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# Optically-isolated 0-5V analogue output module

By Professor Murat Uzam, Department of Electrical and Electronics Engineering, Yozgat Bozok University, Turkey

Figure 1 shows the optically-isolated 0-5V analogue output module, to be used with a 5V microcontroller through its DAC output, with its connections shown in Figure 2.


The circuit contains a Positive Unipolar Photovoltaic Isolation Amplifier 3 (PUPIA3 – explained previously), with HCNR201 high-linearity analogue optocoupler for photovoltaic isolation.

Due to its limited current drive capability, the buffer amplifier (a voltage follower) LM358P-1A must be used on the DAC output. Its output is connected to the input of PUPIA3, which consists of R1, R2 and LM358P-1B as its input, P1, R3, C3 and LM358P-2A as its output, and, of course, the HCNR201 optocoupler. PUPIA3's output is connected to the non-inverting input terminal of LM358P-2B. Provided

PUPIA3's input voltage is limited to 5.00V, its output will also be limited to 5.00V.

Dual series Schottky barrier diodes D1 and D2 divert any overcurrent coming from the terminal  $V_{OUT}$  to the power supply or ground. A ferrite bead connected in series with the output path adds isolation and decoupling from high-frequency transient noises. A transient voltage suppressor (TVS) is used to filter and suppress any transients coming from  $V_{OUT}$ .

The circuit can supply up to 20mA. It is powered by +12V, with another +12V powering the optically-isolated circuit output. When  $0.00V \leq V_{IN} \leq 5.00V$ ,  $V_{OUT} = V_{IN}$ ; see Figure 3 and Table 1.

Set  $V_{IN}$  to +5.00V and, by adjusting P1, ensure that  $V_{OUT} = +5.00V$ . 

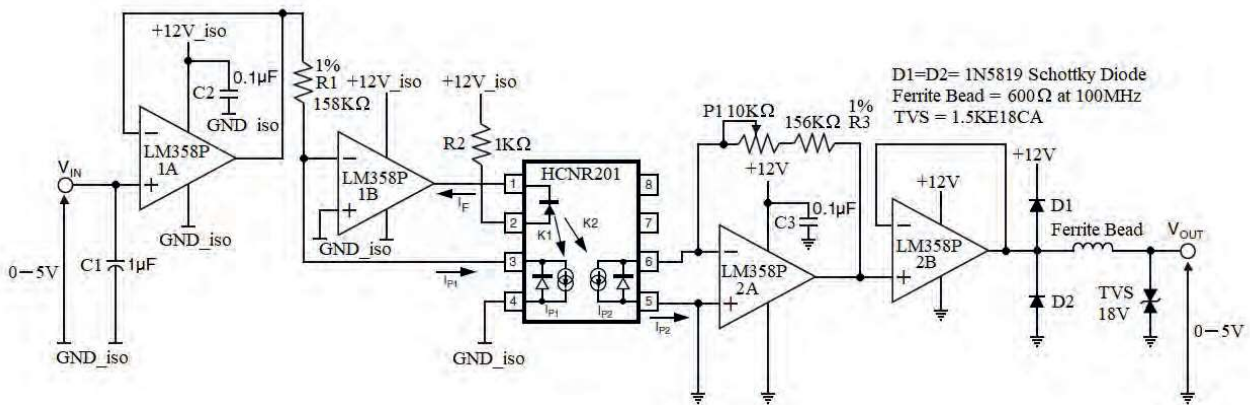


Figure 1: Optically-isolated 0-5V analogue output module

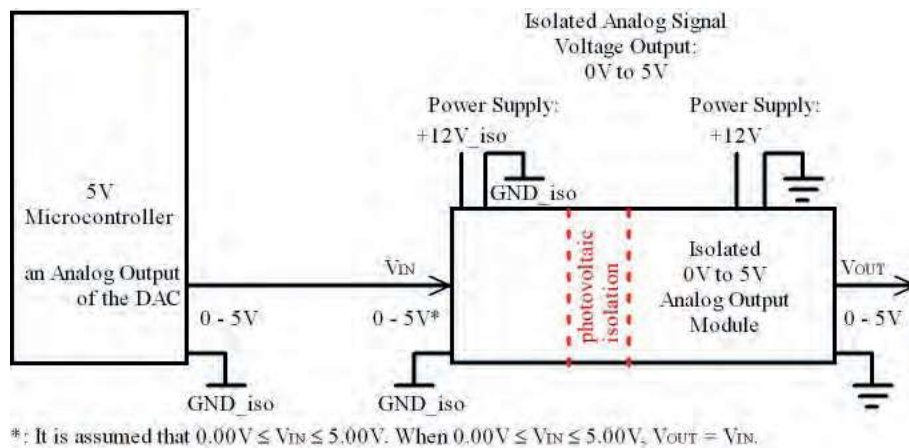


Figure 2: The module's connections

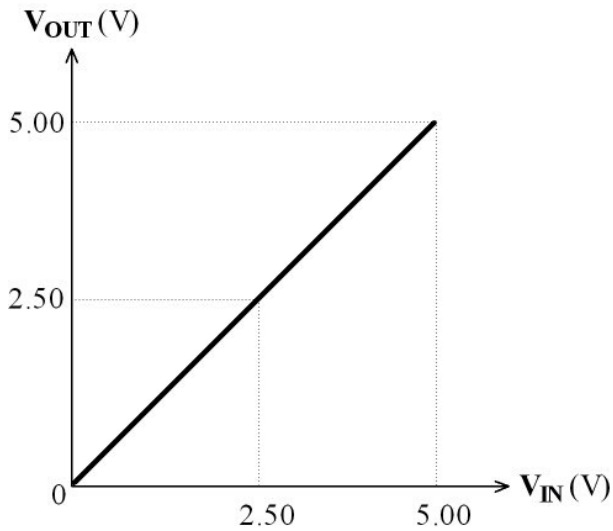


Figure 3:  $V_{OUT}$  vs.  $V_{IN}$  for the optically-isolated 0-5V analogue output module

$V_{IN}(V)$	$V_{OUT}(V)$
5.00	5.00
..	..
4.00	4.00
..	..
3.00	3.00
..	..
2.50	2.50
..	..
2.00	2.00
..	..
1.00	1.00
..	..
0.00	0.00

Table 1: Example input and output voltages for the module, assuming  $0.00V \leq V_{IN} \leq 5.00V$

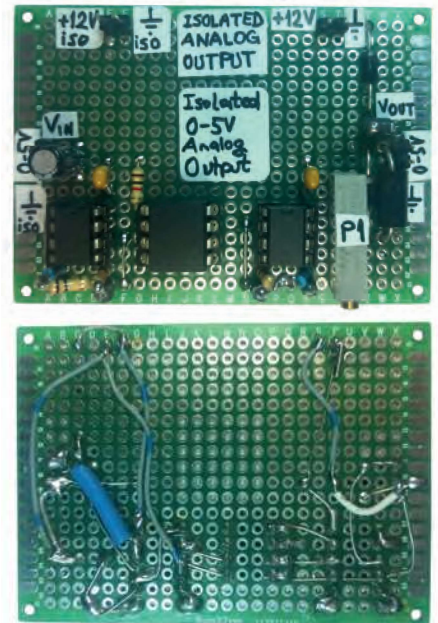


Figure 4: The module's PCB

## IN THE NEXT ISSUE OF ELECTRONICS WORLD

In the November issue of Electronics World magazine, we have special reports focusing on communications and RF design, overall embedded system design, thermal management, optical isolation in power systems, how to manage battery power in new EVs and hybrid vehicles, and design for EMC, among the many other topics.

You will be hard pushed to find a technically in-depth magazine among the others today, which is completely aligned to the professional, practicing engineer, employed by the industry, but also those working in academia, too. The content is primarily applications-led, with many tutorial-style article series.

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