N°12 WhitePaper

MultimediaConnect

NETWORK EQUIPMENT SAFETY
GALVANIC ISOLATION

Communication networks are of paramount importance in a professional context. From hospitals to airports, a variety of technical devices are connected to the network with an RJ45 port. Once “interconnected”, these devices can be managed remotely, and easily upgraded or repaired.

While these new functions broaden the applications of this equipment, it remains susceptible to being damaged by network overvoltage. Electric shocks can cause irreparable damage to electronic circuits.

Depending on how important the device is to the overall network, this type of damage can be prevented with a network isolation system.

The most sensitive or most important pieces of equipment must be protected against electric shocks caused by poor earthing, excessive network traffic, or even lightening.

1. MAIN PRINCIPLE OF GALVANIC ISOLATION

There are three types of galvanic isolation

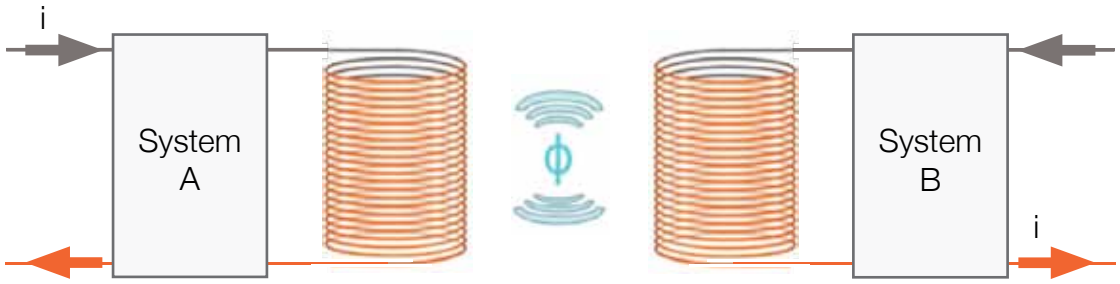
- Converting the electric signal into an electromagnetic signal
- Converting the electric signal into an optical signal (optocoupler)
- Converting the electric signal into mechanical force (electromechanical relay)

The system described in this document provides protection with an electromagnetic transformer.

Galvanic isolation is a very common safety technique when working with high currents or electronics.
It is a transmission type that removes the physical connection between two systems, replacing it with a magnetic transmission.

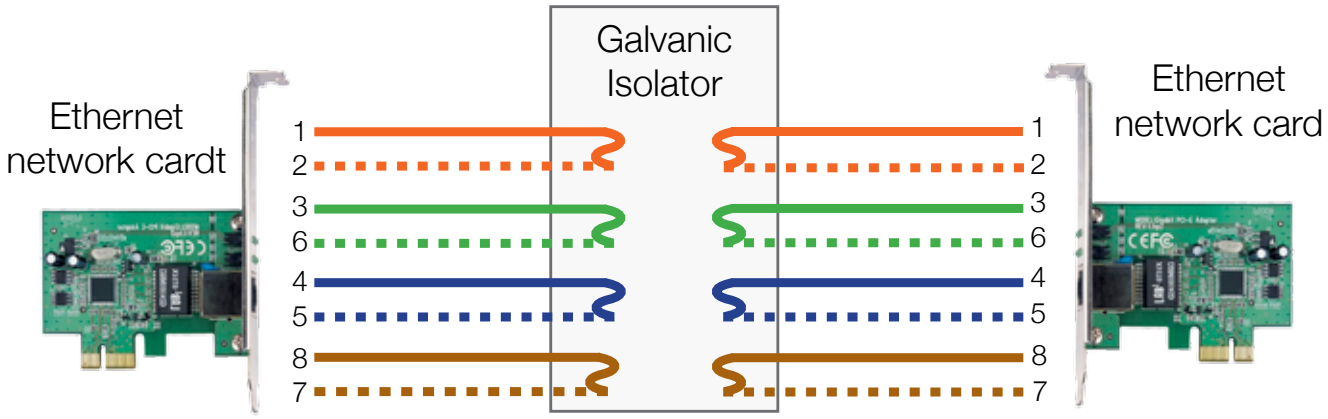
To do this, a transformer is used to create a current through magnetic excitation. We just have to precisely adjust the settings of a transformer so that they “cut” signals that the send/receive system identifies as damaging.

Galvanic isolation using electromagnetic flow



2. GALVANIC ISOLATION IN THE NETWORK

The same transformation technique is used for sending signals in 10 BASE T, 100 BASE T, and 1000 BASE T.

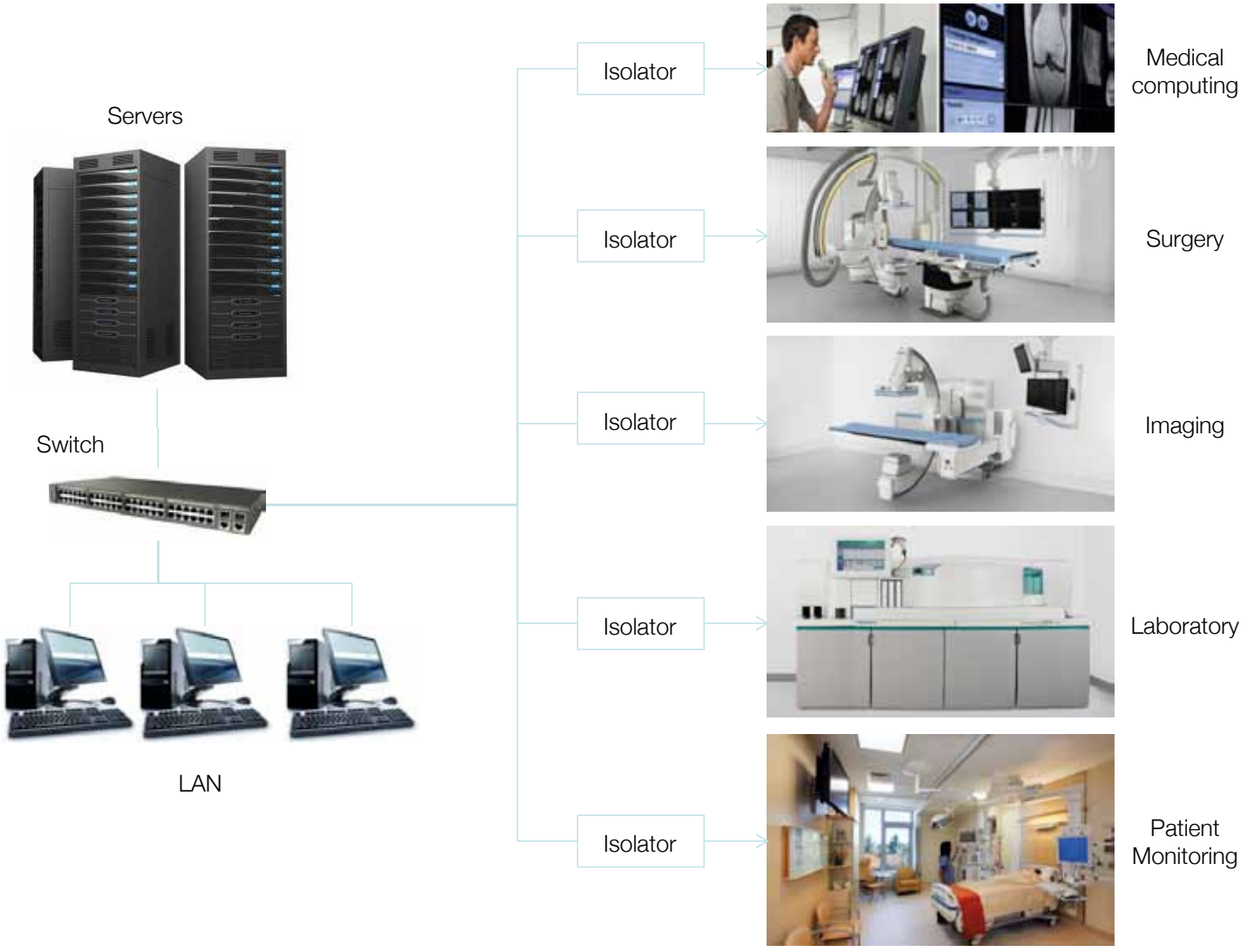


Network isolation is very common in industrial systems with RS485 connections, but the Ethernet section was up until this point left unprotected.
The electrical protection of Ethernet networks was first standardized in an IEC document for the medical field.

Medical equipment a special case

Since 2009, the IEC 606061-1 standard (ELECTRICAL MEDICAL EQUIPMENT - PART 1: GENERAL REQUIREMENTS FOR BASIC SAFETY AND ESSENTIAL PERFORMANCE) defines the safety profiles of medical devices.

It provides safety recommendations to protect devices connected to a local network (LAN) from electric shocks
In the health sector, IT is omnipresent, and imaging equipment and insufflators crucial, yet fragile, devices.



These products could be used to protect any sensitive equipment Principle & pictures of galvanic isolation in the network 1000 Base T operation.

3. THE RJ45 GALVANIC ISOLATOR IN PRACTICE

The galvanic isolator is a male/female RJ45 casing that is connected between the wall socket and the device to protect.
It should be placed as close to the device as possible to prevent any overvoltage created by electromagnetic disturbances in the cable routing.

ISOGALVRJ45

Multimedia Connect ISOGALVRJ45 isolator specifications

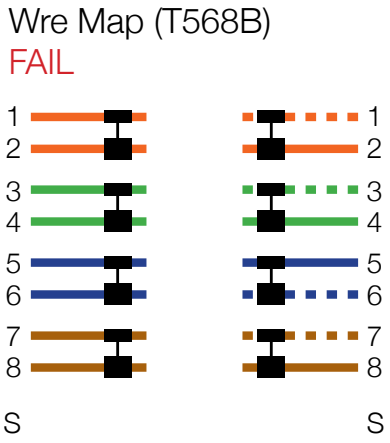
- Protection through differential current between device and network
- Transparent network connection, has no effect on performance up to 100m.
- Plug and Play, no additional cables, uses the device's RJ45 cable.
- Male/female adapter housed in flame resistant casing (UV V0)
- Very low transformation loss

Field testers a special case

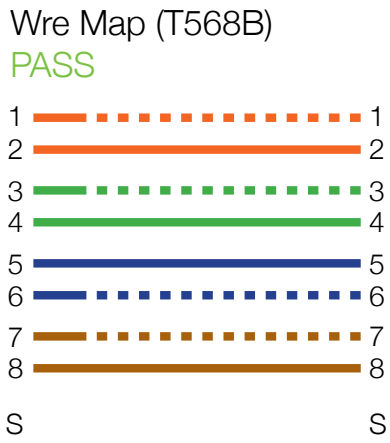
When a field tester is to be used to certify a connection equipped with a galvanic isolator, several errors will appear.

Clarification:

1. Clarification:
   The cable continuity error is caused by the coils connected to the pairs inside the isolation device. The continuity test is carried out by sending a direct signal to each pair, and will therefore identify a short circuit at the coils (1-2, 3-6, 4-5, 7-8).
   However, when signals are sent at high frequencies (>0.1Mhz), the coils act like an open circuit. Thus, there is no short-circuit in network operations.



Direct current test



High frequency alternative current test

2. Insertion loss
   System transmission loss is high This is due to the isolation device.
   Signals are sent by induction, and there is no physical contact between signals within the isolation device. Due to the isolation device's nature, insertion loss is increased. It does not, however, exceed an acceptable value for degradation of the signal-to-noise ratio.

«Ping» test results on a 100m connection

```
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 100, Received = 100, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Documents and Settings\Administrator>
```

4. Return loss
There is a lot of echo on the line. This is linked to the transformer.
Due to the isolation device, return loss increases. Return loss becomes higher in proportion with increases in frequency.

5. Insertion loss and return loss
In telecommunications, insertion loss is the loss of a signal’s power due to a device being inserted onto a transmission line. It is normally expressed in decibels (dB).

Return loss is the loss of a signal’s power as a result of reflection caused by an interruption in the transmission line. This interruption may be dissonance with the end load, or with the device inserted on the line. It is normally expressed in a ratio in decibels (dB).