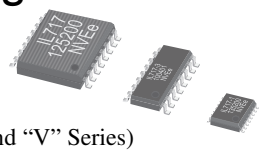
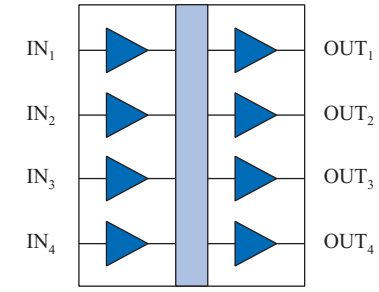
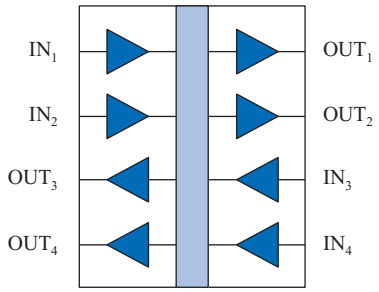
# High Speed Four-Channel Digital Isolators



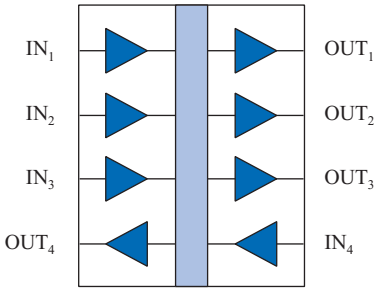
## Functional Diagrams




**IL715**




**IL716**




**IL717**

## Features

- High speed: 110 Mbps
- High temperature: –40 °C to +125 °C (“T” and “V” Series)
- Very high isolation: 6 $kV_{RMS}$ Reinforced Isolation (V-Series)
- 2.7 to 5.5 volt supply range
- 100 kV/µs Common Mode Transient Immunity
- No carrier or clock for low EMI emissions and susceptibility
- 100 ps pulse jitter
- 2 ns channel-to-channel skew
- 10 ns typical propagation delay
- 1.2 mA/channel typical quiescent current
- 44000 year barrier life
- Excellent magnetic immunity
- VDE V 0884 certified; UL 1577 recognized
- 500 $V_{RMS}$ IS -to-IS intrinsically safe
- 0.15" and 0.3" True 8™ mm 16-pin SOIC; 16-pin QSOP packages

## Applications

- ADCs and DACs
- Digital Fieldbus
- Multiplexed data transmission
- Board-to-board communication
- Ground loop elimination
- Parallel bus
- Logic level shifting
- Equipment covered under IEC 61010-1 Edition 3
- 5 $kV_{RMS}$ rated IEC 60601-1 medical applications

## Description

NVE’s IL715, IL716, and IL717 four-channel high-speed digital isolators are CMOS devices manufactured with NVE’s patented* IsoLoop® spintronic Giant Magnetoresistive (GMR) technology.

A unique ceramic/polymer composite barrier provides excellent isolation and virtually unlimited barrier life.

All transmit and receive channels operate at 110 Mbps over the full temperature and supply voltage range. The symmetric magnetic coupling barrier provides a typical propagation delay of only 10 ns and a pulse width distortion of 2 ns, achieving the best specifications of any isolator.

Minimum transient immunity of 100 kV/µs is unsurpassed. High channel density makes these devices ideal for isolating ADCs and DACs, parallel buses and peripheral interfaces.

The IL715, IL716, and IL717 are available in 16-pin 0.3" and 0.15" SOIC, and ultraminiature QSOP packages.

Performance is specified over a temperature range of –40 °C to +100 °C. “T” and “V” Series parts have a maximum operating temperature of 125 °C.

V-Series versions have an extremely high isolation voltage of 6 $kV_{RMS}$.

IsoLoop is a registered trademark of NVE Corporation.
*U.S. Patent numbers 5,831,426; 6,300,617 and others.

**REV. AG**

## Absolute Maximum Ratings

| Parameters | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Storage Temperature | $T_S$ | −55 | | 150 | °C | |
| Junction Temperature | $T_J$ | −55 | | 150 | °C | |
| Ambient Operating Temperature[1] | $T_A$ | −55 | | 130 | °C | |
| Supply Voltage | $V_{DD1}$, $V_{DD2}$ | −0.5 | | 7 | V | |
| Input Voltage | $V_I$ | −0.5 | | $V_{DD}$+0.5 | V | |
| Output Voltage | $V_O$ | −0.5 | | $V_{DD}$+0.5 | V | |
| Output Current Drive | $I_O$ | | | 10 | mA | |
| Lead Solder Temperature | | | | 260 | °C | 10 sec. |
| ESD | | | 2 | | kV | HBM |

## Recommended Operating Conditions

| Parameters | Symbol | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| Ambient Operating Temperature<br>"T" and "V" Versions<br>All other part types | $T_A$ | −40 | | <br>125<br>100 | °C | |
| Junction Temperature<br>"T" and "V" Versions<br>All other part types | $T_J$ | −40 | | <br>125<br>110 | °C | |
| Supply Voltage | $V_{DD1}$, $V_{DD2}$ | 2.7 | | 5.5 | V | |
| Logic High Input Voltage | $V_{IH}$ | 2.4 | | $V_{DD}$ | V | |
| Logic Low Input Voltage | $V_{IL}$ | 0 | | 0.8 | V | |
| Input Signal Rise and Fall Times | $t_{IR}$, $t_{IF}$ | | | 1 | µs | |



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## Safety and Approvals

***VDE V 0884-10*** (VDE V 0884-11 pending)

V-Series (Reinforced Isolation; VDE File Number 5016933-4880-0002)

- Working Voltage ($V_{IORM}$) 1000 $V_{RMS}$ (1415 $V_{PK}$); reinforced insulation; pollution degree 2
- Isolation voltage ($V_{ISO}$) 6000 $V_{RMS}$
- Surge immunity ($V_{IOSM}$) 12.8 $kV_{PK}$
- Surge rating 8 kV
- Transient overvoltage ($V_{IOTM}$) 6000 $V_{PK}$
- Each part tested at 2387 $V_{PK}$ for 1 second, 5 pC partial discharge limit
- Samples tested at 6000 $V_{PK}$ for 60 sec.; then 2122 $V_{PK}$ for 10 sec. with 5 pC partial discharge limit

Standard versions (Basic Isolation; VDE File Number 5016933-4880-0001)

- Working Voltage ($V_{IORM}$) 600 $V_{RMS}$ (848 $V_{PK}$); basic insulation; pollution degree 2
- Isolation voltage ($V_{ISO}$) 2500 $V_{RMS}$
- Transient overvoltage ($V_{IOTM}$) 4000 $V_{PK}$
- Surge rating 4000 V
- Each part tested at 1590 $V_{PK}$ for 1 second, 5 pC partial discharge limit
- Samples tested at 4000 $V_{PK}$ for 60 sec.; then 1358 $V_{PK}$ for 10 sec. with 5 pC partial discharge limit

| Safety-Limiting Values | Symbol | Value | Units |
|---|---|---|---|
| Safety rating ambient temperature | $T_S$ | 180 | °C |
| Safety rating power (180 °C) | $P_S$ | 270 | mW |
| Supply current safety rating (total of supplies) | $I_S$ | 54 | mA |

***IEC 61010-1*** (Edition 2; TUV Certificate Numbers N1502812; N1502812-101)

Reinforced Insulation; Pollution Degree II; Material Group III

| Part No. Suffix | Package | Working Voltage |
|---|---|---|
| -1 | QSOP | 300 $V_{RMS}$ |
| -3 | 0.15" SOIC | 300 $V_{RMS}$ |
| None | 0.3" SOIC (standard) | 300 $V_{RMS}$ |
| V | 0.3" SOIC (high isolation voltage) | 1000 $V_{RMS}$ |

***UL 1577*** (Component Recognition Program File Number E207481)

- 6 kV-rated V-Series parts tested at 7.2 $kV_{RMS}$ (10.2 $kV_{PK}$) for 1 second; each lot sample tested at 6 $kV_{RMS}$ (8485 $V_{PK}$) for 1 minute
- 2.5 kV-rated parts tested at 3000 $V_{RMS}$ (4240 $V_{PK}$) for 1 second; each lot sample tested at 2500 $V_{RMS}$ (3530 $V_{PK}$) for 1 minute

***ATEC / IEC 60079-0 / 60079-11*** (Intrinsic Safety under Explosive Atmosphere Standards)

- IS-to-IS Certification pending
- 500 $V_{RMS}$ rating

## Soldering Profile

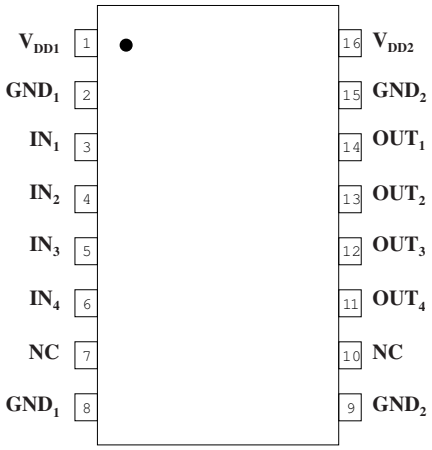
Per JEDEC J-STD-020C, MSL 1



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## IL715 Pin Connections

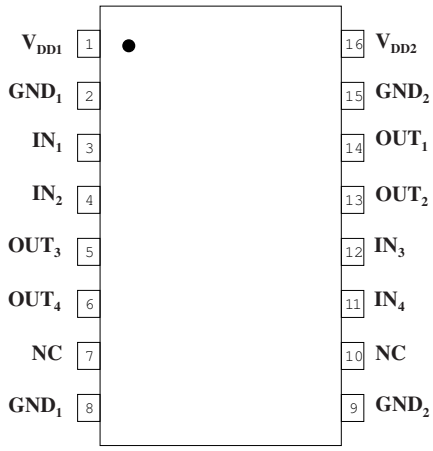
| | | |
|---|---|---|
| 1 | $V_{DD1}$ | Supply voltage |
| 2 | $GND_1$ | Ground return for $V_{DD1}$* |
| 3 | $IN_1$ | Data in, channel 1 |
| 4 | $IN_2$ | Data in, channel 2 |
| 5 | $IN_3$ | Data in, channel 3 |
| 6 | $IN_4$ | Data in, channel 4 |
| 7 | NC | No connection |
| 8 | $GND_1$ | Ground return for $V_{DD1}$* |
| 9 | $GND_2$ | Ground return for $V_{DD2}$* |
| 10 | NC | No connection |
| 11 | $OUT_4$ | Data out, channel 4 |
| 12 | $OUT_3$ | Data out, channel 3 |
| 13 | $OUT_2$ | Data out, channel 2 |
| 14 | $OUT_1$ | Data out, channel 1 |
| 15 | $GND_2$ | Ground return for $V_{DD2}$* |
| 16 | $V_{DD2}$ | Supply voltage |




IL715

## IL716 Pin Connections

| | | |
|---|---|---|
| 1 | $V_{DD1}$ | Supply voltage |
| 2 | $GND_1$ | Ground Return for $V_{DD1}$* |
| 3 | $IN_1$ | Data in, channel 1 |
| 4 | $IN_2$ | Data in, channel 2 |
| 5 | $OUT_3$ | Data out, channel 3 |
| 6 | $OUT_4$ | Data out, channel 4 |
| 7 | NC | No connection |
| 8 | $GND_1$ | Ground Return for $V_{DD1}$* |
| 9 | $GND_2$ | Ground Return for $V_{DD2}$* |
| 10 | NC | No connection |
| 11 | $IN_4$ | Data in, channel 4 |
| 12 | $IN_3$ | Data in, channel 3 |
| 13 | $OUT_2$ | Data out, channel 2 |
| 14 | $OUT_1$ | Data out, channel 1 |
| 15 | $GND_2$ | Ground Return for $V_{DD2}$* |
| 16 | $V_{DD2}$ | Supply voltage |




IL716

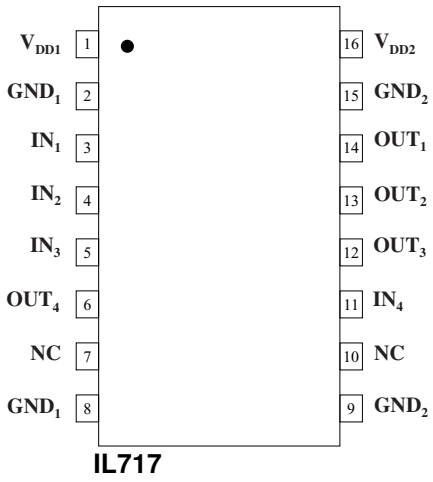
***NOTE:** Pins 2 and 8 are internally connected, as are pins 9 and 15.



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## IL717 Pin Connections

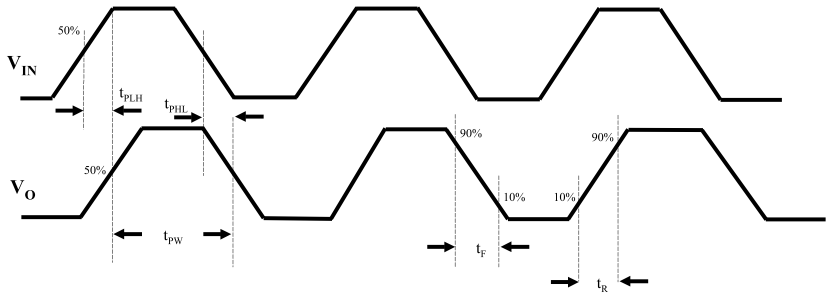
| | | |
|---|---|---|
| 1 | $V_{DD1}$ | Supply voltage |
| 2 | $GND_1$ | Ground return for $V_{DD1}$* |
| 3 | $IN_1$ | Data in, channel 1 |
| 4 | $IN_2$ | Data in, channel 2 |
| 5 | $IN_3$ | Data in, channel 3 |
| 6 | $OUT_4$ | Data out, channel 4 |
| 7 | NC | No connection |
| 8 | $GND_1$ | Ground return for $V_{DD1}$* |
| 9 | $GND_2$ | Ground return for $V_{DD2}$* |
| 10 | NC | No connection |
| 11 | $IN_4$ | Data in, channel 4 |
| 12 | $OUT_3$ | Data out, channel 3 |
| 13 | $OUT_2$ | Data out, channel 2 |
| 14 | $OUT_1$ | Data out, channel 1 |
| 15 | $GND_2$ | Ground return for $V_{DD2}$* |
| 16 | $V_{DD2}$ | Supply voltage |



IL717

***NOTE:** Pins 2 and 8 are internally connected, as are pins 9 and 15.

## 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 |



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| **3.3 Volt Electrical Specifications** ($T_{min}$ to $T_{max}$ unless otherwise stated) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Test Conditions** |
| Input Quiescent Supply Current | | | | | | |
| IL715 and IL715-3 | $I_{DD1}$ | | 16 | 20 | µA | |
| IL715-1 | | | 300 | 400 | µA | |
| IL716 | | | 2.4 | 3.5 | mA | |
| IL717 | | | 1.2 | 1.75 | mA | |
| Output Quiescent Supply Current | | | | | | |
| IL715 | $I_{DD2}$ | | 4.8 | 7 | mA | |
| IL716 | | | 2.4 | 3.5 | mA | |
| IL717 | | | 3.6 | 5.25 | mA | |
| Logic Input Current | $I_I$ | −10 | | 10 | µA | |
| Logic High Output Voltage | $V_{OH}$ | $V_{DD}$ − 0.1 | $V_{DD}$ | | V | $I_O$ = −20 µA, $V_I$ = $V_{IH}$ |
| | | 0.8 x $V_{DD}$ | 0.9 x $V_{DD}$ | | | $I_O$ = −4 mA, $V_I$ = $V_{IH}$ |
| Logic Low Output Voltage | $V_{OL}$ | | 0 | 0.1 | V | $I_O$ = 20 µA, $V_I$ = $V_{IL}$ |
| | | | 0.5 | 0.8 | | $I_O$ = 4 mA, $V_I$ = $V_{IL}$ |

| **Switching Specifications** ($V_{DD}$ = 3.3 V) | | | | | | |
|---|---|---|---|---|---|---|
| Maximum Data Rate | | 100 | 110 | | Mbps | $C_L$ = 15 pF |
| Pulse Width[7] | PW | 10 | | | ns | 50% Points, $V_O$ |
| Propagation Delay Input to Output (High to Low) | $t_{PHL}$ | | 12 | 18 | ns | $C_L$ = 15 pF |
| Propagation Delay Input to Output (Low to High) | $t_{PLH}$ | | 12 | 18 | ns | $C_L$ = 15 pF |
| Pulse Width Distortion [2] | PWD | | 2 | 3 | ns | $C_L$ = 15 pF |
| Propagation Delay Skew [3] | $t_{PSK}$ | | 4 | 6 | ns | $C_L$ = 15 pF |
| Output Rise Time (10%–90%) | $t_R$ | | 2 | 4 | ns | $C_L$ = 15 pF |
| Output Fall Time (10%–90%) | $t_F$ | | 2 | 4 | ns | $C_L$ = 15 pF |
| Common Mode Transient Immunity (Output Logic High or Logic Low)[4] | $\|CM_H\|$,$\|CM_L\|$ | 100 | 150 | | kV/µs | Per IEC 60747 |
| Channel-to-Channel Skew | $t_{CSK}$ | | 2 | 3 | ns | $C_L$ = 15 pF |
| Dynamic Power Consumption[6] | | | | | | |
| ) Output side | | | 140 | 240 | µA/Mbps/ch | |
| Input side | | | 20 | 40 | | |

| **Magnetic Field Immunity**[8] ($V_{DD2}$ = 2.7 V, 2.7 V < $V_{DD1}$ < 5.5V) | | | | | | |
|---|---|---|---|---|---|---|
| Power Frequency Magnetic Immunity | $H_{PF}$ | | 1500 | | A/m | 50Hz/60Hz |
| Pulse Magnetic Field Immunity | $H_{PM}$ | | 2000 | | A/m | $t_p$ = 8µs |
| Damped Oscillatory Magnetic Field | $H_{OSC}$ | | 2000 | | A/m | 0.1Hz – 1MHz |
| Cross-axis Immunity Multiplier[9] | $K_X$ | | 2.5 | | | |

| **5 Volt Electrical Specifications** ($T_{min}$ to $T_{max}$ unless otherwise stated) | | | | | | |
|---|---|---|---|---|---|---|
| **Parameters** | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Test Conditions** |
| Input Quiescent Supply Current | | | | | | |
| IL715 and IL715-3 | $I_{DD1}$ | | 24 | 30 | µA | |
| IL715-1 | | | 350 | 500 | µA | |
| IL716 | | | 3.6 | 5 | mA | |
| IL717 | | | 1.8 | 2.5 | mA | |
| Output Quiescent Supply Current | | | | | | |
| IL715 | $I_{DD2}$ | | 7.2 | 10 | mA | |
| IL716 | | | 3.6 | 5 | mA | |
| IL717 | | | 5.4 | 7.5 | mA | |
| Logic Input Current | $I_I$ | −10 | | 10 | µA | |
| Logic High Output Voltage | $V_{OH}$ | $V_{DD}$ − 0.1 | $V_{DD}$ | | V | $I_O$ = −20 µA, $V_I$ = $V_{IH}$ |
| | | 0.8 x $V_{DD}$ | 0.9 x $V_{DD}$ | | | $I_O$ = −4 mA, $V_I$ = $V_{IH}$ |
| Logic Low Output Voltage | $V_{OL}$ | | 0 | 0.1 | V | $I_O$ = 20 µA, $V_I$ = $V_{IL}$ |
| | | | 0.5 | 0.8 | | $I_O$ = 4 mA, $V_I$ = $V_{IL}$ |

| **Switching Specifications** ($V_{DD}$ = 5V) | | | | | | |
|---|---|---|---|---|---|---|
| Maximum Data Rate | | 100 | 110 | | Mbps | $C_L$ = 15 pF |
| Pulse Width[7] | PW | 10 | | | ns | 50% Points, $V_O$ |
| Propagation Delay Input to Output (High to Low) | $t_{PHL}$ | | 10 | 15 | ns | $C_L$ = 15 pF |
| Propagation Delay Input to Output (Low to High) | $t_{PLH}$ | | 10 | 15 | ns | $C_L$ = 15 pF |
| Pulse Width Distortion[2] | PWD | | 2 | 3 | | $C_L$ = 15 pF |
| Pulse Jitter[10] | $t_J$ | | 100 | | ps | $C_L$ = 15 pF |
| Propagation Delay Skew[3] | $t_{PSK}$ | | 4 | 6 | ns | $C_L$ = 15 pF |
| Output Rise Time (10%–90%) | $t_R$ | | 1 | 3 | ns | $C_L$ = 15 pF |
| Output Fall Time (10%–90%) | $t_F$ | | 1 | 3 | ns | $C_L$ = 15 pF |
| Common Mode Transient Immunity (Output Logic High or Logic Low)[4] | $\|CM_H\|,\|CM_L\|$ | 100 | 150 | | kV/µs | Per IEC 60747 |
| Channel-to-Channel Skew | $t_{CSK}$ | | 2 | 3 | ns | $C_L$ = 15 pF |
| Dynamic Power Consumption[6] | | | | | | |
| Output side | | | 140 | 240 | µA/Mbps/ch | |
| Input side | | | 30 | 50 | | |

| **Magnetic Field Immunity**[8] ($V_{DD2}$= 5V, 2.7 V < $V_{DD1}$ < 5.5V) | | | | | | |
|---|---|---|---|---|---|---|
| Power Frequency Magnetic Immunity | $H_{PF}$ | | 3500 | | A/m | 50Hz/60Hz |
| Pulse Magnetic Field Immunity | $H_{PM}$ | | 4500 | | A/m | $t_p$ = 8µs |
| Damped Oscillatory Magnetic Field | $H_{OSC}$ | | 4500 | | A/m | 0.1Hz – 1MHz |
| Cross-axis Immunity Multiplier[9] | $K_X$ | | 2.5 | | | |



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| Insulation Specifications | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Test Conditions** |
| Creepage Distance (external) | QSOP<br>0.15" SOIC<br>0.3" SOIC | | 4.03<br>4.03<br>8.03 | <br><br>8.3 | | mm | Per IEC 60601 |
| Total Barrier Thickness (internal) | | | 0.012 | 0.016 | | mm | |
| Leakage Current[5] | | | | 0.2 | | µA | 240 $V_{RMS}$, 60 Hz |
| Barrier Resistance[5] | | | | $>10^{14}$ | | Ω | 500 V |
| Barrier Capacitance[5] | | | | 4 | | pF | f = 1 MHz |
| Comparative Tracking Index | QSOP<br>0.15" SOIC<br>0.3" SOIC | CTI | ≥175<br>≥175<br>≥600 | | | $V_{RMS}$ | Per IEC 60112 |
| High Voltage Endurance (Maximum Barrier Voltage for Indefinite Life) | AC<br><br>DC | $V_{IO}$ | 1000<br><br>1500 | | | $V_{RMS}$<br><br>$V_{DC}$ | At maximum operating temperature |
| Surge Immunity ("V" Versions) | | $V_{IOSM}$ | 12.8 | | | $kV_{PK}$ | Per IEC 61000-4-5 |
| Barrier Life | | | | 44000 | | Years | 100°C, 1000 $V_{RMS}$, 60% CL activation energy |

| Thermal Characteristics | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Parameter** | | **Symbol** | **Min.** | **Typ.** | **Max.** | **Units** | **Test Conditions** |
| Junction–Ambient Thermal Resistance | QSOP<br>0.15" SOIC16<br>0.3" SOIC16 | $\theta_{JA}$ | | 100<br>82<br>67 | | °C/W | Double-sided PCB in free air |
| Junction–Case (Top) Thermal Resistance | QSOP<br>0.15" SOIC16<br>0.3" SOIC16 | $\theta_{JC}$ | | 9<br>8<br>12 | | | |
| Junction–Ambient Thermal Resistance | 0.3" SOIC | $\theta_{JA}$ | | 46 | | | 2s2p PCB in free air per JESD51 |
| Junction–Case (Top) Thermal Resistance | | $\theta_{JC}$ | | 9 | | | |
| Power Dissipation | QSOP<br>0.15" SOIC16<br>0.3" SOIC16 | $P_D$ | | | 675<br>675<br>1500 | mW | |

**Notes** (apply to both 3.3 V and 5 V specifications):

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 PWD divided by pulse width.
3. $t_{PSK}$ is the magnitude of the worst-case difference in $t_{PHL}$ and/or $t_{PLH}$ between devices at 25 °C.
4. $CM_H$ and $CM_L$ are the maximum common mode voltage slew rates that can be applied with the outputs remaining stable and within $V_{OL}$ and $V_{OH}$ specifications.
5. Device is considered a two terminal device: pins 1–8 shorted and pins 9–16 shorted.
6. Dynamic power consumption is calculated per channel.
7. Minimum pulse width is the minimum value at which specified PWD is guaranteed.
8. The relevant test and measurement methods are given in the Electromagnetic Compatibility section on p. 10.
9. External magnetic field immunity is improved by this factor if the field direction is "end-to-end" rather than to "pin-to-pin" (see diagram on p. 10).
10. 66,535-bit pseudo-random binary signal (PRBS) NRZ bit pattern with no more than five consecutive 1s or 0s; 800 ps transition time.

## Typical Performance Graphs

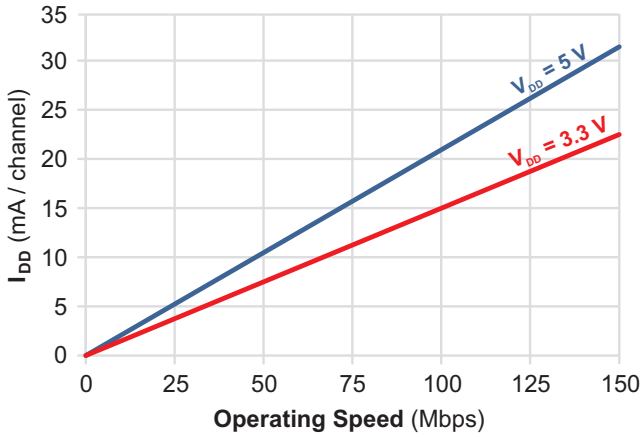



**Figure 1. Supply current (per channel) vs. operating speed.**

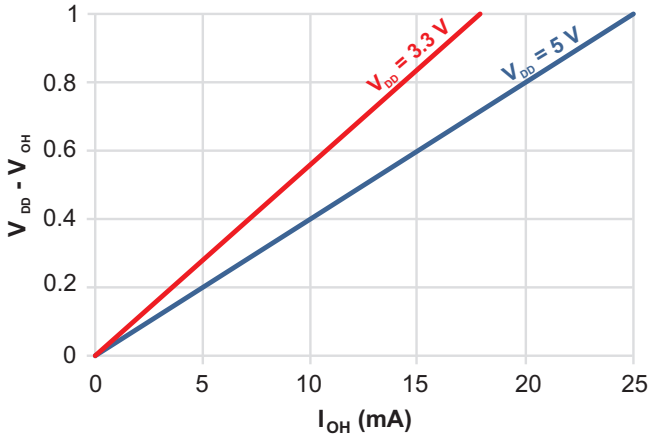



**Figure 2. Typical high output voltage vs. load.**

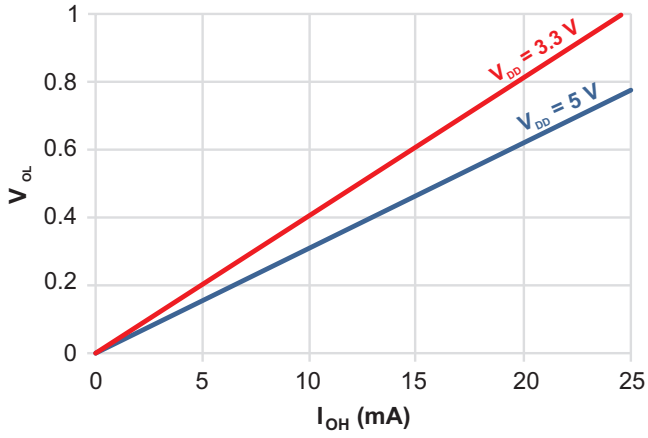



**Figure 3. Typical low output voltage vs. load**

## Application Information

### Isolator Operation

An equivalent circuit is shown below:

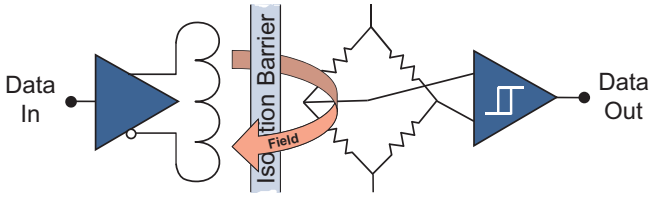



**Figure 4. IL715/IL716/IL717 equivalent circuit (each channel).**

*Isolator Signal Path*

The GMR isolator signal path starts with a buffered input signal that is driven through an ultraminiature coil. This generates a small magnetic field that changes the electron spin polarization of GMR resistors, which are configured as a Wheatstone bridge. The change in spin polarization of the resistors creates a bridge voltage which drives an output comparator to construct an isolated version of the input signal.

*Small Size, High Speed, and Low EMI*

The coil, GMR, and circuitry are integrated to allow small packages. GMR is inherently high speed and low distortion, and unlike transformers, does not rely on energy transfer, so power is low and EMI emissions are minimal.

*High Magnetic Immunity*

GMR provides large signals which improve magnetic immunity, and the Wheatstone bridge configuration cancels ambient common-mode magnetic fields, further enhancing immunity to external magnetic fields.

## Electrostatic Discharge Sensitivity

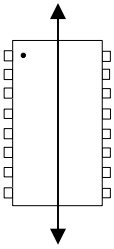
This product has been tested for electrostatic sensitivity to the limits stated in the specifications. However, NVE recommends that all integrated circuits be handled with appropriate care to avoid damage. Damage caused by inappropriate handling or storage could range from performance degradation to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

## Electromagnetic Compatibility

IsoLoop Isolators have the lowest EMC footprint of any isolation technology. IsoLoop Isolators' Wheatstone bridge configuration and differential magnetic field signaling ensure excellent EMC performance against all relevant standards.

These isolators are fully compliant with IEC 61000-6-1 and IEC 61000-6-2 standards for immunity, and IEC 61000-6-3, IEC 61000-6-4, CISPR, and FCC Class A standards for emissions.

Immunity to external magnetic fields is even higher if the field direction is "end-to-end" rather than to "pin-to-pin" as shown in the diagram below:



Cross-axis Field Direction

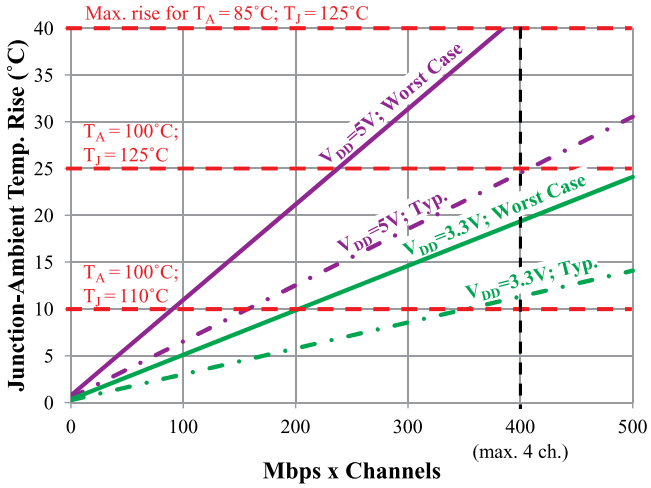
## Dynamic Power Consumption

IsoLoop Isolators achieve their low power consumption from the way 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 2.5 ns, the power consumption is independent of mark-to-space ratio and solely dependent on frequency. This has obvious advantages over optocouplers, which have power consumption heavily dependent on mark-to-space ratio.

## Thermal Management

IsoLoop Isolators are designed for low power dissipation and thermal performance, providing unmatched channel density for high-performance isolators. Nevertheless, package temperature rise should be considered when running multiple channels at high speed. Power consumption is higher at 5 volt operation than at 3.3 volts, and dynamic supply current is higher on the input side of the isolators than the output side, so thermal management is more important with five-volt input-side power supplies.

Based on the specifications contained in this datasheet, the derating curve at typical operating conditions is as follows:




Standard-grade parts have a maximum junction temperature of 110°C. T-Series parts have a maximum operating junction temperature of 125°C for additional margin at extreme operating conditions.

## Power Supply Decoupling

Both power supplies should be decoupled with 0.1 µF typical (0.047 µF minimum) capacitors as close as possible to the $V_{DD}$ pins. Ground planes for both $GND_1$ and $GND_2$ are highly recommended for data rates above 10 Mbps.

## Maintaining Creepage

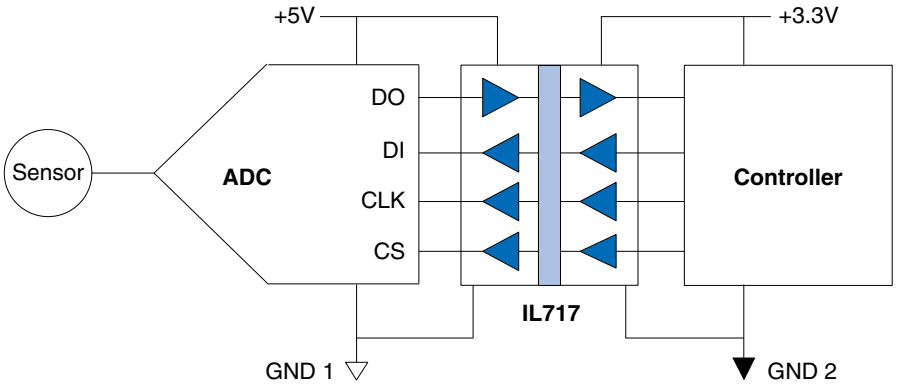
Creepage distances are often critical in isolated circuits. In addition to meeting JEDEC standards, NVE isolator packages have unique creepage specifications. Standard pad libraries often extend under the package, compromising creepage and clearance. Similarly, ground planes, if used, should be spaced to avoid compromising clearance. Package drawings and recommended pad layouts are included in this datasheet.

## Signal Status on Start-up and Shut Down

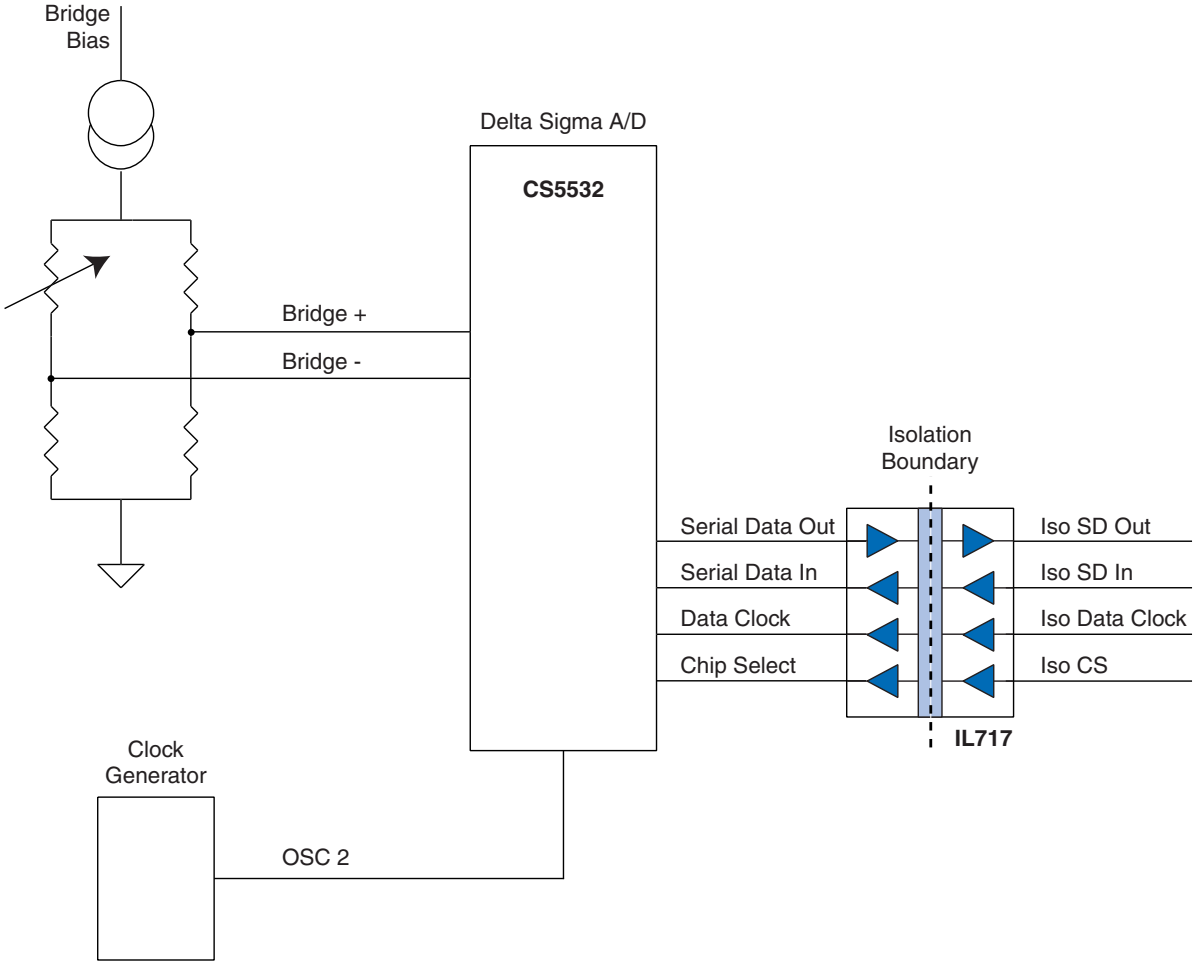
To minimize power dissipation, input signals are differentiated and then latched on the output side of the isolation barrier to reconstruct the signal. This could result in an ambiguous output state depending on power up, shutdown and power loss sequencing. Therefore, the designer should consider including an initialization signal in the start-up circuit. Initialization consists of toggling the input either high then low, or low then high.

## Application Diagrams

### Isolated Logic Level Shifters




### Single-Channel Isolated Delta-Sigma A/D Converter

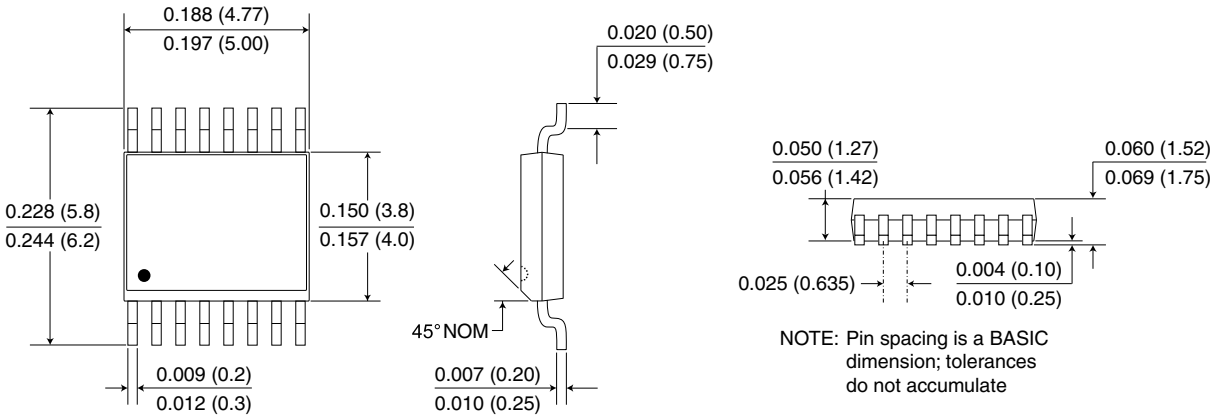



This circuit illustrates a typical single-channel delta-sigma ADC. The A/D is located on the bridge with no signal conditioning electronics between the bridge sensor and the ADC. In this case, the IL717 is the best choice for isolation. It isolates the control bus from the microcontroller. The system clock is located on the isolated side of the system.

## Package Drawings

### **Ultraminiature 16-pin QSOP Package** (-1 suffix)

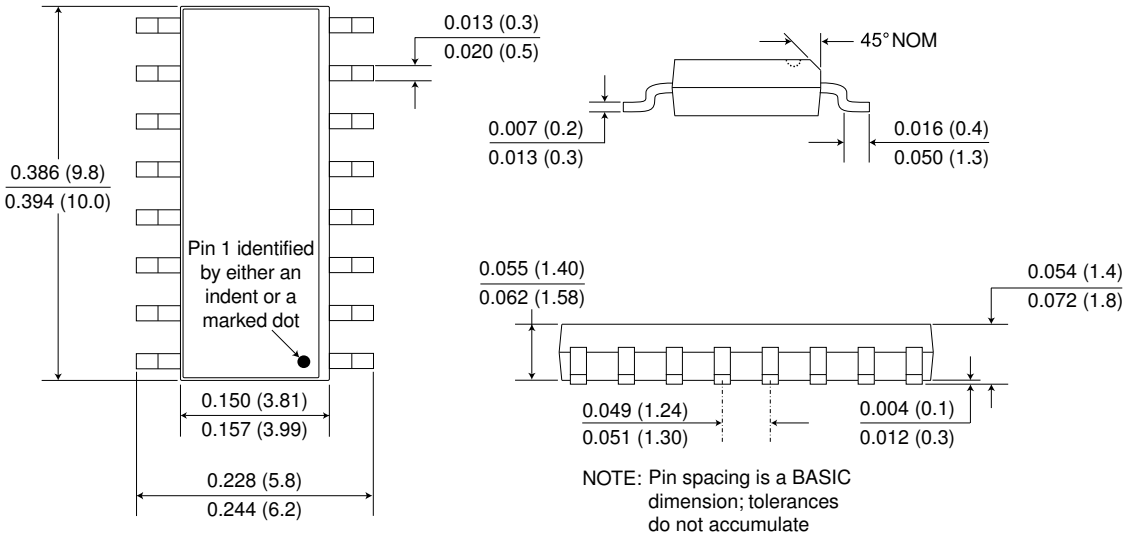
Dimensions in inches (mm); scale = approx. 5X




NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

### **0.15" 16-pin SOIC Package** (-3 suffix)

Dimensions in inches (mm); scale = approx. 5X



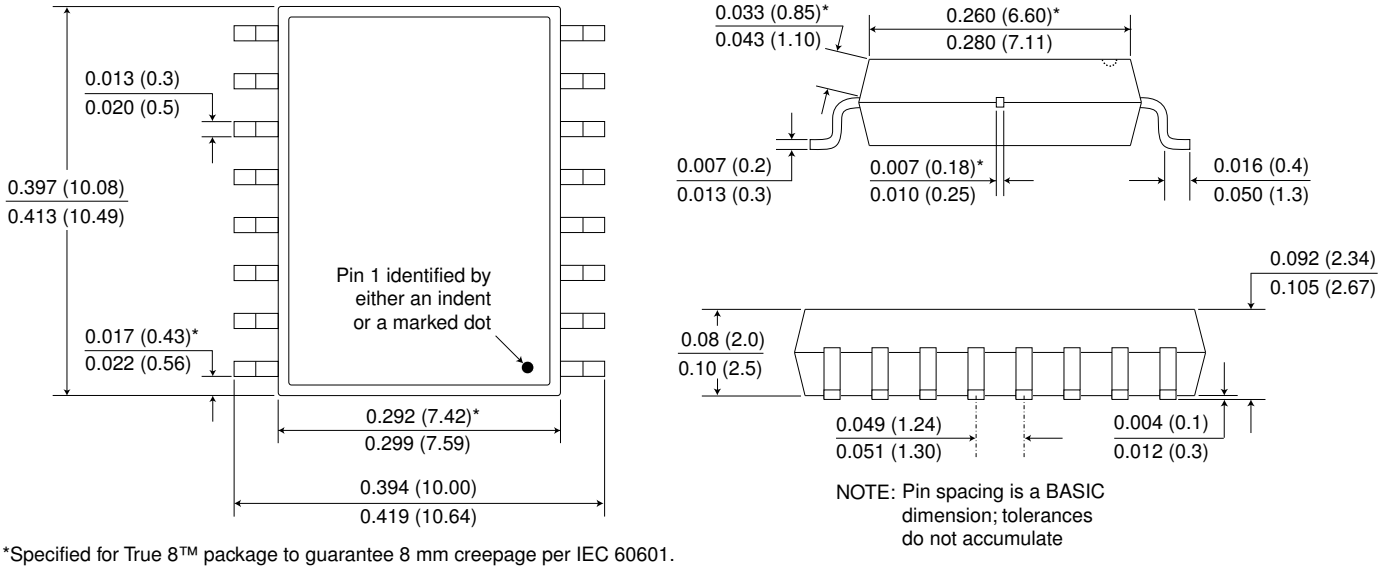

NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate



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## **0.3" 16-pin SOIC Package** (no suffix)

Dimensions in inches (mm); scale = approx. 5X




NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

*Specified for True 8™ package to guarantee 8 mm creepage per IEC 60601.

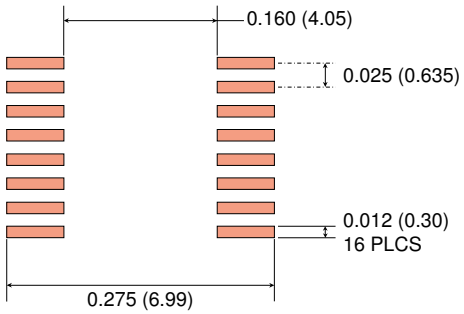


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## Recommended Pad Layouts

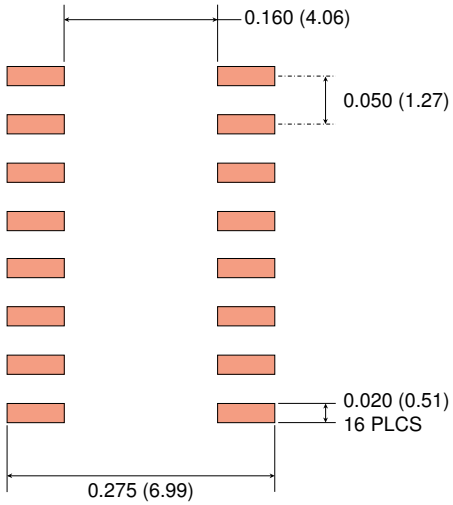
### 4 mm x 5 mm 16-pin QSOP Pad Layout

Dimensions in inches (mm); scale = approx. 5X




### 0.15" 16-pin SOIC Pad Layout

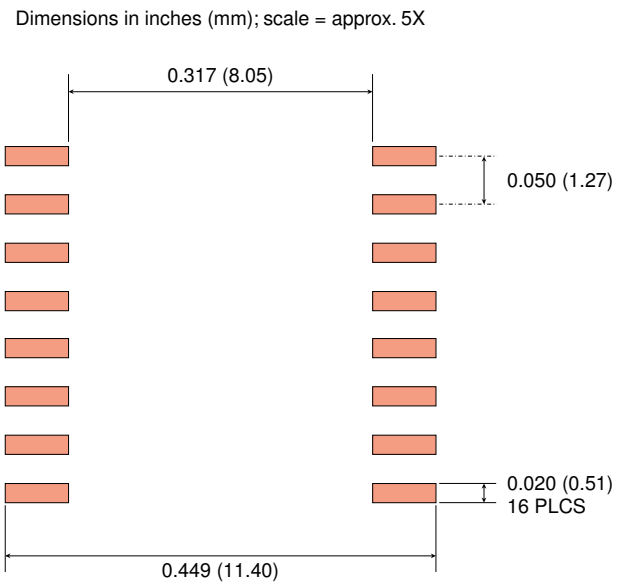
Dimensions in inches (mm); scale = approx. 5X






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## 0.3" 16-pin SOIC Pad Layout






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## Ordering Information

IL 716 T - 3 E TR13

**Bulk Packaging**
Blank = Tube
TR7 = 7" Tape and Reel
TR13 = 13" Tape and Reel

**Package**
Blank = 80/20 Tin/Lead Plating
E = RoHS Compliant Pb-Free

**Package Type**
Blank = 0.30" 16-pin SOIC
-1 = 0.15" 16-pin QSOP
-3 = 0.15" 16-pin SOIC

**Grade**
Blank = Standard Temperature (100 °C) and Isolation Voltage (2.5 kV)
T = High Temperature (125 °C)
V = High Isolation Voltage (6 kV) and High Temperature (125 °C)

**Base Part Number**
715 = 4 Transmit Channels
716 = 2 Transmit Channels; 2 Receive Channels
717 = 3 Transmit Channels; 1 Receive Channel

**Product Family**
IL = Isolators



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## Available Parts

| Available Parts | Transmit Channels | Receive Channels | Maximum Temperature | Isolation Voltage (RMS) | Package | RoHS |
|---|---|---|---|---|---|---|
| IL715-1E | 4 | 0 | 100°C | 2.5 kV | QSOP | Y |
| IL715-3 | 4 | 0 | 100°C | 2.5 kV | Narrow SOIC | N |
| IL715-3E | 4 | 0 | 100°C | 2.5 kV | Narrow SOIC | Y |
| IL715 | 4 | 0 | 100°C | 2.5 kV | Wide SOIC | N |
| IL715E | 4 | 0 | 100°C | 2.5 kV | Wide SOIC | Y |
| IL715T-3 | 4 | 0 | 125°C | 2.5 kV | Narrow SOIC | N |
| IL715T-3E | 4 | 0 | 125°C | 2.5 kV | Narrow SOIC | Y |
| IL715T | 4 | 0 | 125°C | 2.5 kV | Wide SOIC | N |
| IL715TE | 4 | 0 | 125°C | 2.5 kV | Wide SOIC | Y |
| IL715VE | 4 | 0 | 125°C | 6 kV | Wide SOIC | Y |
| IL716-1E | 2 | 2 | 100°C | 2.5 kV | QSOP | Y |
| IL716-3 | 2 | 2 | 100°C | 2.5 kV | Narrow SOIC | N |
| IL716-3E | 2 | 2 | 100°C | 2.5 kV | Narrow SOIC | Y |
| IL716 | 2 | 2 | 100°C | 2.5 kV | Wide SOIC | N |
| IL716E | 2 | 2 | 100°C | 2.5 kV | Wide SOIC | Y |
| IL716T-3 | 2 | 2 | 125°C | 2.5 kV | Narrow SOIC | N |
| IL716T-3E | 2 | 2 | 125°C | 2.5 kV | Narrow SOIC | Y |
| IL716T | 2 | 2 | 125°C | 2.5 kV | Wide SOIC | N |
| IL716TE | 2 | 2 | 125°C | 2.5 kV | Wide SOIC | Y |
| IL716VE | 2 | 2 | 125°C | 6 kV | Wide SOIC | Y |
| IL717-1E | 3 | 1 | 100°C | 2.5 kV | QSOP | Y |
| IL717-3 | 3 | 1 | 100°C | 2.5 kV | Narrow SOIC | N |
| IL717-3E | 3 | 1 | 100°C | 2.5 kV | Narrow SOIC | Y |
| IL717 | 3 | 1 | 100°C | 2.5 kV | Wide SOIC | N |
| IL717E | 3 | 1 | 100°C | 2.5 kV | Wide SOIC | Y |
| IL717T-3 | 3 | 1 | 125°C | 2.5 kV | Narrow SOIC | N |
| IL717T-3E | 3 | 1 | 125°C | 2.5 kV | Narrow SOIC | Y |
| IL717T | 3 | 1 | 125°C | 2.5 kV | Wide SOIC | N |
| IL717TE | 3 | 1 | 125°C | 2.5 kV | Wide SOIC | Y |
| IL717VE | 3 | 1 | 125°C | 6 kV | Wide SOIC | Y |

All part types are available on tape and reel.

**ISB-DS-001-IL715/6/7-AH**
**November 2020**

**Changes**

- Upgraded CMTI specifications.
- Added ATEC / IEC 60079 Intrinsic Safety pending (p. 3).
- Added output-side dynamic current specifications (pp. 6 and 7).

**ISB-DS-001-IL715/6/7-AG**

**Changes**

- Added degree symbol to temperatures on p. 17.
- Deleted redundant parts list table on p. 17.
- Corrected three incorrect RoHS designations in table on p. 18.

**ISB-DS-001-IL715/6/7-AF**

**Changes**

- Extended minimum operating power supply to 2.7 volts.
- Explicitly listed part types for max. operating temperatures.
- Updated EMC standards.
- Deleted minimum magnetic field immunity specifications since it is not 100% tested.
- Revised thermal characteristics.
- Added Typical Performance Graphs.
- More detailed description of operation.

**ISB-DS-001-IL715/6/7-AE**

**Change**

- Updated VDE Reinforced Isolation file number and description.

**ISB-DS-001-IL715/6/7-AD**

**Changes**

- Clarified 600 V CTI specification is for 0.3" SOIC only (p. 2).
- Corrected typographical error in “Available Parts” table (p. 15).

**ISB-DS-001-IL715/6/7-AC**

**Changes**

- Updated VDE certification standard to VDE V 0884-10.
- Upgraded “V” Version Surge Immunity specification to 12.8 kV.
- Upgraded “V” Version VDE 0884-10 rating to reinforced insulation.
- Corrected QSOP pin width dimension (p. 10).

**ISB-DS-001-IL715/6/7-AB**

**Changes**

- Increased V-Series isolation voltage to 6 kVrms.
- Increased typ. Total Barrier Thickness specification to 0.016 mm.
- Increased CTI min. specification to ≥600 Vrms.

**ISB-DS-001-IL715/6/7-AA**

**Changes**

- Added V-Series 5 kV isolation voltage versions.
- More detailed “Available Parts” table.

**ISB-DS-001-IL715/6/7-Z**

**Changes**

- Added package illustrations on first page.
- Added QSOP packages (-1 suffix).
- Revised and added details to thermal characteristic specifications (p. 2).
- Added VDE 0884 Safety-Limiting Values (p. 3).
- Added “Thermal Management” paragraph in Applications section.

**ISB-DS-001-IL715/6/7-Y**

**Changes**

- IEC 60747-5-5 (VDE 0884) certification.

**ISB-DS-001-IL715/6/7-X**

**Changes**

- Tighter quiescent current specifications.
- Upgraded from MSL 2 to MSL 1.



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ISB-DS-001-IL715/6/7-AH

*November 2020*