

Product Overview

NSIP93086 series are high reliability isolated RS-485 transceiver with integrated DC to DC converter. The NSIP93086 isolated DC to DC converter uses on-chip transformer. The feedback PWM signal is sent to primary side (Isolator Side1) by a digital isolator based on Novosense capacity isolation technology. The NSIP93086 series are safety certified by UL1577 supporting 5kVrms insulation withstand voltage, while the high integrated solution can help to simplify system design and improve reliability. The device features a fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted. The device have 96kΩ input impedance that allows up to 256 transceivers on the bus.

Key Features

- Emission optimized to meet CISPR 32 and EN 55032 Class B with >5 dB margin on 2 layers board
- Up to 5000Vrms Insulation voltage
- ISO-Power integrated isolated DC-to-DC converter
- I/O voltage range supports 1.8~5.25V MCU
- Power supply voltage:
VDD: 3V to 5.25V
VDDL:1.8V to 5.5V
- Voltage conversion: 5V to 5V, 5V to 3.3V, 3.3V to 3.3V.
- Over current and over temperature protection
- High CMTI: ±150kV/μs
- Data rate: 16Mbps
- Up to 256 transceivers on the bus
- Operation temperature: -40°C~125°C
- RoHS-compliant packages: SOW16 SOW20

Safety Regulatory Approvals

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

Applications

- Industrial automation system
- Isolated RS-485 communication
- Smart electric meter and water meter
- Security and protection monitoring

Device Information

Part Number	Package	Body Size
NSIP93086(C)-DSWTR	SOW20	12.80mm × 7.50mm
NSIP93086(C)-DSWR	SOW16	10.30mm x 7.50mm
NSIP93086H-DSWR	SOW16	10.30mm x 7.50mm
NSIP93086HV-DSWR	SOW16	10.30mm x 7.50mm

Functional Block Diagrams

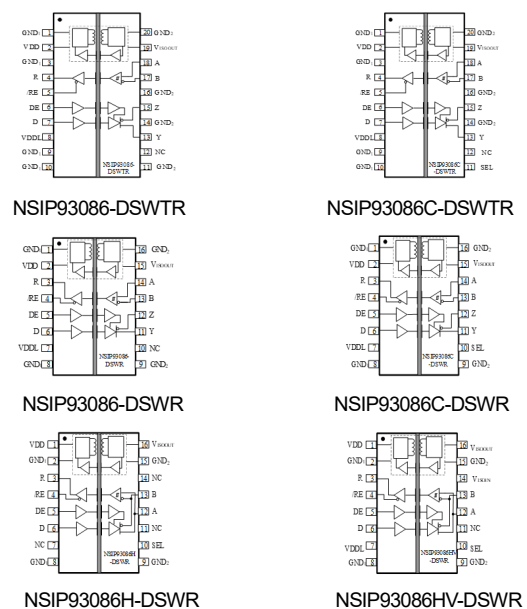


Figure 1. NSIP93086 Block Diagrams

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1. Pin Configuration and Functions

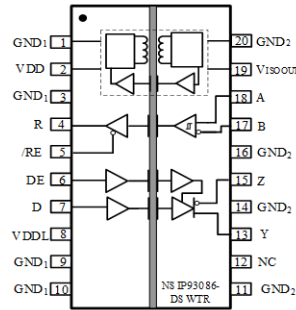


Figure 1.1 NSIP93086-DSWTR Package

Table1.1 NSIP93086-DSWTR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	GND ₁	Ground 1, the ground reference for Isolator Side 1.
2	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND ₁ .
3	GND ₁	Ground 1, the ground reference for Isolator Side 1.
4	R	Receiver output
5	/RE	Receiver enable input, this is an active low input.
6	DE	Driver enable input, this is an active high input.
7	D	Driver transmit data input
8	V _{DDL}	Side1 I/O logic level
9	GND ₁	Ground 1, the ground reference for Isolator Side 1.
10	GND ₁	Ground 2, the ground reference for Isolator Side 2.
11	GND ₂	Ground 2, the ground reference for Isolator Side 2.
12	NC	Not Connected
13	Y	Non-inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
14	GND ₂	Ground 2, the ground reference for Isolator Side 2.
15	Z	Inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
16	GND ₂	Ground 2, the ground reference for Isolator Side 2.
17	B	Inverting Receiver Input
18	A	Non-inverting Receiver Input
19	V _{ISOOUT}	Isolated Power Supply Output. It is recommended this pin have a 0.1 μF and 10μF capacitor to GND ₂ .
20	GND ₂	Ground 2, the ground reference for Isolator Side 2.

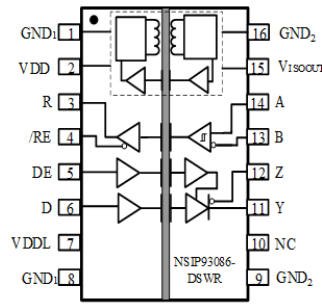


Figure 1.2 NSIP93086-DSWR Package

Table 1.2 NSIP93086-DSWR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	GND ₁	Ground 1, the ground reference for Isolator Side 1.
2	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND ₁ .
3	R	Receiver output
4	/RE	Receiver enable input, this is an active low input.
5	DE	Driver enable input, this is an active high input.
6	D	Driver transmit data input
7	V _{DDL}	Side1 I/O logic level
8	GND ₁	Ground 1, the ground reference for Isolator Side 1.
9	GND ₂	Ground 2, the ground reference for Isolator Side 2.
10	NC	Not Connected
11	Y	Non-inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
12	Z	Inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
13	B	Inverting Receiver Input
14	A	Non-inverting Receiver Input
15	V _{ISOOUT}	Isolated Power Supply Output. It is recommended this pin have a 0.1 μF and 10μF capacitor to GND ₂ .
16	GND ₂	Ground 2, the ground reference for Isolator Side 2.

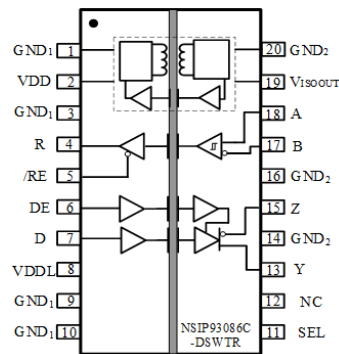


Figure 1.3 NSIP93086C-DSWTR Package

Table 1.3 NSIP93086C-DSWTR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	GND ₁	Ground 1, the ground reference for Isolator Side 1.
2	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND ₁
3	GND ₁	Ground 1, the ground reference for Isolator Side 1.
4	R	Receiver output
5	/RE	Receiver enable input, this is an active low input.
6	DE	Driver enable input, this is an active high input.
7	D	Driver transmit data input
8	VDDL	Side1 I/O logic level
9	GND ₁	Ground 1, the ground reference for Isolator Side 1.
10	GND ₁	Ground 1, the ground reference for Isolator Side 1.
11	SEL	V _{ISOOUT} output voltage select, V _{ISOOUT} =5V when SEL short to V _{ISOOUT} , V _{ISOOUT} =3.3V when SEL short to GND ₂ or floating.
12	NC	Not Connected
13	Y	Non-inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
14	GND ₂	Ground 2, the ground reference for Isolator Side 2.
15	Z	Inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
16	GND ₂	Ground 2, the ground reference for Isolator Side 2.
17	B	Inverting Receiver Input
18	A	Non-inverting Receiver Input
19	V _{ISOOUT}	Isolated Power Supply Output. It is recommended this pin have a 0.1 μF and 10μF capacitor to GND ₂ .
20	GND ₂	Ground 2, the ground reference for Isolator Side 2.

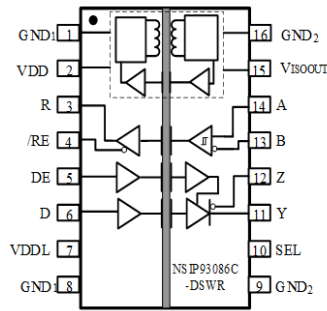


Figure 1.4 NSIP93086C-DSWR Package

Table1.4 NSIP93086C-DSWR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	GND ₁	Ground 1, the ground reference for Isolator Side 1
2	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND ₁ .
3	R	Receiver output
4	/RE	Receiver enable input, this is an active low input.
5	DE	Driver enable input, this is an active high input.
6	D	Driver transmit data input
7	V _{DDL}	Side1 I/O logic level
8	GND ₁	Ground 1, the ground reference for Isolator Side 1.
9	GND ₂	Ground 2, the ground reference for Isolator Side 2.
10	SEL	V _{ISOOUT} output voltage select, V _{ISOOUT} =5V when SEL short to V _{ISOOUT} , V _{ISOOUT} =3.3V when SEL short to GND ₂ or floating.
11	Y	Non-inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
12	Z	Inverting Driver Output. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
13	B	Inverting Receiver Input
14	A	Non-inverting Receiver Input
15	V _{ISOOUT}	Isolated Power Supply Output. It is recommended this pin have a 0.1 μF and 10μF capacitor to GND ₂ .
16	GND ₂	Ground 2, the ground reference for Isolator Side 2.

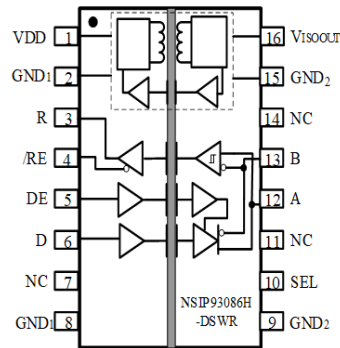


Figure 1.5 NSIP93086H-DSWR Package

Table 1.5 NSIP93086H-DSWR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND ₁ .
2	GND ₁	Ground 1, the ground reference for Isolator Side 1.
3	R	Receiver output
4	/RE	Receiver enable input, this is an active low input.
5	DE	Driver enable input, this is an active high input.
6	D	Driver transmit data input
7	NC	Not Connected
8	GND ₁	Ground 1, the ground reference for Isolator Side 1.
9	GND ₂	Ground 2, the ground reference for Isolator Side 2.
10	SEL	V _{ISOOUT} output voltage select, V _{ISOOUT} =5V when SEL short to V _{ISOOUT} , V _{ISOOUT} =3.3V when SEL short to GND ₂ or floating.
11	NC	Not Connected
12	A	Non-inverting Driver Output/Receiver Input. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
13	B	Inverting Driver Output/Receiver Input. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
14	NC	Not Connected
15	GND ₂	Ground 2, the ground reference for Isolator Side 2.
16	V _{ISOOUT}	Isolated Power Supply Output. It is recommended this pin have a 0.1 μF and 10μF capacitor to GND ₂ .

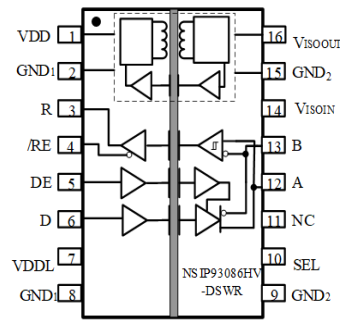


Figure 1.6 NSIP93086HV-DSWR Package

Table 1.6 NSIP93086HV-DSWR Pin Configuration and Description

PIN NO.	SYMBOL	FUNCTION
1	V _{DD}	Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to GND.
2	GND ₁	Ground 1, the ground reference for Isolator Side 1.
3	R	Receiver output
4	/RE	Receiver enable input, this is an active low input.
5	DE	Driver enable input, this is an active high input.
6	D	Driver transmit data input
7	V _{DDL}	Side1 I/O logic level
8	GND ₁	Ground 1, the ground reference for Isolator Side 1.
9	GND ₂	Ground 2, the ground reference for Isolator Side 2.
10	SEL	V _{ISOOUT} output voltage select, V _{ISOOUT} =5V when SEL short to V _{ISOOUT} , V _{ISOOUT} =3.3V when SEL short to GND2 or floating.
11	NC	Not Connected
12	A	Non-inverting Driver Output/Receiver Input. When the driver is disabled, or when V _{DD} is powered down, Pin Y is put into a high impedance state to avoid overloading the bus.
13	B	Inverting Driver Output/Receiver Input. When the driver is disabled, or when V _{DD} is powered down, Pin Z is put into a high impedance state to avoid overloading the bus.
14	V _{ISOIN}	Isolated power supply input. This pin must be connected externally to V _{ISOOUT} . It is recommended this pin have a 0.1μF capacitor to GND ₂ . Connect this pin through a ferrite bead and short trace length to V _{ISOOUT} for operation.
15	GND ₂	Ground 2, the ground reference for Isolator Side 2.
16	V _{ISOOUT}	Isolated Power Supply Output. This pin must be connected externally to V _{ISOIN} . It is recommended this pin have a 0.1μF and 10uF capacitor to GND ₂ . Connect this pin through a ferrite bead and short trace length to V _{ISOIN} for operation.

2. Absolute Maximum Ratings¹

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power Supply Voltage ²	V _{DD}	-0.5		6	V	
Side1 I/O logic level ²	V _{DDL}	-0.5		6	V	
Maximum Input Voltage ²	V _{I/RE} , V _{DE} , V _D , V _{SEL}	-0.5		V _{DDL} +0.5 V _{ISO} +0.5	V	
Driver Output/Receiver Input Voltage	V _A , V _B , V _Y , V _Z	-18		18	V	
Differential input voltage, A with respect to B	V _{ID}	-18		18	V	
R output current	I _o	-15		15	mA	
Junction Temperature	T _J	-40		150	°C	
Storage Temperature	T _{stg}	-40		150	°C	

¹Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

²All voltage values are with respect to the local ground pin (GND₁ or GND₂) and are peak voltage values.

³The maximum voltage at the I/O pins should not exceed 6 V. For NSIP93086H-DSWR, V_{DD} replaces V_{DDL}.

3. ESD Ratings

Ratings		Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD	±8.0	kV
	Charged device model (CDM), per AEC-Q100-011-RevB	±2.0	kV

4. Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V _{DD} @ V _{ISO} = 3.3V	3		5.25	V
	V _{DD} @ V _{ISO} = 5V	4.5		5.25	V
Side1 I/O logic level	V _{DDL}	1.8		5.5	V
High level output current	I _{OH} @ V _{DDL} ¹ = 5V	-4			mA
	I _{OH} @ V _{DDL} ¹ = 3.3V	-2			mA

Parameters	Symbol	Min	Typ	Max	Unit
Low level output current	$I_{OL} @ V_{DDL}^1 = 5V$			4	mA
	$I_{OL} @ V_{DDL}^1 = 3.3V$			2	mA
Side1 High Level Input Voltage	V_{IH}	$0.7 \cdot V_{DDL}^1$		V_{DDL}^1	V
Side1 Low Level Input Voltage	V_{IL}	0		$0.3 \cdot V_{DDL}^1$	V
Data rate	DR			16	Mbps
Voltage at any bus terminal (separately or common mode)	V_I	-7		12	V
Differential input voltage	V_{ID}	-12		12	V
Ambient Temperature	T_a	-40		125	°C

¹For NSIP93086H-DSWR, V_{DD} replaces V_{DDL} .

5. Thermal Information

Parameters	Symbol	SOW16	SOW20	Unit
IC Junction-to-Air Thermal Resistance	θ_{JA}	59.2	55.7	°C/W
Junction-to-top characterization parameter	ψ_{JT}	8.7	8.2	°C/W
Junction-to-board characterization parameter	ψ_{JB}	23	24.5	°C/W

6. Specifications

6.1. DC Electrical Characteristics

(VDD=3V~5.25V, VDDL=1.8~5.5V, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD=5V, VDDL=3.3V, VISOOUT=3.3V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply current 4.5V≤VDD≤5.25V VISOOUT = 5V	IDD (500kbps)		100	128	mA	RL=120Ω
			157	182	mA	RL=54Ω
	IDD (16Mbps)		158	181	mA	RL=120Ω
			192	220	mA	RL=54Ω
	IDDL			5	mA	
Supply current 3V≤VDD≤3.6V VISOOUT = 3.3V	IDD (500kbps)		74	88	mA	RL=120Ω
			100	114	mA	RL=54Ω
	IDD (16Mbps)		97	110	mA	RL=120Ω
			112	127	mA	RL=54Ω
	IDDL			5	mA	
Supply current 4.5V≤VDD≤5.25V VISOOUT = 3.3V	IDD (500kbps)		65	78	mA	RL=120Ω
			86	102	mA	RL=54Ω
	IDD (16Mbps)		84	100	mA	RL=120Ω
			96	114	mA	RL=54Ω
	IDDL			5	mA	
Isolated supply voltage	VISOOUT		5		V	NSIP93086
	VISOOUT		3.3/5		V	NSIP93086C/NSIP93086H/N SIP93086HV
Thermal-Shutdown Threshold	T _{TS}		165		°C	
Common Mode Transient Immunity	CMTI	100	150		kV/μs	Figure 6.14
Side1						
Input High Voltage	V _{IH}	0.7*V _{DDL} ¹			V	DE, D, /RE
Input Low Voltage	V _{IL}			0.3*V _{DDL} ¹	V	DE, D, /RE
Input Current	I _I	-30		30	μA	DE, D, /RE
High Level Output Voltage	V _{OH}	V _{DDL} ¹ -0.4			V	V _{DDL} ¹ = 5V, I _{OH} ≥- 4mA
		V _{DDL} ¹ -0.3			V	V _{DDL} ¹ = 3.3V, I _{OH} ≥- 2mA
Low Level Output Voltage	V _{OL}			0.4	V	V _{DDL} ¹ = 5V, I _{OL} ≤ 4mA

Parameters	Symbol	Min	Typ	Max	Unit	Comments
				0.3	V	$V_{DDL}^1 = 3.3V, I_{OL} \leq 2mA$
Output Short-Circuit Current	I_{OSR}			150	mA	$0 \leq V_R \leq V_{DDL}^1$
Driver						
Differential Output Voltage	$ V_{OD} $			5.5	V	No Load, $V_{ISOOUT}=5V$
		2.7		5.5	V	Figure 6.9 , $R_L=120\Omega, V_{ISOOUT}=5V$
		2.1		5.5	V	Figure 6.9 , $R_L=54\Omega, V_{ISOOUT}=5V$
				3.6	V	No Load, $V_{ISOOUT}=3.3V$
		1.8		3.6	V	Figure 6.9 , $R_L=120\Omega, V_{ISOOUT}=3.3V$
		1.5		3.6	V	Figure 6.9 , $R_L=54\Omega, V_{ISOOUT}=3.3V$
Common-Mode Output Voltage	$ V_{OC} $			3	V	Figure 6.9 , $R_L=120\Omega$ or $R_L=54\Omega$
Driver Short-Circuit Output Current	I_{OSD}			250	mA	$0 \leq V_{Test} \leq 12V$
		-250			mA	$-7V \leq V_{Test} \leq 0V$
Output Leakage Current (Y and Z) Full-Duplex	I_O			200	μA	$DE=0V, V_{Test}=12V$
		-200			μA	$DE=0V, V_{Test}=-7V$
Receiver						
Input Current (A and B)	I_A, I_B			200	μA	$DE=Low, V_{Test}=12V$
		-200			μA	$DE=Low, V_{Test}=-7V$
Positive-going Receiver Differential Threshold Voltage	V_{TH+}			-10	mV	$DE=Low$
Negative-going Receiver Differential Threshold Voltage	V_{TH-}	-200			mV	$DE=Low$
Receiver Input Hysteresis	ΔV_{TH}		30		mV	$DE=Low$
Receiver Input Resistance	R_{IN}	96			k Ω	$-7V \leq V_{CM} \leq 12V, DE=Low$

¹For NSIP93086H-DSWR, V_{DD} replaces V_{DDL} .

6.2. Switching Electrical Characteristics

(VDD=3V~5.25V, VDDL=1.8~5.5V, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD=5V, VDDL=3.3V, VISOOUT=3.3V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Driver						
Maximum Data Rate	f _{MAX}	16			Mbps	
Driver Propagation Delay	t _{PLH}		18.6	50	ns	Figure 6.10 , R _L =54Ω, C _L =50pF
	t _{PHL}		18.8	50	ns	Figure 6.10 , R _L =54Ω, C _L =50pF
Driver Pulse Width Distortion, t _{PHL} - t _{PLH}	t _{skew}		2	15	ns	Figure 6.10 , R _L =54Ω, C _L =50pF
Driver Output Falling Time or Rising time	t _F			15	ns	Figure 6.10 , R _L =54Ω, C _L =50pF
	t _R			15	ns	Figure 6.10 , R _L =54Ω, C _L =50pF
Driver Enable to Output High	t _{ZH}		25.2	60	ns	Figure 6.11 , C _L =50pF
Driver Enable to Output Low	t _{ZL}		18.8	60	ns	Figure 6.11 , C _L =50pF
Driver Disable to Output High	t _{HZ}		30.8	60	ns	Figure 6.11 , C _L =50pF
Driver Disable to Output Low	t _{LZ}		23.4	60	ns	Figure 6.11 , C _L =50pF
Receiver						
Maximum Data Rate	f _{MAX}	16			Mbps	
Receiver Propagation Delay	t _{PLH}		81	140	ns	Figure 6.12 , C _L =15pF
	t _{PHL}		81.6	140	ns	Figure 6.12 , C _L =15pF
Receiver Pulse Width Distortion, t _{PHL} - t _{PLH}	t _{skew}		2	20	ns	Figure 6.12 , C _L =15pF
Receiver Output Falling Time or Rising time	t _F			15	ns	Figure 6.12 , C _L =15pF
	t _R			15	ns	Figure 6.12 , C _L =15pF
Receiver Enable to Output High	t _{ZH}		28.7	60	ns	Figure 6.13 , C _L =15pF
Receiver Enable to Output Low	t _{ZL}		27.1	60	ns	Figure 6.13 , C _L =15pF
Receiver Disable to Output High	t _{HZ}		20	60	ns	Figure 6.13 , C _L =15pF
Receiver Disable to Output Low	t _{LZ}		20.2	60	ns	Figure 6.13 , C _L =15pF

6.3. Typical Performance Characteristics

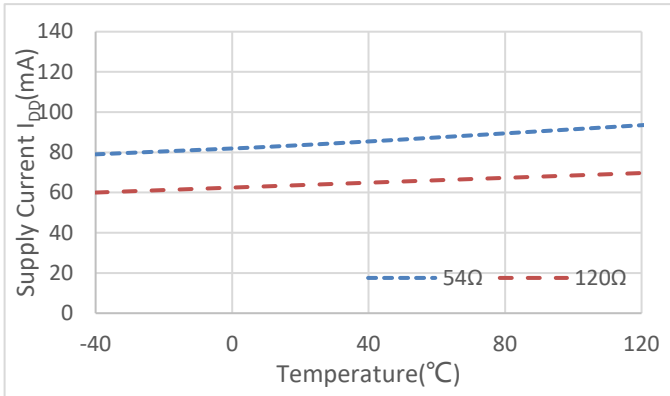


Figure 6.1 supply current vs Temperature

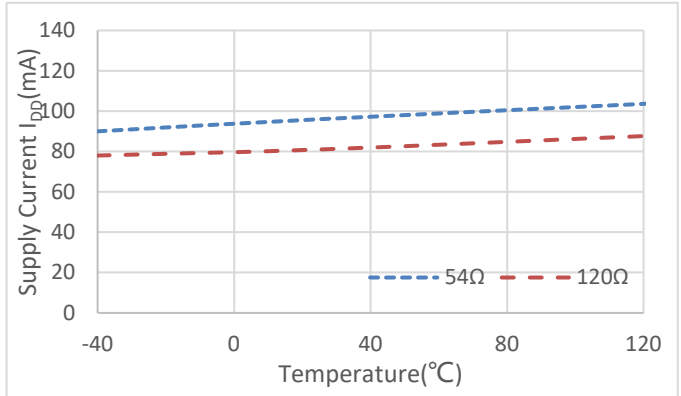


Figure 6.2 supply current vs Temperature

(Data Rate=16MHz, DE=V_{DDL}, /RE=GND, VDD=5V, V_{ISOOUT}=3.3V) (Data Rate=500KHz, DE=V_{DDL}, /RE=GND, VDD=5V, V_{ISOOUT}=3.3V)

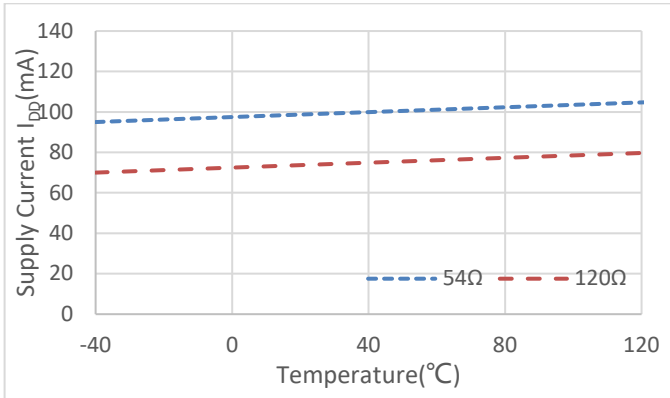


Figure 6.3 supply current vs Temperature

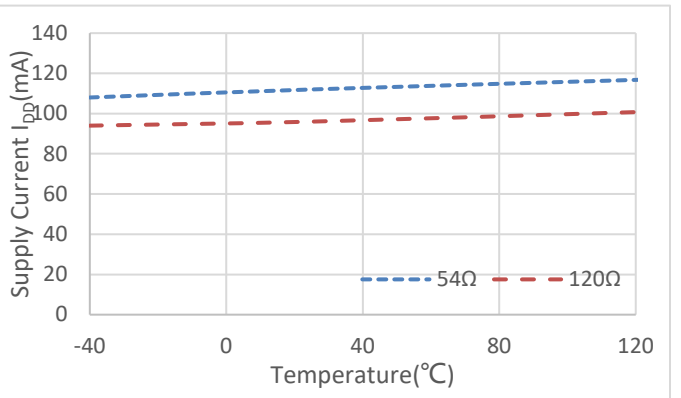


Figure 6.4 supply current vs Temperature

(Data Rate=16MHz, DE=V_{DDL}, /RE=GND, VDD=3.3V, V_{ISOOUT}=3.3V) (Data Rate=500KHz, DE=V_{DDL}, /RE=GND, VDD=3.3V, V_{ISOOUT}=3.3V)

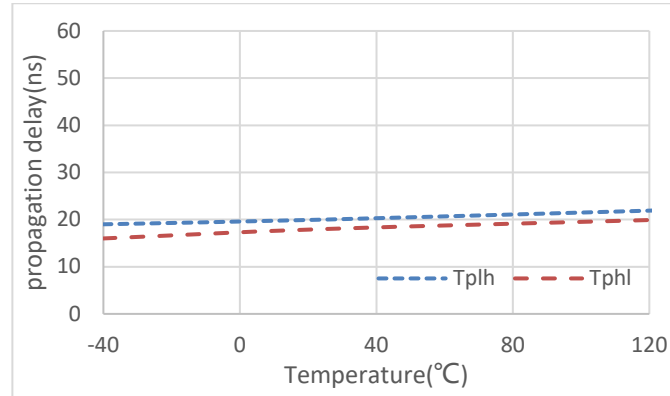


Figure 6.5 Driver Propagation Delay vs Temperature
(VDDL=3.3V, V_{ISOOUT}=3.3V)

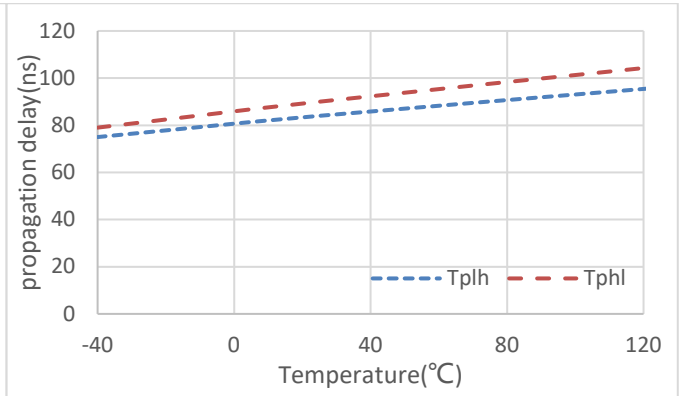


Figure 6.6 Receiver Propagation Delay vs Temperature
(VDDL=3.3V, V_{ISOOUT}=3.3V)

6.4. Parameter Measurement Information

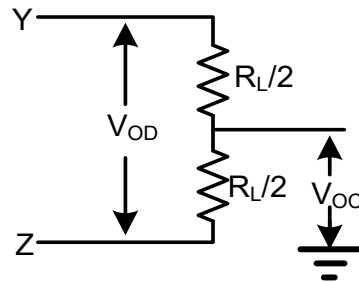


Figure 6.7 Driver DC Test Load

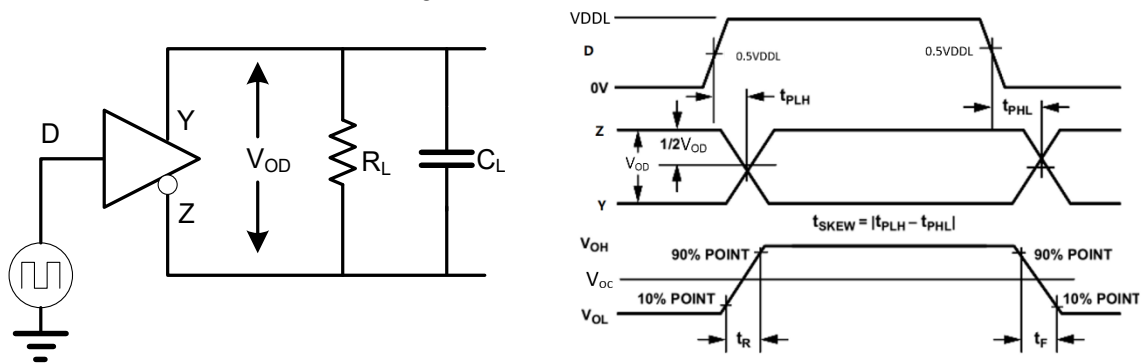


Figure 6.8 Driver Timing Test Circuit and waveform

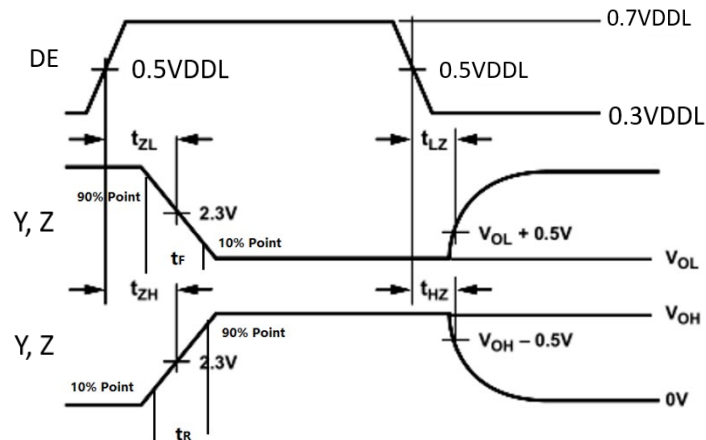
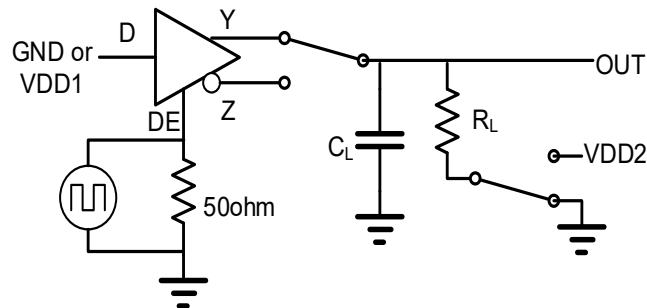


Figure 6.9 Driver Enable Disable Timing Test Circuit and waveform

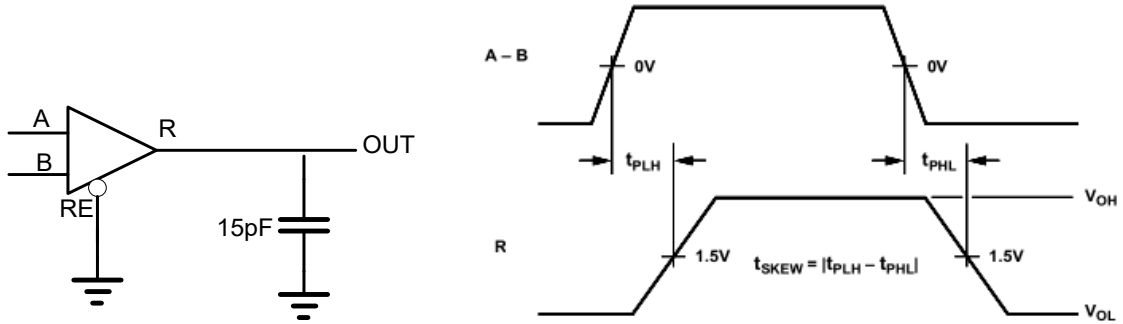


Figure 6.10 Receiver Propagation Delay Test Circuit and waveform

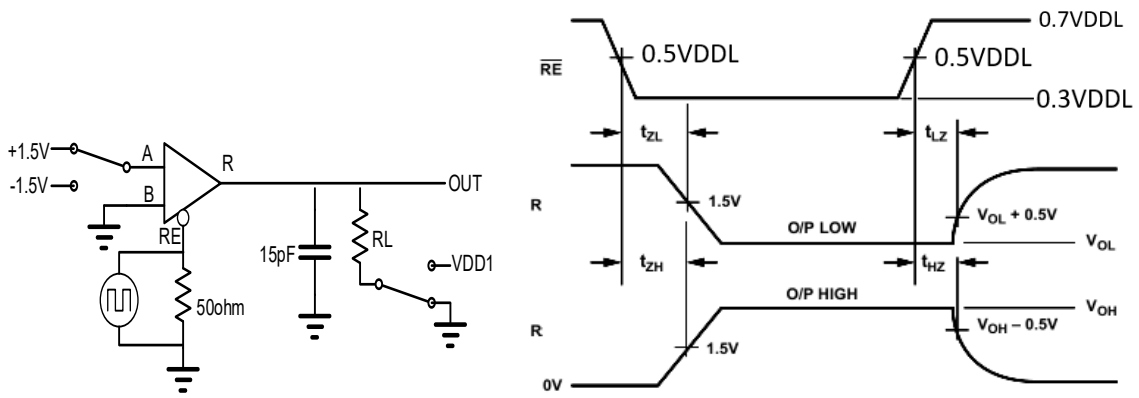


Figure 6.11 Receiver Enable Disable Timing Test Circuit and waveform

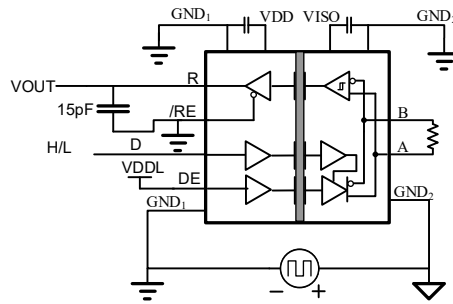


Figure 6.12 Common-Mode Transient Immunity Test Circuit

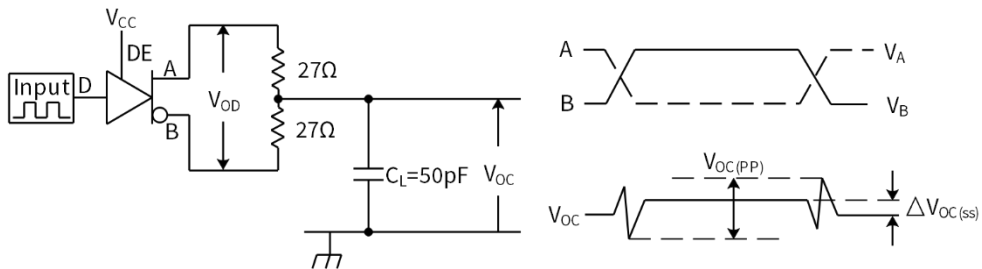


Figure 6.13 Measurement of Driver Common-Mode Output Voltage With RS-485 Load

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>
Minimum External Air Gap (Clearance)	CLR	8.15	mm	Shortest terminal-to-terminal distance through air
Minimum External Tracking (Creepage)	CPG	8.15	mm	Shortest terminal-to-terminal distance across the package surface
Distance Through Insulation	DTI	26	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

<i>Description</i>			<i>Test Condition</i>	<i>Value</i>
Overvoltage Category per IEC60664-1			For Rated Mains Voltage ≤ 150Vrms	I to IV
			For Rated Mains Voltage ≤ 300Vrms	I to IV
			For Rated Mains Voltage ≤ 600Vrms	I to III
Climatic Classification				40/125/21
Pollution Degree per DIN VDE 0110,				2

7.2. Insulation Characteristics

Description	Test Condition	Symbol	Value	Unit
Maximum repetitive isolation voltage		V_{IORM}	1500	V_{PEAK}
Maximum working isolation voltage	AC Voltage	V_{IOWM}	1061	V_{RMS}
	DC Voltage		1500	V_{DC}
Apparent Charge	Method a, after Input/output safety test subgroup 2/3, $V_{ini}=V_{IOTM}$, $t_{ini} = 60s$, $V_{pd(m)}=1.2*V_{IORM}$, $t_m=10s$.	q_{pd}	<5	pC
	Method a, after environmental tests subgroup 1, $V_{ini}=V_{IOTM}$, $t_{ini}=60s$, $V_{pd(m)}=1.6*V_{IORM}$, $t_m=10s$			pC
	Method b, routine test (100% production) and preconditioning (type test); $V_{ini}=1.2*V_{IOTM}$, $t_{ini}=1s$ $V_{pd(m)}=1.875*V_{IORM}$, $t_m=1s$ (method b1) or $V_{pd(m)}=V_{ini}$, $t_m=t_{ini}$ (method b2)			pC
Maximum transient isolation voltage	$t = 60s$	V_{IOTM}	7070	V_{PEAK}
Maximum impulse voltage	Tested in air, 1.2/50 μs waveform per IEC62368-1	V_{IMP}	7600	V_{PEAK}
Maximum Surge Isolation Voltage	Test method per IEC62368-1, 1.2/50 μs waveform, $V_{IOSM} \geq V_{IMP} \times 1.3$	V_{IOSM}	10000	V_{PEAK}
Isolation resistance	$V_{IO} = 500V$, $T_{amb}=25^{\circ}C$	R_{IO}	$>10^{12}$	Ω
	$V_{IO} = 500V$, $100^{\circ}C \leq T_{amb} \leq 125^{\circ}C$	R_{IO}	$>10^{11}$	Ω
	$V_{IO} = 500V$, $T_{amb}=T_s$	R_{IO}	$>10^9$	Ω
Isolation capacitance	$f = 1MHz$	C_{IO}	~4	pF
Safety total power dissipation	$\theta_{JA} = 59.2^{\circ}C/W$, $V_I = 5.25V$, $T_J = 150^{\circ}C$, $T_A = 25^{\circ}C$, package SOW16	P_s	2111	mW
	$\theta_{JA} = 55.7^{\circ}C/W$, $V_I = 5.25V$, $T_J = 150^{\circ}C$, $T_A = 25^{\circ}C$,	P_s	2244	mW

Description	Test Condition	Symbol	Value	Unit
	package SOW20			
Safety input, output, or supply current	$\theta_{JA} = 59.2^{\circ}\text{C/W}$, $V_I = 5.25\text{V}$, $T_J = 150^{\circ}\text{C}$, $T_A = 25^{\circ}\text{C}$, package SOW16	I _s	402	mA
	$\theta_{JA} = 55.7^{\circ}\text{C/W}$, $V_I = 5.25\text{V}$, $T_J = 150^{\circ}\text{C}$, $T_A = 25^{\circ}\text{C}$, package SOW20	I _s	427	mA
Maximum safety temperature		T _s	150	°C
UL1577				
Insulation voltage per UL	$V_{\text{TEST}} = V_{\text{ISO}}$, $t = 60\text{s}$ (qualification), $V_{\text{TEST}} = 1.2 \times V_{\text{ISO}}$, $t = 1\text{s}$ (100% production test)	V _{ISO}	5000	V _{RMS}

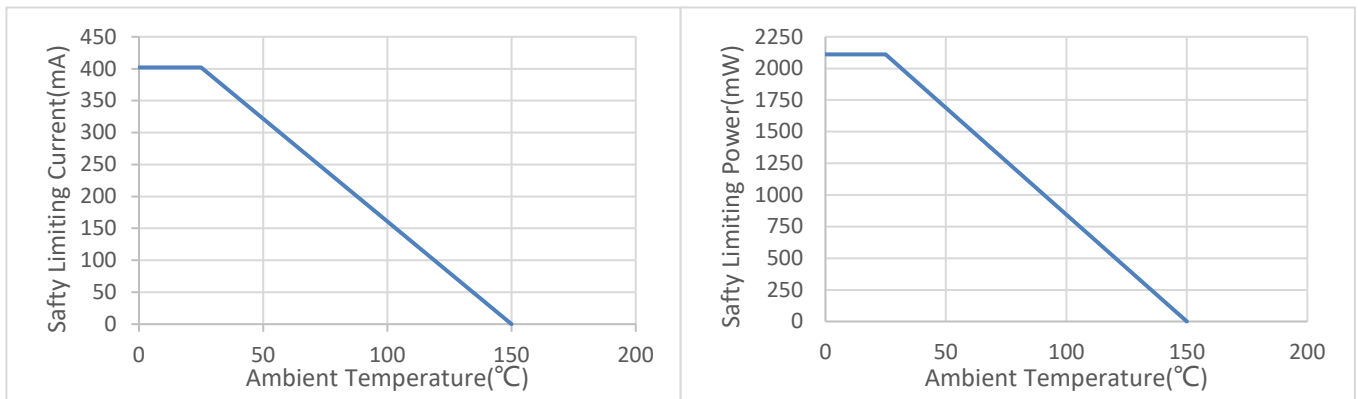


Figure 7.1 NSIP93086 SOW16 Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-17

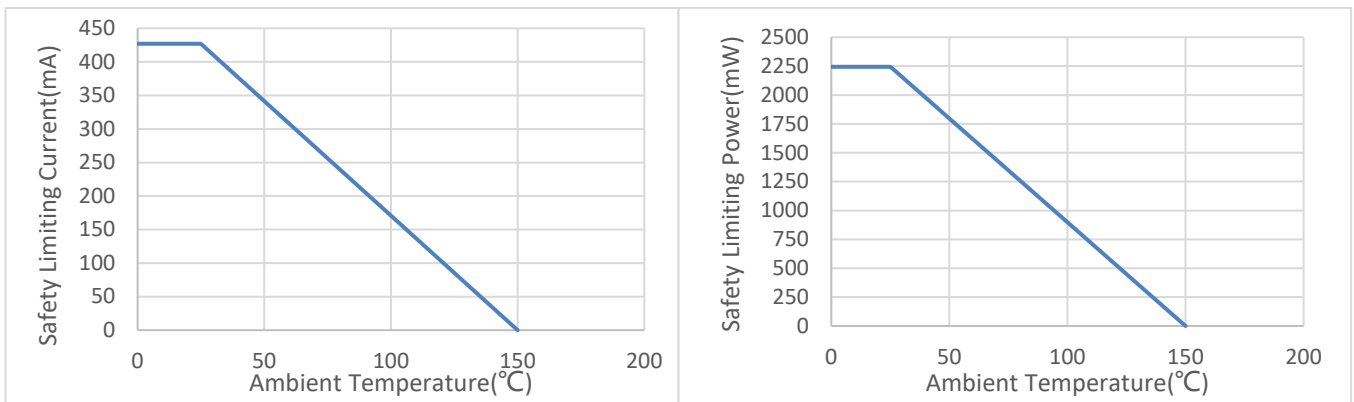


Figure 7.2 NSIP93086 SOW20 Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-17

7.3. Regulatory Information

The NSIP93086 are certified with UL1577, VDE0884-17, GB4943.1, EN IEC 62368-1.

UL1577 & CSA Component Acceptance Notice 5A		DIN EN IEC 60747-17 (VDE 0884-17)	EN IEC62368-1	GB4943.1
Single Protection, 5000V _{rms} Isolation voltage	Single Protection, 5000V _{rms} Isolation voltage	Reinforced Insulation V _{IORM} =1500Vpeak V _{IOTM} =7070Vpeak	5000V _{rms} for 1min	Certified according to GB4943.1
Certified by UL		Certified by TUV		Certified by CQC
E500602	E500602	R50632560 0002	R50574061	CQC23001378663

8. Function Description

NSIP93086 is a high reliability isolated full duplex RS-485 transceiver. Data isolation is achieved using Novosense integrated capacitive isolation that allows data transmission between the logic side and the Bus side. The 93086 series are safety certified by UL1577 supporting 5kV_{RMS} insulation withstand voltage.

8.1. True Fail-Safe Receiver Inputs

The devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted. The receiver threshold is fixed between -10mV and -200mV, which meets EIA/TIA-485 standard. If the differential input voltage ($V_A - V_B$) is greater than or equal to -10mV, receiver output R is logic high. In the case of a terminated bus with all transmitters disabled, the differential input voltage is pulled to zero by the termination resistors. Due to the receiver threshold, the receiver output R is logic high.

8.2. Truth Tables

Table 8.1 Driver Function Table¹

<i>VDD status</i>	<i>Input (D)</i>	<i>Enable Input (DE)</i>	<i>Outputs</i>	
			<i>Y</i>	<i>Z</i>
PU	H	H	H	L
PU	L	H	L	H
PU	X	L	Z	Z
PU	X	OPEN	Z	Z
PU	OPEN	H	H	L
PD	X	X	Z	Z

Table 8.2 Receiver Function Table¹

<i>VDD status</i>	<i>Differential Input (VA-VB)</i>	<i>Enable Input (/RE)</i>	<i>Output (R)</i>
PU	≥-10mV	L/Open	H
PU	≤-200mV	L/Open	L
PU	Open/Short	L/Open	H
PU	X	H	H
PU	Idle	L	H
PD	X	X	Z

¹ PD= Powered down; PU= Powered up; H= Logic High; L= Logic Low; X= Irrelevant; Z= High Impedance;

8.3. EMI Considerations

NSIP93086 use a small on-chip transformer to provide power for RS485 Transceiver. The on-chip transformer operates at high frequency, which may degrade EMI performance, to achieve better EMI performance, special considerations must be taken during PCB layout. Please refer to the application note if needed.

8.4. Output Short and Over Temperature Protection

The NSIP93086 series are protected against output short for V_{ISOOUT} . When short on V_{ISOOUT} occurs, the device will be in Hiccup mode and the power transferred will be limit, which will limit the temperature of the device to protect the device.

The NSIP93086 series also protected against over temperature. When the chip is over 165°C, it will be shut down until the temperature of below 145°C.

9. Application Note

9.1. 256 Transceivers on the Bus

The devices have a 1/8-unit-load receiver input impedance (96k Ω) that allows up to 256 transceivers on the bus. Connect any combination of these devices, and/or other RS-485 devices, for a maximum of 32 unit-loads to the line.

9.2. ESD Protection

ESD protection structures are enhanced on all pins to protect against electrostatic discharge encountered during handling and assembly. The Bus pins have extra protection against static electricity to bus side (V_{ISOOUT} side).

ESD protection can be tested in various ways. Below is the ESD spec of the devices.

Bus pins:

- $\pm 8\text{kV}$ using the Contact Discharge method specified in IEC 61000-4-2

9.3. Layout Considerations

The NSIP93086 requires a $10\mu\text{F}+0.1\mu\text{F}$ bypass capacitor between VDD_1 and GND_1 , $10\mu\text{F}+0.1\mu\text{F}$ bypass capacitor between V_{ISOOUT} and GND_2 . The capacitor should be placed as close as possible to the package. To eliminate line reflections, each cable end (A-B, Y-Z) is terminated with a resistor, whose value matches the characteristic impedance of the cable (54 Ω /120 Ω). It's good practice to place the bus connectors and termination resistor as close as possible to the A and B, Y and Z pins.

9.4. Typical Application

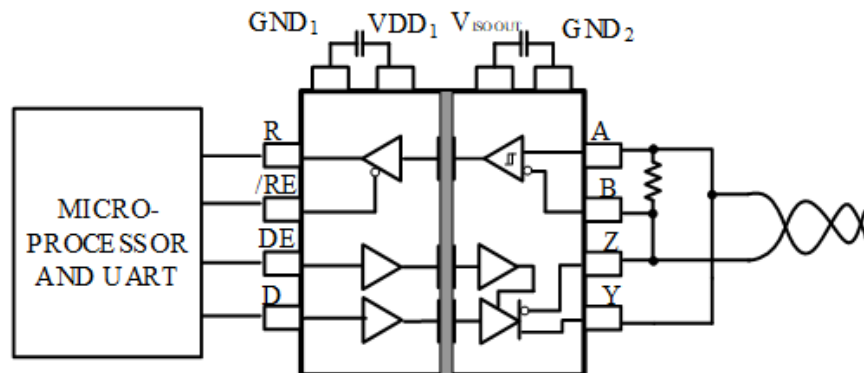


Figure 9.1 NSIP93086 in Half-Duplex RS-485 Mode

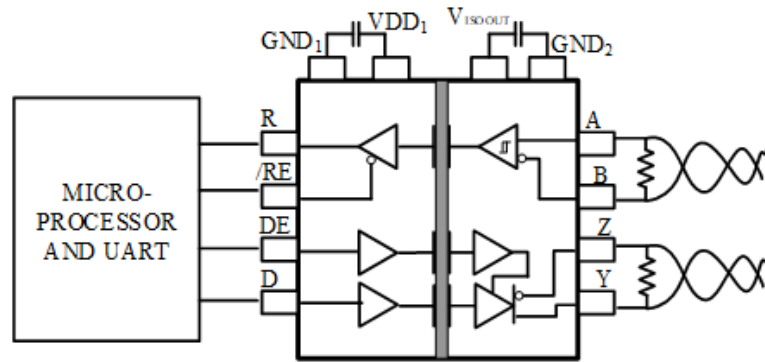


Figure 9.2 NSIP93086 typical application circuit

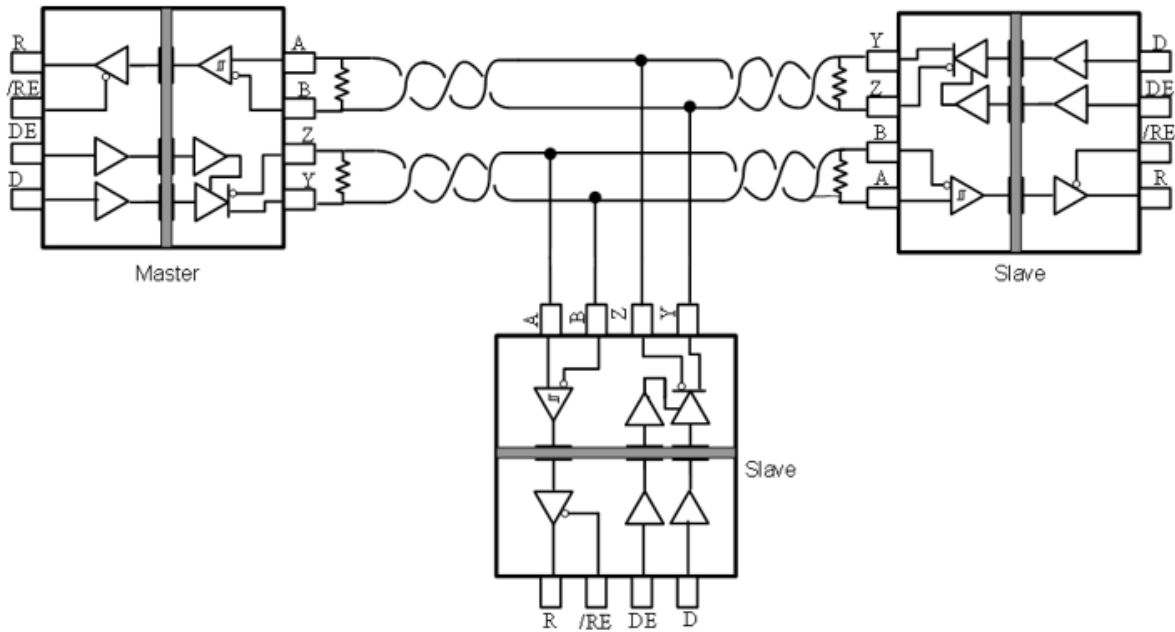


Figure 9.3 Typical isolated Full-Duplex RS-485 application

10. Package Information

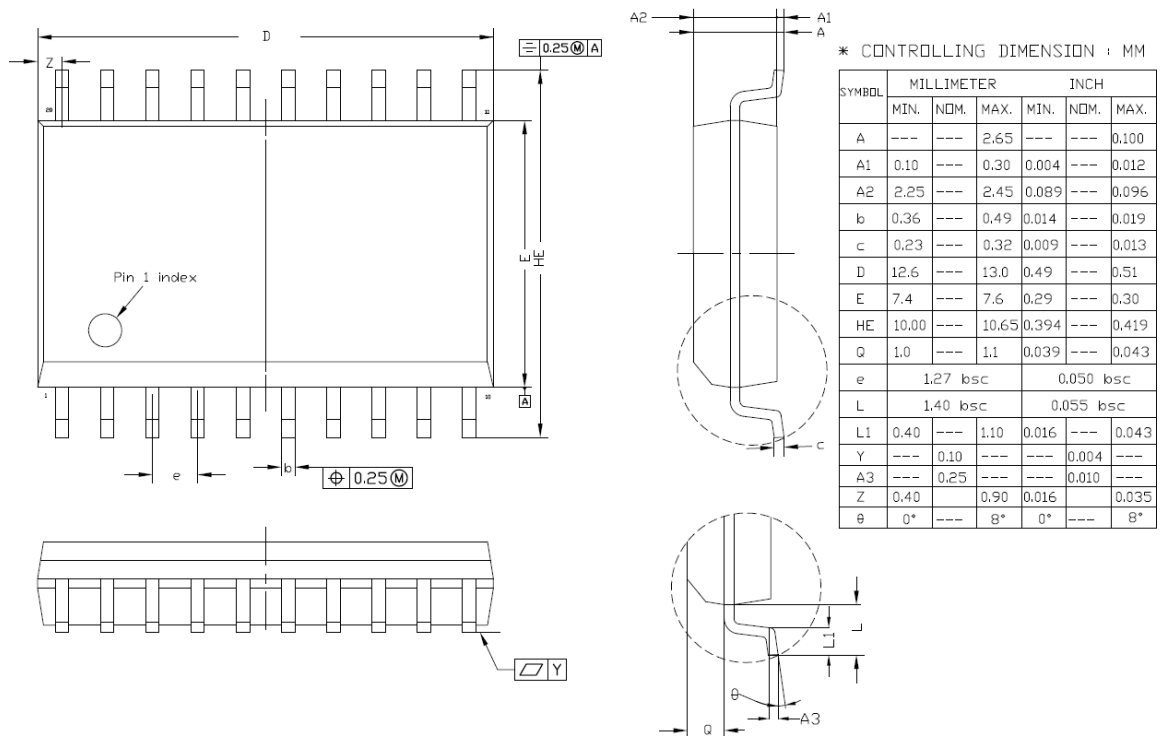


Figure 10.1 SOW20 Package Shape and Dimension in millimeters

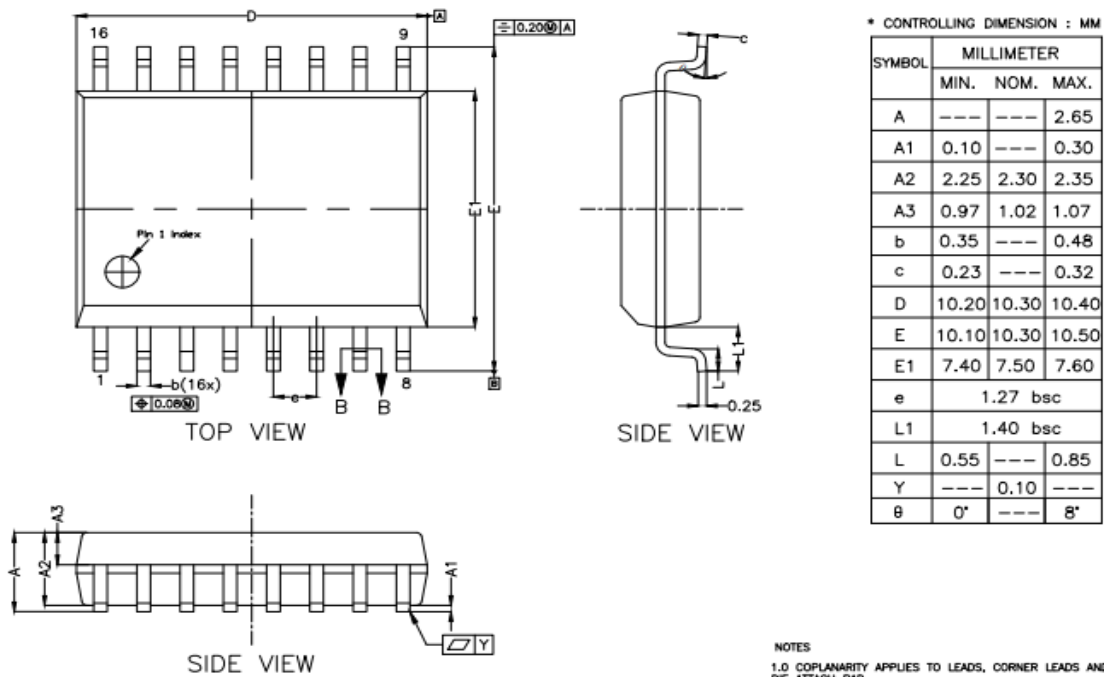


Figure 10.2 SOW16 Package Shape and Dimension in millimeters

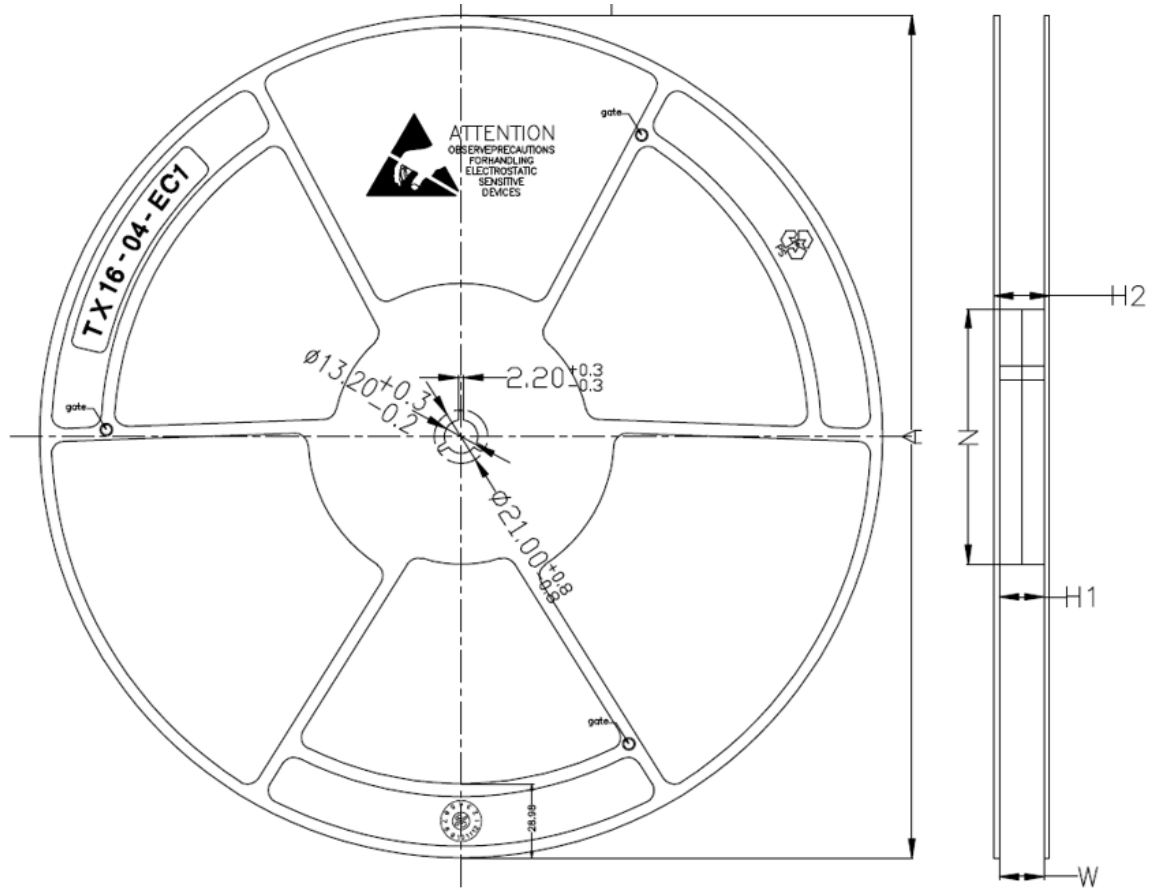
11. Ordering Information

<i>Part Number</i>	<i>Isolation Rating (kV_{RMS})</i>	<i>V_{ISOOUT}</i>	<i>Duplex</i>	<i>Max Data Rate (Mbps)</i>	<i>MSL</i>	<i>Temperature</i>	<i>No. of Nodes</i>	<i>Package Type</i>	<i>Package Drawing</i>	<i>SPQ</i>
NSIP93086-DSWTR	5	5V	Full	16	3	-40 to 125°C	256	SOP20(300mil)	SOW20	1000
NSIP93086-DSWR	5	5V	Full	16	3	-40 to 125°C	256	SOP16(300mil)	SOW16	1500
NSIP93086C-DSWTR	5	5/3.3V	Full	16	3	-40 to 125°C	256	SOP20(300mil)	SOW20	1000
NSIP93086C-DSWR	5	5/3.3V	Full	16	3	-40 to 125°C	256	SOP16(300mil)	SOW16	1500
NSIP93086H-DSWR	5	5/3.3V	Half	16	3	-40 to 125°C	256	SOP16(300mil)	SOW16	1500
NSIP93086HV-DSWR	5	5/3.3V	Half	16	3	-40 to 125°C	256	SOP16(300mil)	SOW16	1500

12. Documentation Support

<i>Part Number</i>	<i>Product Folder</i>	<i>Datasheet</i>	<i>Application Note</i>
NSIP93086	tbd	tbd	tbd

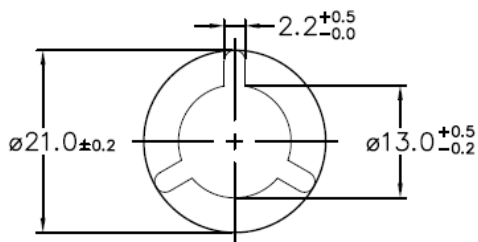
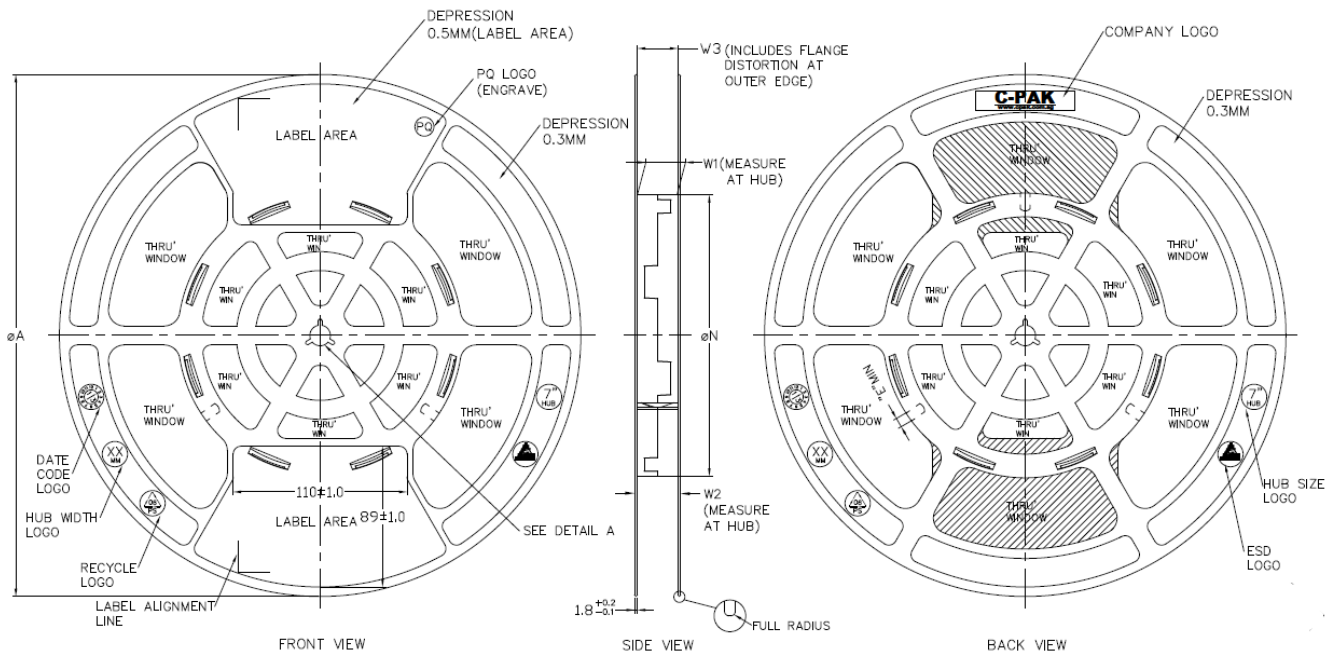
13. Tape And Reel Information



PRODUCT SPECIFICATIONS					
TAPE WIDTH	ϕA^{+2}_{-2}	ϕN^{+2}_{-2}	$H1^{+2}_{-0}$	$H2^{+1}_{-1}$	$W^{+3.5}_{-0.2}$
16MM	330	100	16.4	20.6	16.4

- NOTES:**
- 1.MATERIAL:DISSIPATIVE(BLACK)
 - 2.FLANGE WARPAGE:3 MM MAXIMUM
 - 3.ALL DIMENSIONS ARE IN MM
 - 4.ESD - SURFACE RESISTIVITY-10 TO 10 OHMS/SQ
 - 5.GENERAL TOLERANCE: ± 0.25 MM

Figure 13.1 Tape Information of SOW16

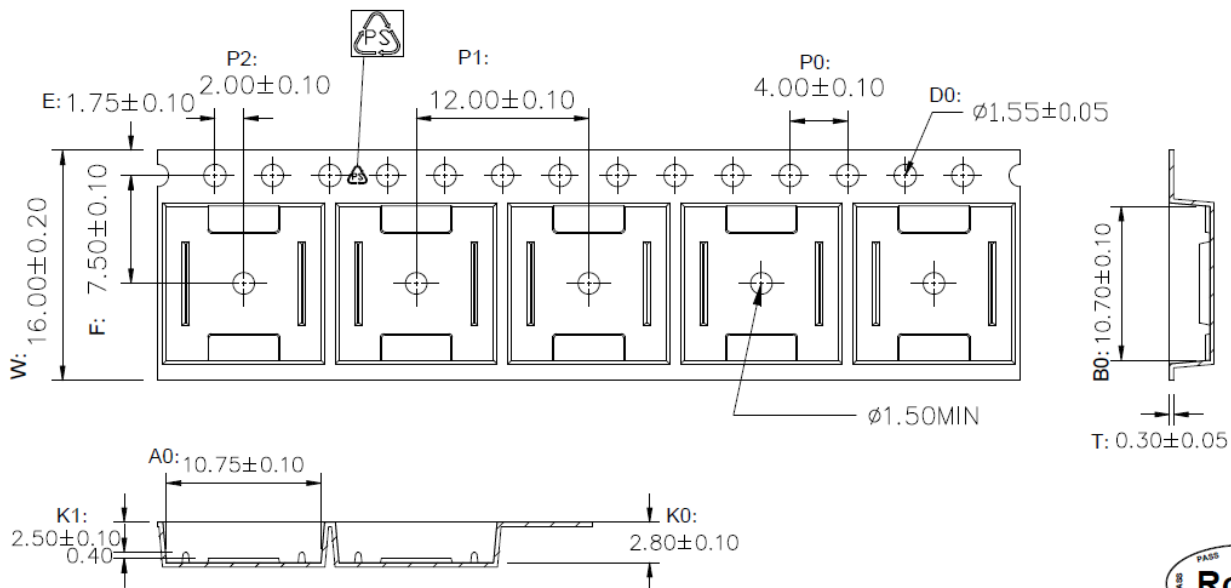


ARBOR HOLE
DETAIL A
SCALE : 3:1

PRODUCT SPECIFICATION						
TAPE WIDTH	ϕA ± 2.0	ϕN ± 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	10^8 TO 10^{11}	ANTISTATIC (COATED)	ALL TYPES

Figure 13.2 Tape Information of SOW20



1. 10 sprocket hole pitch cumulative tolerance ± 0.20 .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy .
4. All dimensions meet EIA-481 requirements.
5. Thickness : 0.30 ± 0.05 mm.
6. Packing length per 22" reel : 378 Meters.(復巻 N=122)
7. Component load per 13" reel : 1000 pcs.
8. Surface resistivity : $10^5 \sim 10^{10} \Omega/\square$



W	16.00±0.20
A0	10.75±0.10
B0	10.70±0.10
K0	2.80±0.10
K1	2.50±0.10

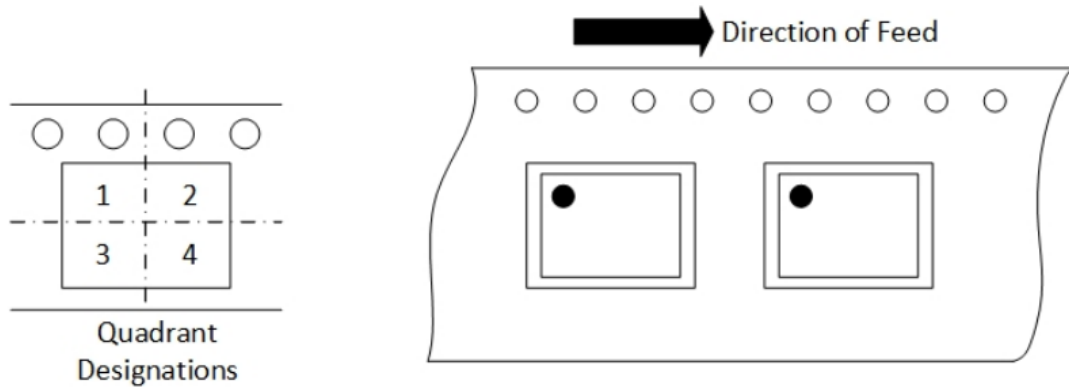


Figure 13.3 Reel Information of SOW16

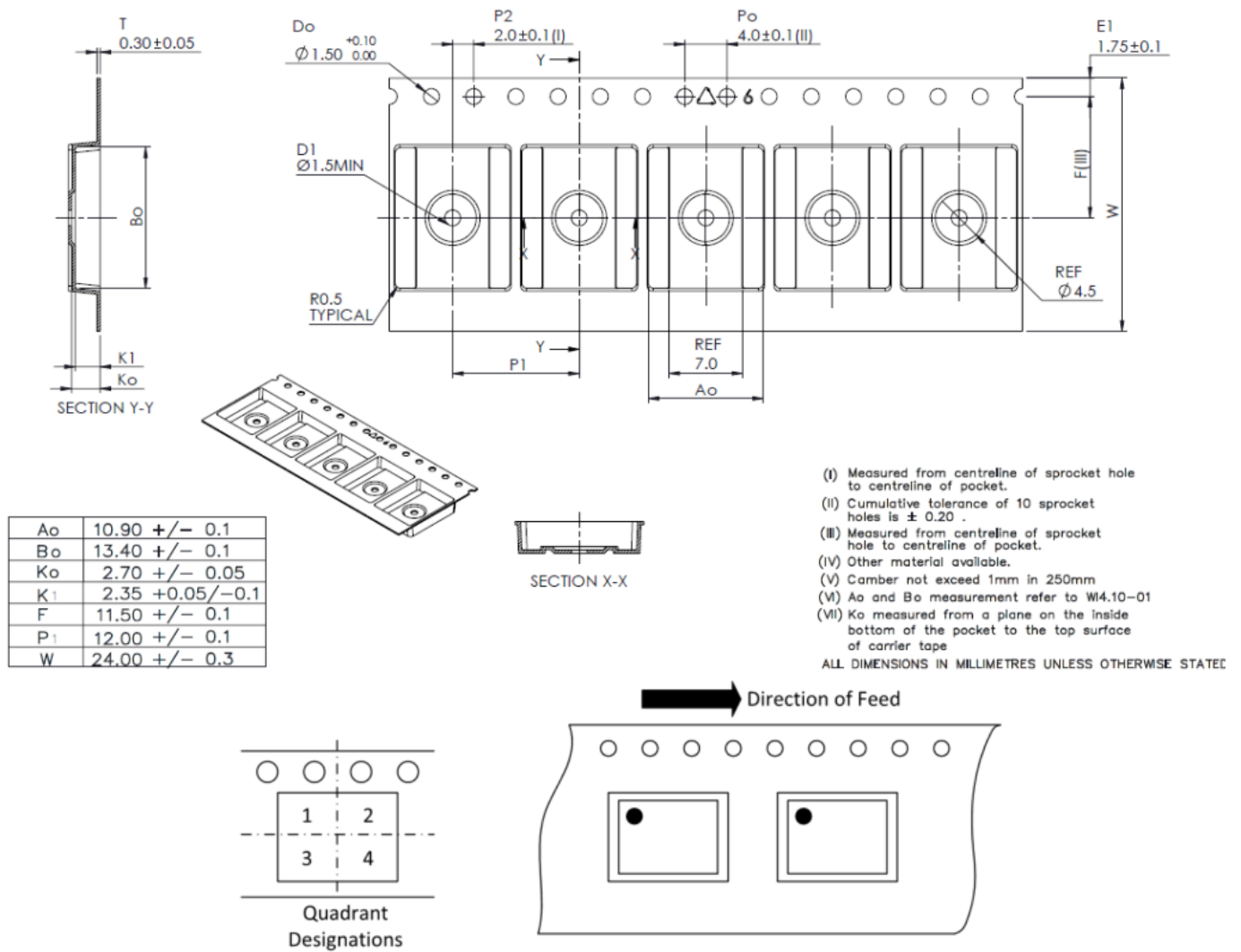


Figure 13.4 Reel Information of SOW20

14. Revision History

Revision	Description	Date
1.0	Initial Version	2025/12/15

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Suzhou Novosense Microelectronics Co., Ltd