

Interfaces between field mounted devices in explosive hazardous areas and non hazardous areas are useful to prevent a transfer of ignition energy from the non hazardous area into the explosive hazardous area.

These interfaces must be able to reproduce the input signals with a minimal error (as low as 10 μ A on 20 mA) with practically no distortion at an absolute minimum of noise level and be immune to Radio Frequency in line with European CE by-laws.

The CENELEC EX- Certification, EMC compatibility per NAMUR and the production unit to have a ATEX certificate are the inputs to make an interface get accepted in Europe.

OSNA Interfaces are available as in the following categories:

- Shunt diode safety zener Barriers.
- Galvanically Isolated Interface Units.

The Zener Barriers being non galvanic belong to the past, and are mainly considered where the very large number of loops force a more economic solution.

Galvanic Isolators:

The Galvanic Isolators ensure that the power supply is galvanically isolated from the FMD (Field Mounted Device) circuit also called the input circuit and also from the output circuit to the DCS, SPS, or control room circuit.

A further galvanic isolation between the input and the output circuits is a standard feature of the OSNA isolators thereby offering what is commonly called a 3 point isolation. An optical isolation through CENELEC Ex- approved opto couplers could be used to enhance / replace transformer based isolation.

Trip Amplifiers:

The need to amplify an input signal before processing could well be understood, as most of field signals from explosive areas would be weak signals in intensity, as otherwise intrinsic safety would not be assured.

This forms the subject matter of Trip and Signal Amplifiers.

Typical example to be seen in a low energy pressure switch located in the explosive hazardous area to switch on a 3 KW compressor motor located in a non hazardous area. through a switch isolating amplifier.

Converters:

It is customary to sense a temperature of a device in the hazardous area and transmit this value across 2 Km into the control room. The mV generated by a thermocouple would first have to be converted into a 4-20mA current signal to avoid transfer “mV” losses!

While using a RTD to measure temperature the RTD output value being a resistance would require a conversion into a 4-20 mA current signal to cross distances.

There is no end to the list of daily requirements in which a speed (frequency) signal has to be converted into a voltage signal for maybe a comparison in a regulation control loop The OSNA range of speed measurement Frequency Current Converters called FSU are well accepted standards in the industry.

A torque in a variable speed drive is normally available as a high current (motor current for eg. 50A) signal which may result in large line losses, if transferred over a 2 Km distance to a control room and hence must be converted into a standard low energy 4 – 20 mA signal to enable a comparison in a negative feed back regulation loop.

Signal Conditioners:

If in the case of the above example of the regulation of the torque in a motor, there was a need to only process the signal if it was within a particular “ window” for eg between a value from 10 A to 25A (corresponding to 7 mA -- 14 mA) , this requirement could be fulfilled by using a standard signal conditioner, which would suppress values outside this range.

Signal Multipliers :

If in the above case the torque value was to be transmitted to 2 different locations at the same time, a signal multiplier could be used to offer 2 Nos. 4-20 mA current outputs for the 1 No. current input signal.

Loop Powered Isolators: (passive isolators)

Often a galvanic isolation is required remote from the control room at a site, where it would be very difficult to lay a cable to offer a power supply to the isolator unit .Or the sheer cost of laying a new cable cannot be justified. In such a situation it maybe possible to install a loop powered unit

Certainly the transfer accuracy of a loop powered unit can never match that of a externally powered unit, but the saving of cabling could sometimes offset the sacrifice in the degree of transfer accuracy.

A small voltage drop at the field input of the unit energizes the unit. The measured signal value gets loaded through this voltage drop. The actual current requirement to operate the galvanic isolation / transfer is just a few micro Amps and hence the transfer accuracy is comparable with the powered units.

The loop powered units cannot amplify the input signal and the output is diminished through the voltage drop within the unit.

The basic law in physics that energy cannot be created must be considered while deciding if the output values of current multiplied by the corresponding output voltage must remain well below the input level of energy.

Intrinsic safe interfaces:

A popular thought that all units which are galvanically isolated are automatically intrinsic safe, as the short circuit energy cannot be transferred to the hazardous area, must be discarded as the design basis for intrinsic safe units must consider a lot more than just galvanic isolation. The european standards EN 50014 and EN 50020 define the limits to heat generation, energy storage in inductances and capacitances and the fallibility of all components which would ensure intrinsic safety to avoid an explosion in the hazardous area.

Signal conversion and conditioning in DCS:

It is but natural that most of the converters and signal conditioning could technically be done within the DCS (Decentralized Control system) or PLC (Programmable Logic Controls), however the cost of an analog input card is still much more than that of an interface unit.

Galvanic isolation between field signals and the DCS is another reason to allow isolators be used.

Basic principle of Galvanic Isolation as a loop powered unit :

Input 4-20 mA from a p/I transmitter

Output 4-20 mA current signal to a controller

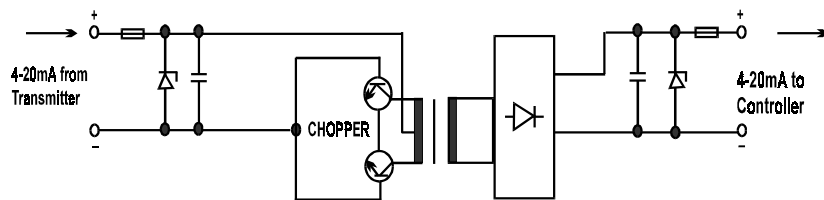


Fig 1 a.

A field 4-20 mA current signal must get chopped prior to transformation and this transformer must be designed for almost zero level losses, if the 20 mA signal is not to be distorted at the output. International standards prescribe an error in the transfer to remain well below 20 micro Amps.

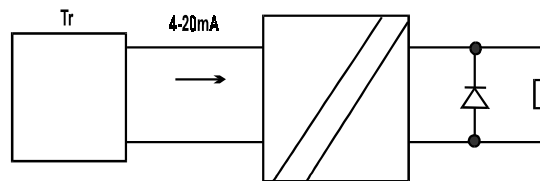


Fig 1b.

In the above case, the output must not remain open circuited, as no primary current would flow. A free wheel diode could remain connected in reverse mode parallel to the output Load as shown.

Basic principle of galvanic isolation of a 24 V DC powered unit:

Input 4 – 20 mA current signal from a transmitter

Output 4 – 20 mA current signal to a DCS.

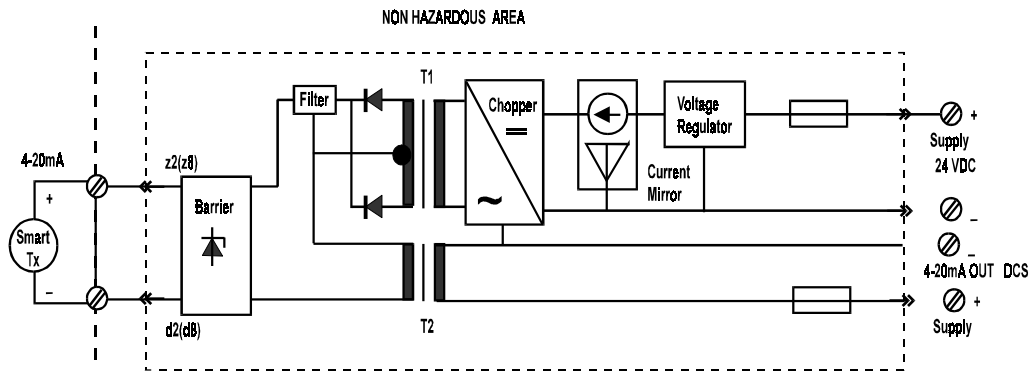


Fig 2

The power supply, if a AC supply, can get isolated from the other circuits by passing the 110V 50 Hz through the primary of a transformer and using the stepped down secondary to feed the electronics control circuitry.

In the case of the power supply being a 24 V DC source, it becomes necessary to first chop the 24V DC into a AC voltage which gets transformed through a transformer and the secondary is rectified and used for the electronics circuitry.

It is customary to allow the 24V DC be a cheap unregulated power supply between +20% and - 15%, hence a good degree of stabilization should be an integral part of a good interface unit. Accordingly heating problems arise which require a careful design.

The present day tendency to accommodate the isolators in thin housings of 17.5mm width can be well understood to allow a large utilization of panel space. However heat ventilation problems require the use of very specialized low loss ferrites as transformers and SMD components help the designer.

There could be no end to the permutation and combination of incorporating galvanic isolation with or without signal conversion or building in signal conditioning into the same unit.

New tendencies are to allow the field staff carry out field parametering with either BCD switches addressing a built in micro processor in the unit or allowing a FSK (Field Shift Key) system of parametering using high and low frequency pulses in a HART protocol using the 4 – 20 mA field lines for pulse setting transmission.

In such a case the isolating unit must be a SMART compatible unit like the OSNA current repeater called OS / CR-EX-1-ST.

The isolators could, in addition to being signal conditioners also be intrinsic safe and offer signal multiplication outputs.

Considerations on the selection of an interface:

- 1.) From which FMD (Field Mounted Device) does the field signal come ?
 - A Pressure Transmitter offers a 4- 20 mA current signal , 4 mA at 0% Pressure and 20 mA at 100% pressure.
 - A RTD offers just a resistance value signal which changes with temperature.
 - A Thermocouple offers a few milli volts value which increases with temperature.
 - A proximity switch NAMUR type would offer a pulse output / frequency output.
- 1) Is the FMD located in an explosive flammable hazardous area ?
 - Answer : An intrinsic safe interface is required.
- 2) What job must the FMD signal do at the control room end ? (PLC or DCS ?)
 - A remote pressure measurement could be achieved by simply repeating the 4 – 20 mA current signal.
 - A remote temperature measurement could only be achieved by first converting the RTD or mV signal into a current (4 – 20 mA) signal to cross a few KMs.
 - No temperature signal conversion would be required if the customer had to process the signal inside the same machine where the temperature was being measured.
 - Maybe the customer required the signal be processed locally and the signal duplicated for an input into another circuit—a pressure of a vessel should be measured in the control room and also should allow a hooter to blow on reaching a 95% value in a separate circuit. You would then select a current multiplier like OS / Ex-1-2U.
- 3) Has the end user standardized on 24V DC or a 110V 50Hz control supply ?
 - Answer : The OS System for 24 V DC or the WE System for 220V 50 Hz could be selected.
- 4) Is the application calling for a saving in control panel space ?
 - Answer : OS System.
- 5) Is the application calling for a low cost solution at the expense of panel space ?
 - Answer : WE System with either 24 V DC voltage or 110 V 50 Hz.
- 6) Is the application subjecting the interface to a high vibration / humidity ?
 - Answer : Resin potting of the unit after consideration of heat ventilation.
- 7) In case the interface has to replace an earlier interface, what went wrong with the earlier interface ?

The smart consultant would try to restrict putting too many special features into the same unit to allow more flexibility in it's replacement and maintenance.

However should the need to utilize the panel space available through a replacement force more functions / outputs in the same space, the OSNA applications engineer could help in tailor-making the right interface combination for a particular application.

Basic Considerations on Signal Transfer:

- a) Should the signal output / reproduction be exactly same as the input signal without any amplification or conditioning ?

If yes, a repeater is required and preferably without any zero offset or span settings. to avoid an error creep into the secondary process through an operator causing a false Secondary value be available as compared to the primary value.

- b) Input Resistance of the Interface: should be of a very high impedance for voltage Transfer and very low impedance for current signals.
- c) The output load for a voltage output is normally defined through the maximum current. Whereas the typical load is stated as 500 Ohm for a 20 mA output current, which would mean a load voltage of 10V.

OSNA current repeaters can feed normally a minimum of 650 Ohms load at 20 mA. This load resistance could be more than 1 K Ω at 10 mA.

- d) Transfer Accuracy could be critical in the exact value of the output of the input analog 20 mA value, this should be with an error of less than 20 uA. In the case of a transfer of digital pulse signals, generated for eg by a proximity switch or a pulse encoder or even a temperature scanning, the transfer accuracy would be reflected in a true reproduction of the digital pulses without blurring or a distortion of the signal pulse chain. This signal distortion could be very easily caused by a saturation of the ferrites used for the galvanic isolation, or capacitors with a large leakage current etc.

The design of OSNA interfaces considers such parameters and in particular the subject of temperature drift.

- e) The Temperature drift of an OSNA interface is as low as just 0.01 %/K which means that if the ambient temperature escalates by 20K, the 20mA current could show an error of 0.2% .

OSNA uses special housings to allow a good heat ventilation inside the interface to cut down on the temperature drift. Experienced consultants do not recommend a very high density of housings per running meter DIN channel length. Accordingly OSNA does not normally use 12.5mm wide housings but restricts the width to 17.5mm to achieve optimal thermal stability.

Only in very weak signal applications does OSNA use the 12.5mm housing

- f) Offset and Span:

The output of an interface is often not zero when the input to the interface is zero.

OSNA interface signal repeaters are designed and calibrated to avoid this. However sometimes site conditions require that a minor “signal conditioning “ should be possible through a potentiometer mounted on the interface. Line resistances and connected line equipment with the interface could warrant a correction of the span through a potentiometer on the interface.

Accordingly it is found to be a good practice to incorporate such zero span and offset potentiometers on most OSNA signal converters.

Certain OSNA housings are available with a transparent screwed cover to avoid an unqualified tampering of these potentiometers through site technicians.

Concept of Safety in Interfaces :

a) **Electrical Safety :**

A standard electrical insulation level of 1500 V is maintained between output and input circuits. OSNA designs consider the European Standard EN 61010 Part 1 governing this safety aspect.

The level of this insulation voltage is a result of the basic design of the housing, the creepage distance between terminals, dielectric strength of the insulation material of housing, CTI (Comparative Track Index) of PCB material used etc. design of terminal shrouding,

b) **Functional Safety :**

Transient voltages through ON / OFF switching in industry could result in the interface having to withstand voltages with a rate of increase of more than 1000V/us. Such voltages if not suppressed could destroy the connected equipment. OSNA interfaces consider the recommendations of the IEC 255-4.

c) **Intrinsic Safety :**

Excess voltages or currents from the non hazardous area should be limited in value incapable of igniting the flammable gas in the hazardous area.

OSNA interfaces designed for intrinsic safety are normally covered by both CENELEC EX-certification.

European Norms EN 50014 and EN 50020 are considered for this aspect of safety.

d) **Safety through Galvanic Isolation :**

All OSNA interfaces are galvanically isolated to ensure that all faults in excess voltages or short circuits in the control room side do not travel into the field mounted devices and are definitely isolated from the primary area terminals in line with VDE 0106-Part 101.

c) **Safety through design:**

The interface basic design undergoes a change dependent upon the safety requirements of the process connected to the interface.

Typical examples are a monitoring of the lead breakage of the FMD connected to the interface.

A failure of a built in power supply transformer could give a wrong information to the connected PLC trying to monitor an underspeed of the motor !

The lead breakage of a thermocouple may warrant a particular fail safe high or low scaling of output value.

The ultimate goal for OSNA is a technical fail safety which is commercially affordable.

d) **Safety through reliability :**

OSNA Quality Assurance is audited annually by third party auditors, which is the basis for the OSNA ATEX certificate. The EECS UK (formerly BASEEFA UK) Has audited the OSNA factory for their Quality Assurance System along with the ISO 9002 guidelines.