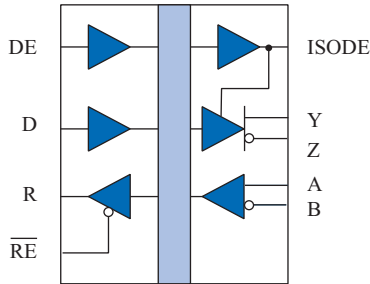




## Isolated RS422/RS485 Interface

### Functional Diagram



**IL422**

#### IL422 Receiver

$\overline{RE}$	R	$V_{(A-B)}$
H	Z	X
L	H	$\geq 200$ mV
L	L	$\leq -200$ mV
L	I	Open

#### IL422 Driver

DE	D	$V_{(Y-Z)}$
L	X	Z
H	H	$\geq 1.5$ V
H	L	$\leq -1.5$ V

H = High Level, L = Low Level  
I = Indeterminate, X = Irrelevant, Z = High Impedance

### Features

- 3.3 V Input Supply Compatible
- 25 ns Maximum Propagation Delay
- 25 Mbps Data Rate
- 1 ns Pulse Skew (typ.)
- $\pm 60$  mA Driver Output Capability
- Thermal Shutdown Protection
- Meets or Exceeds ANSI 422-B, EIA 485-A and ITU Recommended V11
- Low EMC Footprint
- $-40$  °C to  $+85$  °C Operating Temperature
- PROFIBUS Compliant
- 2500  $V_{rms}$  Isolation
- IEC 60747-17 (VDE 0884-17):2021-10 certified; UL 1577 recognized
- 16-pin Wide-Body SOIC Package

### Applications

Multi-point or multi-drop transmission on long bus lines in noisy environments.

### Description

The IL422 is a galvanically isolated, high-speed differential bus transceiver, designed for bidirectional data communication on balanced transmission lines. The devices use NVE's patented\* spintronic Giant Magnetoresistance (GMR) technology. The IL422 was the first isolated RS-422 interface in a standard 16-pin SOIC package to meet the ANSI Standards EIA/TIA-422-B and RS-485.

The IL422 has current limiting and thermal shutdown features to protect against output short circuits and bus contention situations that could cause excessive power dissipation.

## Absolute Maximum Ratings<sup>(11)</sup>

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Storage Temperature	$T_s$	-65		150	°C	
Junction Temperature	$T_j$	-65		150	°C	
Voltage Range at A or B Bus Pins		-7		12	V	
Supply Voltage <sup>(1)</sup>	$V_{DD1}, V_{DD2}$	-0.5		7	V	
Digital Input Voltage		-0.5		5.5	V	
Digital Output Voltage		-0.5		$V_{DD} + 1$	V	
Continuous Total Power Dissipation				725 377	mW	25°C 85°C
Maximum Output Current	$I_o$			95	mA	
Lead Solder Temperature				260	°C	10 sec.
ESD			2		kV	HBM

## Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Supply Voltage	$V_{DD1}$ $V_{DD2}$	3.0 4.5		5.5 5.5	V	
Input Voltage at any Bus Terminal (separately or common mode)	$V_i$ $V_{IC}$			12 -7	V	
High-Level Digital Input Voltage	$V_{IH}$	2.4 3.0		$V_{DD1}$	V	$V_{DD1} = 3.3\text{ V}$ $V_{DD1} = 5.0\text{ V}$
Low-Level Digital Input Voltage	$V_{IL}$	0		0.8	V	
Differential Input Voltage <sup>(2)</sup>	$V_{ID}$			±12	V	
High-Level Output Current (Driver)	$I_{OH}$			60	mA	
High-Level Digital Output Current (Receiver)	$I_{OH}$			8	mA	
Low-Level Output Current (Driver)	$I_{OL}$	-60			mA	
Low-Level Digital Output Current (Receiver)	$I_{OL}$	-8			mA	
Ambient Operating Temperature	$T_A$	-40		85	°C	
Junction Temperature	$T_j$	-40		100	°C	
Transient Immunity		20			kV/μs	
Digital Input Signal Rise and Fall Times	$t_{IR}, t_{IF}$					DC Stable

## Safety and Approvals

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**IEC 60747-17 (VDE 0884-17):2021-10** (Basic Isolation; VDE File Number 5016933-4880-0001)

- 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.
- Working Voltage ( $V_{IORM}$ ) 600  $V_{RMS}$  (848  $V_{PK}$ ); basic insulation; pollution degree 2

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

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

- 2500 V rating
- Each part tested at 3000  $V_{RMS}$  (4243  $V_{PK}$ ) for 1 second
- Each lot sample tested at 2500  $V_{RMS}$  (3536  $V_{PK}$ ) for 1 minute

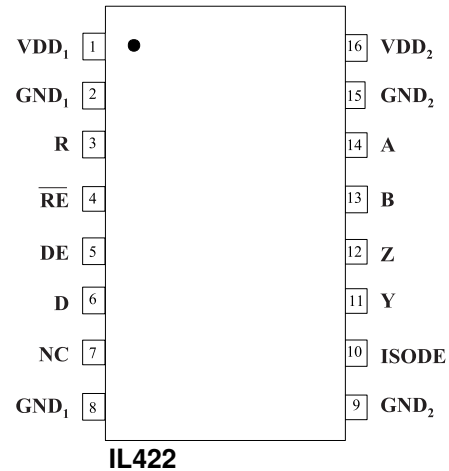
## Soldering Profile

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Per JEDEC J-STD-020C, MSL-1

## IL422 Pin Connections

1	V <sub>DD1</sub>	Input Power Supply
2	GND <sub>1</sub>	Input Power Supply Ground*
3	R	Output Data from Bus
4	$\overline{\text{RE}}$	Read Data Enable (if RE is high, R = high impedance)
5	DE	Drive Enable
6	D	Data Input to Bus
7	NC	No Internal Connection
8	GND <sub>1</sub>	Input Power Supply Ground*
9	GND <sub>2</sub>	Output Power Supply Ground*
10	ISODE	Isolated DE Output for use in Profibus applications where the state of the isolated drive enable node needs to be monitored
11	Y	Y Bus (Drive – True)
12	Z	Z Bus (Drive – Inverse)
13	B	B Bus (Receive – Inverse)
14	A	A Bus (Receive – True)
15	GND <sub>2</sub>	Output Power Supply Ground*
16	V <sub>DD2</sub>	Output Power Supply



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

## Driver Section

Electrical specifications are  $T_{min}$  to  $T_{max}$  and  $V_{DD} = 4.5$  V to 5.5 V unless otherwise stated.

Parameters	Symbol	Min.	Typ. <sup>(5)</sup>	Max.	Units	Test Conditions
Input Clamp Voltage	$V_{IK}$			-1.5	V	$I_L = -18$ mA
Output voltage	$V_O$	0		6	V	$I_O = 0$
Differential Output Voltage <sup>(2)</sup>	$ V_{OD1} $	1.5		6	V	$I_O = 0$
Differential Output Voltage <sup>(2)</sup>	$ V_{OD2} $	1.5	2.5	5	V	$R_L = 54 \Omega$ , $V_{DD} = 5$ V
Differential Output Voltage <sup>(2)(6)</sup>	$V_{OD3}$	1.5		5	V	$R_L = 54 \Omega$ , $V_{DD} = 4.5$ V
Change in Magnitude of Differential Output Voltage <sup>(7)</sup>	$\Delta V_{OD} $			$\pm 0.2$	V	$R_L = 54 \Omega$ or $100 \Omega$
Common Mode Output Voltage	$V_{OC}$			3 -1	V	$R_L = 54 \Omega$ or $100 \Omega$
Change in Magnitude of Common Mode Output Voltage <sup>(7)</sup>	$\Delta V_{OC} $			$\pm 0.2$	V	$R_L = 54 \Omega$ or $100 \Omega$
Output Current <sup>(4)</sup> <i>Output Disabled</i>	$I_O$			1 -0.8	mA	$V_O = 12$ V $V_O = -7$ V
High Level Input Current	$I_{IH}$			10	$\mu$ A	$V_I = 3.5$ V
Low Level Input Current	$I_{IL}$			-10	$\mu$ A	$V_I = 0.4$ V
Short-circuit Output Current	$I_{OS}$			250 -150 -250	mA	$V_O = -6$ V $V_O = 0$ V $V_O = 8$ V
Supply Current	$I_{DD1}$		4	6	mA	No Load
	$I_{DD1}$		3	3	mA	(Outputs Enabled)
Switching Specifications						
Parameters	Symbol	Min.	Typ. <sup>(5)</sup>	Max.	Units	Test Conditions
Maximum Data Rate		25			Mbps	$R_L = 54 \Omega$ , $C_L = 50$ pF
Differential Output Prop Delay	$t_D(OD)$		16	25	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Pulse Skew <sup>(10)</sup>	$t_S(P)$		1	6	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Differential Output Rise & Fall Time	$t_T(OD)$		8	10	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Output Enable Time to High Level	$t_{PZH}$		31	65	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Output Enable Time to Low Level	$t_{PZL}$		22	35	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Output Disable Time from High Level	$t_{PHZ}$		28	50	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Output Disable Time from Low Level	$t_{PLZ}$		16	32	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF
Skew Limit <sup>(3)</sup>	$t_{SK}(LIM)$		2	8	ns	$R_L = 54 \Omega$ , $C_L = 50$ pF

## Receiver Section

Electrical specifications are  $T_{min}$  to  $T_{max}$  and  $V_{DD} = 4.5$  V to 5.5 V unless otherwise stated.

Parameters	Symbol	Min.	Typ. <sup>(5)</sup>	Max.	Units	Test Conditions
Positive-going Input Threshold Voltage	$V_{IT+}$			0.2	V	$V_O = 2.7$ V, $I_O = -0.4$ mA
Negative-going Input Threshold Voltage	$V_{IT-}$	-0.2			V	$V_O = 0.5$ V, $I_O = 8$ mA
Hysteresis Voltage ( $V_{IT+} - V_{IT-}$ )	$V_{HYS}$		60		mV	
High Level Digital Output Voltage	$V_{OH}$	$V_{DD} - 0.2$			V	$V_{ID} = 200$ mV $I_{OH} = -20$ $\mu$ A
Low Level Digital Output Voltage	$V_{OL}$			0.2	V	$V_{ID} = -200$ mV $I_{OH} = 20$ $\mu$ A
High-impedance-state output current	$I_{OZ}$			$\pm 10$	$\mu$ A	$V_O = 0.4$ to $(V_{DD2} - 0.5)$ V
Line Input Current <sup>(8)</sup>	$I_I$			1 -0.8	mA	$V_I = 12$ V $V_I = -7$ V Other Input <sup>(11)</sup> = 0 V
Input Resistance	$r_I$	12	20		k $\Omega$	
Supply Current	$I_{DD2}$		27	34	mA	No load Outputs Enabled

### Switching Characteristics at 5 V

Parameters	Symbol	Min.	Typ. <sup>(5)</sup>	Max.	Units	Test Conditions
Maximum Data Rate		25			Mbps	$R_L = 54$ $\Omega$ , $C_L = 50$ pF
Propagation Delay <sup>(9)</sup>	$t_{PD}$		24	32	ns	$V_O = -1.5$ V to 1.5 V, $C_L = 15$ pF
Pulse Skew <sup>(10)</sup>	$t_{sk}(P)$		1	6	ns	$V_O = -1.5$ V to 1.5 V, $C_L = 15$ pF
Skew Limit <sup>(3)</sup>	$t_{sk}(LIM)$		2	8	ns	$R_L = 54$ $\Omega$ , $C_L = 50$ pF
Output Enable Time To High Level	$t_{PZH}$		17	24	ns	$C_L = 15$ pF
Output Enable Time To Low Level	$t_{PZL}$		30	45	ns	$C_L = 15$ pF
Output Disable Time From High Level	$t_{PHZ}$		30	45	ns	$C_L = 15$ pF
Output Disable Time From Low Level	$t_{PLZ}$		18	27	ns	$C_L = 15$ pF

### Switching Characteristics at 3.3 V

Parameters	Symbol	Min.	Typ. <sup>(5)</sup>	Max.	Units	Test Conditions
Maximum Data Rate		25			Mbps	$R_L = 54$ $\Omega$ , $C_L = 50$ pF
Propagation Delay <sup>(9)</sup>	$t_{PD}$		27	32	ns	$V_O = -1.5$ V to 1.5 V, $C_L = 15$ pF
Pulse Skew <sup>(10)</sup>	$t_{sk}(P)$		2	6	ns	$V_O = -1.5$ V to 1.5 V, $C_L = 15$ pF
Skew Limit <sup>(3)</sup>	$t_{sk}(LIM)$		4	8	ns	$R_L = 54$ $\Omega$ , $C_L = 50$ pF
Output Enable Time To High Level	$t_{PZH}$		20	24	ns	$C_L = 15$ pF
Output Enable Time To Low Level	$t_{PZL}$		33	45	ns	$C_L = 15$ pF
Output Disable Time From High Level	$t_{PHZ}$		33	45	ns	$C_L = 15$ pF
Output Disable Time From Low Level	$t_{PLZ}$		20	27	ns	$C_L = 15$ pF

## Magnetic Field Immunity<sup>(11)</sup>

Magnetic Field Immunity at 5 V						
Power Frequency Magnetic Immunity	$H_{PF}$		3500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	$H_{PM}$		4500		A/m	$t_p = 8$ $\mu$ s
Damped Oscillatory Magnetic Field	$H_{OSC}$		4500		A/m	0.1Hz - 1MHz
Cross-axis Immunity Multiplier <sup>(12)</sup>	$K_X$		2.5			
Magnetic Field Immunity at 3.3 V						
Power Frequency Magnetic Immunity	$H_{PF}$		1500		A/m	50Hz/60Hz
Pulse Magnetic Field Immunity	$H_{PM}$		2000		A/m	$t_p = 8$ $\mu$ s
Damped Oscillatory Magnetic Field	$H_{OSC}$		2000		A/m	0.1Hz - 1MHz
Cross-axis Immunity Multiplier <sup>(12)</sup>	$K_X$		2.5			

## Insulation Specifications

Parameters	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Creepage Distance		8.08				mm
Barrier Impedance			>10 <sup>14</sup>   7			Ω    pF
Leakage Current			0.2		μA	240 V <sub>RMS</sub> , 60 Hz

## Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Junction–Ambient Thermal Resistance	θ <sub>JA</sub>		67		°C/W	Double-sided PCB in free air
Junction–Case (Top) Thermal Resistance	θ <sub>JC</sub>		12			
Junction–Ambient Thermal Resistance	θ <sub>JA</sub>		46			2s2p PCB in free air per JESD51
Junction–Case (Top) Thermal Resistance	θ <sub>JC</sub>		9			
Power Dissipation	P <sub>D</sub>			1500	mW	

## Notes:

- All voltage values are with respect to network ground except differential I/O bus voltages.
- Differential input/output voltage is measured at the noninverting terminal A with respect to the inverting terminal B.
- Skew limit is the maximum propagation delay difference between any two devices at 25°C.
- The power-off measurement in ANSI Standard EIA/TIA-422-B applies to disabled outputs only and is not applied to combined inputs and outputs.
- All typical values are at V<sub>DD1</sub> = 3.3 V or 5 V and V<sub>DD2</sub> = 5 V, and T<sub>A</sub> = 25°C.
- The minimum V<sub>OD2</sub> with a 100 Ω load is either ½ V<sub>OD1</sub> or 2 V, whichever is greater.
- Δ|V<sub>OD</sub>| and Δ|V<sub>OC</sub>| are the changes in magnitude of V<sub>OD</sub> and V<sub>OC</sub>, respectively, that occur when the input is changed from one logic state to the other.
- This applies for both power on and power off, refer to ANSI standard RS-485 for exact condition. The EIA/TIA-422-B limit does not apply for a combined driver and receiver terminal.
- Includes 8 ns read enable time. Maximum propagation delay is 25 ns after read assertion.
- Pulse skew is defined as |t<sub>PLH</sub> – t<sub>PHL</sub>| of each channel.
- The relevant test and measurement methods are given in the Electromagnetic Compatibility section.
- External magnetic field immunity is improved by this factor if the field direction is “end-to-end” rather than to “pin-to-pin.”

**Application Information**

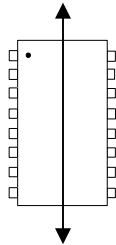
**Electrostatic Discharge Sensitivity**

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**

The IL422 is 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 frequency and time.

The approximate power supply current per channel is:

$$I_{IN} = 40 \times \frac{f}{f_{MAX}} \times \frac{1}{4} \text{ mA}$$

Where f = operating frequency

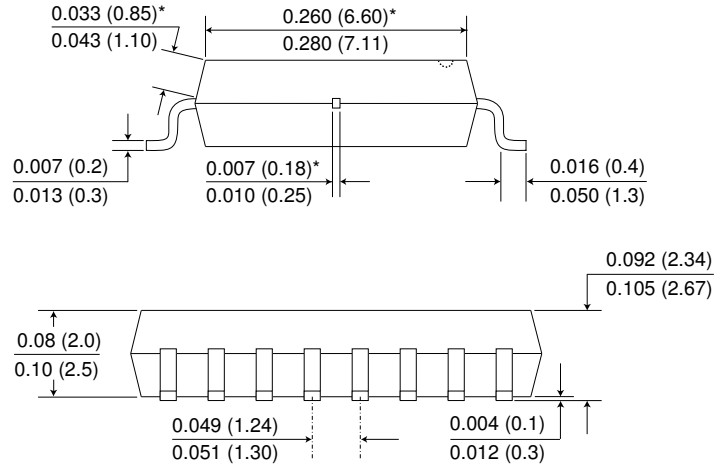
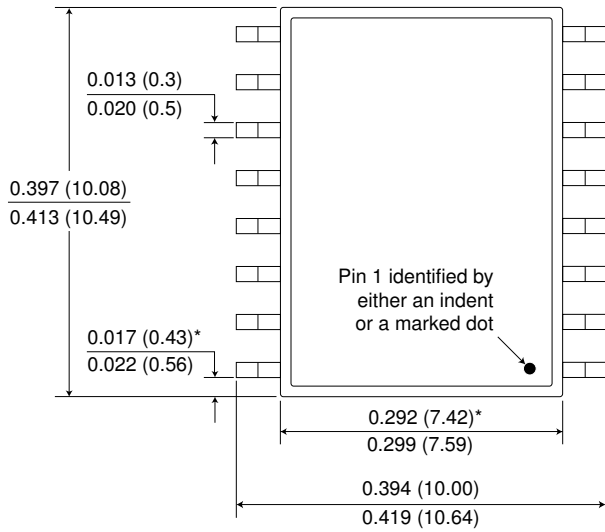
$$f_{MAX} = 50 \text{ MHz}$$

**Power Supply Decoupling**

V<sub>DD1</sub> and V<sub>DD2</sub> should be bypassed with 0.1 μF typical (0.047 μF minimum) capacitors as close as possible to the V<sub>DD</sub> pins.

**0.3" 16-pin SOIC Package**

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

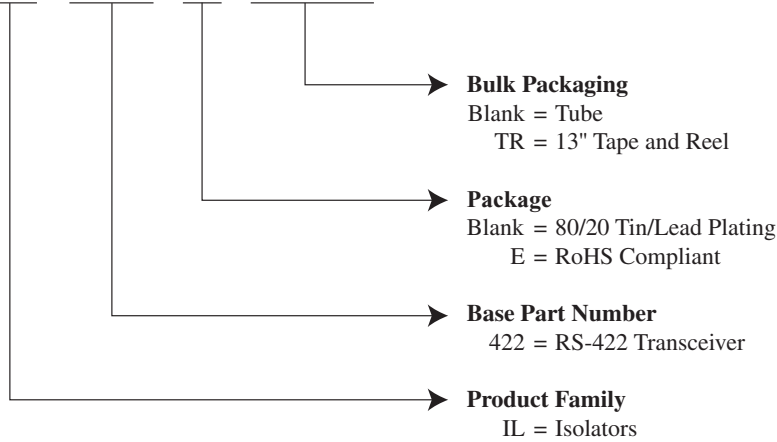


NOTE: Pin spacing is a BASIC dimension; tolerances do not accumulate

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

**Ordering Information and Valid Part Numbers**

**IL 422 E TR13**



**Valid Part Numbers**

IL422  
IL422E

All IL422 part types are available on tape and reel.



**ISB-DS-001-IL422-S**  
**October 2022**

**Changes**

- Upgrade to VDE 0884-17 (p. 3).
- Updated EMC standards.
- Deleted minimum magnetic field immunity specifications (p. 6) since it is not 100% tested.
- Added thermal characteristics (p. 7).

**ISB-DS-001-IL422-R**

**Change**

- Updated MSL, agency approvals, magnetic immunity, and other specifications.

**ISB-DS-001-IL422-Q**

**Change**

- Update terms and conditions.

**ISB-DS-001-IL422-P**

**Change**

- Added clarification of internal ground connections.

**ISB-DS-001-IL422-O**

**Change**

- Added low EMC footprint.

**ISB-DS-001-IL422-N**

**Changes**

- Added magnetic field immunity and electromagnetic compatibility specifications.
- Added note on package drawing that pin-spacing tolerances are non-accumulating.

**ISB-DS-001-IL422-M**

**Change**

- Changed ordering information to reflect that devices are now fully RoHS compliant with no exemptions.

**ISB-DS-001-IL422-L**

**Change**

- Reorganized supply current specifications; misc. minor changes

**ISB-DS-001-IL422-K**

**Change**

- Eliminated soldering profile chart

**ISB-DS-001-IL422-J**

**Change**

- Updated open input state in truth table

**ISB-DS-001-IL422-I**

**Change**

- Updated package drawing; misc.

**ISB-DS-001-IL422-H**

**Change**

- Updated UL and IEC approvals

**ISB-DS-001-IL422-G**

**Changes**

- Revision letter added.
- Ordering Information Removed.
- IEC 61010-1 Classification: “Reinforced Insulation” added.
- Notes added.
- IR Soldering Profile added
- Ordering Information added.

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ISB-DS-001-IL422-S

*October 2022*

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