

# High Speed Dual-Channel, Bi-Directional Ceramic Digital Isolator

## NCID9211

### Description

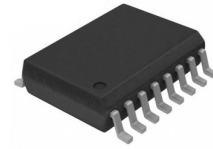
The NCID9211 is a galvanically isolated full duplex, bi-directional, high-speed dual-channel digital isolator with output enable. This device supports isolated communications thereby allowing digital signals to communicate between systems without conducting ground loops or hazardous voltages.

It utilizes onsemi's patented galvanic off-chip capacitor isolation technology and optimized IC design to achieve high insulation and high noise immunity, characterized by high common mode rejection and power supply rejection specifications. The thick ceramic substrate yields capacitors with ~25 times the thickness of thin film on-chip capacitors and coreless transformers. The result is a combination of the electrical performance benefits that digital isolators offer with the safety reliability of a >0.5 mm insulator barrier similar to what has historically been offered by optocouplers.

The device is housed in a 16-pin wide body small outline package.

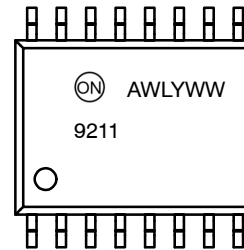
### Features

- Off-Chip Capacitive Isolation to Achieve Reliable High Voltage Insulation
  - ◆ DTI (Distance Through Insulation):  $\geq 0.5$  mm
  - ◆ Maximum Working Insulation Voltage: 2000 V<sub>peak</sub>
- Full Duplex, Bi-directional Communication
- 100 KV/ $\mu$ s Minimum Common Mode Rejection
- High Speed:
  - ◆ 50 Mbit/s Data Rate (NRZ)
  - ◆ 25 ns Maximum Propagation Delay
  - ◆ 10 ns Maximum Pulse Width Distortion
- 8 mm Creepage and Clearance Distance to Achieve Reliable High Voltage Insulation.
- Specifications Guaranteed Over 2.5 V to 5.5 V Supply Voltage and -40°C to 125°C Extended Temperature Range
- Over Temperature Detection
- Output Enable Function (Primary and Secondary Side)
- NCIV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable (Pending)
- Safety and Regulatory Approvals
  - ◆ UL1577, 5000 V<sub>RMS</sub> for 1 Minute
  - ◆ DIN EN/IEC 60747-17 (Pending)



SOIC16 W  
CASE 751EN

### MARKING DIAGRAM



A = Assembly Location  
 WL = Wafer Lot / Assembly Lot  
 Y = Year  
 WW = Work Week  
 9211 = Specific Device Code

### ORDERING INFORMATION

See detailed ordering and shipping information on page 10 of this data sheet.

### Typical Applications

- Isolated PWM Control
- Industrial Fieldbus Communications
- Microprocessor System Interface (SPI, I<sup>2</sup>C, etc.)
- Programmable Logic Control
- Isolated Data Acquisition System
- Voltage Level Translator

## PIN CONFIGURATION

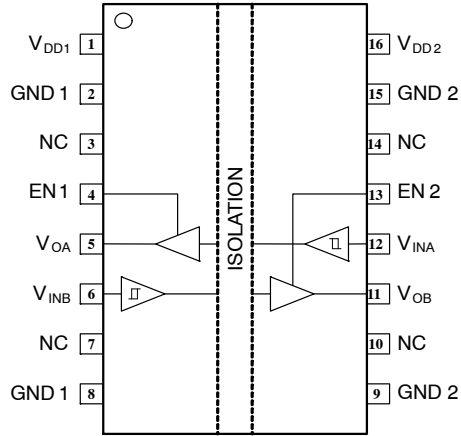


Figure 1. Pin and Channel Configuration

## BLOCK DIAGRAM

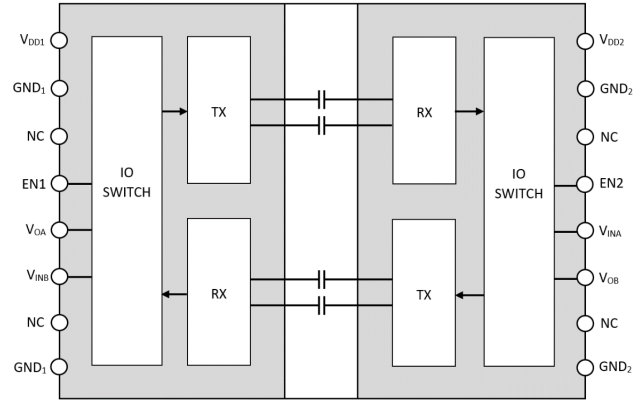


Figure 2. Functional Block Diagram

## PIN DEFINITIONS

Pin No.	Name	Description
1	V <sub>DD1</sub>	Power Supply, Primary Side
2	GND1	Ground, Primary Side
3	NC	No Connect
4	EN1	Enable, Primary Side
5	V <sub>OA</sub>	Output, Channel A
6	V <sub>INB</sub>	Input, Channel B
7	NC	No Connect
8	GND1	Ground, Primary Side
9	GND2	Ground, Secondary Side
10	NC	No Connect
11	V <sub>OB</sub>	Output, Channel B
12	V <sub>INA</sub>	Input, Channel A
13	EN2	Enable, Secondary Side
14	NC	No Connect
15	GND2	Ground, Secondary Side
16	V <sub>DD2</sub>	Power Supply, Secondary Side

## TRUTH TABLE (Note 1)

V <sub>INX</sub>	EN <sub>X</sub>	V <sub>DD1</sub>	V <sub>DDO</sub>	V <sub>OX</sub>	Comment
H	H / NC	Power Up	Power Up	H	Normal Operation
L	H / NC	Power Up	Power Up	L	Normal Operation
NC	H / NC	Power Up	Power Up	L	Default Low
X	L	Power Up	Power Up	Hi-Z	
X	H / NC	Power Down	Power Up	L	Default low; V <sub>OX</sub> return to normal operation when V <sub>DD1</sub> change to Power Up
X	H / NC	Power Up	Power Down	Undetermined (Note 2)	V <sub>OX</sub> return to normal operation when V <sub>DDO</sub> change to Power Up

- V<sub>INX</sub> = Input signal of a given channel (A or B). EN<sub>X</sub> = Enable pin for primary or secondary side (1 or 2). V<sub>OX</sub> = Output signal of a given channel (A or B). V<sub>DD1</sub> = Input-side V<sub>DD</sub>. V<sub>DDO</sub> = Output-side V<sub>DD</sub>. X = Irrelevant. H = High level. L = Low level. NC = No Connection.
- The outputs are in undetermined state when V<sub>DDO</sub> < V<sub>UVLO</sub>.

# SAFETY AND INSULATION RATINGS

As per DIN EN/IEC 60747-17, this digital isolator is suitable for “safe electrical insulation” only within the safety limit data. Compliance with the safety ratings must be ensured by means of protective circuits.

Symbol	Parameter	Min	Typ	Max	Unit
	Installation Classifications per DIN VDE 0110/1.89 Table 1 Rated Mains Voltage	< 150 V <sub>RMS</sub>	I-IV		
		< 300 V <sub>RMS</sub>	I-IV		
		< 450 V <sub>RMS</sub>	I-IV		
		< 600 V <sub>RMS</sub>	I-IV		
		< 1000 V <sub>RMS</sub>	I-III		
	Climatic Classification		40/125/21		
	Pollution Degree (DIN VDE 0110/1.89)		2		
CTI	Comparative Tracking Index (DIN IEC 112/VDE 0303 Part 1)	600			
V <sub>PR</sub>	Input-to-Output Test Voltage, Method b, V <sub>IORM</sub> × 1.875 = V <sub>PR</sub> , 100% Production Test with t <sub>m</sub> = 1 s, Partial Discharge < 5 pC	3750			V <sub>peak</sub>
	Input-to-Output Test Voltage, Method a, V <sub>IORM</sub> × 1.6 = V <sub>PR</sub> , Type and Sample Test with t <sub>m</sub> = 10 s, Partial Discharge < 5 pC	3200			V <sub>peak</sub>
V <sub>IORM</sub>	Maximum Working Insulation Voltage	2000			V <sub>peak</sub>
V <sub>IOTM</sub>	Highest Allowable Over Voltage	8000			V <sub>peak</sub>
	External Creepage	8.0			mm
	External Clearance	8.0			mm
	Insulation Thickness	0.50			mm
T <sub>Case</sub>	Safety Limit Values – Maximum Values in Failure; Case Temperature	150			°C
P <sub>S,INPUT</sub>	Safety Limit Values – Maximum Values in Failure; Input Power	350			mW
P <sub>S,OUTPUT</sub>	Safety Limit Values – Maximum Values in Failure; Output Power	350			mW
R <sub>IO</sub>	Insulation Resistance at TS, V <sub>IO</sub> = 500 V	10 <sup>9</sup>			Ω

# ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise specified)

Symbol	Parameter	Value	Unit
T <sub>STG</sub>	Storage Temperature	–55 to +150	°C
T <sub>OPR</sub>	Operating Temperature	–40 to +125	°C
T <sub>J</sub>	Junction Temperature	–40 to +150	°C
T <sub>SOL</sub>	Lead Solder Temperature (Refer to Reflow Temperature Profile)	260 for 10sec	°C
V <sub>DD</sub>	Supply Voltage (V <sub>DDx</sub> )	–0.5 to 6	V
V	Voltage (V <sub>INx</sub> , V <sub>OX</sub> , ENx)	–0.5 to 6	V
I <sub>O</sub>	Average Output Current	15	mA
PD	Power Dissipation	210	mW

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min.	Max.	Unit
$T_A$	Ambient Operating Temperature	-40	+125	°C
$V_{DD1} V_{DD2}$	Supply Voltage (Notes 3, 4)	2.5	5.5	V
$V_{INH}$	High Level Input Voltage	$0.7 \times V_{DDI}$	$V_{DDI}$	V
$V_{INL}$	Low Level Input Voltage	0	$0.1 \times V_{DDI}$	V
$V_{UVLO+}$	Supply Voltage UVLO Rising Threshold	2.2		V
$V_{UVLO-}$	Supply Voltage UVLO Falling Threshold	2.0		V
$UVLO_{HYS}$	Supply Voltage UVLO Hysteresis	0.1		V
$I_{OH}$	High Level Output Current	-2	-	mA
$I_{OL}$	Low Level Output Current	-	2	mA
DR	Signaling Rate	0	50	Mbps

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

- During power up or down, ensure that both the input and output supply voltages reach the proper recommended operating voltages to avoid any momentary instability at the output state.
- For reliable operation at recommended operating conditions,  $V_{DD}$  supply pins require at least a pair of external bypass capacitors, placed within 2 mm from  $V_{DD}$  pins 1 and 16 and GND pins 2 and 15. Recommended values are 0.1  $\mu$ F and 1  $\mu$ F.

## ISOLATION CHARACTERISTICS

Apply over all recommended conditions. All typical values are measured at  $T_A = 25^\circ\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
$V_{ISO}$	Input-Output Isolation Voltage	$T_A = 25^\circ\text{C}$ , Relative Humidity < 50%, $t = 1.0$ minute, $I_{I-O} \leq 10 \mu\text{A}$ , 50 Hz (Notes 5, 6, 7)	5000			$V_{RMS}$
$R_{ISO}$	Isolation Resistance	$V_{I-O} = 500$ V (Note 5)		$10^{11}$		
$C_{ISO}$	Isolation Capacitance	$V_{I-O} = 0$ V, Frequency = 1.0 MHz (Note 5)		1		pF

- Device is considered a two-terminal device: pins 1 to 8 are shorted together and pins 9 to 16 are shorted together.
- 5,000  $V_{RMS}$  for 1-minute duration is equivalent to 6,000  $V_{RMS}$  for 1-second duration.
- The input-output isolation voltage is a dielectric voltage rating per UL1577. It should not be regarded as an input-output continuous voltage rating. For the continuous working voltage rating, refer to equipment-level safety specification or DIN EN/IEC 60747-17 Safety and Insulation Ratings Table on page 3.

## ELECTROSTATIC DISCHARGE RATINGS

Symbol	Parameter	Conditions	Ratings	Units
HBM	Human Body Model	JS-001-2017; AEC-Q100-002-Rev E (Note 9)	$\pm 3000$	V
CDM	Charged Device Model	JS-002-2018; AEC-Q100-011-Rev D (Note 10)	$\pm 1000$	
ESDI	Contact Discharge	IEC 61000-4-2 Insulation Barrier Withstand Test (Note 8)	$\pm 8000$	
	Air Discharge		$\pm 15000$	

- Device is considered a two-terminal device: pins 1 to 8 are shorted together and pins 9 to 16 are shorted together.
- ESD Human Body Model for NCID9211 tested per JEDEC JS-001-2017 standard; NCIV9211 tested per AEC-Q100-002-Rev E standard.
- ESD Charged Device Model for NCID9211 tested per JEDEC JS-002-2018 standard; NCIV9211 tested per AEC-Q100-011-Rev D standard.

# ELECTRICAL CHARACTERISTICS

Apply over all recommended conditions,  $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{DD1} = V_{DD2} = 2.5\text{ V}$  to  $5.5\text{ V}$ , unless otherwise specified. All typical values are measured at  $T_A = 25^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
$V_{OH}$	High Level Output Voltage	$I_{OH} = -4\text{ mA}$	$V_{DDO} - 0.4$	$V_{DDO} - 0.1$		V	7
$V_{OL}$	Low Level Output Voltage	$I_{OL} = 4\text{ mA}$		0.11	0.4	V	8
$V_{INT+}$	Rising Input Voltage Threshold				$0.7 \times V_{DDI}$	V	
$V_{INT-}$	Falling Input Voltage Threshold		$0.1 \times V_{DDI}$			V	
$V_{INT(HYS)}$	Input Threshold Voltage Hysteresis		$0.1 \times V_{DDI}$	$0.2 \times V_{DDI}$		V	
$I_{INH}$	High Level Input Current	$V_{IH} = V_{DDI}$			1	$\mu\text{A}$	
$I_{INL}$	Low Level Input Current	$V_{IL} = 0\text{ V}$	-1			$\mu\text{A}$	
CMTI	Common Mode Transient Immunity	$V_I = V_{DDI}$ or $0\text{ V}$ , $V_{CM} = 1500\text{ V}$	100	150		kV/ $\mu\text{s}$	12
$C_{IN}$	Input Capacitance	$V_{IN} = V_{DDI}/2 + 0.4 \times \sin(2\pi ft)$ , $f = 1\text{ MHz}$ , $V_{DD} = 5\text{ V}$		2		pF	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# SUPPLY CURRENT CHARACTERISTICS

Apply over all recommended conditions,  $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  unless otherwise specified. All typical values are measured at  $T_A = 25^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
I <sub>DD1</sub>	DC Supply Current Input Low	V <sub>DD</sub> = 5 V, EN = 0 V / 5 V, V <sub>IN</sub> = 0 V		4.5	6.3	mA	
I <sub>DD2</sub>				5.0			
I <sub>DD1</sub>		V <sub>DD</sub> = 3.3 V, EN = 0 V / 3.3 V, V <sub>IN</sub> = 0 V		4.4	6.1		
I <sub>DD2</sub>				4.9			
I <sub>DD1</sub>		V <sub>DD</sub> = 2.5 V, EN = 0 V / 2.5 V, V <sub>IN</sub> = 0 V		4.3	6		
I <sub>DD2</sub>				4.8			
I <sub>DD1</sub>	DC Supply Current Input High	V <sub>DD</sub> = 5 V, EN = 0 V / 5 V, V <sub>IN</sub> = 5 V		11.8	14.5	mA	
I <sub>DD2</sub>				12.1			
I <sub>DD1</sub>		V <sub>DD</sub> = 3.3 V, EN = 0 V / 3.3 V, V <sub>IN</sub> = 3.3 V		11.7	14.3		
I <sub>DD2</sub>				11.9			
I <sub>DD1</sub>		V <sub>DD</sub> = 2.5 V, EN = 0 V / 2.5 V, V <sub>IN</sub> = 2.5 V		11.6	14.3		
I <sub>DD2</sub>				11.8			
I <sub>DD1</sub>	AC Supply Current 1 Mbps	V <sub>DD</sub> = 5 V, EN = 5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 5 V Square Wave		8.3	10.5	mA	3,4
I <sub>DD2</sub>				8.7			
I <sub>DD1</sub>		V <sub>DD</sub> = 3.3 V, EN = 3.3 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 3.3 V Square Wave		8.1	10.3		
I <sub>DD2</sub>				8.5			
I <sub>DD1</sub>		V <sub>DD</sub> = 2.5 V, EN = 2.5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 2.5 V Square Wave		8.0	10.1		
I <sub>DD2</sub>				8.4			
I <sub>DD1</sub>	AC Supply Current 10 Mbps	V <sub>DD</sub> = 5 V, EN = 5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 5 V Square Wave		9.9	12	mA	
I <sub>DD2</sub>				10.2			
I <sub>DD1</sub>		V <sub>DD</sub> = 3.3 V, EN = 3.3 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 3.3 V Square Wave		8.9	11		
I <sub>DD2</sub>				9.3			
I <sub>DD1</sub>		V <sub>DD</sub> = 2.5 V, EN = 2.5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 2.5 V Square Wave		8.6	10.5		
I <sub>DD2</sub>				9.0			
I <sub>DD1</sub>	AC Supply Current 50 Mbps	V <sub>DD</sub> = 5 V, EN = 5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 5 V Square Wave		14.8	17.5	mA	
I <sub>DD2</sub>				15.2			
I <sub>DD1</sub>		V <sub>DD</sub> = 3.3 V, EN = 3.3 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 3.3 V Square Wave		12.1	14.3		
I <sub>DD2</sub>				12.6			
I <sub>DD1</sub>		V <sub>DD</sub> = 2.5 V, EN = 2.5 V, C <sub>L</sub> = 15 pF V <sub>IN</sub> = 2.5 V Square Wave		11.1	13		
I <sub>DD2</sub>				11.6			

# SWITCHING CHARACTERISTICS

Apply over all recommended conditions,  $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  unless otherwise specified. All typical values are measured at  $T_A = 25^{\circ}\text{C}$ .

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
$t_{\text{PHL}}$	Propagation Delay to Logic Low Output (Note 8)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		17.0	25	ns	6,9
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		18.3			
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		20.0			
$t_{\text{PLH}}$	Propagation Delay to Logic High Output (Note 9)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		13.0	25	ns	
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		14.5			
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		16.0			
PWD	Pulse Width Distortion $ t_{\text{PHL}} - t_{\text{PLH}} $ (Note 10)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		3.6	10	ns	
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		3.8			
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		3.8			
$t_{\text{PSK(PP)}}$	Propagation Delay Skew (Part to Part) (Note 11)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$	-10		10	ns	
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$					
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$					
$t_{\text{R}}$	Output Rise Time (10% to 90%)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		1.1		ns	
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		1.5			
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		2.2			
$t_{\text{F}}$	Output Fall Time (90% to 10%)	$V_{\text{DD}} = \text{EN} = 5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		1.1		ns	
		$V_{\text{DD}} = \text{EN} = 3.3\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		1.4			
		$V_{\text{DD}} = \text{EN} = 2.5\text{ V}$ , $V_{\text{IN}}$ Square Wave, $C_L = 15\text{ pF}$		3.0			
$t_{\text{PZL}}$	High Impedance to Logic Low Output Delay (Note 12)	$V_{\text{DD}} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$		8.1	25	ns	10
		$V_{\text{DD}} = 3.3\text{ V}$ , $R_L = 1\text{ k}\Omega$		9.7			
		$V_{\text{DD}} = 2.5\text{ V}$ , $R_L = 1\text{ k}\Omega$		12.0			
$t_{\text{PLZ}}$	Logic Low to High Impedance Output Delay (Note 13)	$V_{\text{DD}} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$		10.4	25	ns	
		$V_{\text{DD}} = 3.3\text{ V}$ , $R_L = 1\text{ k}\Omega$		12.2			
		$V_{\text{DD}} = 2.5\text{ V}$ , $R_L = 1\text{ k}\Omega$		16.5			
$t_{\text{PZH}}$	High Impedance to Logic High Output Delay (Note 14)	$V_{\text{DD}} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$		0.54	1	$\mu\text{s}$	11
		$V_{\text{DD}} = 3.3\text{ V}$ , $R_L = 1\text{ k}\Omega$		0.51			
		$V_{\text{DD}} = 2.5\text{ V}$ , $R_L = 1\text{ k}\Omega$		0.50			
$t_{\text{PHZ}}$	Logic High to High Impedance Output Delay (Note 15)	$V_{\text{DD}} = 5\text{ V}$ , $R_L = 1\text{ k}\Omega$		11.0	25	ns	
		$V_{\text{DD}} = 3.3\text{ V}$ , $R_L = 1\text{ k}\Omega$		12.3			
		$V_{\text{DD}} = 2.5\text{ V}$ , $R_L = 1\text{ k}\Omega$		14.0			

11. Propagation delay  $t_{\text{PHL}}$  is measured from the 50% level of the falling edge of the input pulse to the 50% level of the falling edge of the  $V_O$  signal.

12. Propagation delay  $t_{\text{PLH}}$  is measured from the 50% level of the rising edge of the input pulse to the 50% level of the rising edge of the  $V_O$  signal.

13. PWD is defined as  $|t_{\text{PHL}} - t_{\text{PLH}}|$  for any given device.

14. Part-to-part propagation delay skew is the difference between the measured propagation delay times of a specified channel of any two parts at identical operating conditions and equal load.

15. Enable delay  $t_{\text{PZL}}$  is measured from the 50% level of the rising edge of the EN pulse to the 50% of the falling edge of the  $V_O$  signal as it switches from high impedance state to low state.

16. Disable delay  $t_{\text{PLZ}}$  is measured from the 50% level of the falling edge of the EN pulse to 0.5 V level of the rising edge of the  $V_O$  signal as it switches from low state to high impedance state.

17. Enable delay  $t_{\text{PZH}}$  is measured from the 50% level of the rising edge of the EN pulse to the 50% of the rising edge of the  $V_O$  signal as it switches from high impedance state to high state.

18. Disable delay  $t_{\text{PHZ}}$  is measured from the 50% level of the falling edge of the EN pulse to  $V_{\text{OH}} - 0.5\text{ V}$  level of the falling edge of the  $V_O$  signal as it switches from high state to high impedance state.

TYPICAL PERFORMANCE CHARACTERISTICS

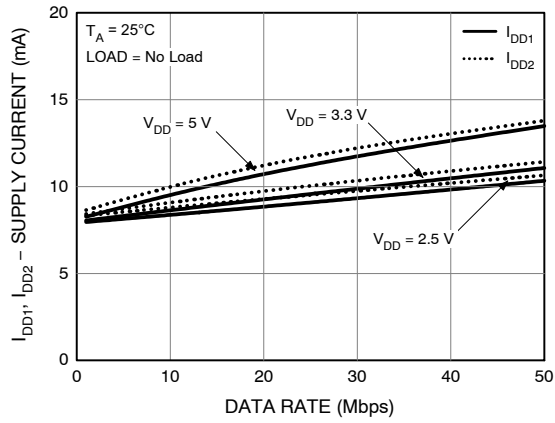


Figure 3. Supply Current vs. Data Rate (No Load)

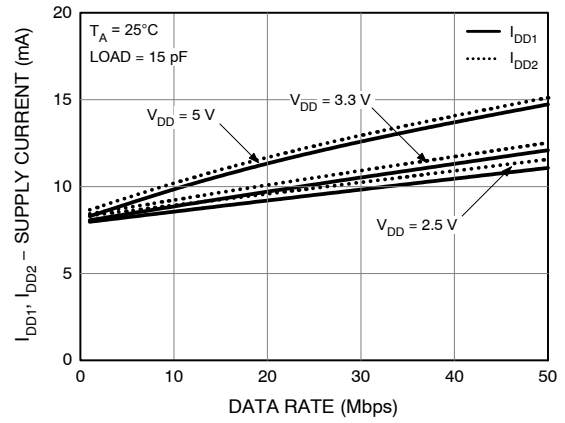


Figure 4. Supply Current vs. Data Rate (Load = 15 pF)

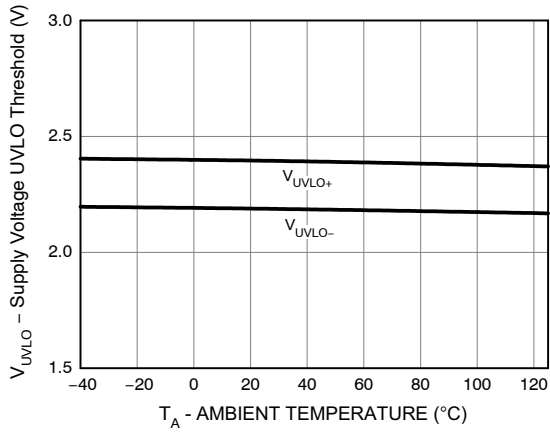


Figure 5. Supply Voltage UVLO Threshold vs. Ambient Temperature

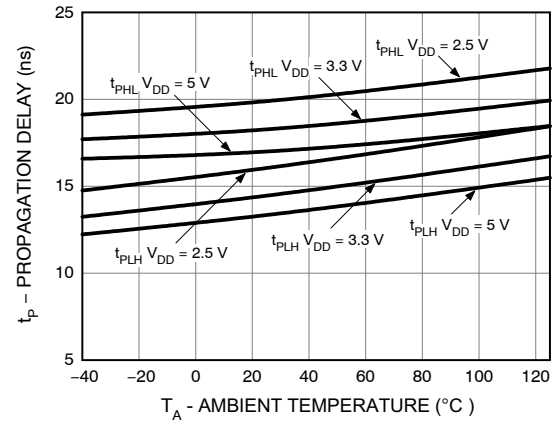


Figure 6. Propagation Delay vs. Ambient Temperature

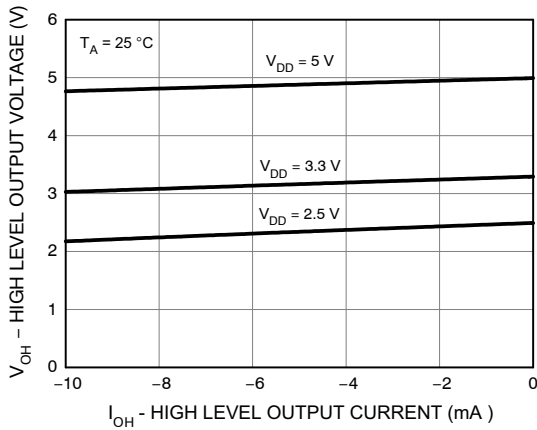


Figure 7. High Level Output Voltage vs. Current

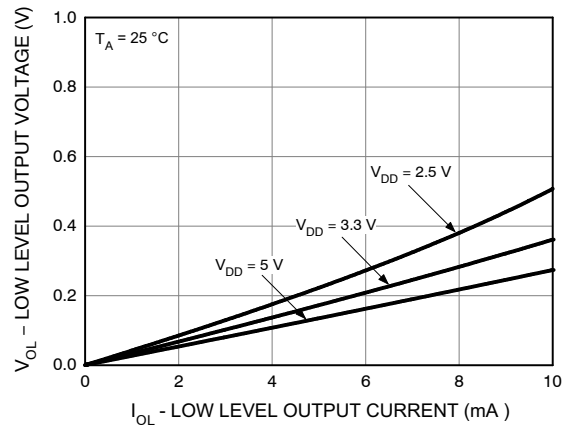


Figure 8. Low Level Output Voltage vs. Current

TEST CIRCUITS

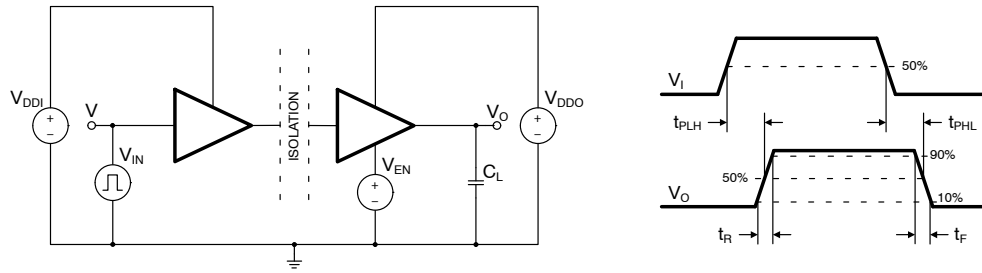


Figure 9.  $V_{IN}$  to  $V_O$  Propagation Delay Test Circuit and Waveform

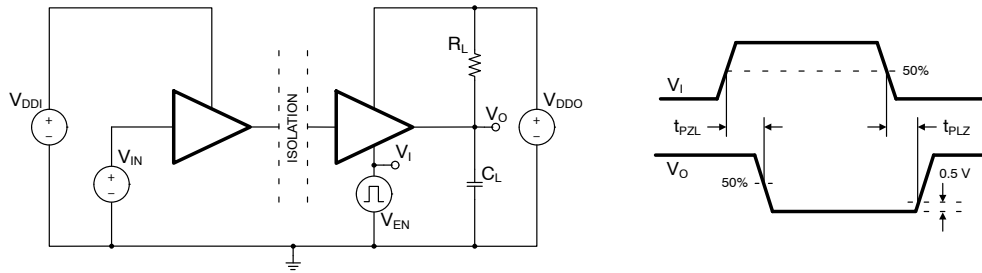


Figure 10. EN to Logic Low  $V_O$  Propagation Delay Test Circuit and Waveform

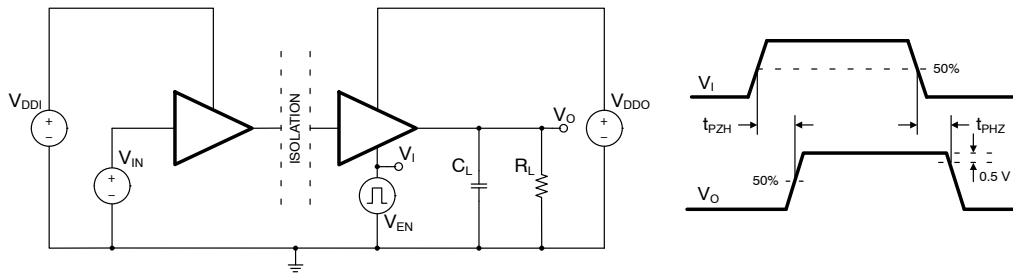


Figure 11. EN to Logic High  $V_O$  Propagation Delay Test Circuit and Waveform

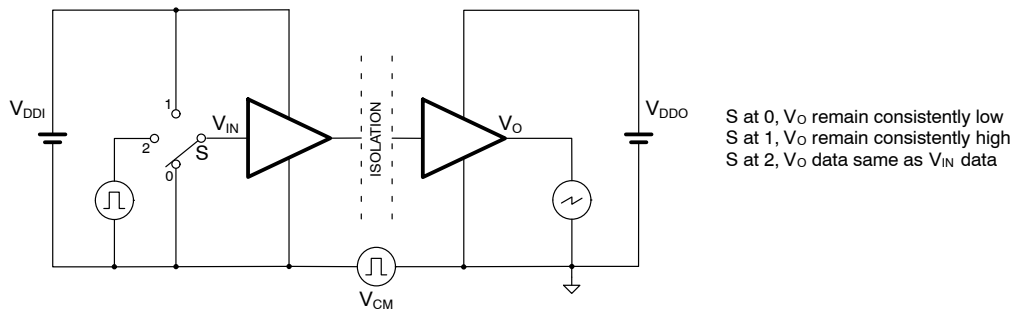


Figure 12. Common Mode Transient Immunity Test Circuit

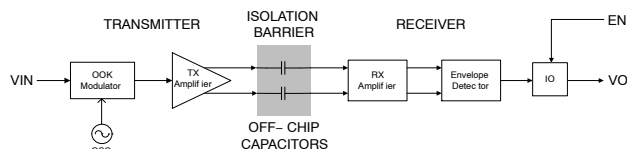


## APPLICATIONS INFORMATION

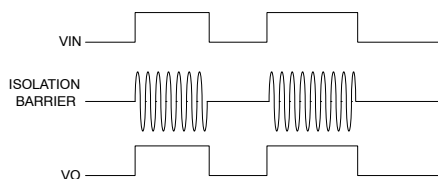
### Theory of Operation

NCID9211 is a dual-channel digital isolator that enables bi-directional communication between two isolated circuits. It uses off-chip ceramic capacitors that serve both as the isolation barrier and as the medium of transmission for signal switching using on-off keying (OOK) technique, illustrated in the single channel operational block diagram in Figure 13.

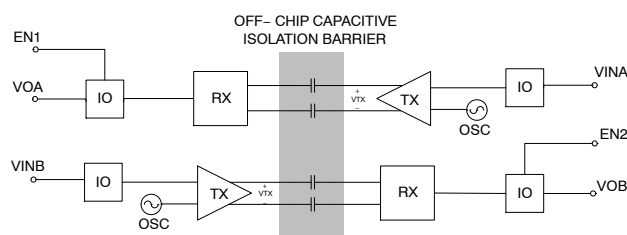
At the transmitter side, the  $V_{IN}$  input logic state is modulated with a high frequency carrier signal. The resulting signal is amplified and transmitted to the isolation barrier. The receiver side detects the barrier signal and demodulates it using an envelope detection technique. The output signal determines the  $V_O$  output logic state when the output enable control EN is at high. When EN is at low, output  $V_O$  is at high impedance state.  $V_O$  is at default state low when the power supply at the transmitter side is turned off or the input  $V_{IN}$  is disconnected.



**Figure 13. Operational Block Diagram of Single Channel**



**Figure 14. On-Off Keying Modulation Signals**



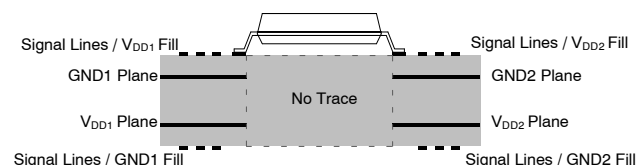
**Figure 15. NCID9211 Operational Block Diagram**

### Layout Recommendation

Layout of the digital circuits relies on good suppression of unwanted noise and electromagnetic interference. It is recommended to use 4-layer FR4 PCB, with ground plane

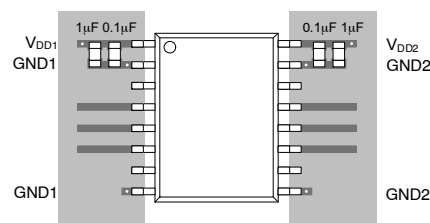
below the components, power plane below the ground plane, signal lines and power fill on top, and signal lines and ground fill at the bottom. The alternating polarities of the layers creates interplane capacitances that aids the bypass capacitors required for reliable operation at digital switching rates.

In the layout with digital isolators, it is required that the isolated circuits have separate ground and power planes. The section below the device should be clear with no power, ground or signal traces. Maintain a gap equal to or greater than the specified minimum creepage clearance of the device package.



**Figure 16. 4-Layer PCB for Digital Isolator**

For NCID9211, it is highly advised to connect at least a pair of low ESR supply bypass capacitors, placed within 2mm from the power supply pins 1 and 16 and ground pins 2 and 15. Recommended values are 1  $\mu$ F and 0.1  $\mu$ F, respectively. Place them between the  $V_{DD}$  pins of the device and the via to the power planes, with the higher frequency, lower value capacitor closer to the device pins. Directly connect the device ground pins 1, 8, 9 and 15 by via to their corresponding ground planes.



**Figure 17. Placement of Bypass Capacitors**

### Over Temperature Detection

NCID9211 has a built-in Over Temperature Detection (OTD) feature that protects the IC from thermal damage. The output pins will automatically switch to default state when the ambient temperature exceeds the maximum junction temperature at threshold of approximately 160°C. The device will return to normal operation when the temperature decreases approximately 20°C below the OTD threshold.

## NCID9211

### ORDERING INFORMATION

Part Number	Grade	Package	Shipping <sup>†</sup>
NCID9211	Industrial	SOIC16 W	50 Units / Tube
NCID9211R2	Industrial	SOIC16 W	750 Units / Tape & Reel
NCIV9211* (pending)	Automotive	SOIC16 W	50 Units / Tube
NCIV9211R2* (pending)	Automotive	SOIC16 W	750 Units / Tape & Reel

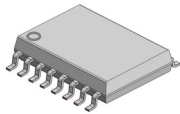
<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

\*NCIV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

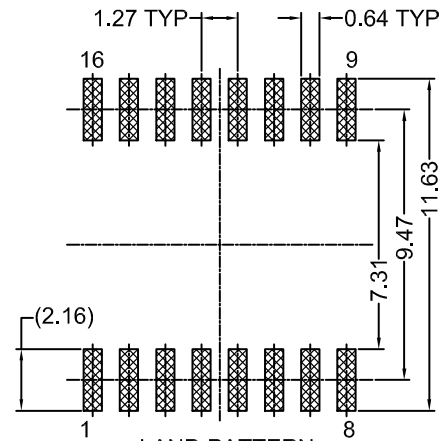
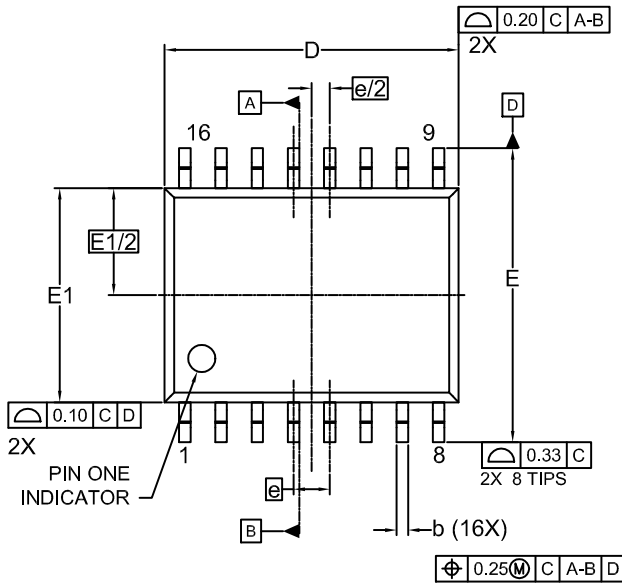
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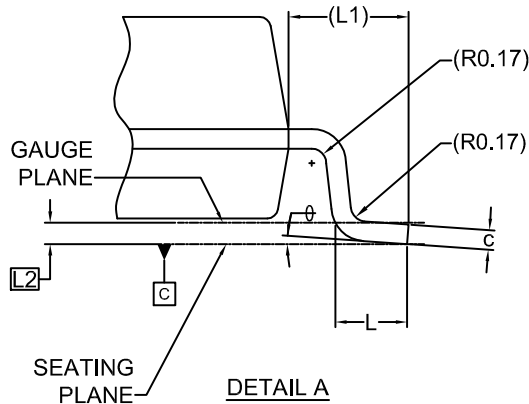
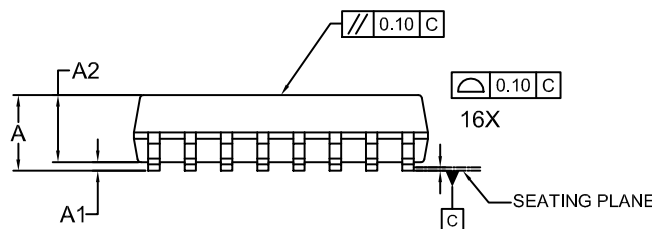
## SOIC16 W CASE 751EN ISSUE A

DATE 24 AUG 2021



### LAND PATTERN RECOMMENDATION

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PB-FREE STRATEGY AND SOLDERING  
DETAILS, PLEASE DOWNLOAD THE ON  
SEMICONDUCTOR SOLDERING AND  
MOUNTING TECHNIQUES REFERENCE  
MANUAL, SOLDERRM/D.



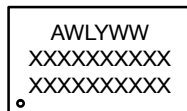
### NOTES: UNLESS OTHERWISE SPECIFIED

- A) DRAWING REFERS TO JEDEC MS-013, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS
- D) DRAWING CONFORMS TO ASME Y14.5M-1994
- E) LAND PATTERN STANDARD: SOIC127P1030X275-16N
- F) DRAWING FILE NAME: MKT-M16FREV2
- G) OPTOCOUPLER COMES IN WHITE MOLD BODY.

A

DIM	MILLIMETER		
	MIN.	NOM.	MAX.
A	—	—	3.00
A1	0.15	0.30	0.45
A2	2.25	2.35	2.45
b	0.31	0.41	0.51
c	0.19	0.22	0.25
D	10.20	10.30	10.40
E	10.10	10.30	10.50
E1	7.40	7.50	7.60
E1/2	3.75 BSC		
e	1.27 BSC		
e/2	0.635 BSC		
L	0.40	0.84	1.27
L1	1.42 REF		
L2	0.25 BSC		
θ	0°	—	8°

### GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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