موضوع مقاله : چرا سیستم ها باید از هم ایزوله شوند ؟

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چکیده : این مقاله به طور مختصر و کوتاه به این پرسش پاسخ می دهد که چرا سیستم ها باید از هم ایزوله گردند ؟ بررسی مزایای ایزوله بودن سیستم ها و نیز معایب عدم وجود ایزولاتور در مدارات الکترونیک را عنوان می کند .

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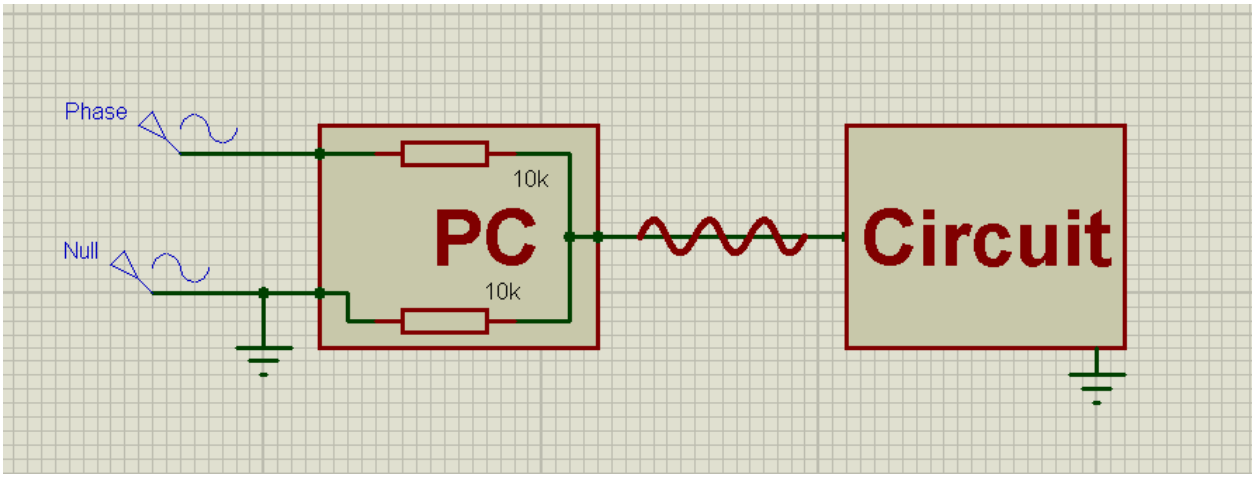
چرا باید سیستم ها از هم ایزوله شوند ؟



قبل از اتصال دو مدار الکتریکی نکته بسیار مهمی هست که گاهی کاربران مبتدی از آن قافل هستند ایزوله بودن آن هاست.

در بسیاری از منابع تغذیه و دستگاه ها اتصال دستگاه با برق شهر یا زمین به صورت کامل قطع نیست و یا عدم اتصال مناسب دستگاه به زمین مشکلاتی را ایجاد می کند .

برای مثال شما می خواهید کامپیوتر و یک میکرو کنترلر را با پورت سریال به هم وصل کنید .

کامپیوتر کمی نشتی ولتاژ در بدنه دارد مانند زمانی که شما به بدنه کامپیوتر دست می زنید و برق شما را میگیرد و این یعنی اتصال بدنه کامپیوتر به صورت غیر مستقیم با تغذیه برق شهر در نتیجه بدنه و منفی پورت سریال حاوی ولتاژ هستند .

در بسیاری از مدارات این ولتاژ آسیبی به مدار نمی ز ند ولی فرض کنید که مدار میکرو کنترلری شما نیز همین مشکل را داشته باشد و یا مدار میکرو کنترلری شما در بخش تغذیه به زمین متصل شده باشد . این یعنی ولتاژی که بدنه کامپیوتر دارد به سمت مدار شما شروع به جریان می کند و این موضوع هم می تواند به پورت یا مدار آسیب بزند و هم ایجاد نویز و خرابی اطلاعات کند .

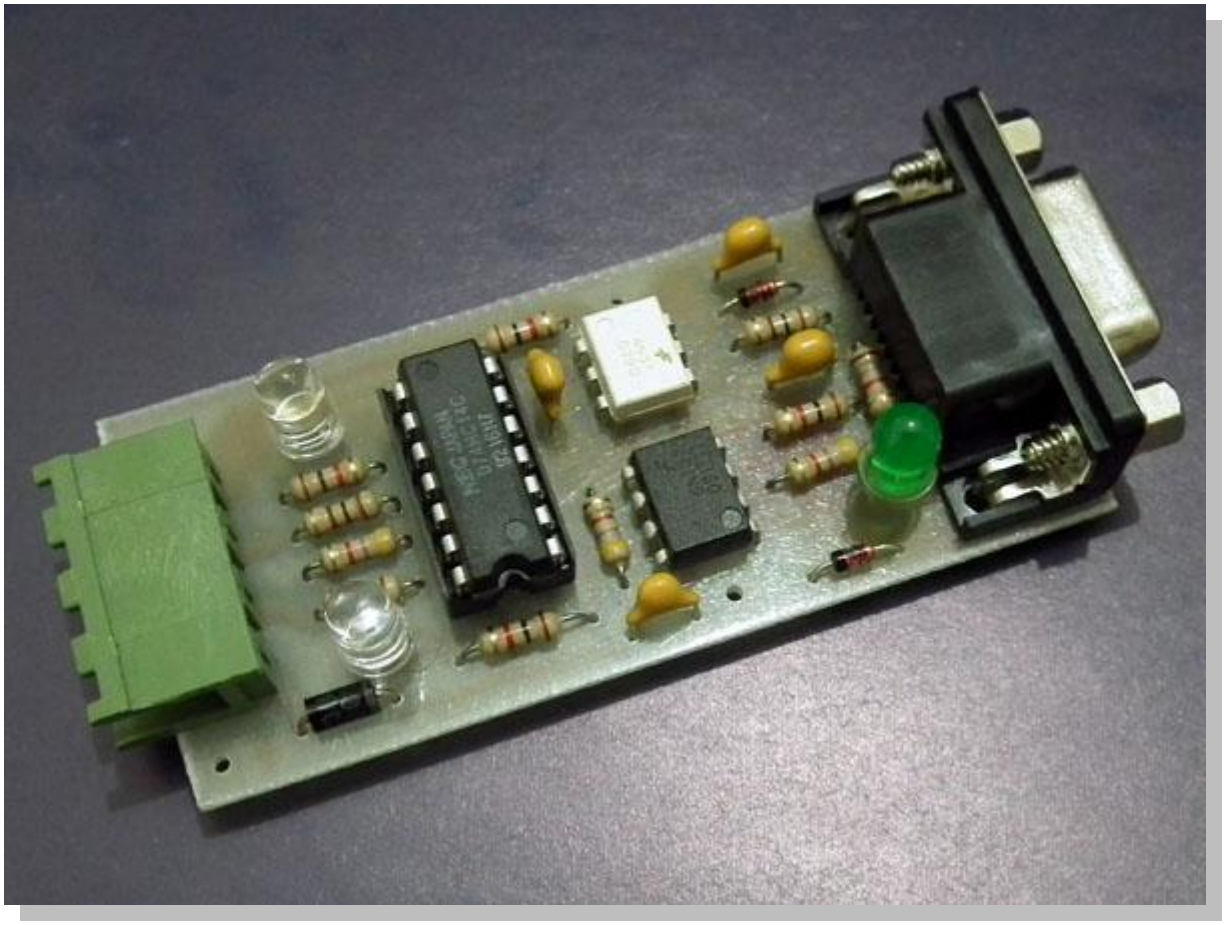
راه حلی که برای این گونه شرایط استفاده می شود ایزوله کردن اطلاعات است که امری رایج در سیستم های الکترونیکیست .

اگر شما مبتدی هستید ویا معمولا به ایزوله بودن سیستم ها توجه نمی کنید ویا از عدم ایزوله بودن سیستم ها آگاهید و می میخواهید با کامپیوتر ارتباط بر قرار کنید ما به شما استفاده از ایزولاتور های سریال را توصیه می کنیم .

که این کار موجب :

1 - اطمینان از عدم آسیب رسانی به کامپیوتر حتی در صورت اشتباه از طرف کاربر است .
2 - عدم امکان اشتباه در اتصال به کامپیوتر (اتصالات به صورت سوکتی هستند)
3 - مقاوم در خصوص بروز برخی اشتباهات از جمله اشتباه در اتصالات
4 - داشتن 3 چراغ راهنما برای کسب اطلاع از شرایط ایزولاتور
5 - استفاده نسبتا آسان
6 - کاهش نویز و خرابی اطلاعات
7 - به همراه کتابخانه pcb جهت استفاده به عنوان یک قطعه در مدار
8 - هزینه نسبتا کم (تقریبا هم قیمت MAX233)
9 - جداسازی منفی مدار ها (گاهی می تواند امتیاز بزرگی باشد)

شما فقط کافیست در نقشه پروتل خود از این مدار که از قبل برای پر وتل طراحی شده و در سایت موجود است استفاده کنید.



لینک خرید ایزولاتور

اما اگر به صورت تخصصی در این زمینه فعالیت می کنید شاید این مطلب مفید باشد .

Overview

In a research laboratory, one of the main technical difficulties you will face as a physicist is eliminating or suppressing noise. This is particularly true when using analog circuit, but occasionally it can also be a problem with digital circuits. Frequently, ground loop noise will appear when you connect two separate and relatively noiseless circuits. In this chapter, we will explore the nature of such noise and ways to avoid it.

I. Ground loops

A ground loop occurs when several circuit elements which should be at ground (i.e. 0 Volts), but are not quite at ground, are connected. Generally, a ground is constructed by connecting a wire to a central point which is defined as the "official" ground. Unfortunately, all wires have some resistance which is generally fairly small, but which can produce a significant voltage drop if enough current is flowing. There are three common causes of ground loops:

1. Normal current produces unexpected voltage drop

If the ground wire is too thin or is poorly connected, then it will have a significant resistance. Any current flowing through the wire will produce a significant voltage drop across the wire, according the Ohm's law (V=IR). If this ground wire is connected to another ground wire (with or without the same problem), then since the two "ground" wires are not both at ground (0 V), then a current will flow between them and mimic a signal.

2. A time-varying magnetic field induces a current in a looped ground wire

A time-varying magnetic field cannot induce a current or voltage between the outer conductor and the central conductor of a coaxial cable (and with difficulty between the conductors of a twisted pair). However, a current can be induced along the ground shield of a coaxial cable if the cable forms a loop. Generally, this current can be ignored, since the inner conductor will have the same current (and cancel it), but if the ground has finite resistance, then a voltage difference will be produced which will mimic a signal.

3. Technical noise (at some specific frequency) that you don't understand

Frequently, researchers will accuse a ground loop for any technical noise (at specific frequency) that they don't understand and are having trouble eliminating.

One of the most common ground loops (type 1) is between two pieces of relatively noiseless equipment that are connected to two different electrical outlets that do not share the same ground (i.e. the third pins on the two plugs are only remotely connected through the electrical grid). Separately, the two pieces of equipment work fine, but when you connect them you develop a ground loop. Most ground loops are at 60 Hz, but they can also show up in the kHz and MHz ranges. At high frequencies, circuits and instruments

whose grounds are not physically connected by a wire can still be grounded together by stray capacitive or inductive coupling.

Here are some tips to help you minimize ground loops and their effects:

a. Star configuration for ground

You should connect all your instruments to the same set of power receptacles and avoid making a daisy chain of power bars and extension cords. As much as possible, all the power for your instruments should come from a central point.

b. Multi-conductor ground wire

Since the voltage drop in a ground loop depends on the resistance of wires involved, you should try to make their resistance as small as possible. This means that the cross-section of the ground wire should be a large as possible. Since at high frequencies, most of the current travels close to the surface of a wire (i.e. skin effect), you should also maximize the surface area of your ground wire by using stranded, multi-conductor wire.

c. Determine the ground layout in your lab

You should identify which power sockets in your work environment are connected to a common ground. The electronics lab, Small Hall room 148, has at least two separate grounds which differ by a several tens of volts. You should only connect instruments which share a common ground.

d. Disconnected ground

When connecting two instruments, you should consider disconnecting the ground on the power cord, so that only one instrument defines the ground – the ground of the "ungrounded" instrument is defined by the coaxial cable shield connecting the two instruments. Alternatively, you can connect the cable shield to only one of the instruments – this frequently done with tri-axial cable (twisted pair inside a coaxial cable.

e. Amplify your signal

If you cannot eliminate your ground loop, you can amplify your signal enough that the ground loop noise contribution to it becomes negligible.

f. Digital transmission

Digital signals are much less prone to ground loop noise, so you should consider sending your signal digitally. However, the clock signal timing of a digital signal can be affected by ground loop noise.

g. Debugging tip: use a multimeter or a floating oscilloscope

Finding the source of your ground loop noise can be very difficult (days can spent searching). The difficulty of this task is compounded by the fact that oscilloscopes are always grounded to some degree (even if you do not connect the ground pin on the power cord). This means that by attaching the oscilloscope to your multi instrument circuit, you are actually changing the current path of the ground loop noise. Instead, you should either use a multimeter (it does not have its own ground since it runs on batteries) or use a floating oscilloscope that truly is not connected to the grounds of your circuit. You can float an oscilloscope by using an isolation transformer or, even better, a UPS battery back-up supply. In fact you can also float some of the instruments participating in your apparatus with battery power.

h. The cure-all: opto-isolators

If you must absolutely eliminate all ground loop noise, then you should consider using opto-isolators to connect several separate instruments and circuits together.

II. Opto-isolators

Opto-isolators are integrated circuits for transmitting signals and information between two separate circuits without ever connecting them electrically. As their name implies, opto-isolators transmit signals between two circuits with light. An LED converts the electrical signal to light, while a photo-detector with separate power and ground converts the light signal back into an electrical signal. Opto-isolators are primarily used for transmitting digital signals, but they are also available for analog signals.

The popular 6N137 digital opto-coupler can transmit data at a rate of 10 Mbits/s, though speeds of up to 50 Mbits/s are now possible with more recent opto-couplers. On the analog side, the ISO100 optical isolation amplifier by Burr-Brown (now Texas Instruments) has a bandwidth of 60 kHz, though the more recent HCNR200 opto-isolator by Avago technologies (formerly Hewlett-Packard and Agilent) boasts a bandwidth of 1 MHz.

Opto-isolators are useful for eliminating ground loop noise, but are also used to connect devices that operate at vastly different voltages. For example, opto-isolators are used to exchange data with a device that is floated to several thousands volts as is frequently the case in particle accelerators. Also, medical

instruments which connect to humans must be isolated from the wall power by mandatory isolation circuits.

There exist other isolation technologies, such as transformer isolation and capacitive isolation, but these do not isolate as well as opto-isolators, since electrical noise can still get through a capacitor or a transformer. Light conversion can potentially provide total isolation between two circuits because there is no capacitive or inductive coupling at optical frequencies.