

# Avago Optocouplers in Intrinsic Safety Applications

## Introduction

The IECEx is a certification system which verifies compliance with IEC international standards relating to equipment for use in explosive atmospheres. The safety requirement for equipment under IECEx is based on the description in the international standards IEC 60079 series (Table 1). IEC 60079-11 specifies the construction and testing of intrinsically safe apparatus intended for use in an explosive atmosphere and for associated apparatus, which is intended for connection to intrinsically safe circuits which enter such atmospheres.

Table 1. Type of IEC 60079-x standards

Number	Title	Number	Title
60079-0	General requirements	60079-7	Increased safety 'e'
60079-1	Flameproof enclosures 'd'	60079-11	Intrinsic safety 'i'
60079-2	Pressurized enclosures 'p'	60079-13	Pressurized room 'p'
60079-5	Powder filling 'q'	60079-15	Type of protection 'n'
60079-6	Oil immersion 'o'	60079-18	Encapsulation "m"

## IEC 60079-11 Intrinsic Safety

The basic principle of IEC 60079-11 to achieve intrinsic safety is for the energy in the power circuit to be limited preventing unusually high temperatures, ignition sparks or electric arcs that create ignition energy required to cause and explosion. To limit the energy (power), a fuse or resistor in series (current limiting) and a zener diode in parallel (voltage limiting) should be implemented.

IEC 60079-11 requires separation of conductive parts between intrinsically safe and non- intrinsically safe circuits. From Table 2 IEC 60079-11, General Safety Requirements including clearance, creepage distances and separations, there are different requirements of separation distance through insulation structures. Avago optocouplers include internal clearance, or distance through insulation (DTI), as part of the insulation and safety related specifications. Using optical technology for galvanic isolation, the DTI forms the straight-line distance thickness between the LED emitter and the detector within the optocoupler. The optocoupler's DTI is able to meet the separation distance requirements of gas zone classification 0 to 2, depend on voltage level of protection.

Table 2. IEC 60079-11 General Safety Requirements of clearance, creepage distances and separations

Voltage (pk)	Clearance		Separation distance through solid insulation		Creepage	
	mm		mm		mm	
V	ia, ib	ic	ia, ib	ic	ia, ib	ic
Level of protection	ia, ib	ic	ia, ib	ic	ia, ib	ic
60	3.0	0.8	0.5	0.3	3.0	1.9
90	4.0	0.8	0.7	0.3	4.0	2.1
375	6.0	2.5	1.0	0.6	10.0	4.0
750	8.0	5.0	1.4	0.9	18.0	10.0
1,000	10.0	7.0	1.7	1.1	25.0	12.5
1,300	14.0	8.0	2.3	1.7	36.0	13.0

ia : Very high ignition protection level; application for zones 0, 1, 2

ib : High ignition protection level; application for zones 1, 2

ic : Improved ignition protection level; application for zone 2

Zones 0, 1, 2 refer to the gas zone classification. Zone 0 is classified as explosive atmosphere exists always, frequently or long term. Zone 1 is classified as occurs occasionally in normal operation. Zone 3 is classified as normally does not occur in normal operation or only for short times

**Table 3: Avago optocouplers of clearance, creepage distances and separations**

Optocoupler Prefix Number	ACNV	ACNW / HCNW / HCNR	ACNT-Hxxx	ACPL-Cxxx
DTI (mm)	2	1	0.5	0.5
Creepage (mm)	13	10	14.2	8
Clearance (mm)	13	9.6	14.2	8
Level of protection	375V (ia, ib), 1300V (ic)	375V (ia, ib), 750V (ic)	60V (ia, ib), 90V (ic)	60V (ia, ib), 90V (ic)

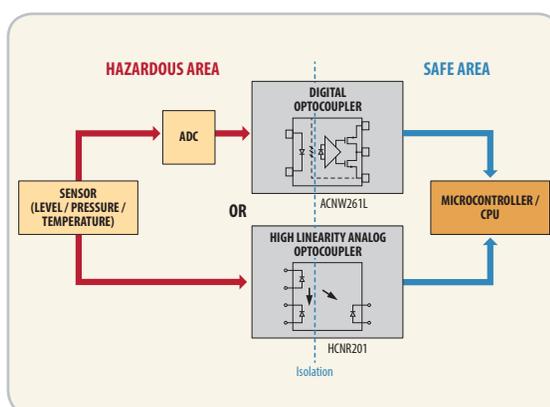
## Avago Optocouplers Meet Intrinsic Safety Criteria

While Avago optocouplers meet the stringent separation distance requirements, alternative technology isolators are not able to achieve this with their structural DTI at less than 20µm. The 13 mm creepage/clearance ACNV optocouplers family, the 10 mm widebody optocouplers, and the 8 mm ACPL-Cxxx optocouplers, have insulation material that allows ACNV optocouplers to meet up to 375V (ia, ib) level of protection and ACNW/HCNW optocouplers up to 375V (ia, ib) level of protection (Table 3).

## Applications

Optocouplers are used in intrinsically safety applications such as flow meters and field transmitters that require level, pressure, and temperature measurement. Optocouplers meet the safety requirements and provide reinforced insulation between field sensors and microcontroller of the control board. Figure 1 block diagram illustrates this.

An application example of optocouplers use in equipments with work environment of explosive atmosphere is fluid pumps in sewage and petrol stations. Avago's widebody 10MBd low power ACNW261L, is used as isolated serial communication in the control board for sewage flow meters. The optocoupler's DTI of 1 mm is critical as waste in the sewers move constantly and this exposes the fluid pump to the explosive methane gas. Avago optocouplers, with its unique strength of a thick internal clearance, or distance through insulation, are able to meet the separation distance requirements defined by IEC 60079-11 in intrinsic safety applications as required by IECEx.



**Figure 1: Isolation in a Field Transmitter (Flow / Level / Pressure / Temperature)**

## Conclusion

Avago optocouplers, with its unique strength of a thick internal clearance, or distance through insulation, are able to meet the separation distance requirements defined by IEC 60079-11 in intrinsic safety applications as required by IECEx.

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