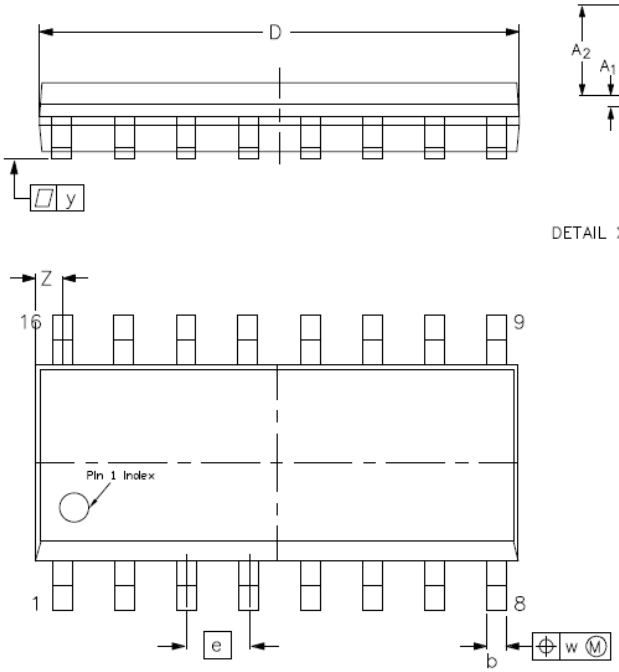


Figure 6.3 NSi8142N Package



* CONTROLLING DIMENSION : MM

SYMBOL	MILLIMETER			INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	---	---	1.75	---	---	0.069
A1	0.10	---	0.25	0.004	---	0.010
A2	1.25	---	1.45	0.049	---	0.057
b	0.36	---	0.49	0.014	---	0.019
c	0.19	---	0.25	0.007	---	0.010
D	9.80	9.90	10.0	0.386	0.390	0.394
E	3.80	3.90	4.00	0.150	0.154	0.158
HE	5.80	---	6.20	0.228	---	0.244
Q	0.60	---	0.70	0.024	---	0.028
e	1.27 bsc			0.050 bsc		
L	1.05 bsc			0.041 bsc		
Lp	0.40	---	1.00	0.016	---	0.039
Y	---	0.10	---	---	0.004	---
A3	---	0.25	---	---	0.010	---
Z	0.30		0.70	0.012		0.028
θ	0°	---	8°	0°	---	8°

Figure 6.4 NB SOIC16 Package Shape and Dimension in millimeters (inches)

Table6.1 NSi8140N/ NSi8141N/ NSi8142N Pin Configuration and Description

NSi8140N PIN NO.	*NSi8141N PIN NO.*	*NSi8142N PIN NO.*	*SYMBOL*	*FUNCTION*
1	1	1	VDD_1	Power Supply for Isolator Side 1
2	2	2	GND_1	Ground 1, the ground reference for Isolator Side 1

3	3	3	INA	Logic Input A
4	4	4	INB	Logic Input B
5	5	12	INC	Logic Input C
6	11	11	IND	Logic Input D
7	7	7	NC/ EN_1	No Connection. or Output Enable 1. Active high logic input. When EN_1 is high or NC, the output of Side 1 are enabled. When EN_1 is low, the output of Side 1 are disabled to high impedance state.
8	8	8	GND_1	Ground 1, the ground reference for Isolator Side 1
9	9	9	GND_2	Ground 2, the ground reference for Isolator Side 2
10	10	10	EN_2	Output Enable 2. Active high logic input. When EN_2 is high or NC, the output of Side 2 are enabled. When EN_2 is low, the output of Side 2 are disabled to high impedance state.
11	6	6	OUTD	Logic Output D
12	12	5	OUTC	Logic Output C
13	13	13	OUTB	Logic Output B
14	14	14	OUTA	Logic Output A
15	15	15	GND2	Ground 2, the ground reference for Isolator Side 2
16	16	16	VDD2	Power Supply for Isolator Side 2

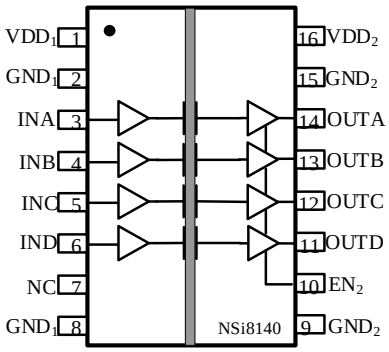


Figure 6.5 NSi8140W Package

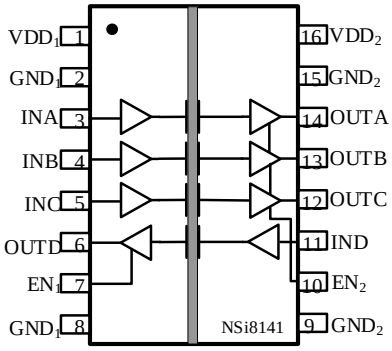


Figure 6.6 NSi8141W Package

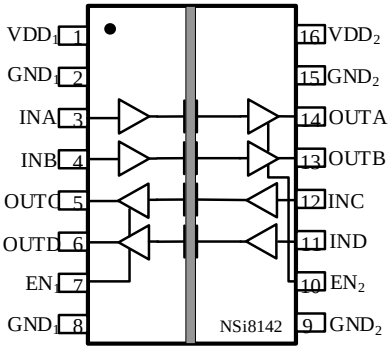
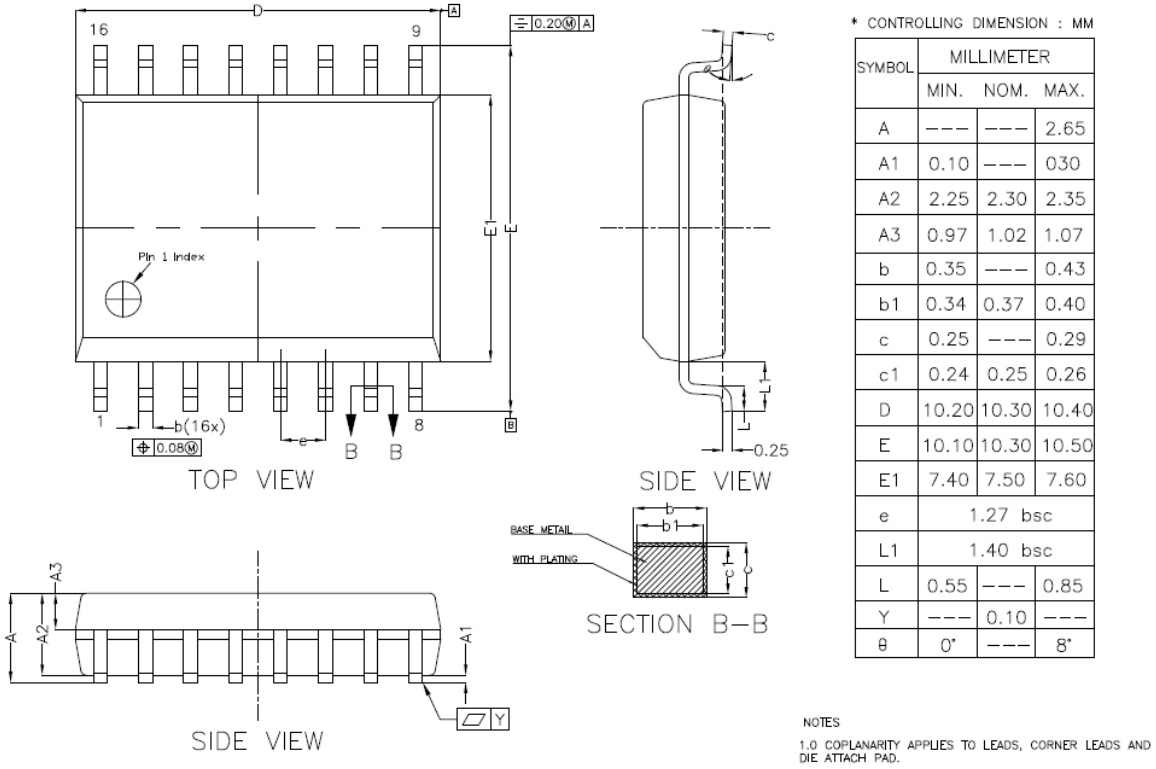


Figure 6.7 NSi8142W Package



SYMBOL	MILLIMETER		
	MIN.	NOM.	MAX.
A	---	---	2.65
A1	0.10	---	030
A2	2.25	2.30	2.35
A3	0.97	1.02	1.07
b	0.35	---	0.43
b1	0.34	0.37	0.40
c	0.25	---	0.29
c1	0.24	0.25	0.26
D	10.20	10.30	10.40
E	10.10	10.30	10.50
E1	7.40	7.50	7.60
e	1.27 bsc		
L1	1.40 bsc		
L	0.55	---	0.85
Y	---	0.10	---
θ	0°	---	8°

Figure 6.8 WB SOIC16 Package Shape and Dimension in millimeters and (inches)

Table 6.2 NSi8140W/ NSi8141W/ NSi8142W Pin Configuration and Description

NSi8140W PIN NO.	*NSi8141W PIN NO.*	*NSi8142W PIN NO.*	*SYMBOL*	*FUNCTION*
1	1	1	VDD_1	Power Supply for Isolator Side 1
2	2	2	GND_1	Ground 1, the ground reference for Isolator Side 1
3	3	3	INA	Logic Input A
4	4	4	INB	Logic Input B
5	5	12	INC	Logic Input C
6	11	11	IND	Logic Input D
7	7	7	NC/ EN_1	No Connection. or Output Enable 1. Active high logic input. When EN_1 is high or NC, the output of Side 1 are enabled. When EN_1 is low, the output of Side 1 are disabled to high impedance state.
8	8	8	GND_1	Ground 1, the ground reference for Isolator Side 1
9	9	9	GND_2	Ground 2, the ground reference for Isolator Side 2
10	10	10	EN_2	Output Enable 2. Active high logic input. When EN_2 is high or NC, the output of Side 2 are enabled. When EN_2 is low, the output of Side 2 are disabled to high impedance state.
11	6	6	OUTD	Logic Output D

12	12	5	OUTC	Logic Output C
13	13	13	OUTB	Logic Output B
14	14	14	OUTA	Logic Output A
15	15	15	GND2	Ground 2, the ground reference for Isolator Side 2
16	16	16	VDD2	Power Supply for Isolator Side 2

7.0 ORDER INFORMATION

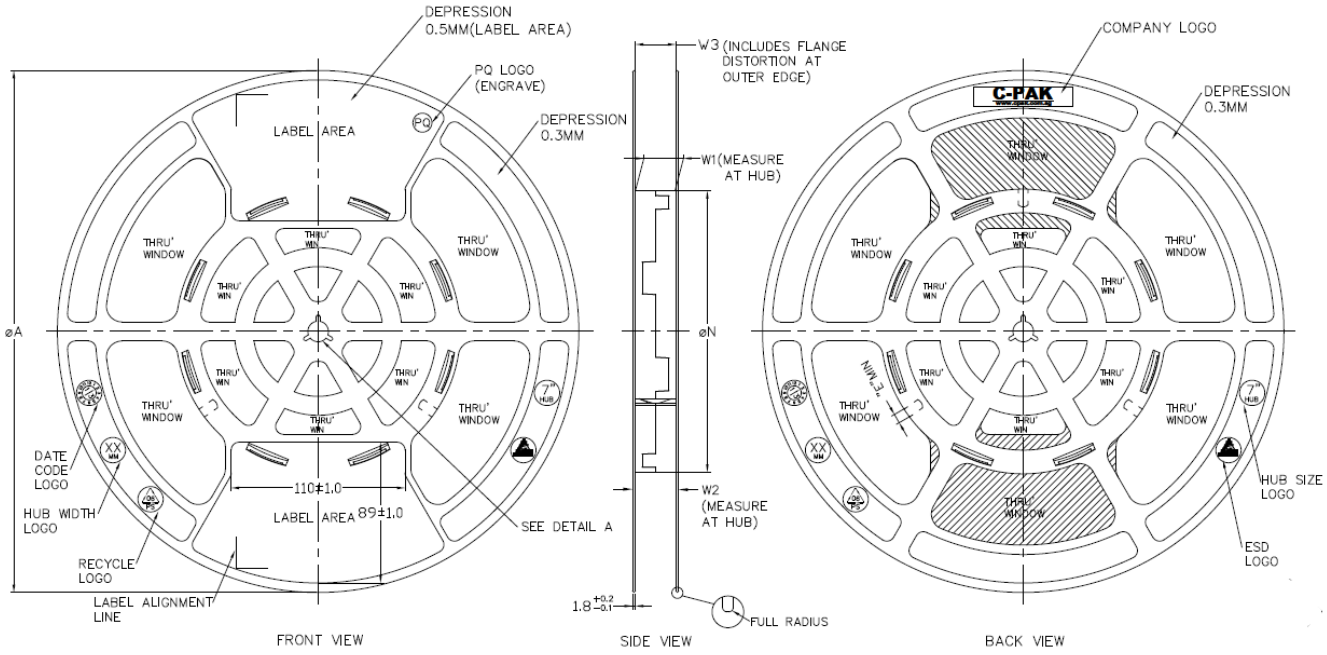
Part No.	*Isolation Rating (kV)*	*Number of side 1 inputs*	*Number of side 2 inputs*	*Max Data Rate (Mbps)*	*Default Output State*	*MSL level*	*Temperature*	*Automotive*	Package Qty	*Package*
NSi8140N0	3.75	4	0	150	Low	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8140N1	3.75	4	0	150	High	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8141N0	3.75	3	1	150	Low	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8141N1	3.75	3	1	150	High	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8142N0	3.75	2	2	150	Low	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8142N1	3.75	2	2	150	High	1	-40 to 125℃	NO	2500	NB SOIC16
NSi8140W0	5	4	0	150	Low	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8140W1	5	4	0	150	High	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8141W0	5	3	1	150	Low	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8141W1	5	3	1	150	High	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8142W0	5	2	2	150	Low	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8142W1	5	2	2	150	High	2	-40 to 125℃	NO	1000	WB SOIC16
NSi8140W0Q	5	4	0	150	Low	2	-40 to 125℃	YES	1000	WB SOIC16
NSi8140W1Q	5	4	0	150	High	1	-40 to 125℃	YES	1000	WB SOIC16
NSi8141W0Q	5	3	1	150	Low	1	-40 to 125℃	YES	1000	WB SOIC16
NSi8141W1Q	5	3	1	150	High	1	-40 to 125℃	YES	1000	WB SOIC16
NSi8142W0Q	5	2	2	150	Low	1	-40 to 125℃	YES	1000	WB SOIC16
NSi8142W1Q	5	2	2	150	High	1	-40 to 125℃	YES	1000	WB SOIC16
NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260 °C according to the JEDEC industry standard classifications and peak solder temperatures. All devices are AEC-Q100 qualified.										

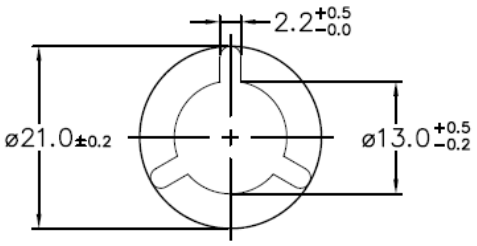
Part Number Rule:

NSi(81)(4)(1)(N)(1)(Q)

- Series Number
- Total Channel Amount: N=N Channels N=1,2,4… N=0: I²C Part
- Reverse Channel Amount: N=N Channels N=0,1,2…
- Package Type: N= NB SOIC16 W= WB SOIC16
- Fail-Safe Output State: 0 = Logic Low 1 = Logic High
- Q = Automotive version

8.0 TAPE AND REEL INFORMATION

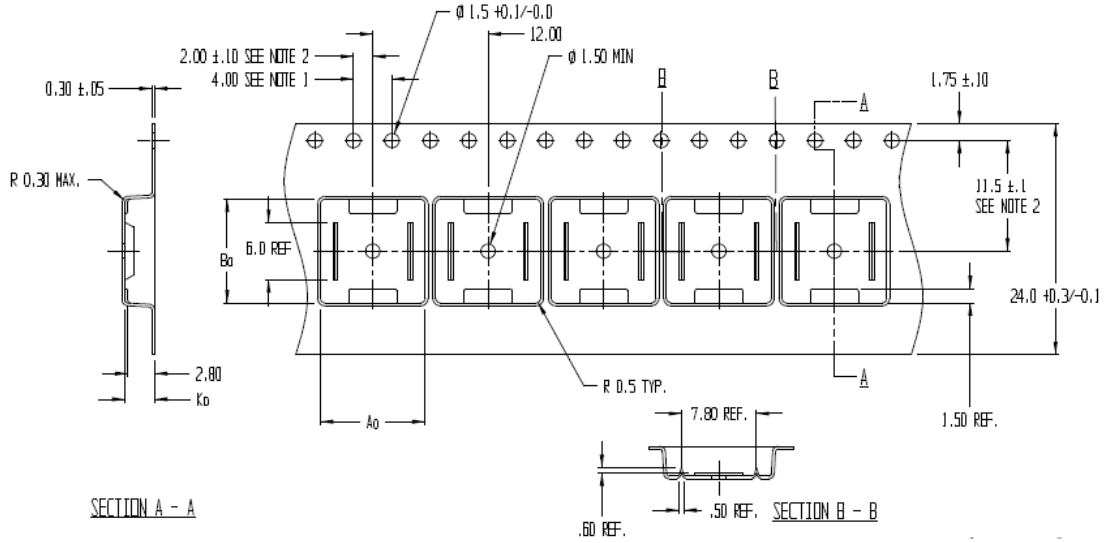




ARBOR HOLE
DETAIL A
SCALE : 3:1

PRODUCT SPECIFICATION						
TAPE WIDTH	øA ±2.0	øN ±2.0	W1	W2 (MAX)	W3	E (MIN)
08MM	330	178	8.4 +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

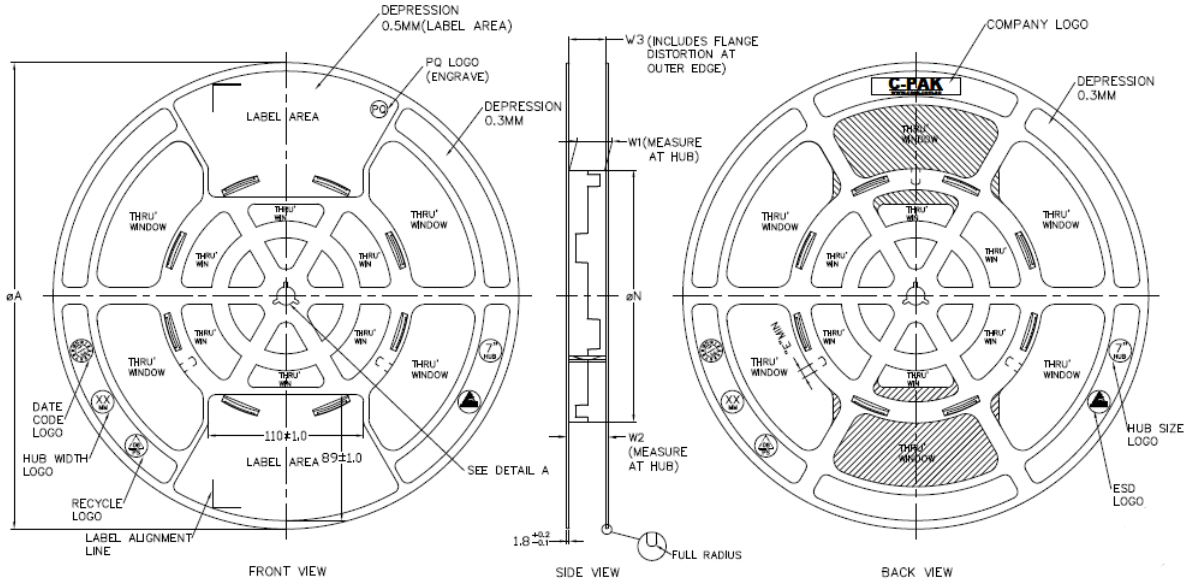
SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW 10^{12}	ANTISTATIC	ALL TYPES
B	10^{6} TO 10^{11}	STATIC DISSIPATIVE	BLACK ONLY
C	10^{5} & BELOW 10^{5}	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10^{9} TO 10^{11}	ANTISTATIC (COATED)	ALL TYPES

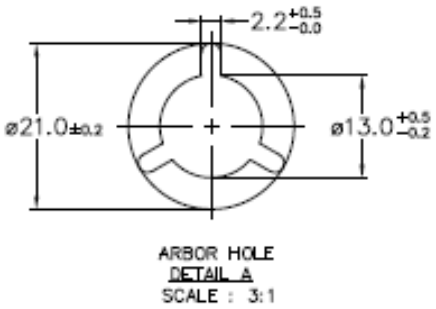


NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE
3. Ao AND Bo ARE CALCULATED ON A PLANE AT A DISTANCE "R" ABOVE THE BOTTOM OF THE POCKET.

Ao = 10.90
Bo = 10.80
Ko = 3.1

Figure 8.1 Tape and Reel Information of WB SOIC16





PRODUCT SPECIFICATION						
TAPE WIDTH	øA ±2.0	øN ±2.0	W1	W2 (MAX)	W3	E (MIN)
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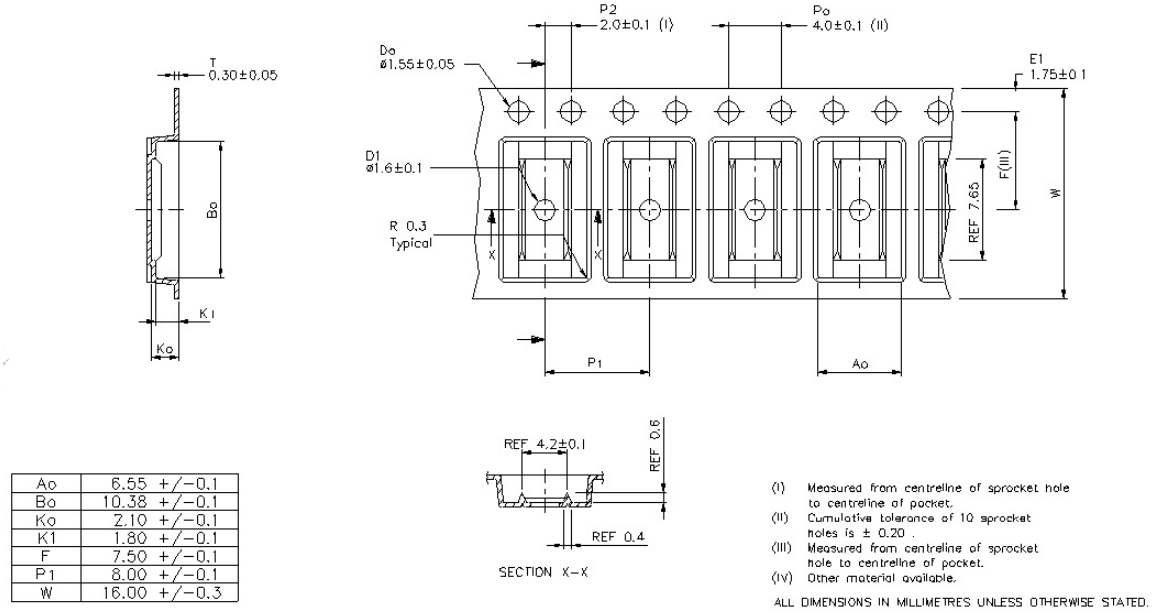
16MM	330	178	16.4 +2.0 −0.0	22.4		5.5
24MM	330	178	24.4 +2.0 −0.0	30.4		5.5
32MM	330	178	32.4 +2.0 −0.0	38.4		5.5

SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW 10^{12}	ANTISTATIC	ALL TYPES
B	10^{5} TO 10^{11}	STATIC DISSIPATIVE	BLACK ONLY
C	10^{3} & BELOW 10^{5}	CONDUCTIVE (GENERIC)	BLACK ONLY
E	10^{6} TO 10^{11}	ANTISTATIC (COATED)	ALL TYPES



Ao	6.55 +/−0.1
Bo	10.38 +/−0.1
Ko	2.10 +/−0.1
K1	1.80 +/−0.1
F	7.50 +/−0.1
P1	8.00 +/−0.1
W	16.00 +/−0.3

Figure 8.2 Tape and Reel Information of NB SOIC16

9.0 REVISION HISTORY

Revision	Description	Date
1.0		2017/11/15
1.1	Add maximum operation current spec.	2018/10/12
1.2	Change to ordering information	2018/12/20
1.3	Change Certification Information	2019/06/17
1.4	Add Thermal characteristics, MSL level，Recommended schematic diagram，Simplified Channel Diagram; change Package Shape and Dimension in millimeters and (inches) add recommended operation recommEnded operating conditions	2020/2/11
1.5	Change NSi8140 IDD1(Q0) MAX value	2020/4/17