# Dual Digital Isolator

## Functional Diagram
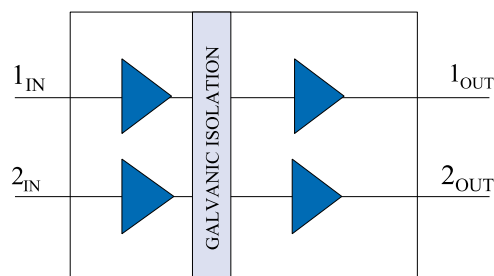


**IL711**
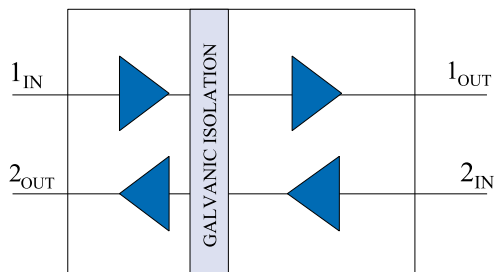


**IL712**

## Ordering Information

| Model | Package Type | |
|-------|--------|--------|
|       | *8–PDIP* | *8–SOIC* |
| IL711 | -2 | -3 |
| IL712 | -2 | -3 |

**IL711-2** is an 8–PDIP package

**IL712-3** is an 8–SOIC package

If requesting tape and reel, please specify as TR.

Example: **IL711-3TR**

*Isoloop*® is a registered trademark of NVE Corporation

\* US Patent number 5,831,426; 6,300,617 and others

## Features

· +5V and +3.3V CMOS/TTL Compatible
· 2 ns Typical Pulse Width Distortion
· 10 ns Typical Propagation Delay
· High Speed: 110 MBaud Typical
· 2 ns Channel-to-Channel Skew
· 30 kV/µs Typical Transient Immunity
· 2500$V_{RMS}$ Isolation (1 min)
· 8-pin PDIP and 8-pin SOIC Packages
· UL1577 Approved (File # E207481)
· IEC 61010-1 Approved (Report # 607057)
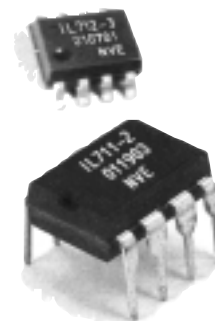
## Applications

· Isolated Data Transmission
· Isolated ADCs and DACs
· Fieldbus Isolation
· High Speed Digital Systems
· Computer Peripheral Interfaces
· Logic Level Shifting

## Description

The IL711 and IL712 offer the user a level of true logic integration in an isolation product not previously available. The high-speed digital isolators are configured as dual unidirectional in the IL711, and as a bi-directional pair in the IL712. Both devices are integrated with patented\* *IsoLoop*® technology giving them an excellent transient immunity specification. The symmetric magnetic coupling barrier gives these devices a propagation delay of only 10ns and a pulse width distortion of 2 ns.

Both the IL711 and the IL712 have 100Mbaud data rates which are independent of direction, *i.e.* the IL712 operates in full duplex mode making it ideal for many Fieldbus bus applications. PROFIBUS / RS485 configurations are achieved by combinations of IL710 and the IL711 or IL712, either combination meeting the overall propagation delay requirements of the specification. Available in 8-pin PDIP and 8-pin SOIC packages, the IL711 and IL712 are specified over the temperature range of -40°C to +100°C without any performance derating.

# IL711/712 *IsoLoop®*

## Absolute Maximum Ratings

| Parameters | Symbol | Min. | Max. | Units |
|---|---|---|---|---|
| Storage Temperature | $T_S$ | -55 | 175 | ºC |
| Ambient Operating Temperature[1] | $T_A$ | -55 | 125 | ºC |
| Supply Voltage | $V_{DD1}, V_{DD2}$ | -0.5 | 7 | Volts |
| Input Voltage | $V_I$ | -0.5 | $V_{DD1}+0.5$ | Volts |
| Input Voltage | $V_{OE}$ | -0.5 | $V_{DD2}+0.5$ | Volts |
| Output Voltage | $V_O$ | -0.5 | $V_{DD2}+0.5$ | Volts |
| Drive Channel Output Current | $I_O$ | | 10 | mA |
| Lead Solder Temperature (10s) | | | 260 | ºC |
| ESD | 2kV Human Body Model | | | |

## Recommended Operating Conditions

| Parameters | Symbol | Min. | Max. | Units |
|---|---|---|---|---|
| Ambient Operating Temperature | $T_A$ | -40 | 100 | ºC |
| Supply Voltage | $V_{DD1}, V_{DD2}$ | 3.0 | 5.5 | Volts |
| Logic High Input Voltage | $V_{IH}$ | 2.4 | $V_{DD1}$ | Volts |
| Logic Low Input Voltage | $V_{IL}$ | 0 | 0.8 | Volts |
| Minimum Signal Rise and Fall Times | $t_{IR}, t_{IF}$ | | 1 | μsec |

## Insulation Specifications

| Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Barrier Impedance | | | $>10^{14} \| 3$ | | $\Omega \| pF$ |
| Creepage Distance (External) | | 7.036 (PDIP) 4.026 (SOIC) | | | mm |
| Leakage Current | 240 $V_{RMS}$ 60Hz | | 0.2 | | μA |

## Package Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Capacitance (Input-Output)[5] | $C_{I-O}$ | | 2 | | pF | f = 1MHz |
| Thermal Resistance (PDIP) | $\theta_{JCT}$ | | 150 | | ºC/W | Thermocouple located at center underside of package |
| Thermal Resistance (SOIC) | $\theta_{JCT}$ | | 240 | | ºC/W | Thermocouple located at center underside of package |
| Package Power Dissipation | $P_{PD}$ | | | 150 | mW | |

## IEC61010-1

TUV Certificate Numbers:  B 01 07 44230 001  (PDIP)
                          B 01 07 44230 002  (SOIC)

Classification as Table 1.

| Model | Pollution Degree | Material Group | Max Working Voltage | Package Type | |
|---|---|---|---|---|---|
| | | | | *8–PDIP* | *8–SOIC* |
| IL710-2, IL711-2 | II | III | 300 V$_{RMS}$ | ✓ | |
| IL710-3, IL711-3 | II | III | 150 V$_{RMS}$ | | ✓ |

## UL 1577

Component Recognition program. File # E207481
Rated 2500Vrms for 1min.

## Electrical Specifications

Electrical Specifications are $T_{min}$ to $T_{max}$ unless otherwise stated.

| Parameter DC Specifications | | Symbol | 3.3 Volt Specifications | | | 5 Volt Specifications | | | Units | Test Conditions |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | | |
| Input Quiescent Supply Current | IL711 | $I_{DD1}$ | | 8 | 10 | | 10 | 15 | µA | |
| | IL712 | | | 1.5 | 2 | | 2.5 | 3 | mA | |
| Output Quiescent Supply Current | IL711 | $I_{DD2}$ | | 3.3 | 4 | | 5 | 6 | mA | |
| | IL712 | | | 1.5 | 2 | | 2.5 | 3 | mA | |
| Logic Input Current | | $I_I$ | -10 | | 10 | -10 | | 10 | µA | |
| Logic High Output Voltage | | $V_{OH}$ | $V_{DD}$-0.1 0.8*$V_{DD}$ | $V_{DD}$ $V_{DD}$-0.5 | | $V_{DD}$-0.1 0.8*$V_{DD}$ | $V_{DD}$ $V_{DD}$-0.5 | | V | $I_O$ =-20 µA, $V_I$ =$V_{IH}$ $I_O$ = -4 mA, $V_I$ =$V_{IH}$ |
| Logic Low Output Voltage | | $V_{OL}$ | | 0 0.5 | 0.1 0.8 | | 0 0.5 | 0.1 0.8 | V | $I_O$ = 20 µA, $V_I$ =$V_{IL}$ $I_O$ = 4 mA, $V_I$ =$V_{IL}$ |
| **Switching Specifications** | | | | | | | | | | |
| Maximum Data Rate | | | 100 | 110 | | 100 | 110 | | MBd | $C_L$ = 15 pF |
| Pulse Width | | PW | 10 | | | 10 | | | ns | |
| Propagation Delay Input to Output (High to Low) | | $t_{PHL}$ | | 12 | 18 | | 10 | 15 | ns | $C_L$ = 15 pF |
| Propagation Delay Input to Output ( Low to High) | | $t_{PLH}$ | | 12 | 18 | | 10 | 15 | ns | $C_L$ = 15 pF |
| Pulse Width Distortion[2] \| tPHL- tPLH \| | | PWD | | 2 | 3 | | 2 | 3 | ns | $C_L$ = 15 pF |
| Propagation Delay Skew[3] | | $t_{PSK}$ | | 4 | 6 | | 4 | 6 | ns | $C_L$ = 15 pF |
| Output Rise Time (10-90%) | | $t_R$ | | 2 | 4 | | 1 | 3 | ns | $C_L$ = 15 pF |
| Output Fall Time (10-90%) | | $t_F$ | | 2 | 4 | | 1 | 3 | ns | $C_L$ = 15 pF |
| Transient Immunity (Output Logic High or Logic Low)[4] | | \|CMH\| \|CML\| | 20 | 30 | | 20 | 30 | | kV/µs | Vcm = 300V |
| Channel to Channel Skew | | $T_{CSK}$ | | 2 | 3 | | 2 | 3 | ns | $C_L$ = 15 pF |

## Timing Diagram
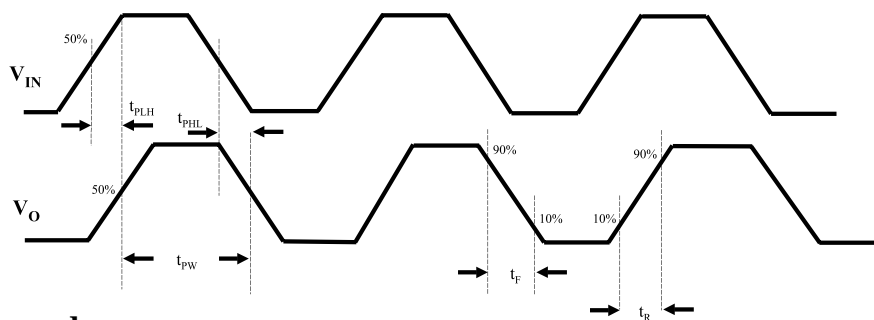


## Legend

| | |
|---|---|
| $t_{PLH}$ | Propagation Delay, Low to High |
| $t_{PHL}$ | Propagation Delay, High to Low |
| $t_{PW}$ | Minimum Pulse Width |
| $t_R$ | Rise Time |
| $t_F$ | Fall Time |

# IL711/712 $^{\textit{IsoLoop}®}$

## Notes:

1. Absolute Maximum ambient operating temperature means the device will not be damaged if operated under these conditions. It does not guarantee performance.
2. PWD is defined as $| t_{PHL} - t_{PLH} |$. %PWD is equal to the PWD divided by the pulse width.
3. $t_{PSK}$ is equal to the magnitude of the worst case difference in $t_{PHL}$ and/or $t_{PLH}$ that will be seen between units at 25°C.
4. $CM_H$ is the maximum common mode voltage slew rate that can be sustained while maintaining $V_O > 0.8 \ V_{DD}$. $CM_L$ is the maximum common mode input voltage that can be sustained while maintaining $V_O < 0.8$ V. The common mode voltage slew rates apply to both rising and falling common mode voltage edges.
5. Device is considered a two terminal device: pins 1-4 shorted and pins 5-8 shorted.

## Application Notes:

**Power Consumption**

Isoloop® devices achieve their low power consumption from the manner by which they transmit data across the isolation barrier. By detecting the edge transitions of the input logic signal and converting these to narrow current pulses a magnetic field is created around the GMR Wheatstone bridge. Depending on the direction of the magnetic field, the bridge causes the output comparator to switch following the input logic signal. Since the current pulses are narrow, about 2.5ns wide, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers whose power consumption is heavily dependent on their on-state and frequency.

The approximate power supply current per channel for

Isoloop® is: $I(\text{input}) = 40 \left( \dfrac{f}{\text{fmax}} \right) \left( \dfrac{1}{4} \right) \text{mA}$

where f = operating frequency
    fmax = 50 MHz

**Power Supplies**

Because the IL711 and IL712 operate internally by using narrow current pulses, it is recommended that low ESR ceramic capacitors be used to decouple the supplies. 47nF capacitors should be placed as close to the device as possible between $V_{DD1}$ and $GND_1$ as well as between $V_{DD2}$ and $GND_2$.

**Signal Status on Start-up and Shut Down**

To minimize power dissipation, the input signals to the IL711 and IL712 are differentiated and then latched on the output side of the isolation barrier to reconstruct the signal. This could result in an ambiguous output state depending on power up, shutdown and power loss sequencing. Therefore, the designer should consider the inclusion of an initialization signal in the start–up circuit.

**Electrostatic Discharge Sensitivity**

This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to complete failure.
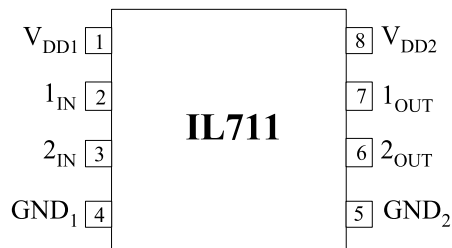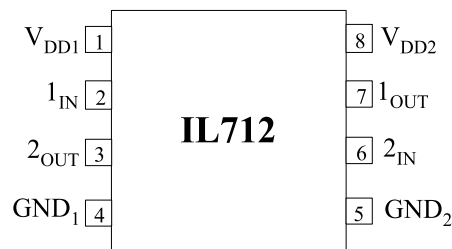
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## IR Soldering Profile
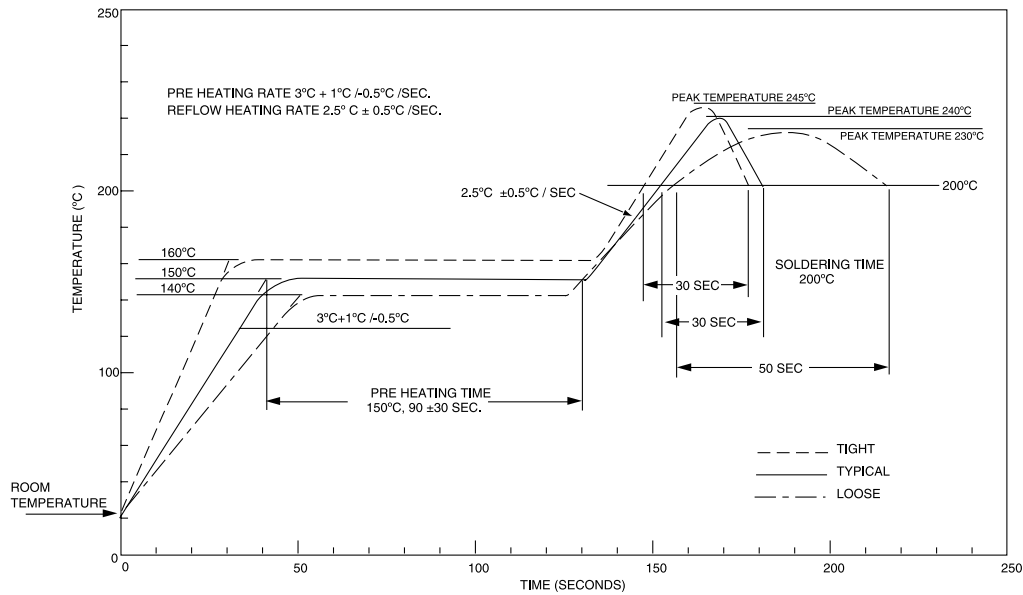


## Pin Connections

| 1 | $V_{DD1}$ | Input Power Supply |
|---|---|---|
| 2 | $1_{IN}$ | Channel 1 Logic Input Signal |
| 3 | $2_{IN}$ | Channel 2 Logic Input Signal |
| 4 | $GND_1$ | Input Power Supply Ground |
| 5 | $GND_2$ | Output Power Supply Ground |
| 6 | $2_{OUT}$ | Channel 2 Logic Output Signal |
| 7 | $1_{OUT}$ | Channel 1 Logic Output Signal |
| 8 | $V_{DD2}$ | Output Power Supply |

IL711

| $V_{DD1}$ | 1 | | 8 | $V_{DD2}$ |
| $1_{IN}$ | 2 | | 7 | $1_{OUT}$ |
| $2_{IN}$ | 3 | | 6 | $2_{OUT}$ |
| $GND_1$ | 4 | | 5 | $GND_2$ |

| 1 | $V_{DD1}$ | Input Power Supply |
|---|---|---|
| 2 | $1_{IN}$ | Channel 1 Logic Input Signal |
| 3 | $2_{OUT}$ | Channel 2 Logic Output Signal |
| 4 | $GND_1$ | Input Power Supply Ground |
| 5 | $GND_2$ | Output Power Supply Ground |
| 6 | $2_{IN}$ | Channel 2 Logic Input Signal |
| 7 | $1_{OUT}$ | Channel 1 Logic Output Signal |
| 8 | $V_{DD2}$ | Output Power Supply |

IL712

| $V_{DD1}$ | 1 | | 8 | $V_{DD2}$ |
| $1_{IN}$ | 2 | | 7 | $1_{OUT}$ |
| $2_{OUT}$ | 3 | | 6 | $2_{IN}$ |
| $GND_1$ | 4 | | 5 | $GND_2$ |

# IL711/712 *IsoLoop®*

## IL711-2 and IL712-2 (8-Pin PDIP Package)



Dimensions: inches (mm)
$$\frac{min}{max}$$

0.240 (6.096)
0.260 (6.604)

0.370 (9.398)
0.400 (10.160)

0.120 (3.048)
0.150 (3.810)

0.015 (0.381)
0.035 (0.889)

0.030 (0.762)
0.045 (1.143)

0.090 (2.286)
0.110 (2.794)

0.015 (0.380)
0.023 (0.584)

0.045 (1.143)
0.065 (1.651)

0.290 (7.366)
0.310 (7.874)

0.55 (1.397)
0.65 (1.651)

0.008 (0.203)
0.015 (0.381)

0.300 (7.620)
0.370 (9.398)

3°
8°
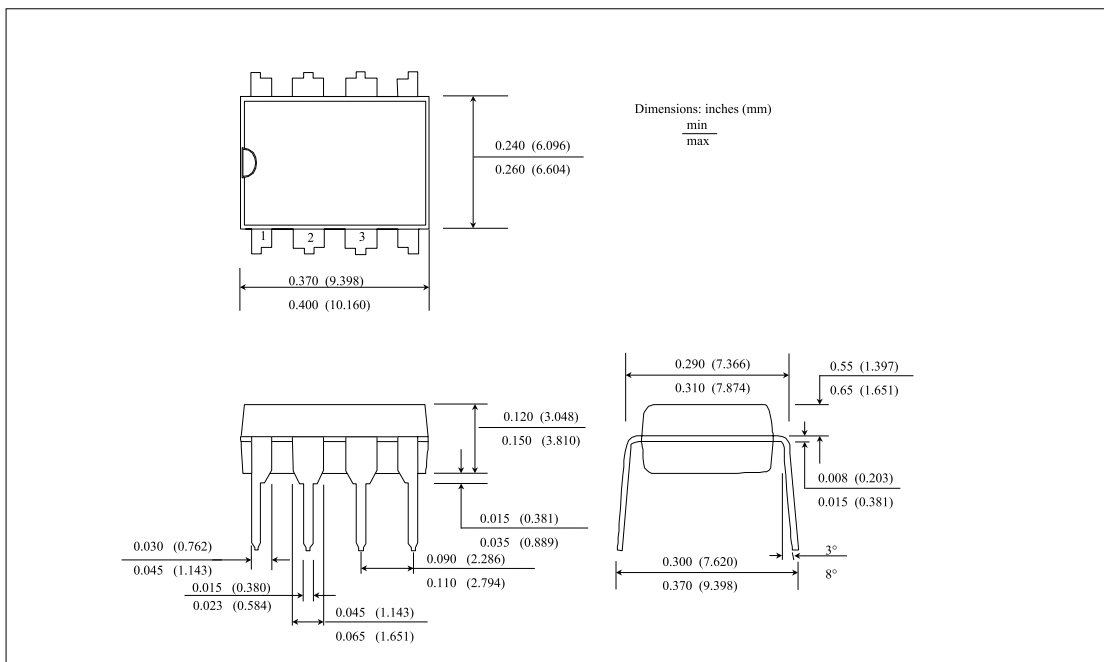
## IL711-3 and IL712-3 (Small Outline SOIC-8 package)



0.189 (4.80)
0.197 (5.00)

0.228 (5.80)
0.244 (6.20)

0.150 (3.80)
0.157 (4.00)

0.010 (0.25)
0.020 (0.50)
x45°

0.013 (0.33)
0.020 (0.51)

0°
8°

0.016 (0.40)
0.050 (1.27)

0.008 (0.19)
0.010 (0.25)

Dimensions: inches (mm)
$$\frac{min}{max}$$

0.054 (1.37)
0.069 (1.75)

0.004 (0.10)
0.010 (0.25)

0.040 (1.016)
0.060 (1.524)

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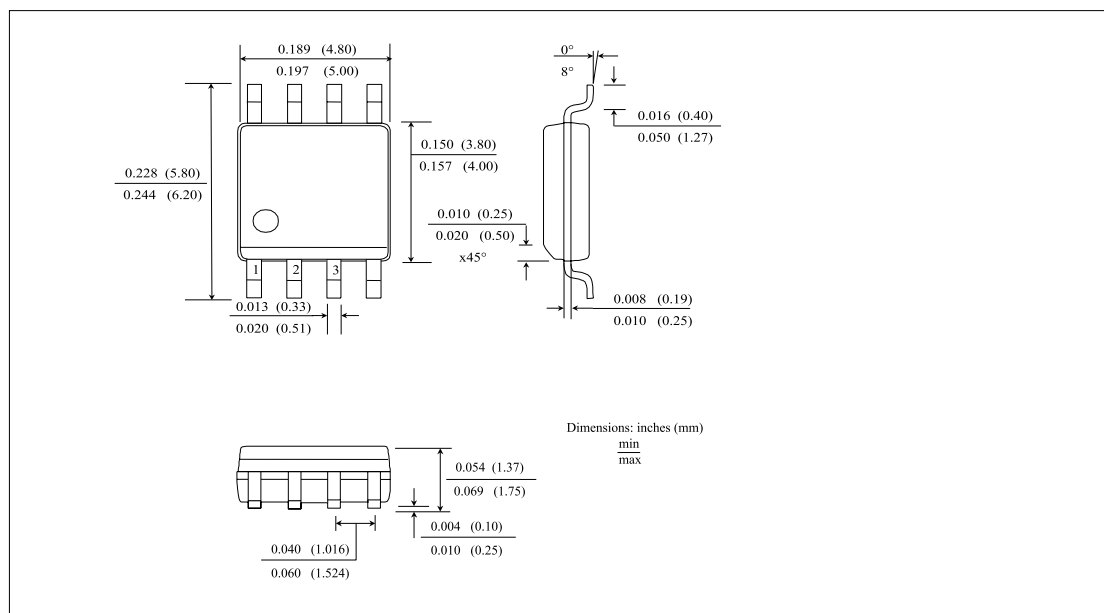
## Applications

### Isolated PROFIBUS / RS-485



**RS-485 Truth Table**

| D | DE | A | B | R |
|---|----|----|----|----|
| 1 | 0 | Z | Z | X |
| 0 | 0 | Z | Z | X |
| 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |

65ALS176 (-40°C to +85°C)
75ALS176 (0°C to +70°C)

$V_{DD1}$ and $V_{ISO}$ should be decoupled with a 10nF capacitor
at the IL710 supply pins and a 47 nF capacitor at the IL711.
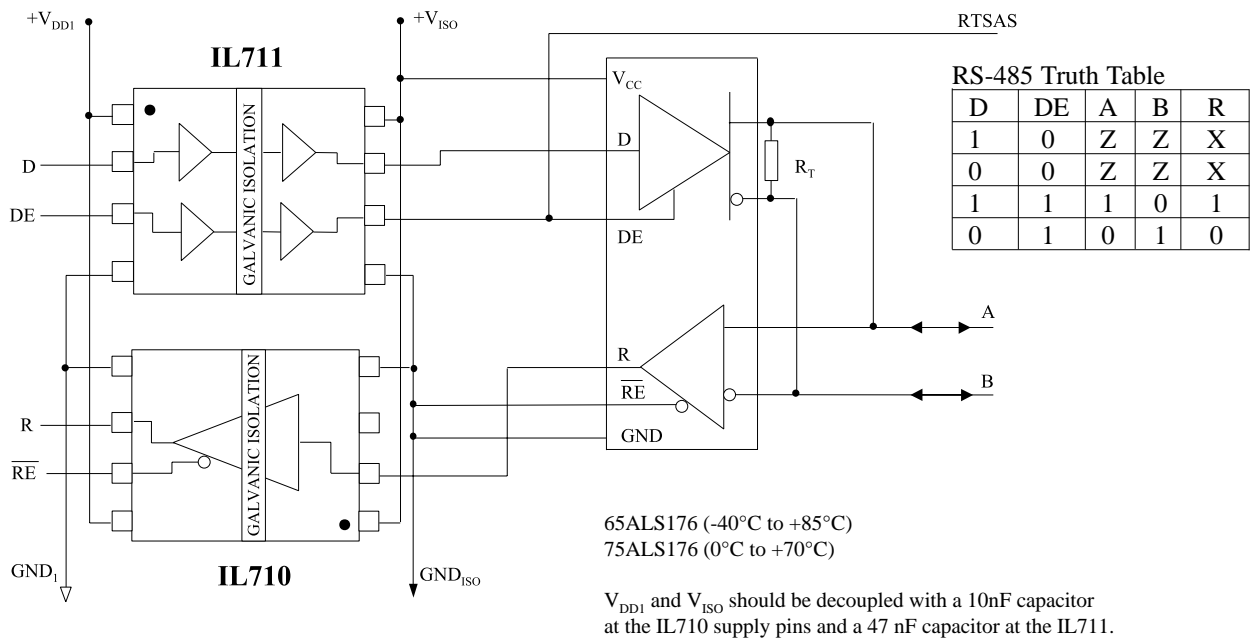
### Isolated DeviceNet / CAN Transceiver



| TXD | CANH | CANL | BUS | RXD |
|-----|------|------|-----|-----|
| 0 | high | low | dominant | 0 |
| 1 | floating | floating | recessive | 1 |

$V_{DD1}$ and $V_{ISO}$ should be decoupled with 47nF capacitors
at the IL712 supply pins.

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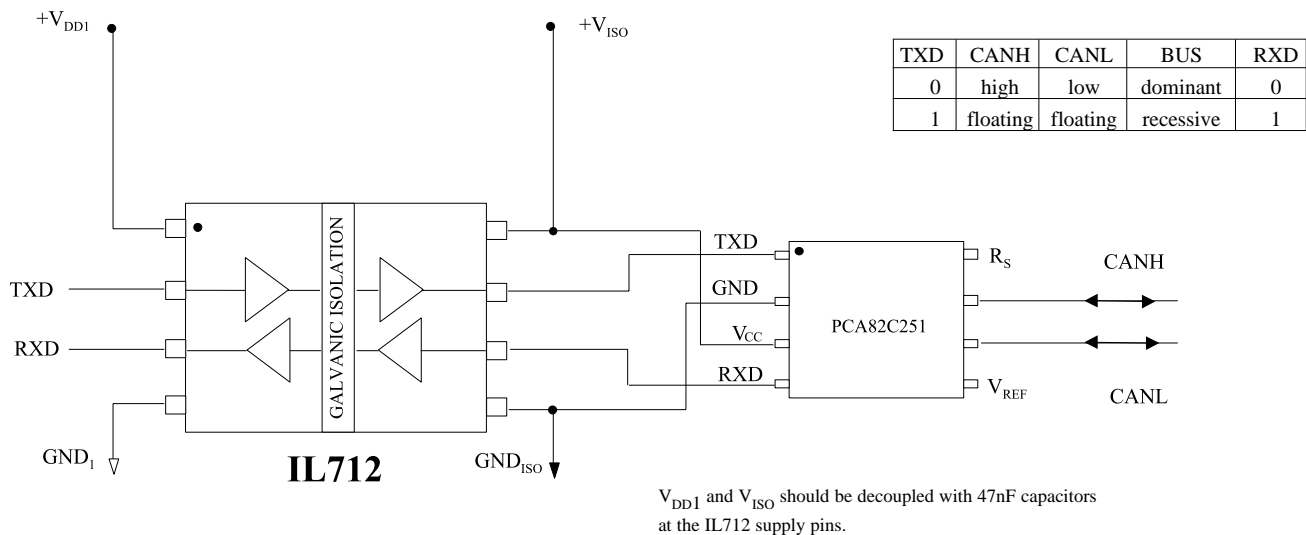
**About NVE Corporation**

An ISO 9001 Certified Company

NVE Corporation is a high technology components manufacturer having the unique capability to combine leading edge Giant Magnetoresistive (GMR) materials with integrated circuits to make high performance electronic components. Products include Magnetic Field Sensors, Magnetic Field Gradient Sensors (Gradiometer), Digital Magnetic Field Sensors, Digital Signal Isolators and Isolated Bus Transceivers.

NVE is a leader in GMR research and in 1994 introduced the world's first products using GMR material, a line of GMR magnetic field sensors that can be used for position, magnetic media, wheel speed and current sensing.

NVE is located in Eden Prairie, Minnesota, a suburb of Minneapolis. Please visit our Web site at www.nve.com or call 952-829-9217 for information on products, sales or distribution.

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