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0-5V analogue input modules 3, 4 and 5

This column is dedicated to a project involving thirteen analogue input modules and seven analogue output modules for use with a 5V microcontroller through its ADC and DAC channels.

Previously, we covered the 0-5V analogue input modules 1 and 2, which accept DC input voltages from 0V to 6.26V and 12V, respectively. In this month's column, we will focus on 0-5V analogue input modules 3, 4 and 5, which accept up to 24V DC inputs.

0-5V Analogue Input Module 3

Figure 1 shows the 0-5V analogue input module 3, with its connections shown in Figure 2. In this design it is assumed that the input voltage range (V_{IN}) = 0-24V. When 0V – V_{IN} – 5V, V_{OUT} = V_{IN} (Figure 3). When 5.01V – V_{IN} – 24V, V_{OUT} will be equal to a value from 5.01V to 5.07V, due to the particular electrical properties of the LM358P-A used. Input voltages up to 24V do not damage the circuit, which outputs values between 5.01V and 5.07V.

This circuit is identical to 0-5V analogue input module 2 discussed last month, except for the 12V DC power. Here, the power supply is 24V, but for exact operation of the circuit refer to last month's article.

Table 1 shows some example input and output voltages for the 0-5V analogue input module 3, with a prototype circuit board shown in Figure 4.

0-5V Analogue Input Module 4

Figure 5 shows the schematic diagram of 0-5V analogue input module 4 to be used with an ADC input of a 5V microcontroller, with its connections to the MCU shown in Figure 6. Here it is assumed

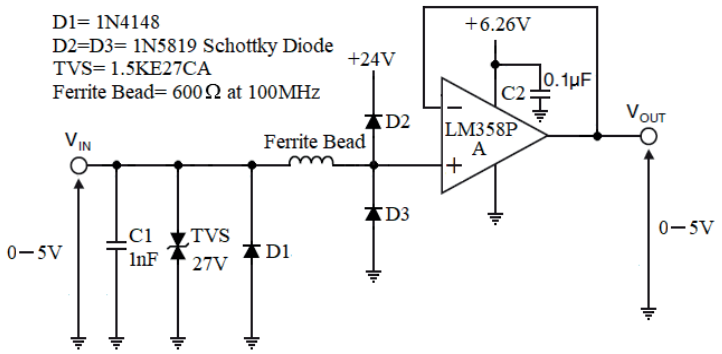
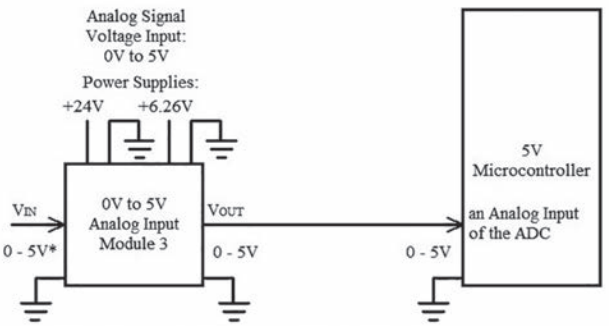


Figure 1: Schematic diagram of 0-5V analogue input module 3



*: Input voltage values up to 24V are accepted without any damage.
When 0.00V ≤ VIN ≤ 5.00V, VOUT = VIN.
When 5.01V ≤ VIN ≤ 24V, VOUT will be equal to a value from 5.01V to 5.07V.

Figure 2: Connection of 0-5V analogue input module 3 to the analogue input of a 5V microcontroller

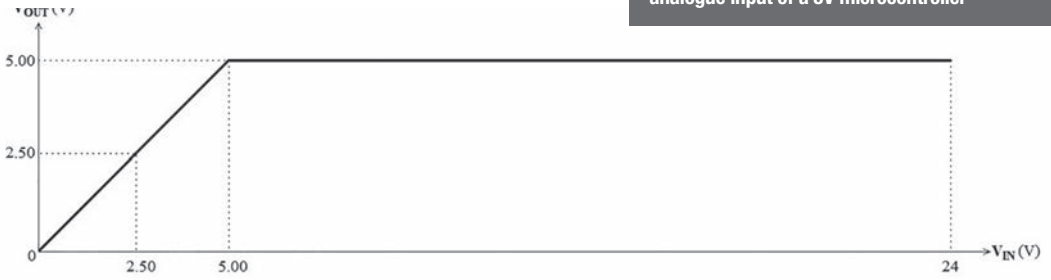


Figure 3: V_{OUT} vs V_{IN} for 0-5V analogue input module 3 shown in Figure 1

V_{IN}(V)	V_{OUT}(V)
24.00	5.0X
..	5.0X
20.00	5.0X
..	5.0X
10.00	5.0X
..	5.0X
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 of input and output voltage values for 0-5V analogue input module 3. 5.0X is a value from 5.01V to 5.07V, due to the electrical properties of the LM358P-A used

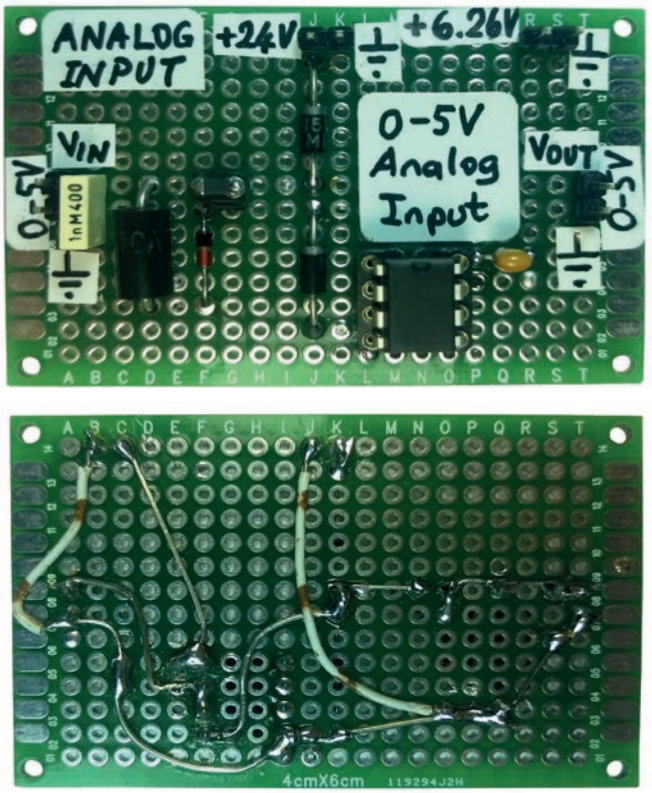


Figure 4: Top and bottom of the prototype circuit board of 0-5V analogue input module 3

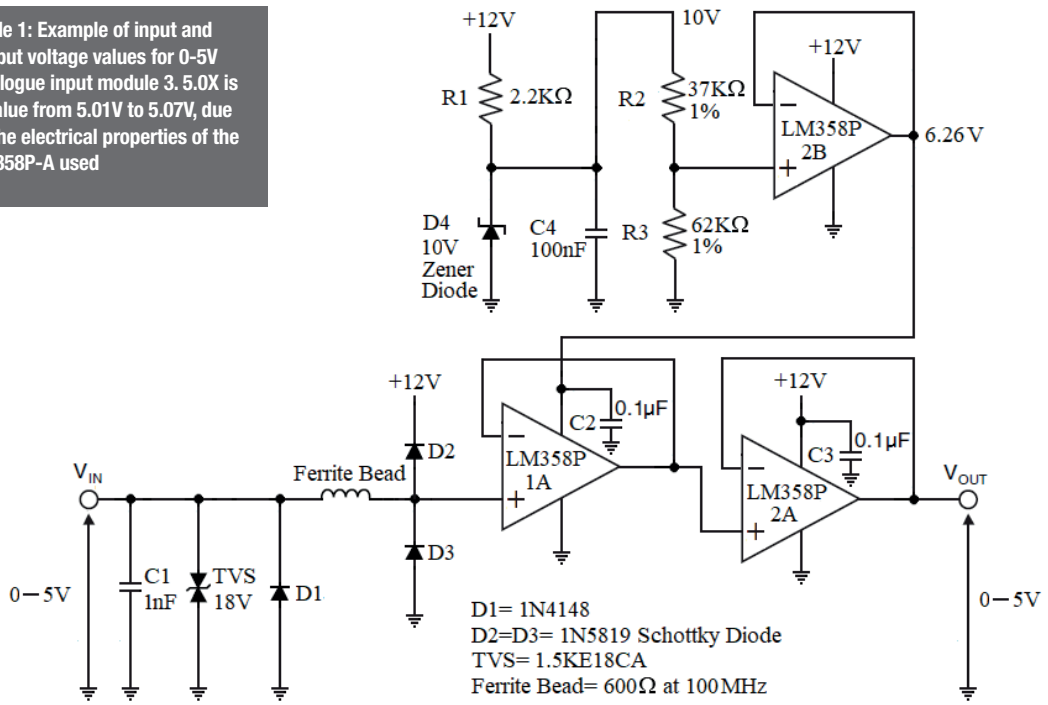


Figure 5: Schematic diagram of 0-5V analogue input module 4

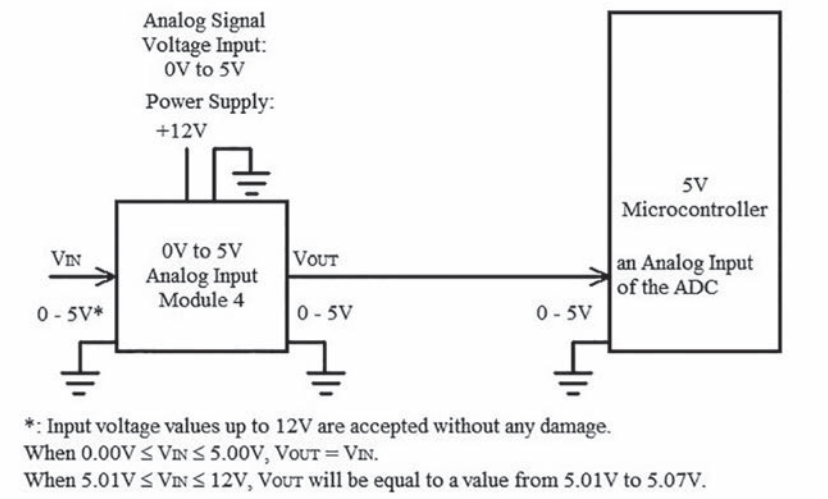
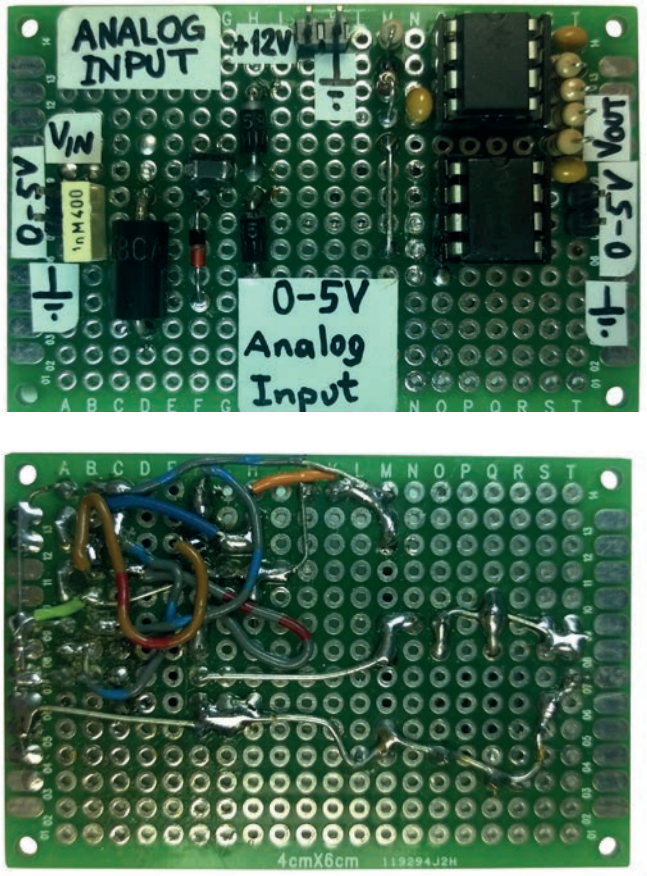


Figure 6: Connection of 0-5V analogue input module 4 to the analogue input of a 5V microcontroller

that the input voltage range (V_{IN}) = 0-12V. When 0.00V – V_{IN} – 5.00V, V_{OUT} = V_{IN}. When 5.01V – V_{IN} – 12V, V_{OUT} will be equal to a value between 5.01V and 5.07V, due to the electrical properties of the LM358Ps used. The relationship between V_{OUT} and V_{IN} is the same as in the 0-5V analogue input module 2.



Apart from the buffer amplifier LM358P-2A from which the output voltage V_{OUT} is obtained, the bottom part of the schematic diagram is identical to that of 0-5V analogue input module 2, explained in the last issue. The top part of the circuit generates the 6.26V reference voltage. R1, D4 (10V zener diode) and C4 provide a 10V reference voltage from a 12V power supply. This reference voltage is then divided using resistors R2 and R3 to obtain 6.26V, which in turn is connected to the non-inverting input of buffer amplifier LM358P-2B, whose output is fixed as 6.26V, capable of sourcing up to 20mA.

This module's prototype circuit board is shown in Figure 7.

An important implementation tip here is that, for proper operation, make sure that R3/(R2+R3) = 62.62%.

0-5V Analogue Input Module 5

Figure 8 shows the schematic diagram of 0-5V analogue input module 5 for use with the ADC input of a 5V microcontroller, with its connections shown in Figure 9. In this design, it is assumed that input voltage range (V_{IN}) = 0-24V. When 0.00V – V_{IN} – 5.00V, V_{OUT} = V_{IN}. When 5.01V – V_{IN} – 24V, V_{OUT} will be from 5.01V to 5.07V.

Except for the buffer amplifier LM358P-2A from which the output voltage V_{OUT} is obtained, the lower part of the schematic diagram is identical to that of 0-5V analogue input module 3. The top part of the circuit supplies the 6.26V reference voltage. R1, D4 (10V zener diode) and C4 provide a 10V reference voltage from 24V. Then, this 10V reference voltage is divided with R2 and R3 to obtain the 6.26V reference voltage, which is connected to the non-inverting input of the buffer amplifier LM358P-2B, whose output is fixed as 6.26V reference voltage, capable of sourcing up to 20mA.

The top and bottom of this module's prototype circuit board are shown in Figure 10.

As before, it's worth noting that, for proper operation of the circuit, R3/(R2+R3) = 62.62%. ❖

Figure 7: Top and bottom of the prototype circuit board of 0-5V analogue input module 4

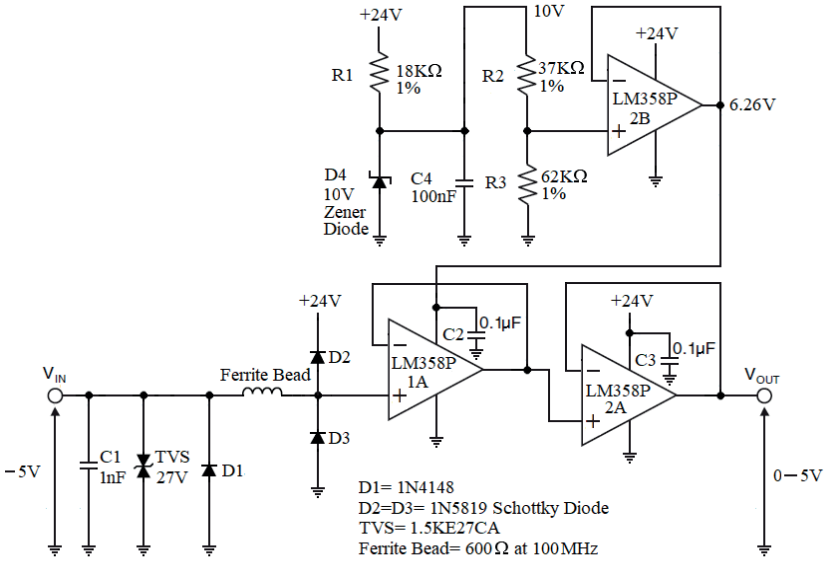
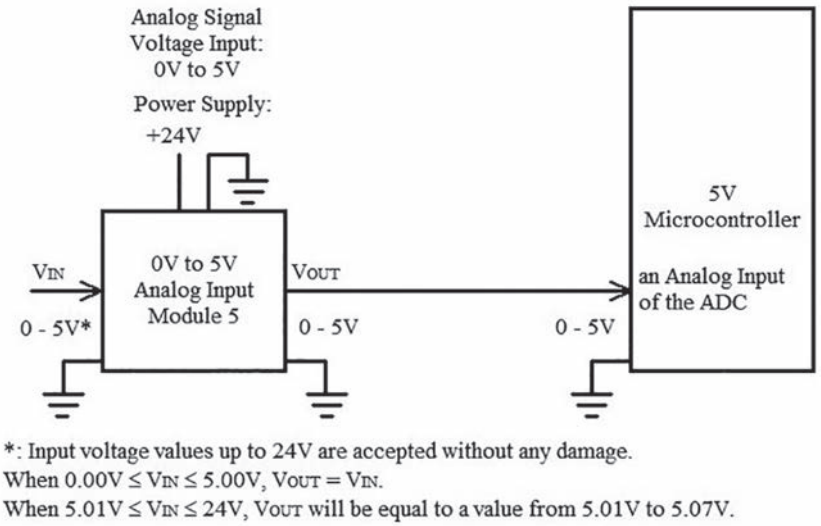


Figure 8: Schematic diagram of 0-5V analogue input module 5



*: Input voltage values up to 24V are accepted without any damage.
When 0.00V ≤ VIN ≤ 5.00V, VOUT = VIN.
When 5.01V ≤ VIN ≤ 24V, VOUT will be equal to a value from 5.01V to 5.07V.

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Figure 9: Connection of 0-5V analogue input module 5 to the analogue input of a 5V microcontroller

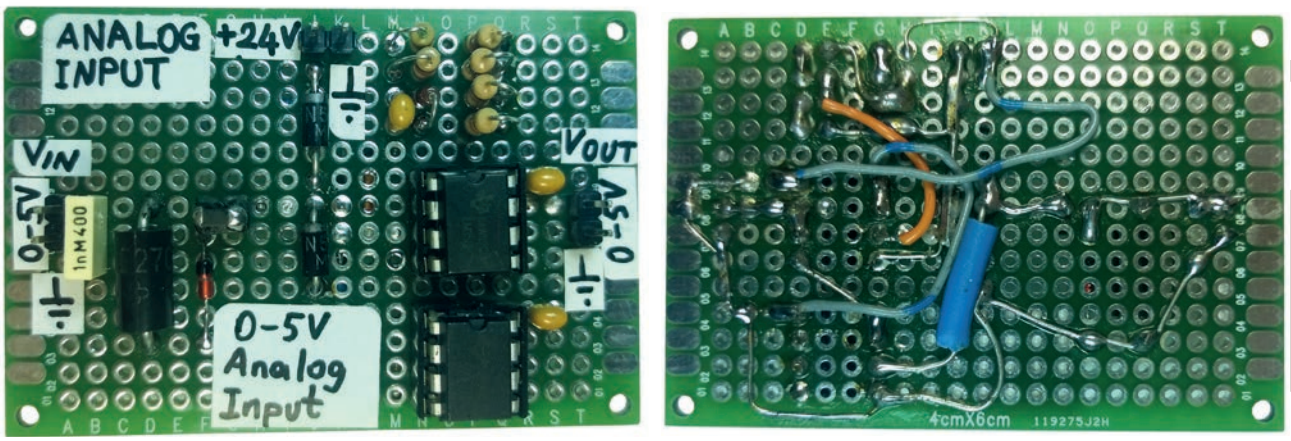

Figure 10: Top and bottom of the prototype circuit board of 0-5V analogue input module 5