

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

## NCID9211 / NCIV9211

### Description

The NCID(V)9211 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 ON Semiconductor 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
- AEC-Q100 qualified: NCIV9211 (Pending)
- Over Temperature Detection
- Output Enable Function (Primary and Secondary Side)
- Safety and Regulatory Approvals (Pending)
  - ◆ UL1577, 5000 V<sub>RMS</sub> for 1 Minute
  - ◆ DIN VDE V 0884-11

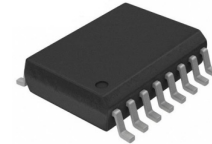
### Typical Applications

- 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



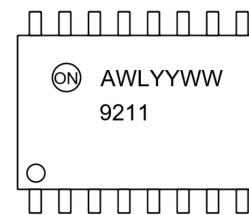
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SOIC16 W  
CASE 751EN

### MARKING DIAGRAM

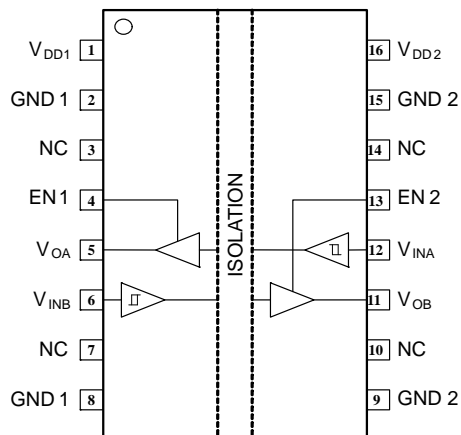


A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
9211 = Specific Device Code

### ORDERING INFORMATION

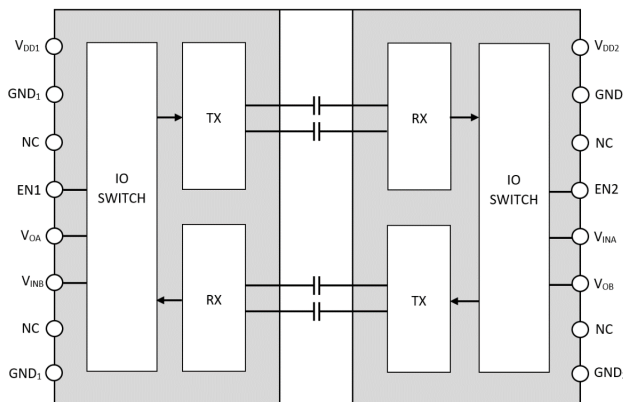
See detailed ordering and shipping information on page 10 of this data sheet.

**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>DD0</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
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>DD0</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>DD0</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>DD0</sub> < V<sub>UVLO</sub>.

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## SAFETY AND INSULATION RATINGS

As per DIN VDE V 0884-11, 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.	Units
	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		40/100/21		
	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	100			mW
P <sub>S,OUTPUT</sub>	Safety Limit Values – Maximum Values in Failure; Output Power	600			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	Units
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 <sub>A</sub>	Ambient Operating Temperature	-40	+125	°C
V <sub>DD1</sub> V <sub>DD2</sub>	Supply Voltage (Notes 3, 4)	2.5	5.5	V
V <sub>INH</sub>	High Level Input Voltage	0.7 x V <sub>DDI</sub>	V <sub>DDI</sub>	V
V <sub>INL</sub>	Low Level Input Voltage	0	0.3 x V <sub>DDI</sub>	V
V <sub>UVLO+</sub>	Supply Voltage UVLO Rising Threshold	2.2		V
V <sub>UVLO-</sub>	Supply Voltage UVLO Falling Threshold	2.0		V
UVLO <sub>HYS</sub>	Supply Voltage UVLO Hysteresis	0.1		V
I <sub>OH</sub>	High Level Output Current	-2	-	mA
I <sub>OL</sub>	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<sub>DD</sub> supply pins require at least a pair of external bypass capacitors, placed within 2 mm from V<sub>DD</sub> pins 1 and 16 and GND pins 2 and 15. Recommended values are 0.1 μF and 1 μF.

**ISOLATION CHARACTERISTICS**

Apply over all recommended conditions. All typical values are measured at T<sub>A</sub> = 25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V <sub>ISO</sub>	Input-Output Isolation Voltage	T <sub>A</sub> = 25°C, Relative Humidity < 50%, t = 1.0 minute, I <sub>I-O</sub> ≤ 10 μA, 50 Hz (Notes 5, 6, 7)	5000			V <sub>RMS</sub>
R <sub>ISO</sub>	Isolation Resistance	V <sub>I-O</sub> = 500 V (Note 5)		10 <sup>11</sup>		
C <sub>ISO</sub>	Isolation Capacitance	V <sub>I-O</sub> = 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<sub>RMS</sub> for 1-minute duration is equivalent to 6,000 V<sub>RMS</sub> 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 VDE V 0884-11 Safety and Insulation Ratings Table on page 3.

**ELECTRICAL CHARACTERISTICS**

Apply over all recommended conditions, T<sub>A</sub> = -40°C to +125°C, V<sub>DD1</sub> = V<sub>DD2</sub> = 2.5 V to 5.5 V, unless otherwise specified. All typical values are measured at T<sub>A</sub> = 25°C.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units	Figure
V <sub>OH</sub>	High Level Output Voltage	I <sub>OH</sub> = -4 mA	V <sub>DDO</sub> - 0.4	V <sub>DDO</sub> - 0.1		V	7
V <sub>OL</sub>	Low Level Output Voltage	I <sub>OL</sub> = 4 mA		0.11	0.4	V	8
V <sub>INT+</sub>	Rising Input Voltage Threshold				0.7 x V <sub>DDI</sub>	V	
V <sub>INT-</sub>	Falling Input Voltage Threshold		0.1 x V <sub>DDI</sub>			V	
V <sub>INT(HYS)</sub>	Input Threshold Voltage Hysteresis		0.1 x V <sub>DDI</sub>	0.2 x V <sub>DDI</sub>		V	
I <sub>INH</sub>	High Level Input Current	V <sub>IH</sub> = V <sub>DDI</sub>			1	μA	
I <sub>INL</sub>	Low Level Input Current	V <sub>IL</sub> = 0 V	-1			μA	
CMTI	Common Mode Transient Immunity	V <sub>I</sub> = V <sub>DDI</sub> or 0 V, V <sub>CM</sub> = 1500 V	100	150		kV/μs	12
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = V <sub>DDI</sub> /2 + 0.4 x sin(2πft), f=1MHz, V <sub>DD</sub> =5 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.

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## 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
$I_{DD1}$	DC Supply Current Input Low	$V_{DD} = 5\text{ V}, EN = 0\text{ V} / 5\text{ V}, V_{IN} = 0\text{ V}$		4.5	6.3	mA	
$I_{DD2}$				5.0			
$I_{DD1}$		$V_{DD} = 3.3\text{ V}, EN = 0\text{ V} / 3.3\text{ V}, V_{IN} = 0\text{ V}$		4.4	6.1		
$I_{DD2}$				4.9			
$I_{DD1}$		$V_{DD} = 2.5\text{ V}, EN = 0\text{ V} / 2.5\text{ V}, V_{IN} = 0\text{ V}$		4.3	6		
$I_{DD2}$				4.8			
$I_{DD1}$	DC Supply Current Input High	$V_{DD} = 5\text{ V}, EN = 0\text{ V} / 5\text{ V}, V_{IN} = 5\text{ V}$		11.8	14.5	mA	
$I_{DD2}$				12.1			
$I_{DD1}$		$V_{DD} = 3.3\text{ V}, EN = 0\text{ V} / 3.3\text{ V}, V_{IN} = 3.3\text{ V}$		11.7	14.3		
$I_{DD2}$				11.9			
$I_{DD1}$		$V_{DD} = 2.5\text{ V}, EN = 0\text{ V} / 2.5\text{ V}, V_{IN} = 2.5\text{ V}$		11.6	14.3		
$I_{DD2}$				11.8			
$I_{DD1}$	AC Supply Current 1 Mbps	$V_{DD} = 5\text{ V}, EN = 5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 5\text{ V Square Wave}$		8.3	10.5	mA	3,4
$I_{DD2}$				8.7			
$I_{DD1}$		$V_{DD} = 3.3\text{ V}, EN = 3.3\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 3.3\text{ V Square Wave}$		8.1	10.3		
$I_{DD2}$				8.5			
$I_{DD1}$		$V_{DD} = 2.5\text{ V}, EN = 2.5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 2.5\text{ V Square Wave}$		8.0	10.1		
$I_{DD2}$				8.4			
$I_{DD1}$	AC Supply Current 10 Mbps	$V_{DD} = 5\text{ V}, EN = 5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 5\text{ V Square Wave}$		9.9	12	mA	
$I_{DD2}$				10.2			
$I_{DD1}$		$V_{DD} = 3.3\text{ V}, EN = 3.3\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 3.3\text{ V Square Wave}$		8.9	11		
$I_{DD2}$				9.3			
$I_{DD1}$		$V_{DD} = 2.5\text{ V}, EN = 2.5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 2.5\text{ V Square Wave}$		8.6	10.5		
$I_{DD2}$				9.0			
$I_{DD1}$	AC Supply Current 50 Mbps	$V_{DD} = 5\text{ V}, EN = 5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 5\text{ V Square Wave}$		14.8	17.5	mA	
$I_{DD2}$				15.2			
$I_{DD1}$		$V_{DD} = 3.3\text{ V}, EN = 3.3\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 3.3\text{ V Square Wave}$		12.1	14.3		
$I_{DD2}$				12.6			
$I_{DD1}$		$V_{DD} = 2.5\text{ V}, EN = 2.5\text{ V}, C_L = 15\text{ pF}$ $V_{IN} = 2.5\text{ V Square Wave}$		11.1	13		
$I_{DD2}$				11.6			

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

8. Propagation delay  $t_{PHL}$  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.
9. Propagation delay  $t_{PLH}$  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.
10. PWD is defined as  $|t_{PHL} - t_{PLH}|$  for any given device.
11. 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.
12. Enable delay  $t_{PZL}$  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.
13. Disable delay  $t_{PLZ}$  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.
14. Enable delay  $t_{PZH}$  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.
15. Disable delay  $t_{PHZ}$  is measured from the 50% level of the falling edge of the EN pulse to  $V_{OH} - 0.5\text{ V}$  level of the falling edge of the  $V_O$  signal as it switches from high state to high impedance state.

TYPICAL PERFORMANCE CHARACTERISTICS

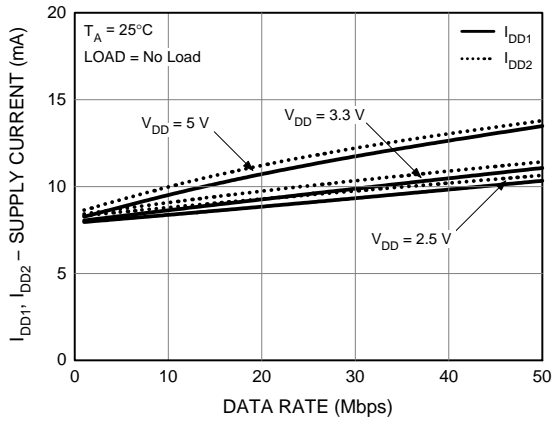


Figure 3. Supply Current vs. Data Rate (No Load)

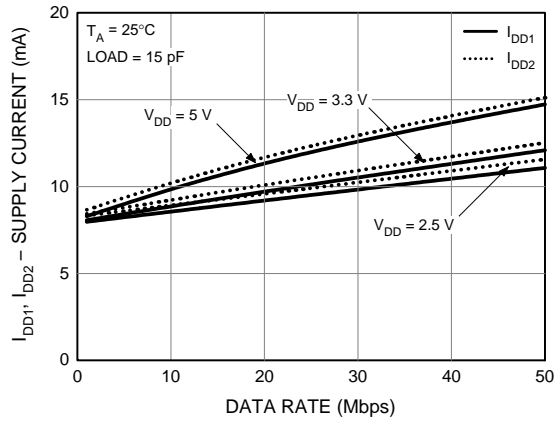


Figure 4. Supply Current vs. Data Rate (Load = 15 pF)

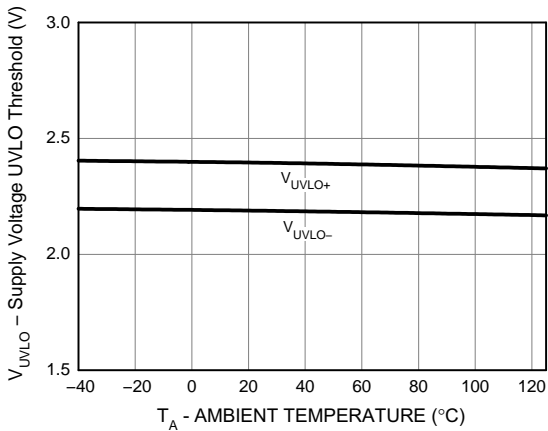


Figure 5. Supply Voltage UVLO Threshold vs. Ambient Temperature

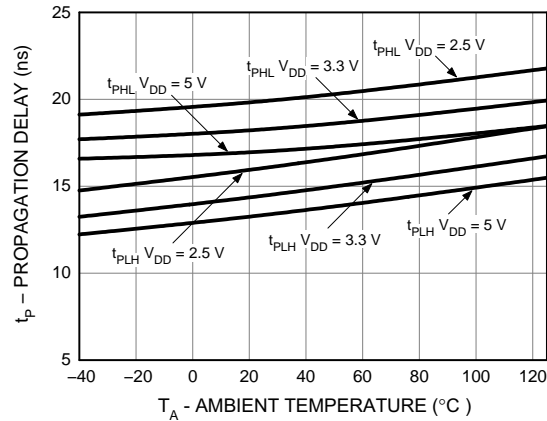


Figure 6. Propagation Delay vs. Ambient Temperature

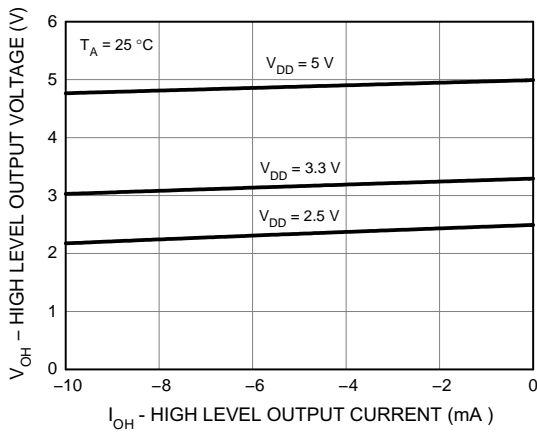


Figure 7. High Level Output Voltage vs. Current

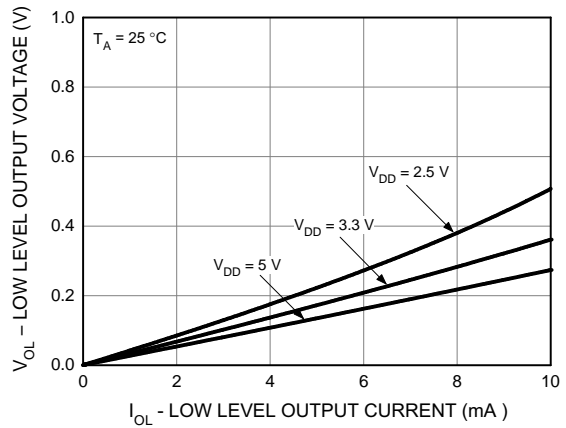


Figure 8. Low Level Output Voltage vs. Current

TEST CIRCUITS

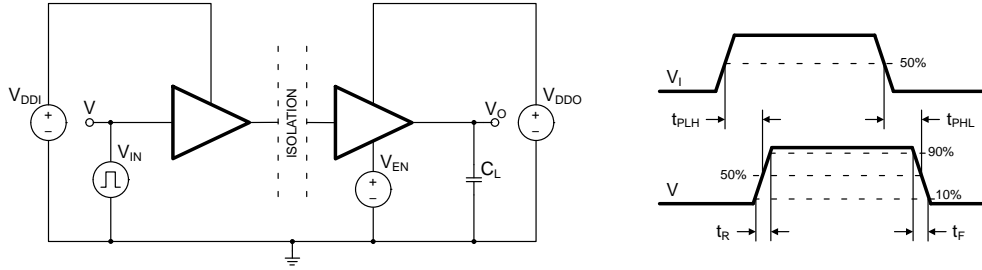


Figure 9.  $V_{IN}$  to  $V_O$  Propagation Delay Test Circuit and Waveform

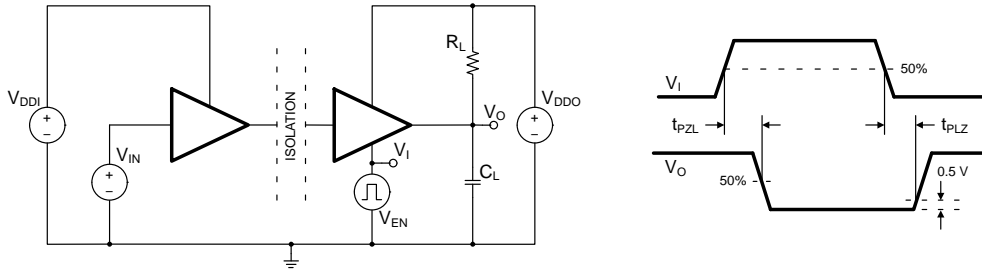


Figure 10. EN to Logic Low  $V_O$  Propagation Delay Test Circuit and Waveform

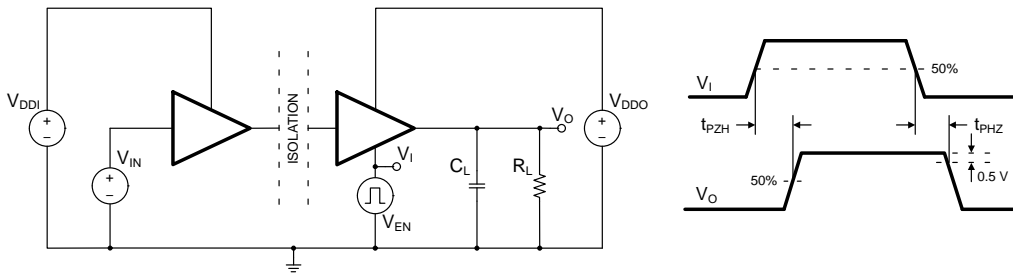


Figure 11. EN to Logic High  $V_O$  Propagation Delay Test Circuit and Waveform

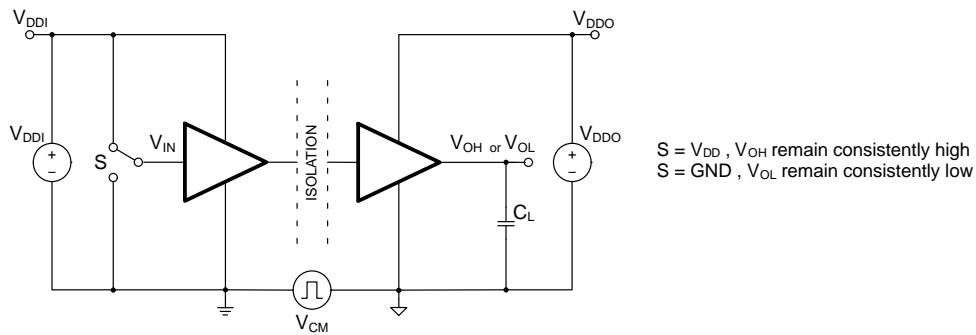


Figure 12. Common Mode Transient Immunity Test Circuit



APPLICATIONS INFORMATION

Theory of Operation

NCID(V)9211 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.

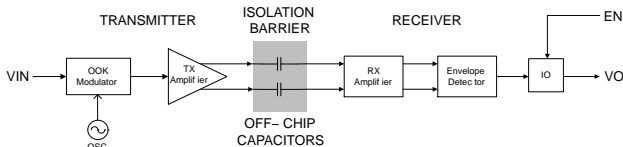


Figure 13. Operational Block Diagram of Single Channel

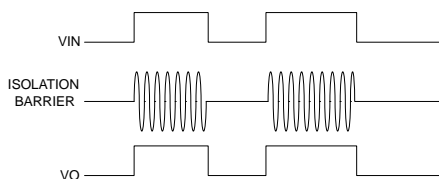


Figure 14. On-Off Keying Modulation Signals

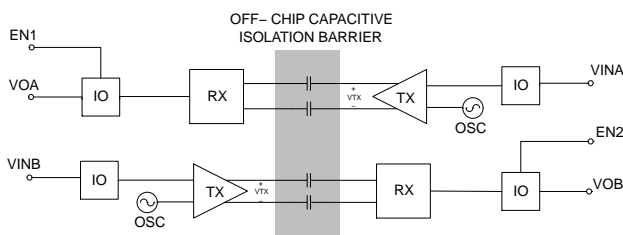


Figure 15. NCID(V)9211 Operational Block Diagram

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.

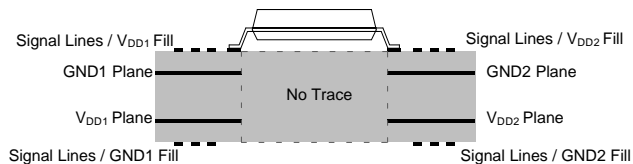


Figure 16. 4-Layer PCB for Digital Isolator

For NCID(V)9211, 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.

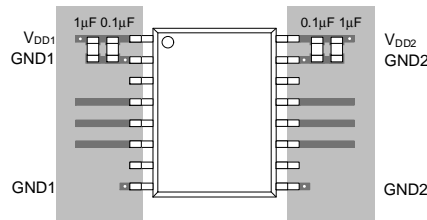


Figure 17. Placement of Bypass Capacitors

Over Temperature Detection

NCID(V)9211 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 / NCIV9211

### ORDERING INFORMATION

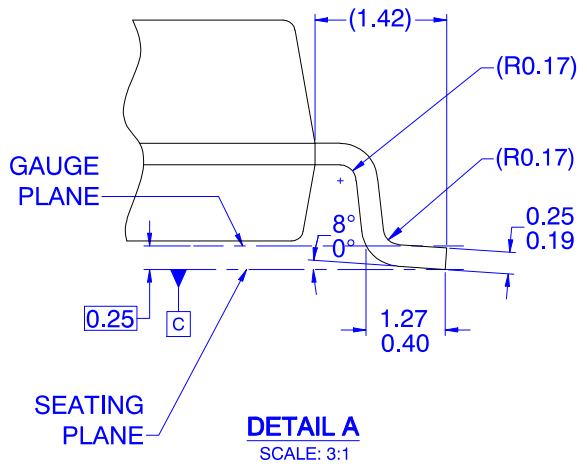
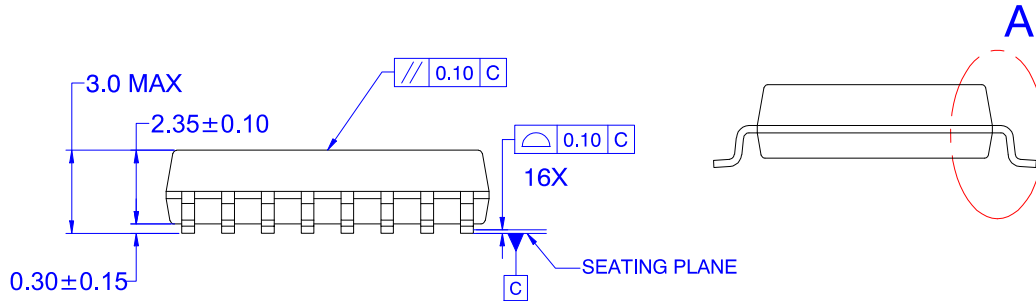
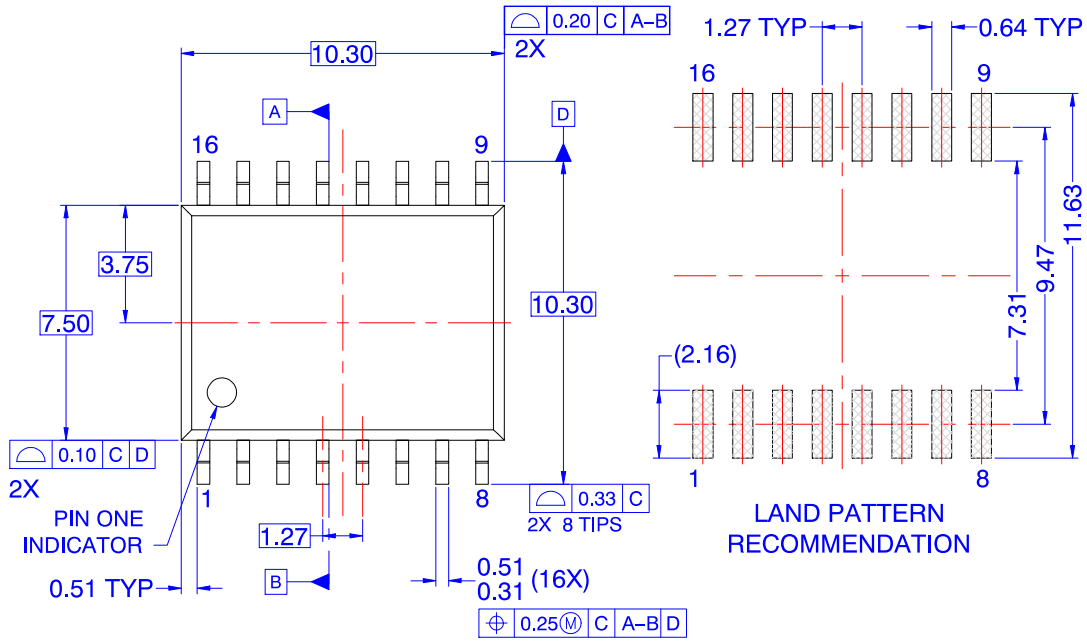
Part Number	Grade	Package	Shipping†
NCID9211	Industrial	SOIC16 W	50 Units / Tube
NCID9211R2	Industrial	SOIC16 W	750 Units / Tape & Reel
NCIV9211 (pending)	Automotive	SOIC16 W	50 Units / Tube
NCIV9211R2 (pending)	Automotive	SOIC16 W	750 Units / Tape & Reel

†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.

# NCID9211 / NCIV9211

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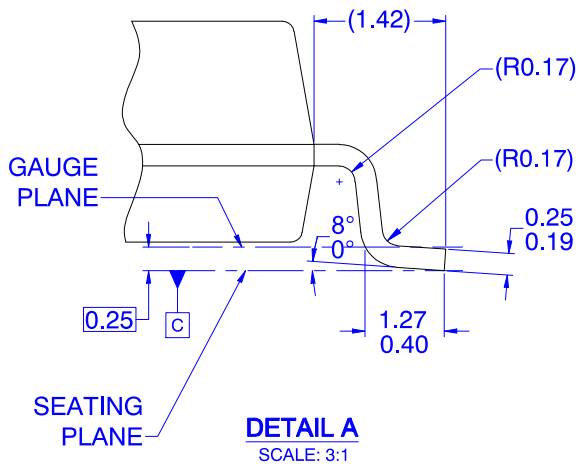
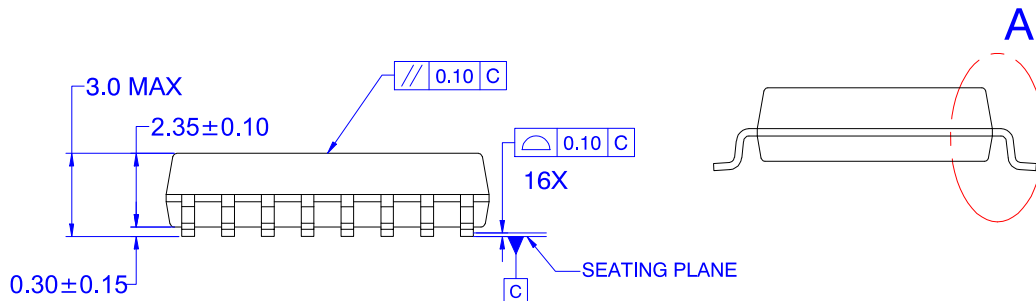
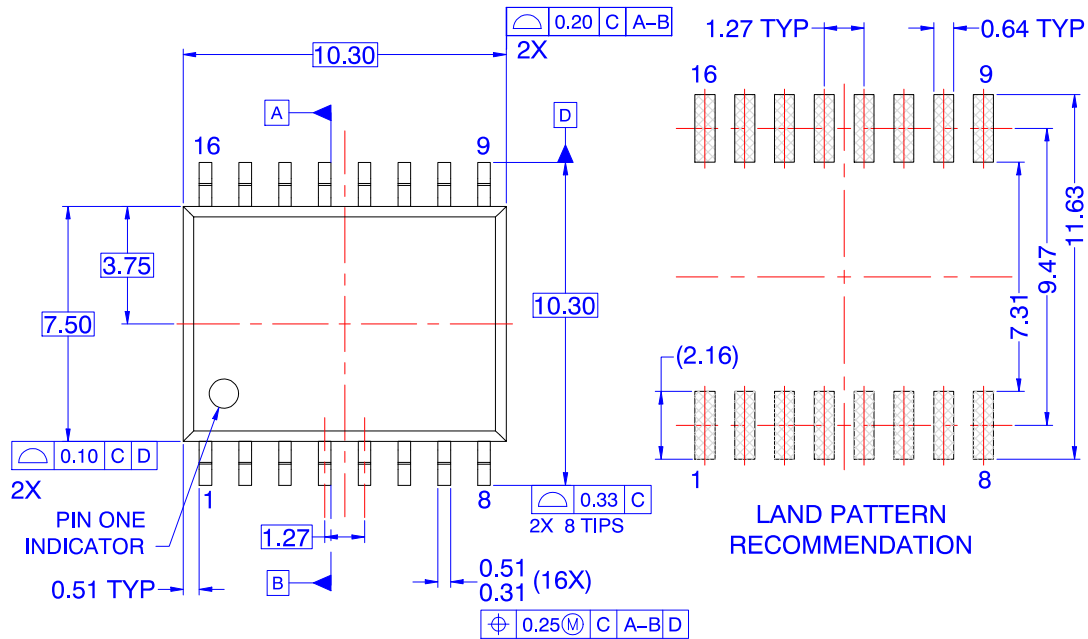
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