

Re: How do I convert 0–10V to –5V +5V differential?

Source: <http://sci.tech–archive.net/Archive/sci.electronics.basics/2005–09/msg00075.html>

- *From:* "Chris" <cfoley1064@xxxxxxxxxx>
 - *Date:* 2 Sep 2005 12:03:29 –0700
-

John Fields wrote:

> On 1 Sep 2005 08:01:11 –0700, "Chris" <cfoley1064@xxxxxxxxxx> wrote:

>

>>

>>John Fields wrote:

>>> On 31 Aug 2005 13:13:19 –0700, kasterborus@xxxxxxxxxx wrote:

>>>

>>>>Thanks for you all your help – I have all the parts to build the op–amp

>>>>solution at home – the only thing that puzzles me a bit is the

>>>>+15V/–15V power to the 741 – how do I create +15 and –15V from a

>>>>standard transformer.

>>>

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>>> Since the 741 can take an input supply of plus and minus 22 volts,

>>> max, you can easily get less than that that from a simple,

>>> unregulated, half wave supply using a 12V transformer, like this:

>>>

>>>

>>>

>>> +---[IN4001>]-----+----->+17V

>>> ||

>>> ||

>>> MAINS>--+ || +---[<1N4001]--+-----|----->-17V

>>> || || ||

>>> P || S || +

>>> R || E [C1] [C2]

>>> I || C |+ |

>>> || || ||

>>> MAINS>--+ || +-----+-----+----->GND

>>>

>>>

>>>

>>>> Since your output is only going to swing between +5 and –5V, and the

>>>> 741 needs about 3V above and below that to let that happen, you've

>>>> got about 9V of headroom to either rail so C1 and C2 can be fairly

>>>> modest, depending on what else you're going to use the supply for.

>>>>

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` o-----|----. --- ___ |>---o---o
` ph B ||| in(+)o-|___|-o--|+/-
` |'-----o----. |||
` | +| | .- . |
` | C2--- === |||
` | --- GND |||
` | D | '-' |
` |'-----|<---o-----|. ||
` | === |
` | GND |
` |'-----'

```

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Let's assume that, at turn-on, ph A is more positive than ph B. That means C1 will start charging up in a positive direction. Several mA of current will start to flow through the op amp Vcc pin to the Vee pin. For that half cycle, the – of C2 will be more positive than GND. As ph B goes negative with respect to ph A, C2 will start to charge negatively with respect to GND, relieving the problem.

Since there are 22K resistors between the inputs and GND, the possibility of latchup on turn-on is not there for an LM741. It becomes more of a hazard if one of the op amp inputs is grounded. And it becomes more of a hazard as the DC current draw of the circuit increases. Obviously the several mA of one op amp won't charge up the 470uF cap to a big voltage in 1/2 line cycle. But for some op amps or 4000-series logic using unregulated dual supplies, or for heavier DC loads, this can be a problem.

The problem is exacerbated when you have two different circuits with two different power supplies. If the signal generator turns on when this one is still off, this phantom reverse charging of the power supply can be a more significant failure mode, because it can be continuous. The 0–10VDC ramp voltage would cause this phantom reverse charging on C2 through the non-inverting input to the Vee pin if the signal generator is on before the wall wart is turned on — that is, unless you had the extra diode to keep the cap at less than –0.7V. Again, with the series resistors, I don't believe you'd get latchup at turn-on with most op amps. This was my main concern, and the reason I threw in the extra diodes. Any reverse charging is current limited, so the cap would also probably be OK, too.

The thing is, once old dogs like me learn good tricks (usually the hard way), we tend to stick with them. But it's good to get some feedback from somebody who's thinking things through. It's probable the two extra diodes aren't necessary, if the OP uses an LM741 (and he could be using a CMOS op-amp, which would mean the diodes just might be necessary — they sometimes latch up at lower currents). I guess I just like to use them on unregulated dual supplies like the above, especially if there's more than one power source lurking around. And after all, the OP's buying a pack of 25 diodes. That means 23 spares

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— might as well.

Thanks for the heads up, and the obviously more efficient solution.

Chris

• ***Follow-Ups:***

- ◆ ***Re: How do I convert 0–10V to –5V +5V differential?***
◇ *From:* John Fields

• ***References:***

- ◆ ***Re: How do I convert 0–10V to –5V +5V differential?***
◇ *From:* kasterborus
 - ◆ ***Re: How do I convert 0–10V to –5V +5V differential?***
◇ *From:* John Fields
 - ◆ ***Re: How do I convert 0–10V to –5V +5V differential?***
◇ *From:* Chris
 - ◆ ***Re: How do I convert 0–10V to –5V +5V differential?***
◇ *From:* John Fields
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