

Re: Isolation transformer and RCD for isolated power question

Source: <http://sci.tech-archive.net/Archive/sci.electronics.design/2004-10/7566.html>

From: Terry Given (*my_name_at_ieee.org*)
Date: 10/27/04

Date: Wed, 27 Oct 2004 20:35:23 +1300

Alan Perry wrote:

> Terry Given <my_name_at_ieee.org> wrote in message news:<ackfd.2693\$IF1.69232@news.xtra.co.nz>...

>

>>Alan Perry wrote:

>>

>>>Having had experience of ground loops and general interference

>>>I wanted to design a system that was as isolated as possible, but

>>>still safe. To start with the mains power feed I researched around

>>>and I believe it boils down to this...

>>>

>>>Is this How you use an Isolation Transformer and RCD to protect equipment

>>>and break ground loops?

>>>

>>> Primary | Secondary

>>>

>>> -----

>>> L ----- | ----- | |----- L2

>>> ((| |

>>>)) | |

>>> ((| |

>>>)) | RCD 30mA |

>>> ((| |

>>> N ----- | ----- + --- | |----- N2

>>> | | | |

>>> | ----- | |----- E2

>>> E -----

>>>

>>> ^

>>> |

>>> Isolation transformer

>>>

>>>Also can charge build up be solved with a 1M resister between the

>>>two earths?

>>>

>>>Cheers

>>>

>>>Alan

>>

>>Sorry Alan, but you use *EITHER* an RCD or an isolating transformer. As it
>>stands, your isolating transformer adds weight, cost and *NO PROTECTION*
>>*WHATSOEVER* to the user. Here is why:

>

>

> who said I wanted to protect the user? oh yeah I did say safe.... :)

>

>

>>An isolation transformer is used to minimise electric shock hazards in
>>MEN (Multiple Earthed Neutral) power systems. With the MEN system,
>>distribution transformer secondary star-points (ie neutral connections)
>>are connected to "the body of the earth" at multiple points. There are
>>thus 2 ways of getting an electric shock:
>>1) hook yourself up across Phase & Neutral
>>2) hook yourself between phase and the planet (eg wet concrete floor, or
>>muddy paddock etc).

>>

>>Obviously the latter is the most common technique for electrocution, as
>>in general we are always in good contact with the earth. MEN is used to
>>ensure a low impedance to fault currents (which are correspondingly
>>high) thereby ensuring protective devices quickly trip. This is a good
>>thing; the downside is the increased risk of electrocution.

>>

>>The use of an isolation transformer removes the connection between the
>>neutral conductor and earth. This removes #2 as a means for getting
>>zapped – now you must hook up to both phase and neutral, which takes
>>considerably more effort – but is achievable, if you try hard enough :)

>>

>>Alas in your schematic the second "earth" terminal is of course not
>>connected to earth, but is actually the neutral conductor. In the case
>>of metallic equipment, you have now ensured that the case is securely
>>connected to neutral – ie you just achieved half of the necessary
>>connections for electrocution to occur. Its worth noting that an
>>isolation transformer has no "phase" and "neutral" outputs – they are
>>interchangeable (hey, its AC...). Iso trannys generally have a fuse in
>>each output lead.

>

>

> The earth-neutral connection did bother me, hence the post....

the flip side to my argument is of course for equipment with metal cases, any phase-to-case internal fault will immediately blow the iso tranny fuses when connected as drawn. If you leave the earth pin unconnected (as in a conventional iso tranny) then a phase-to-case fault means the case is at the phase potential. Because phase is floating wrt earth, this does precisely nothing. OTOH if you touch this appliances case with one hand, and the neutral conductor with the other – zap, you're dead (at least you probably are with 230Vac :)

>
>
>>An iso tranny with 1 outlet has NO CONNECTION to the earth pin at all.
>>An iso tranny with 2 or more outlets will have all of the earth pins
>>connected together, but going nowhere. The reason for this is as
>>follows: imagine two appliances, one having a phase-to-case fault, the
>>other with a neutral-to-case fault. If you plug the first one into a
>>dual-output iso tranny (with earth unconnected), the case now sits at
>>the phase conductor potential. The operator will not get a shock, and
>>the equipment will continue to operate. However if they plug the second
>>faulty device into the same iso tranny, one case is at phase potential,
>>the other at neutral potential. one hand on either appliance WILL KILL
>>YOU. OTOH if the two outlet earths are connected together, then as soon
>>as you plug in the 2nd appliance, one or both output fuses will rupture
>>(the first appliance means the phase conductor is at earth potential,
>>the 2nd shorts phase to neutral thru the earth terminal link).
>>
>>an RCD is a controlled-electrocution device, and will trip an isolating
>>device very rapidly (< 300ms) when earth current (>= 30mA) is detected.
>>Of course this earth current must flow (for a little while). If faulty
>>equipment causes the earth leakage current, then the RCD will trip when
>>you plug in said equipment. If it is the operator getting a belt that
>>causes the earth leakage current, then the operator must get said belt
>>before the RCD will trip.
>>
>>cheers
>>Terry
>
>
> So I must connect my earths together (on my isolated side), but not to
> 'neutral' (which I am instinctively more happy with)

Bingo. And that connection is specifically for the two-faulty-appliance case (pun intentional :). Most countries have electrical regulations governing the use of iso trannies, which specifically forbids connecting the "earth" E2 to N2. NZ certainly does – I just passed my electrical registration B exam a couple of weeks ago, allowing me to service 3-phase 400V fixed-wired toasters. We specifically studied the regs concerning iso tranny's

>
> If I include an RCD, this is another level of fault protection (in
> addition to fuses in both output lines)

only if you connect your "earth" E2 to neutral N2 a-la the diagram. if E2 is unconnected, then the RCD will never trip.

so you see that putting in the RCD requires the E2-N2 connection, which you are not supposed to do with an iso tranny. normally one uses either an rcd or an iso tranny, not both.

sci.electronics.design: Re: Isolation transformer and RCD for isolated power question

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- > *As I am expecting fault conditions to occur, any thing that helps*
- > *protect the equipment and user will be welcome (just as long as it's*
- > *not too expensive.... :)*
- >

what equipment are you actually trying to protect?

- >
- > *Thanks*
- >
- > *Alan*

Cheers
Terry