# NSiP83086

# Signal Isolated RS-485 Transceiver With Integrated DC to DC Converter

Datasheet (EN) 1.0

## Product Overview

NSiP83086 series are high reliability isolated full duplex RS-485 transceiver with integrated DC to DC converter. The NSiP83086 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 NSiP83086 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 Bus pins of NSiP83086 are protected from ±8kV system level ESD to $GND_2$. 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 96k Ω input impedance that allows up to 256 transceivers on the bus.

## Key Features

- Up to 5000Vrms Insulation voltage
- ISO-Power integrated isolated DC-to-DC converter
- I/O voltage range supports 1.8~5.5V MCU
- Power supply voltage:
  - VDD: 4.5V to 5.5V for NSiP83086
  - 3V to 5.5V for NSiP83086C and NSiP83086V
  - VDDL: 1.8V to 5.5V
- Over current and over temperature protection
- High CMTI: ±150kV/us
- Data rate: 16Mbps
- Up to 256 transceivers on the bus
- High system level EMC performance:
  - BUS Pins meet IEC61000-4-2 ±8kV ESD
  - Other Pins meet IEC61000-4-2 ±7kV ESD
- Operation temperature: -40℃~105℃
- RoHS-compliant packages: SOW20 SOW16

## Safety Regulatory Approvals

- UL recognition: up to 5000$V_{RMS}$ for 1 minute per UL1577
- CQC certification per GB4943.1-2022
- CSA component notice 5A
- DIN VDE V 0884-11:2017-01

## Applications

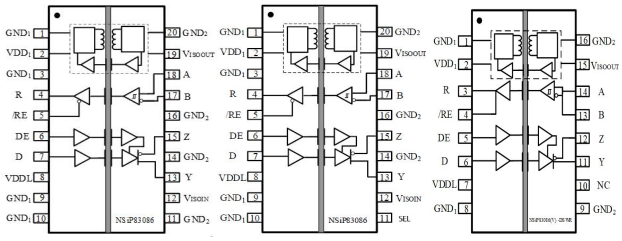
- Industrial automation system
- Isolated RS-485 communication
- Smart electric meter and water meter
- Security and protection monitoring

## Device Information

| *Part Number* | *Package* | *Body Size* |
|---|---|---|
| NSiP83086(C)(V)-DSWTR | SOW20 | 12.80mm × 7.50mm |
| NSiP83086(V)-DSWR | SOW16 | 10.30mm x 7.50mm |

Note: (C), (V) could be empty representing 5V output version. V represents 3.3V output version, C version has SEL pin which can choose 3.3/5V output

## Functional Block Diagrams



NSiP83086(V)-DSWTR NSiP83086C-DSWTR NSiP83086(V)-DSWR

Figure 1. NSiP83086 Block Diagrams

# INDEX

1. PIN CONFIGURATION AND FUNCTIONS ..... 3
2. ABSOLUTE MAXIMUM RATINGS ..... 7
3. RECOMMENDED OPERATING CONDITIONS ..... 7
4. THERMAL INFORMATION ..... 7
5. SPECIFICATIONS ..... 8
5.1. DC ELECTRICAL CHARACTERISTICS ..... 8
5.2. NSIP83086 SWITCHING ELECTRICAL CHARACTERISTICS ..... 10
5.3. TYPICAL PERFORMANCE CHARACTERISTICS ..... 11
5.4. PARAMETER MEASUREMENT INFORMATION ..... 12
6. HIGH VOLTAGE FEATURE DESCRIPTION ..... 14
6.1. INSULATION AND SAFETY RELATED SPECIFICATIONS ..... 14
6.2. DIN VDE V 0884-11（VDE V 0884-11）:2017-01 INSULATION CHARATERISTICS ..... 14
6.3. REGULATORY INFORMATION ..... 16
7. FUNCTION DESCRIPTION ..... 16
7.1. TRUE FAIL-SAFE RECEIVER INPUTS ..... 16
7.2. TRUTH TABLES ..... 17
7.3. EMI CONSIDERATIONS ..... 17
7.4. OUTPUT SHORT AND OVER TEMPERATURE PROTECTION ..... 17
8. APPLICATION NOTE ..... 18
8.1. 256 TRANSCEIVERS ON THE BUS ..... 18
8.2. ESD PROTECTION ..... 18
8.3. LAYOUT CONSIDERATIONS ..... 18
8.4. TYPICAL APPLICATION ..... 18
9. PACKAGE INFORMATION ..... 20
10. ORDER INFORMATION ..... 21
11. DOCUMENTATION SUPPORT ..... 21
12. TAPE AND REEL INFORMATION ..... 22
13. REVISION HISTORY ..... 24

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# 1. Pin Configuration and Functions

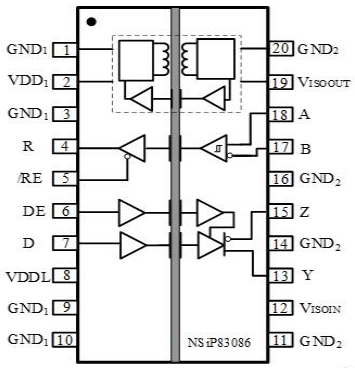



Figure 1.1 NSiP83086(V)-DSWTR Package

Table1.1 NSiP83086(V)-DSWTR Pin Configuration and Description

| PIN NO. | SYMBOL | FUNCTION |
|---|---|---|
| 1 | $GND_1$ | Ground 1, the ground reference for Isolator Side 1 |
| 2 | $VDD_1$ | Power Supply for Isolator Side 1 ,It is recommended this pin have a 0.1μF + 10 μF capacitor to $GND_1$ (Pin1,Pin3 ) |
| 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 | I/O Power Supply input, 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 | $GND_2$ | Ground 2, the ground reference for Isolator Side 2 |
| 12 | $V_{ISOIN}$ | Isolated power supply input. This pin must be connected externally to $V_{ISOOUT}$. It is recommended this pin have a 0.1 μF capacitor to $GND_2$ (Pin11). Connect this pin to $V_{ISOOUT}$ through a ferrite bead and short trace length for operation. |
| 13 | Y | Non-inverting Driver Output. When the driver is disabled, or when VDDL 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 VDD 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 |

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| | | |
|---|---|---|
| 18 | A | Non-inverting Receiver Input |
| 19 | $V_{ISOOUT}$ | Isolated Power Supply Output. This pin must be connected externally to $V_{ISOIN}$. It is recommended this pin have a 0.1 μF and 10μF capacitor to $GND_2$ (Pin20). Connect this pin through a ferrite bead and short trace length to $V_{ISOIN}$ for operation. |
| 20 | $GND_2$ | Ground 2, the ground reference for Isolator Side 2 |

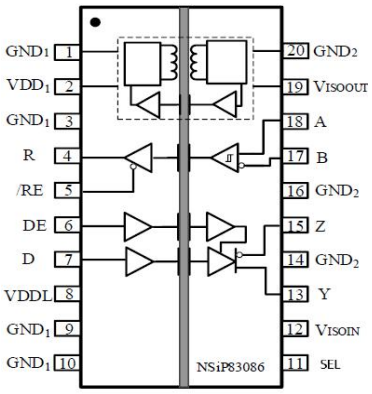



Figure 1.2 NSiP83086C-DSWTR Package

Table1.2NSiP83086C-DSWTR Pin Configuration and Description

| *PIN NO.* | *SYMBOL* | *FUNCTION* |
|---|---|---|
| 1 | $GND_1$ | Ground 1, the ground reference for Isolator Side 1 |
| 2 | $VDD_1$ | Power Supply for Isolator Side 1 ,It is recommended this pin have a 0.1μF + 10 μF capacitor to $GND_1$ (Pin1,Pin3 ) |
| 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 | I/O Power Supply input, 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 | VISO output voltage select, $V_{ISOOUT}$ =5V when SEL is floating or connect to $V_{ISOIN}$, $V_{ISOOUT}$ =3.3V when SEL short to $GND_2$ |
| 12 | $V_{ISOIN}$ | Isolated power supply input. This pin must be connected externally to $V_{ISOOUT}$. It is recommended this pin have a 0.1 μF capacitor to $GND_2$ . Connect this pin to $V_{ISOOUT}$ through a ferrite bead and short trace length for operation. |
| 13 | Y | Non-inverting Driver Output. When the driver is disabled, or when VDDL 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 |

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| | | |
|---|---|---|
| 15 | Z | Inverting Driver Output. When the driver is disabled, or when VDD 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. This pin must be connected externally to $V_{ISOIN}$. It is recommended this pin have a 0.1 μF and 10μF capacitor to $GND_2$ (Pin20). Connect this pin through a ferrite bead and short trace length to $V_{ISOIN}$ for operation. |
| 20 | $GND_2$ | Ground 2, the ground reference for Isolator Side 2 |

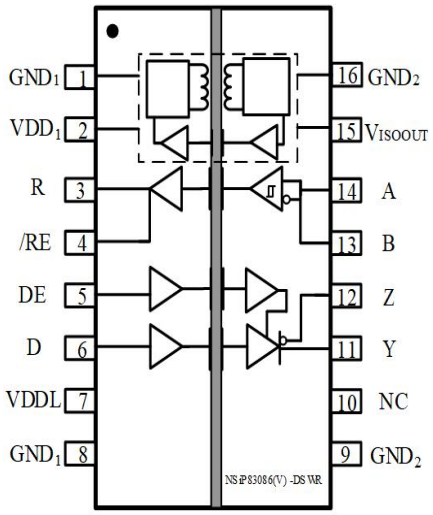



Figure 1.3 NSiP83086(V)-DSWR Package

Table1.3NSiP83086(V)-DSWR Pin Configuration and Description

| PIN NO. | SYMBOL | FUNCTION |
|---|---|---|
| 1 | $GND_1$ | Ground 1, the ground reference for Isolator Side 1 |
| 2 | $VDD_1$ | Power Supply for Isolator Side 1. It is recommended this pin have a 0.1 μF + 10 μF capacitor to $GND_1$ (Pin1) |
| 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 | VDDL | I/O Power Supply input, 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 |

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| | | |
|---|---|---|
| 11 | Y | Non-inverting Driver Output. When the driver is disabled, or when VDD 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 VDD 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 $GND_2$ (Pin16). |
| 16 | $GND_2$ | Ground 2, the ground reference for Isolator Side 2. |

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## 2. Absolute Maximum Ratings

| Parameters | Symbol | Min | Typ | Max | Unit | Comments |
|---|---|---|---|---|---|---|
| Power Supply Voltage | VDD,VDDL | -0.5 | | 6 | V | |
| Maximum Input Voltage | /RE, DE, D | -0.4 | | VDDL+0.4 | V | |
| Driver Output/Receiver Input Voltage | $V_A$, $V_B$, $V_Y$, $V_Z$ | -7 | | 12 | V | |
| R output current | $I_O$ | -15 | | 15 | mA | |
| Operating Temperature | Topr | -40 | | 105 | ℃ | |
| Storage Temperature | Tstg | -40 | | 150 | ℃ | |
| Electrostatic discharge | HBM | | | ±8000 | V | |
| | CDM | | | ±2000 | V | |

## 3. Recommended Operating Conditions

| Parameters | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| NSiP83086 Power Supply Voltage | VDD | 4.5 | 5 | 5.5 | V |
| NSiP83086C and NSiP83086V Power Supply Voltage | VDD | 3 | 3.3/5 | 5.5 | V |
| Operating Temperature | Topr | -40 | | 105 | ℃ |
| Side1 High Level Input Voltage | $V_{IH}$ | 0.7*VDDL | | VDDL | V |
| Side1 Low Level Input Voltage | $V_{IL}$ | 0 | | 0.3*VDDL | V |
| Data rate | DR | | | 16 | Mbps |

## 4. Thermal Information

| Parameters | Symbol | SOW20 | SOW16 | Unit |
|---|---|---|---|---|
| IC Junction-to-Air Thermal Resistance | $\theta_{JA}$ | 68.5 | 61 | °C/W |
| Junction-to-top characterization parameter | $\psi_{JT}$ | 17.1 | 10.2 | °C/W |
| Junction-to-board characterization parameter | $\psi_{JB}$ | 50.9 | 37.2 | °C/W |

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# 5. Specifications

## 5.1. DC Electrical Characteristics

(VDD=4.5V~5.5V, VDDL=1.8~5.5V, Ta=-40℃ to 105℃. Unless otherwise noted, Typical values are at VDD=VDDL=5V,$V_{ISOOUT}$=5V, Ta = 25℃)

| *Parameters* | *Symbol* | *Min* | *Typ* | *Max* | *Unit* | *Comments* |
|---|---|---|---|---|---|---|
| Power supply voltage NSiP83086 | $VDD_1$ | 4.5 | | 5.5 | V | |
| | VDDL | 1.8 | | 5.5 | V | |
| Power supply voltage NSiP83086C/NSiP83086V | $VDD_1$ | 3 | | 5.5 | V | |
| | VDDL | 1.8 | | 5.5 | V | |
| Supply current condition: VDD=4.5V~5.5V, VDDL=1.8~5.5V, Ta=-40℃ to 105℃. | | | | | | |
| Supply current $V_{ISOOUT}$ = 5V | IDD (500kbps) | | 72 | 90 | mA | VDD=5V VDDL=3.3V $R_L$=120 Ω |
| | | | 118 | 140 | mA | VDD=5V VDDL=3.3V $R_L$=54 Ω |
| | IDD (16Mbps) | | 100 | 130 | mA | VDD=5V VDDL=3.3V $R_L$=120 Ω |
| | | | 130 | 160 | mA | VDD=5V VDDL=3.3V $R_L$=54 Ω |
| | IDDL | | | 5 | mA | |
| Supply current condition: VDD=3~5.5V, VDDL=1.8~5.5V, Ta=-40℃ to 105℃. | | | | | | |
| Supply current $V_{ISOOUT}$ = 3.3V | IDD (500kbps) | | 40 | 55 | mA | VDD=5V VDDL=3.3V $R_L$=120 Ω |
| | | | 61 | 80 | mA | VDD=5V VDDL=3.3V $R_L$=54 Ω |
| | IDD (16Mbps) | | 45 | 65 | mA | VDD=5V VDDL=3.3V $R_L$=120 Ω |
| | | | 60 | 80 | mA | VDD=5V VDDL=3.3V $R_L$=54 Ω |
| | IDDL | | | 5 | mA | |
| Isolated supply voltage | $V_{ISOOUT}$ | | 5 | | V | NSiP83086 |
| | $V_{ISOOUT}$ | | 3.3/5 | | V | NSiP83086C |
| | $V_{ISOOUT}$ | | 3.3 | | V | NSiP83086V |
| Thermal-Shutdown Threshold | $T_{TS}$ | | 165 | | ℃ | |
| Thermal-Shutdown Hysteresis | $T_{TSH}$ | | 15 | | ℃ | |
| Common Mode Transient Immunity | CMTI | 100 | 150 | | kV/us | Figure 5.12 |
| **Side1** | | | | | | |
| Input High Voltage | $V_{IH}$ | 0.7*VDDL | | | V | DE, D, /RE |
| Input Low Voltage | $V_{IL}$ | | | 0.3*VDDL | V | DE, D, /RE |
| Input Current | $I_I$ | -20 | | 20 | uA | D, DE, /RE |

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|---|---|---|---|---|---|---|
| Output Voltage High | $V_{OH}$ | 0.8*VDDL | | | V | IOH = -4mA |
| Output Voltage Low | $V_{OL}$ | | | 0.2*VDDL | V | IOL = 4mA |
| Output Short-Circuit Current | $I_{OSR}$ | | | 150 | mA | $0 \le V_R \le$VDDL |
| Three-State Output Current | $I_{OZR}$ | | | 15 | uA | $0 \le V_R \le$ VDDL , /RE = high |
| Input Capacitance | $C_{IN}$ | | 2 | | pF | DE, D, /RE |
| **Driver** | | | | | | |
| Differential Output Voltage | $\lvert V_{OD} \rvert$ | | | 5.5 | V | No Load， $V_{ISOOUT}$=5V |
| | | 2.7 | | 5.5 | V | Figure 5.7,$R_L$=120Ω $V_{Isoout}$=5V |
| | | 2.1 | | 5.5 | V | Figure 5.7,$R_L$=54Ω (RS-485) $V_{Isoout}$=5V |
| Change in magnitude of the differential output voltage | $\Delta\lvert V_{OD} \rvert$ | | | 0.2 | V | , $R_L$=120Ω or $R_L$=54Ω $V_{Isoout}$=5V |
| Common-Mode Output Voltage | $\lvert V_{OC} \rvert$ | | | 3 | V | , $R_L$=120Ω or $R_L$ =54Ω $V_{Isoout}$=5V |
| Change in Magnitude of Common-Mode Voltage | $\Delta\lvert V_{OC} \rvert$ | | | 0.2 | V | , $R_L$=120Ω or $R_L$ =54Ω $V_{Isoout}$=5V |
| Driver Short-Circuit Output Current | $I_{OSD}$ | | | 200 | mA | $0 \le V_{Test} \le$ 12 V |
| | | -200 | | | mA | $-7V \le V_{Test} \le 0V$ |
| Output Leakage Current (Y and Z) Full-Duplex | $I_O$ | | | 200 | uA | DE=0V, $V_{Test}$=12V |
| | | -200 | | | uA | DE=0V, $V_{Test}$=-7V |
| **Receiver** | | | | | | |
| Input Current (A and B) | $I_A$ , $I_B$ | | | 200 | uA | DE=0V, $V_{ISOIN}$=0V, $V_{Test}$=12V |
| | | -200 | | | uA | DE=0V, $V_{ISOIN}$=0V, $V_{Test}$=-7V |
| Receiver Differential Threshold Voltage | $V_{TH}$ | -200 | -125 | -10 | mV | $V_{CM}$=0V |
| Receiver Input Hysteresis | $\Delta V_{TH}$ | | 15 | | mV | $V_A$+$V_B$=0 |
| Receiver Input Resistance | $R_{IN}$ | 96 | | | kΩ | $-7V \le V_{CM} \le$ 12V, DE=0V |

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## 5.2. Switching Electrical Characteristics

(VDD=3V~5.5V,VDDL=1.8~5.5V, Ta=-40℃ to 105℃. Unless otherwise noted, Typical values are at VDD=VDDL = 5V, Ta = 25℃)

| Parameters | Symbol | Min | Typ | Max | Unit | Comments |
|---|---|---|---|---|---|---|
| **Driver** | | | | | | |
| Maximum Data Rate | $f_{MAX}$ | | | 16 | Mbps | |
| Driver Propagation Delay | $t_{PLH}$ | | 22 | 60 | ns | See Figure 5.8, $R_L$=54Ω, $C_L$=50pF |
| | $t_{PHL}$ | | 21 | 60 | ns | See Figure 5.8, $R_L$=54Ω, $C_L$=50pF |
| Driver Pulse Width Distortion, $\lvert t_{PHL} - t_{PLH} \rvert$ | $t_{skew}$ | | 1 | 8 | ns | See Figure 5.8, $R_L$=54Ω, $C_L$=50pF |
| Driver Output Falling Time or Rising time | $t_F$ | | | 15 | ns | See Figure 5.8, $R_L$=54Ω, $C_L$=50pF |
| | $t_R$ | | | 15 | ns | See Figure 5.8, $R_L$=54Ω, $C_L$=50pF |
| Driver Enable to Output High | $t_{ZH}$ | | 22.8 | 50 | ns | See Figure 5.9, $R_L$=120Ω, $C_L$=50pF |
| Driver Enable to Output Low | $t_{ZL}$ | | 19.1 | 50 | ns | See Figure 5.9, $R_L$=120Ω, $C_L$=50pF |
| Driver Disable to Output High | $t_{HZ}$ | | 28 | 50 | ns | See Figure 5.9, $R_L$=120Ω, $C_L$=50pF |
| Driver Disable to Output Low | $t_{LZ}$ | | 27.1 | 50 | ns | See Figure 5.9, $R_L$=120Ω, $C_L$=50pF |
| **Receiver** | | | | | | |
| Maximum Data Rate | $f_{MAX}$ | 16 | | | Mbps | |
| Receiver Propagation Delay | $t_{PLH}$ | | 65.8 | 140 | ns | See Figure 5.10, $C_L$=15pF |
| | $t_{PHL}$ | | 71.4 | 140 | ns | See Figure 5.10, $C_L$=15pF |
| Receiver Pulse Width Distortion, $\lvert t_{PHL} - t_{PLH} \rvert$ | $t_{skew}$ | | 5.6 | 12 | ns | See Figure 5.10, $C_L$=15pF |
| Receiver Output Falling Time or Rising time | $t_F$ | | | 15 | ns | See Figure 5.10, $C_L$=15pF |
| | $t_R$ | | | 15 | ns | See Figure 5.10, $C_L$=15pF |
| Receiver Enable to Output High | $t_{ZH}$ | | 6 | 15 | ns | See Figure 5.11, $R_L$=1kΩ, $C_L$=15pF |
| Receiver Enable to Output Low | $t_{ZL}$ | | 6 | 15 | ns | See Figure 5.11, $R_L$=1kΩ, $C_L$=15pF |
| Receiver Disable to Output High | $t_{HZ}$ | | 8 | 15 | ns | See Figure 5.11, |

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| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | $R_L$=1kΩ, $C_L$=15pF |
| Receiver Disable to Output Low | $t_{LZ}$ | | 8 | 15 | ns | See Figure 5.11, $R_L$=1kΩ, $C_L$=15pF |

## 5.3. Typical Performance Characteristics

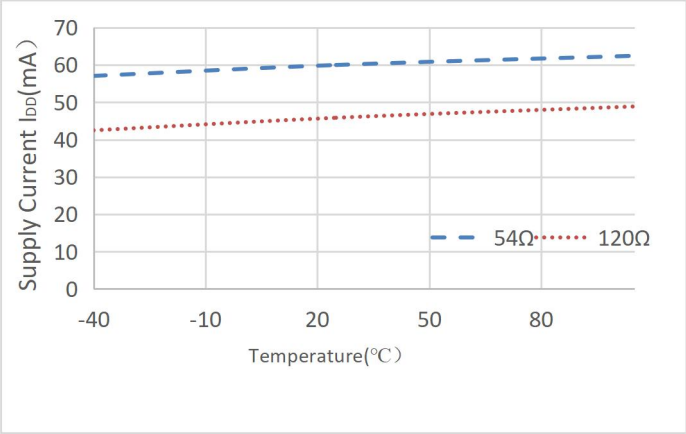



Figure 5.1 NSiP83086 supply current vs Temperature
(Data Rate=16MHz,DE=VDDL,/RE=GND,VDD=5V,$V_{ISOOUT}$=3.3V)

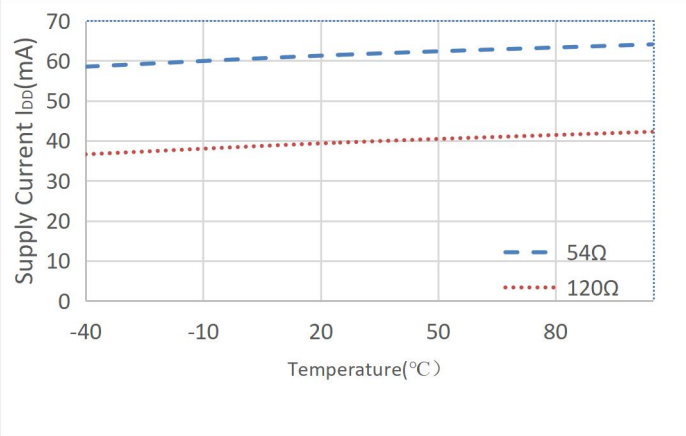



Figure 5.2 NSiP83086 supply current vs Temperature
(Data Rate=500KHz,DE=VDDL,/RE=GND,VDD=5,$V_{ISOOUT}$=3.3V)

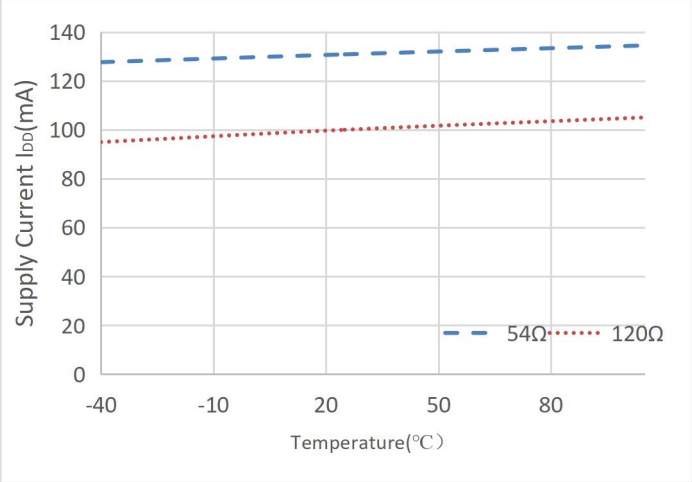



Figure 5.3 NSiP83086 supply current vs Temperature
(Data Rate=16MHz,DE=VDDL,/RE=GND,VDD=5V,$V_{ISOOUT}$=5V)

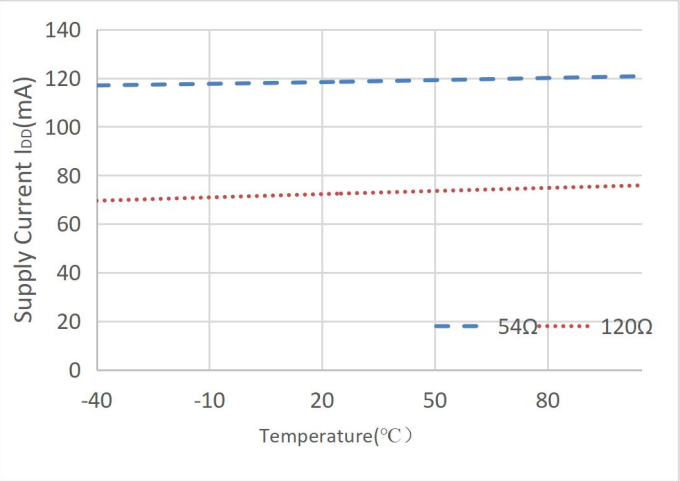



Figure 5.4 NSiP83086 supply current vs Temperature
(Data Rate=500KHz,DE=VDDL,/RE=GND,VDD=5V,$V_{ISOOUT}$=5V)

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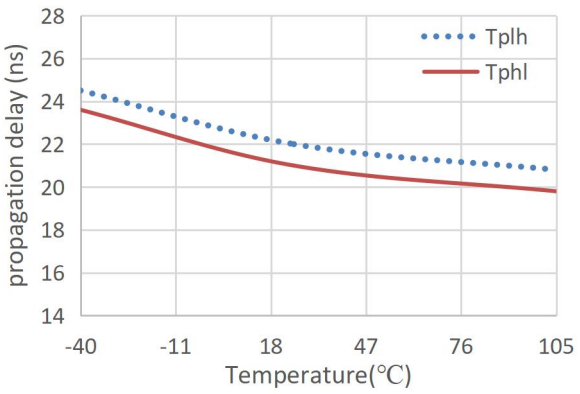



Figure 5.5 Driver Propagation Delay vs Temperature

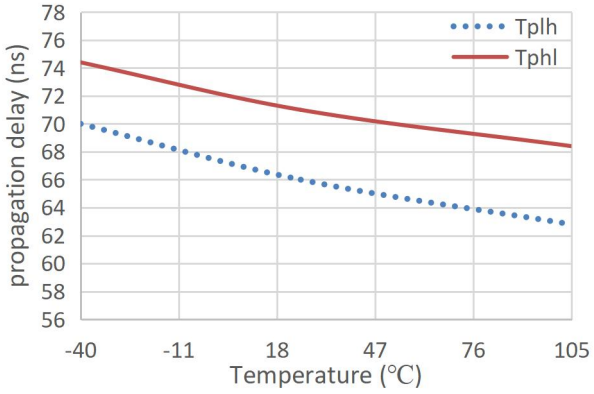



Figure 5.6 Receiver Propagation Delay vs Temperature

## 5.4. Parameter Measurement Information

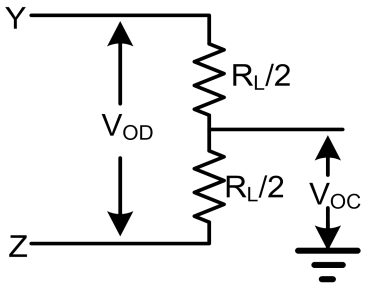



Figure 5.7 Driver DC Test Load

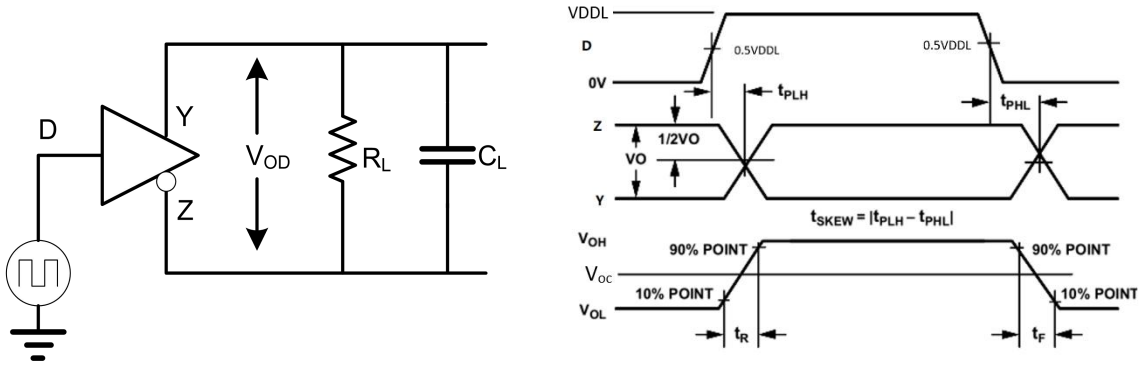
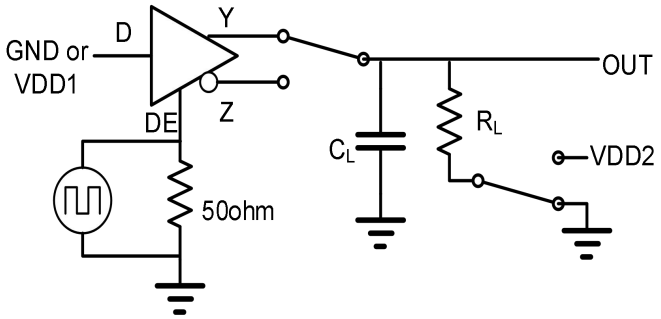



Figure5.8 Driver Timing Test Circuit and waveform




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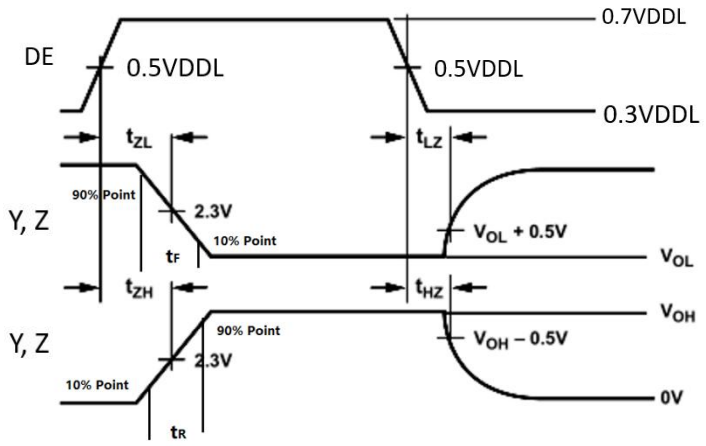



Figure5.9 Driver Enable Disable Timing Test Circuit and waveform

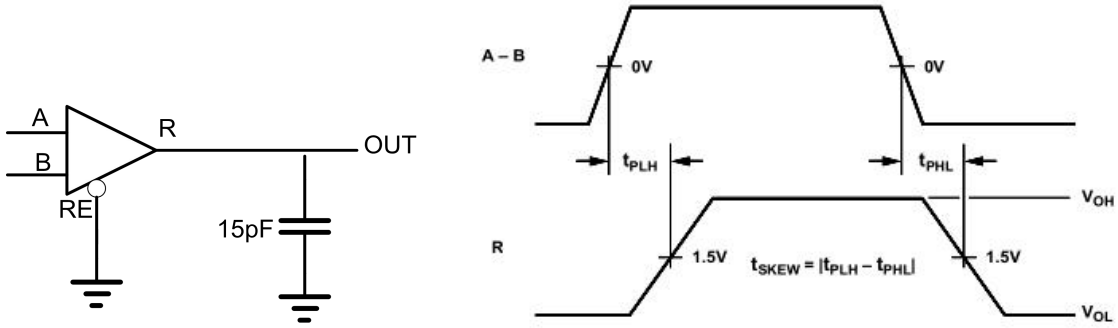



Figure 5.10 Receiver Propagation Delay Test Circuit and waveform

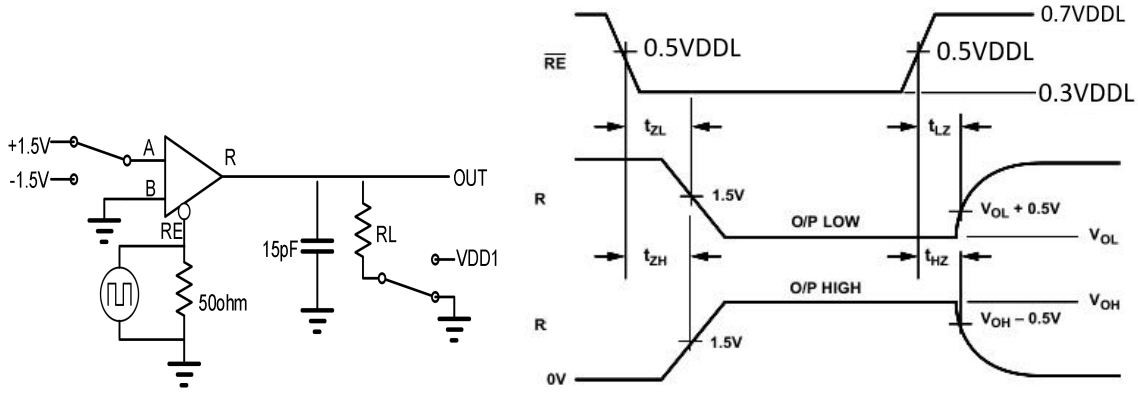



Figure 5.11 Receiver Enable Disable Timing Test Circuit and waveform

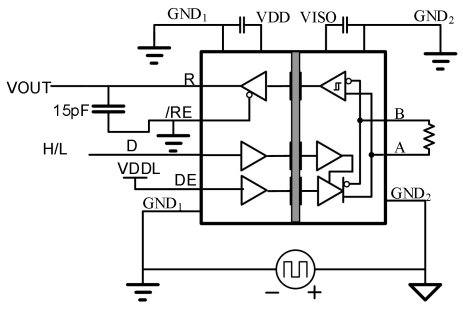



Figure5.12 Common-Mode Transient Immunity Test Circuit

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# 6. High Voltage Feature Description

## 6.1. Insulation and Safety Related Specifications

| *Parameters* | *Symbol* | *Value* | *Unit* | *Comments* |
|---|---|---|---|---|
| Minimum External Air Gap (Clearance) | CLR | 8.0 | mm | Shortest terminal-to-terminal distance through air |
| Minimum External Tracking (Creepage) | CPG | 8.0 | mm | Shortest terminal-to-terminal distance across the package surface |
| Distance through the insulation | DTI | 16 | um | Minimum internal gap (internal clearance – capacitive signal isolation) |
| | | 100 | um | Minimum internal gap (internal clearance – transformer power isolation) |
| Tracking Resistance (Comparative Tracking Index) | CTI | >600 | V | DIN EN 60112 (VDE 0303-11); IEC 60112 |
| Material Group | | I | | |

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

| *Description* | *Test Condition* | *Symbol* | *Value* | *Unit* |
|---|---|---|---|---|
| Installation Classification per DIN VDE 0110 | | | | |
| 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 | | | 40/105/21 | |
| Pollution Degree per DIN VDE 0110, Table 1 | | | 2 | |
| Maximum repetitive peak isolation voltage | AC voltage(bipolar) | $V_{IORM}$ | 1166 | Vpeak |
| Maximum working isolation voltage | AC voltage(TDDB) test | $V_{IOWM}$ | 824 | Vrms |
| | DC Voltage | $V_{IOWM}$ | 1166 | $V_{DC}$ |
| 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 | $V_{pd(m)}$ | 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 | $V_{pd(m)}$ | 1399 | Vpeak |

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| | | | | |
|---|---|---|---|---|
| | discharge < 5 pC | | | |
| 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 | $V_{pd(m)}$ | 1399 | Vpeak |
| Maximum transient isolation voltage | $V_{TEST} = V_{IOTM}$; t = 60 s (qualification); $V_{TEST} = 1.2 \times V_{IOTM}$; t = 1 s (100% production) | $V_{IOTM}$ | 7000 | Vpeak |
| Maximum Surge Isolation Voltage | Test method per IEC60065,1.2/50us waveform, $V_{TEST} = 1.3 \times V_{ISOM}$ | $V_{IOSM}$ | 5384 | Vpeak |
| Isolation resistance | $V_{IO}$ =500V | $R_{IO}$ | >$10^{12}$ | Ω |
| Isolation capacitance | f = 1MHz | $C_{IO}$ | 0.6 | pF |
| Total Power Dissipation at 25℃ for SOW20 Package | | $P_S$ | 1459 | mW |
| Safety input, output, or supply current for SOW20 Package | $\theta_{JA}$ = 68.5°C/W, $V_I$ = 5.5 V, $T_J$ = 125 °C, $T_A$ = 25 °C | Is | 265 | mA |
| Total Power Dissipation at 25℃ for SOW16 Package | | $P_S$ | 1639 | mW |
| Safety input, output, or supply current for SOW16 Package | $\theta_{JA}$ = 61°C/W, $V_I$ = 5.5 V, $T_J$ = 125 °C, $T_A$ = 25 °C | $I_S$ | 298 | mA |
| Safety Temperature | | Ts | 125 | ℃ |

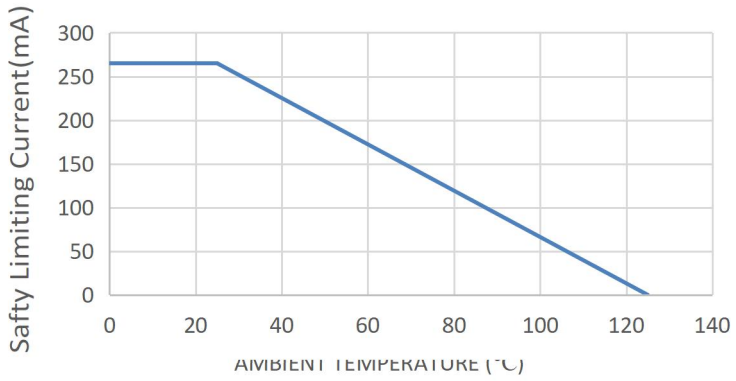



Figure 6.1NSiP83086 Thermal Derating Curve for SOW20 package, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

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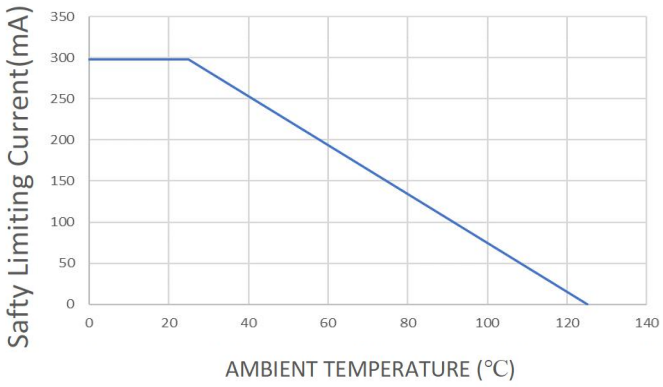



Figure 6.2NSiP83086 Thermal Derating Curve for SOW16 package, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

### 6.3. Regulatory Information

The NSiP83086 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<br>GB4943.1-2022 |
| Single Protection, 5000$V_{RMS}$ Isolation voltage | Single Protection, 5000$V_{RMS}$Isolation voltage | Basic Insulation 1166Vpeak, $V_{IOSM}$=5384$V_{PEAK}$ | Basic insulation |
| File (pending) | File (pending) | File (pending) | File (pending) |

## 7. Function Description

NSiP83086 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 83086 series are safety certified by UL1577 supporting 5k$V_{RMS}$ insulation withstand voltage.

### 7.1. 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.

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## 7.2. Truth Tables

Table 7.1 Driver Function Table

| *$VDD_1$ status* | *Input (D)* | *Enable Input (DE)* | *Outputs Y* | *Z* |
|---|---|---|---|---|
| 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 7.2 Receiver Function Table[1]

| *VDD status* | *Differential Input (VA-VB)* | *Enable Input (/RE)* | *Output (R)* |
|---|---|---|---|
| PU | ≥-10mV | L/Open | H |
| PU | ≤-200mV | L/Open | L |
| PU | Open/Short | L/Open | H |
| PU | X | H | Z |
| 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;

## 7.3. EMI Considerations

NSIP83086 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 see the application note if needed.

## 7.4. Output Short and Over Temperature Protection

The NSiP83086 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 NSiP83086 series also protected against over temperature. When the chip is over 165℃, it will be shut down until the temperature of below 145℃.

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# 8. Application Note

## 8.1. 256 Transceivers on the Bus

The devices have a 1/8-unit-load receiver input impedance (96kΩ) 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.

## 8.2. ESD Protection

ESD protection structures are enhanced on all pins to protect against electrostatic discharge encountered during handing 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:

- ±8kV using the Contact Discharge method specified in IEC 61000-4-2

Other pins except bus pins:

- ±7kV using the Contact Discharge method specified in IEC 61000-4-2

## 8.3. Layout Considerations

The NSiP83086 requires a 10μF+0.1μF bypass capacitor between $VDD_1$ and $GND_1$, 10uF+0.1uF 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(54Ω/120Ω). 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.

## 8.4. Typical Application

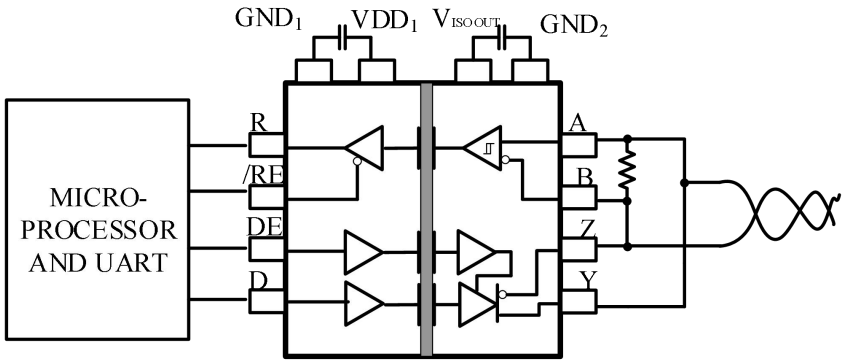



Figure 8.1 NSiP83086 in Half-Duplex RS-485 Mode

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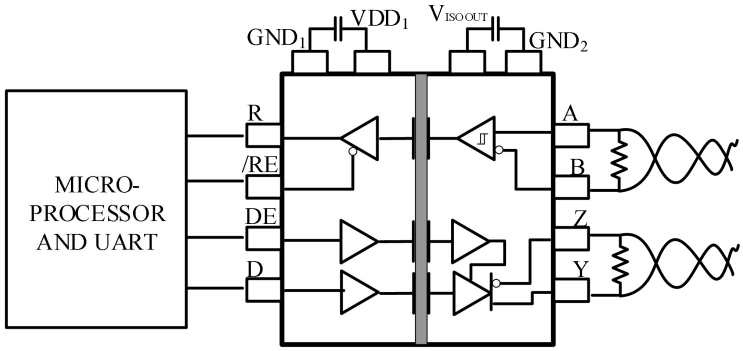



Figure 8.2 NSiP83086 typical application circuit

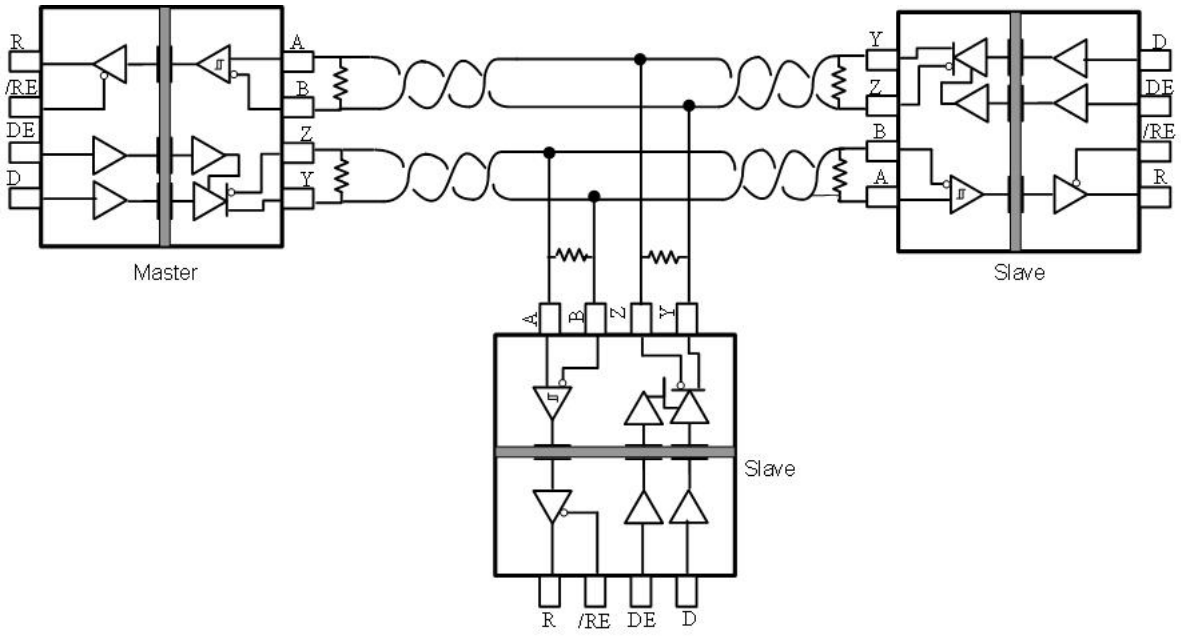
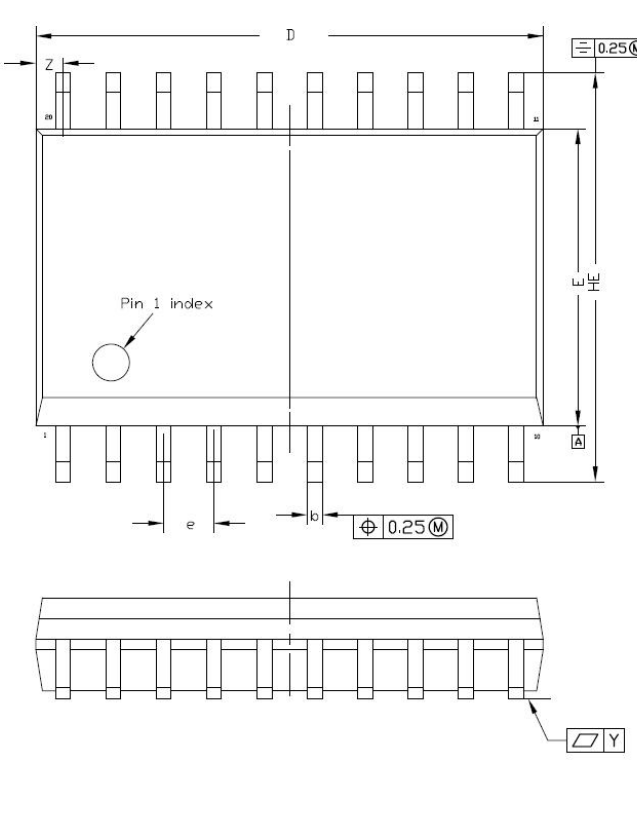



Figure 8.3 Typical isolated Full-Duplex RS-485 application

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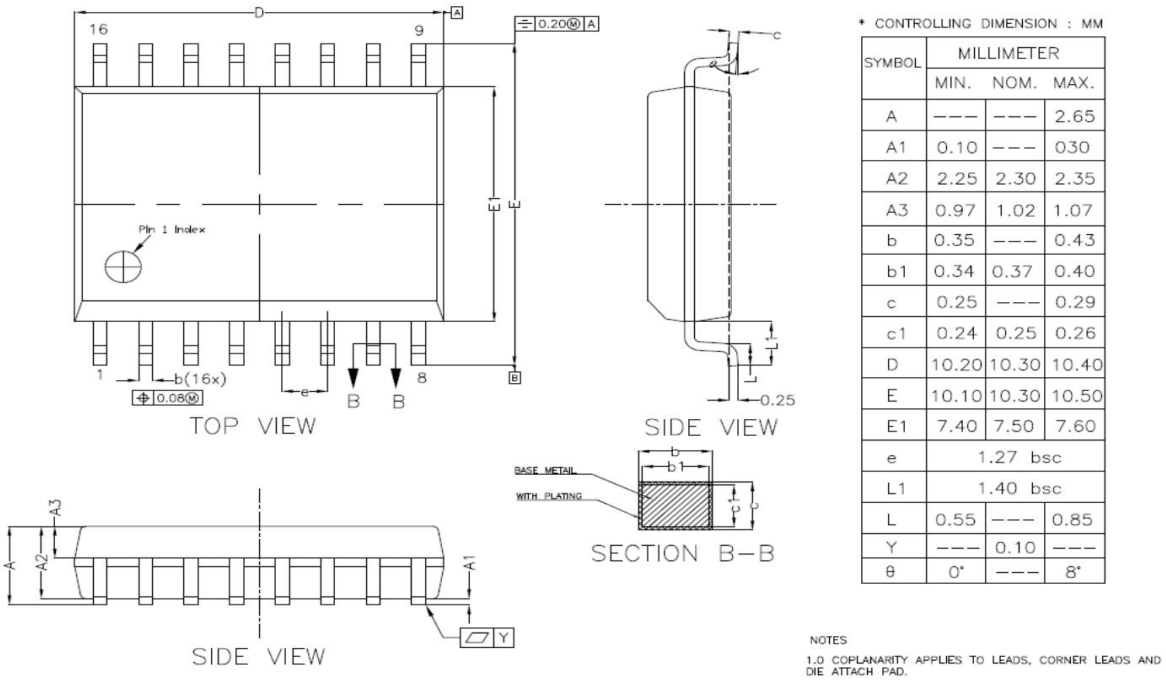
# 9. Package Information




* CONTROLLING DIMENSION : MM

| SYMBOL | MILLIMETER | | | INCH | | |
|---|---|---|---|---|---|---|
| | MIN. | NOM. | MAX. | MIN. | NOM. | MAX. |
| A | --- | --- | 2.65 | --- | --- | 0.100 |
| A1 | 0.10 | --- | 0.30 | 0.004 | --- | 0.012 |
| A2 | 2.25 | --- | 2.45 | 0.089 | --- | 0.096 |
| b | 0.36 | --- | 0.49 | 0.014 | --- | 0.019 |
| c | 0.23 | --- | 0.32 | 0.009 | --- | 0.013 |
| D | 12.6 | --- | 13.0 | 0.49 | --- | 0.51 |
| E | 7.4 | --- | 7.6 | 0.29 | --- | 0.30 |
| HE | 10.00 | --- | 10.65 | 0.394 | --- | 0.419 |
| Q | 1.0 | --- | 1.1 | 0.039 | --- | 0.043 |
| e | 1.27 bsc | | | 0.050 bsc | | |
| L | 1.40 bsc | | | 0.055 bsc | | |
| L1 | 0.40 | --- | 1.10 | 0.016 | --- | 0.043 |
| Y | --- | 0.10 | --- | --- | 0.004 | --- |
| A3 | --- | 0.25 | --- | --- | 0.010 | --- |
| Z | 0.40 | | 0.90 | 0.016 | | 0.035 |
| θ | 0° | --- | 8° | 0° | --- | 8° |

Figure 9.1 SOW20 Package Shape and Dimension in millimeters and inches




* CONTROLLING DIMENSION : MM

| 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° |

NOTES
1.0 COPLANARITY APPLIES TO LEADS, CORNER LEADS AND DIE ATTACH PAD.

Figure 9.2 SOW16 Package Shape and Dimension in millimeters

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## 10. Ordering Information

| Part Number | Isolation Rating ($kV_{RMS}$) | $V_{ISOOUT}$ | Duplex | Max Data Rate (Mbps) | MSL | Temperature | No. of Nodes | Package Type | Package Drawing | SPQ |
|---|---|---|---|---|---|---|---|---|---|---|
| NSiP83086-DSWTR | 5 | 5V | Full | 16 | 3 | -40 to 105℃ | 256 | SOP20(300mil) | SOW20 | 1000 |
| NSiP83086C-DSWTR | 5 | 5/3.3V | Full | 16 | 3 | -40 to 105℃ | 256 | SOP20(300mil) | SOW20 | 1000 |
| NSiP83086V-DSWTR | 5 | 3.3V | Full | 16 | 3 | -40 to 105℃ | 256 | SOP20(300mil) | SOW20 | 1000 |
| NSiP83086-DSWR | 5 | 5V | Full | 16 | 3 | -40 to 105℃ | 256 | SOP16(300mil) | SOW16 | 1000 |
| NSiP83086V-DSWR | 5 | 3.3V | Full | 16 | 3 | -40 to 105℃ | 256 | SOP16(300mil) | SOW16 | 1000 |
| | NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260 °C according to the JEDEC industry standard classifications and peak solder temperatures. | | | | | | | | | |

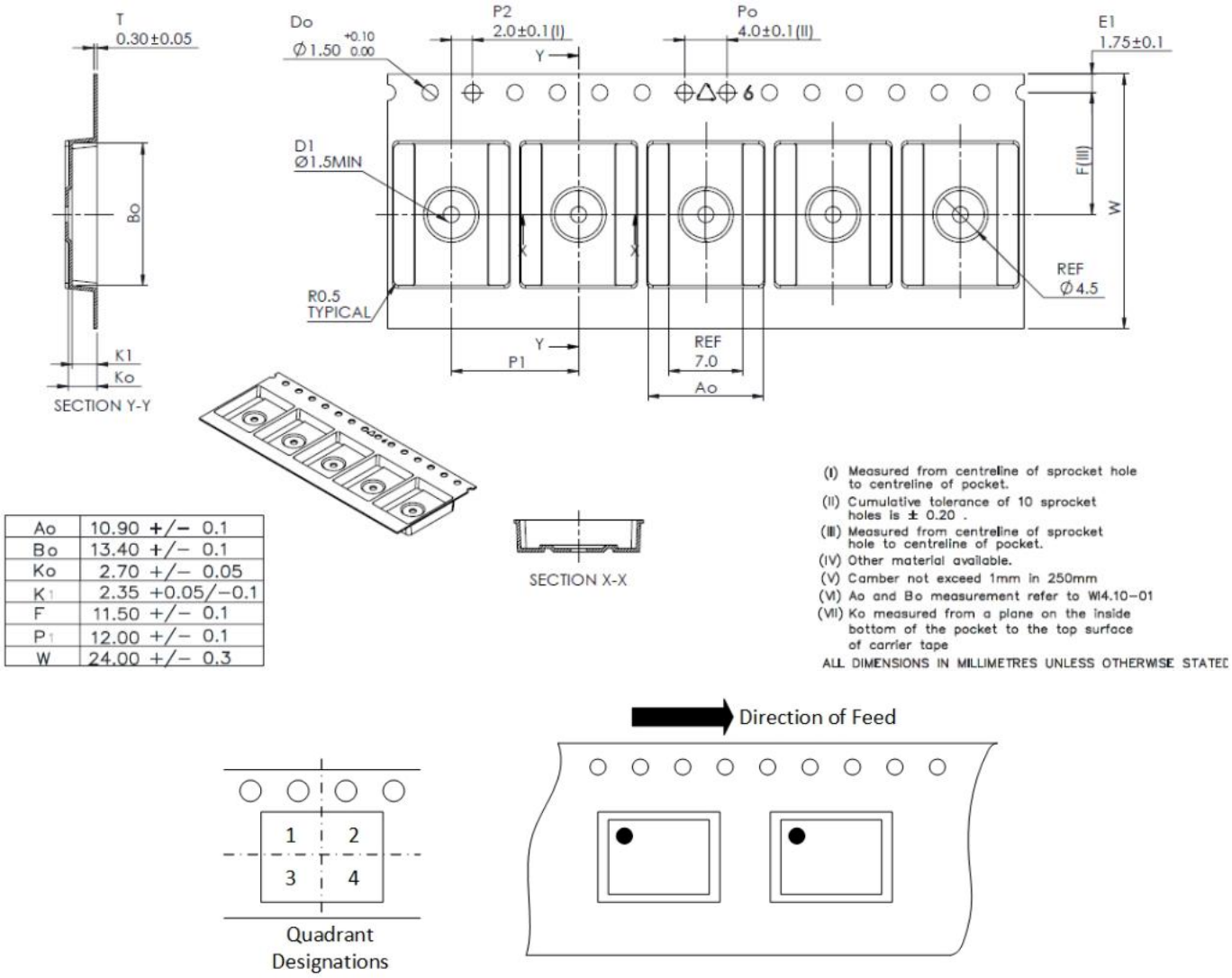
## 11. Documentation Support

| Part Number | Product Folder | Datasheet | Application Note |
|---|---|---|---|
| NSiP83086 | tbd | tbd | tbd |

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## 12. Tape And Reel Information

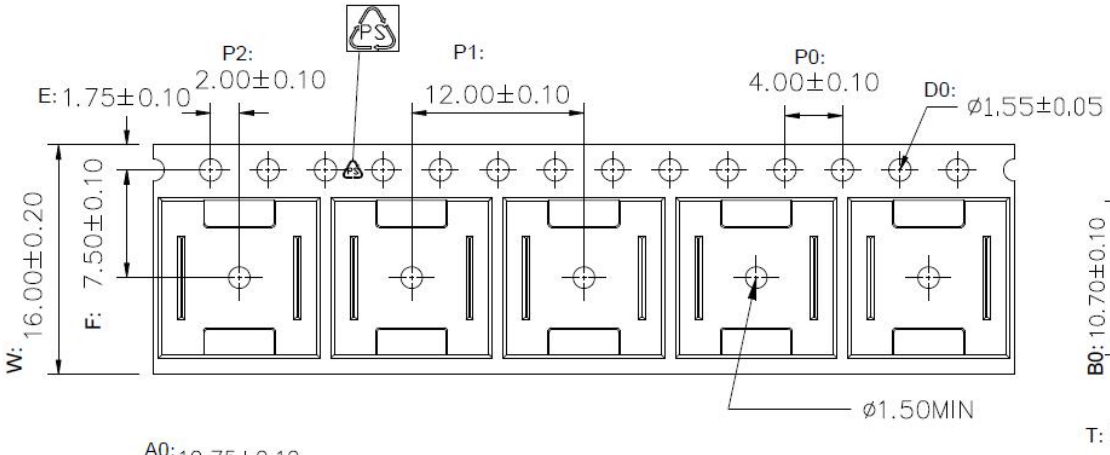


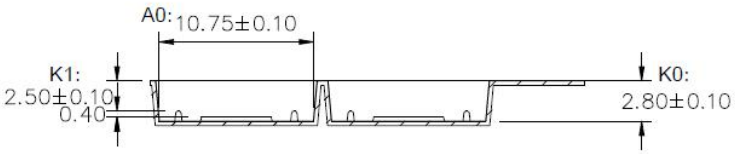

| | |
|---|---|
| Ao | 10.90 +/− 0.1 |
| Bo | 13.40 +/− 0.1 |
| Ko | 2.70 +/− 0.05 |
| K1 | 2.35 +0.05/−0.1 |
| F | 11.50 +/− 0.1 |
| P1 | 12.00 +/− 0.1 |
| W | 24.00 +/− 0.3 |

Figure 12.1 Tape and Reel Information of SOW20

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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±0.05mm.
6. Packing length per 22" reel : 378 Meters.(復卷 N=122）
7. Component load per 13" reel : 1000 pcs.
8. Surface resistivity :$10^{5}$ ~ $10^{10}\Omega/\square$

RoHS

| | |
|---|---|
| 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 |

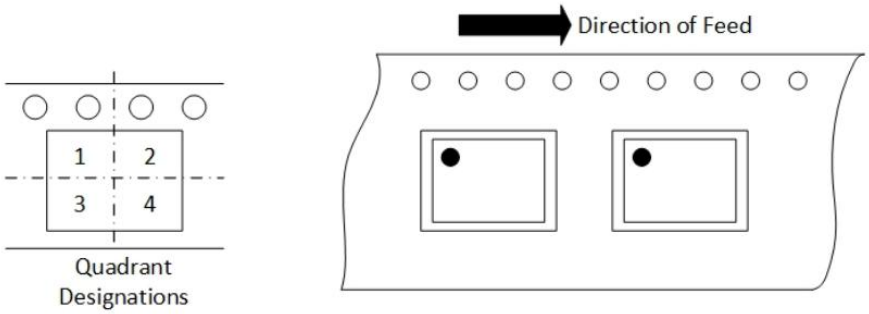



Figure 12.2 Tape and Reel Information of SOW16

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# 13. Revision History

| Revision | Description | Date |
|---|---|---|
| 1.0 | Initial Version | 2022/11/30 |

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