APPLICATION NOTE

Photo Interrupter (ITR) in rotation direction application

1. Introduction

As technology improve, every electronic companies have higher expectation in automation accuracy, more companies are using sensor components to improve automation accuracy. Most sensors use IR to avoid human eyes effect by surrounding products or equipment light interference. This application note will use IR LED and photo transistor (PT) to detect rotation direction application. IR LED and PT basic circuit application in figure 1

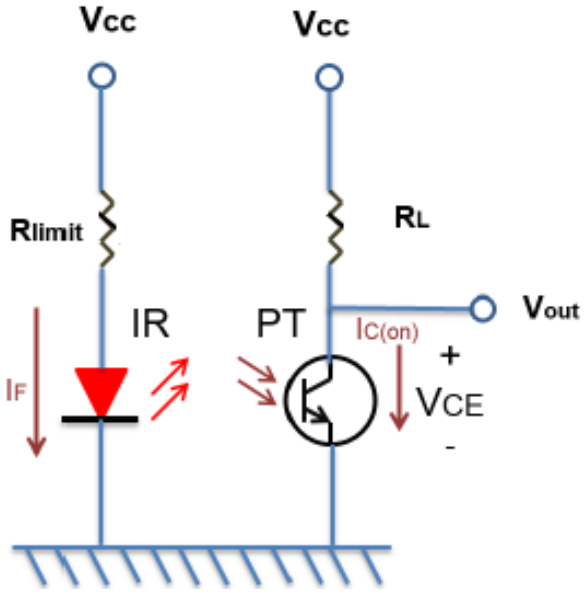

Figure 1. IR LED and PT basic circuit application

V_{out} outcome description:

- No IR irradiance ➔ PT cut-off and V_{out} in high voltage level
- High IR irradiance ➔ PT saturate and V_{out} in low voltage level

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2. Transmissive ITR Rotation Direction Detections

Rotation direction detections circuit has some different from IR LED and PT basic circuit application, rotation direction detection add one more PT (will explain later), figure 2 shows 2PT basic circuit.

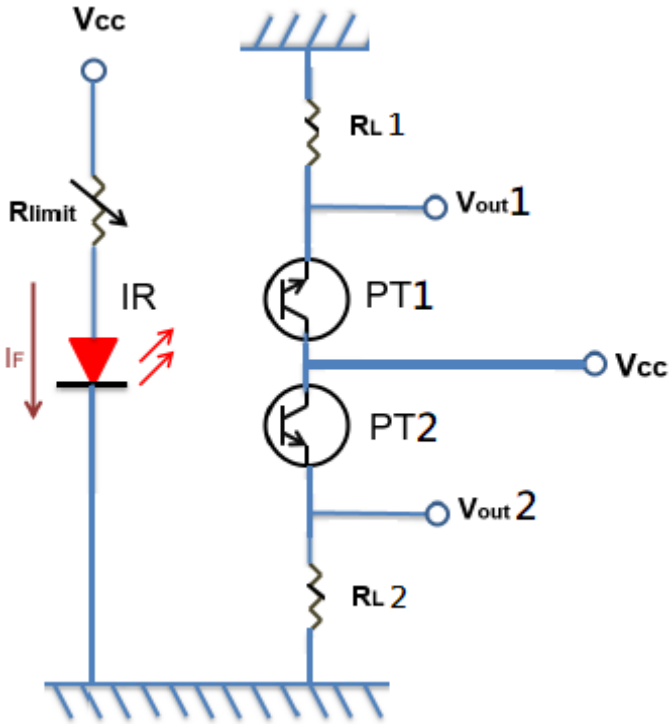

Figure 2. 2PT basic circuit

2PT V_{out} outcome description:

- No IR irradiance ➔ PT cut-off and V_{out} in low voltage level
- High IR irradiance ➔ PT saturate and V_{out} in high voltage level

Reason for add one more PT is because rotation direction need two signals to determine whether is going clockwise or counter-clockwise. When code wheel rotates clockwise, code wheel slits will block PT1 first which PT1 output will be in low voltage level then block PT2 make PT2 output in low voltage level. Counter-clockwise detection is opposite to clockwise detection. Figure 3 and 4 shows clockwise and counter-clockwise rotation detection.

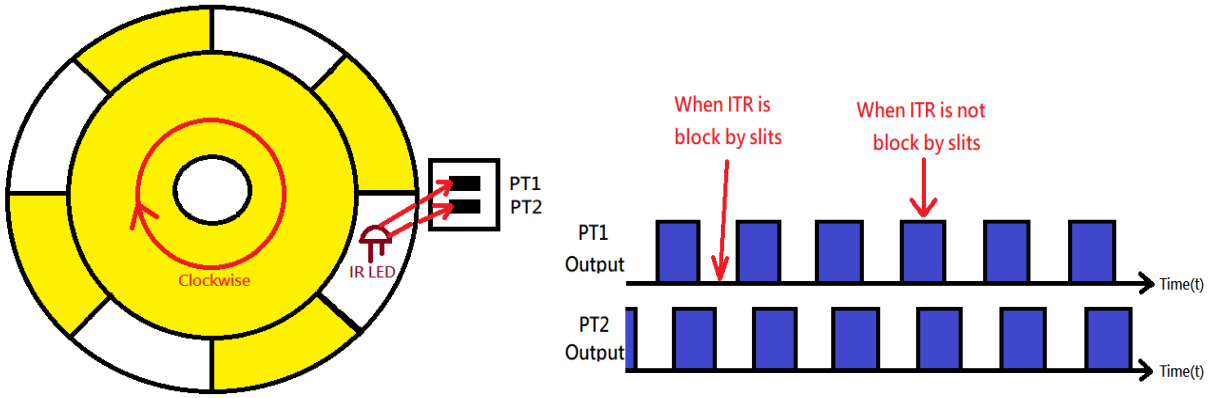

Figure 3. Clockwise rotation

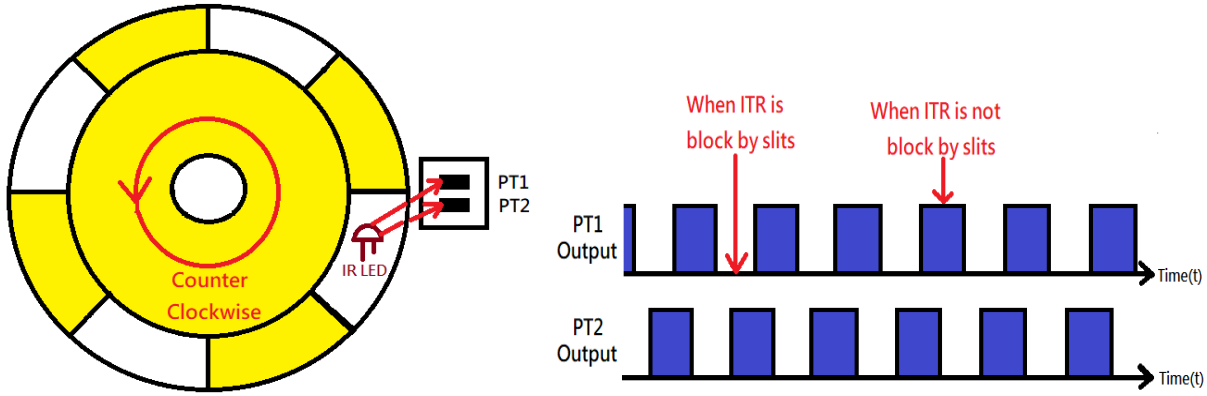

Figure 4. Counter-Clockwise rotation

Is important for code wheel slit length to be longer than 2PT width, so the direction of rotation can be determined from the order of the 2 PT outputs when rotating.

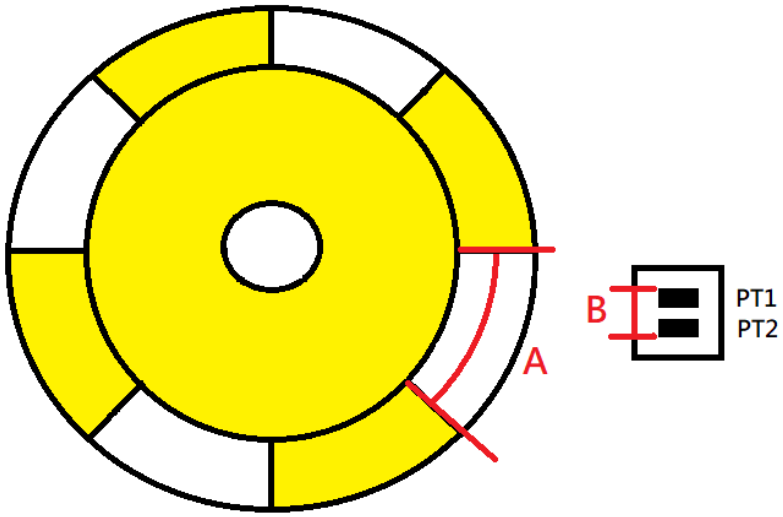

Figure 5. A distance needs to longer than B distance

3. Actual Operation

This is IR LED and 2PT actual operation, figure 6 shows when code wheel rotates clockwise, picture 7 shows when code wheel rotates counter-clockwise. Ch1 is PT2 output and Ch2 is PT1 output.

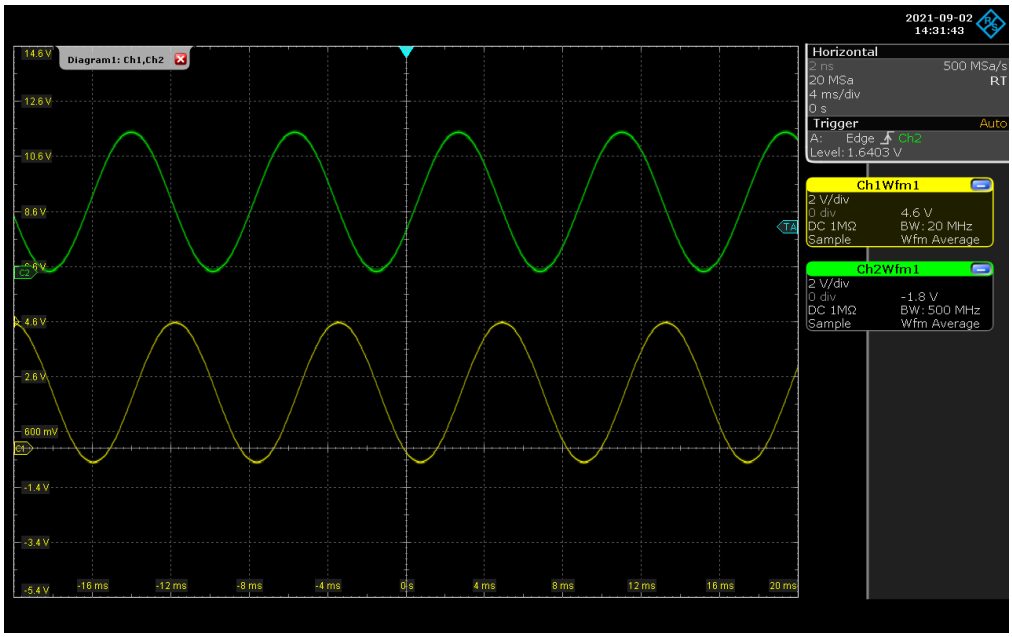

Figure 6. Clockwise rotation

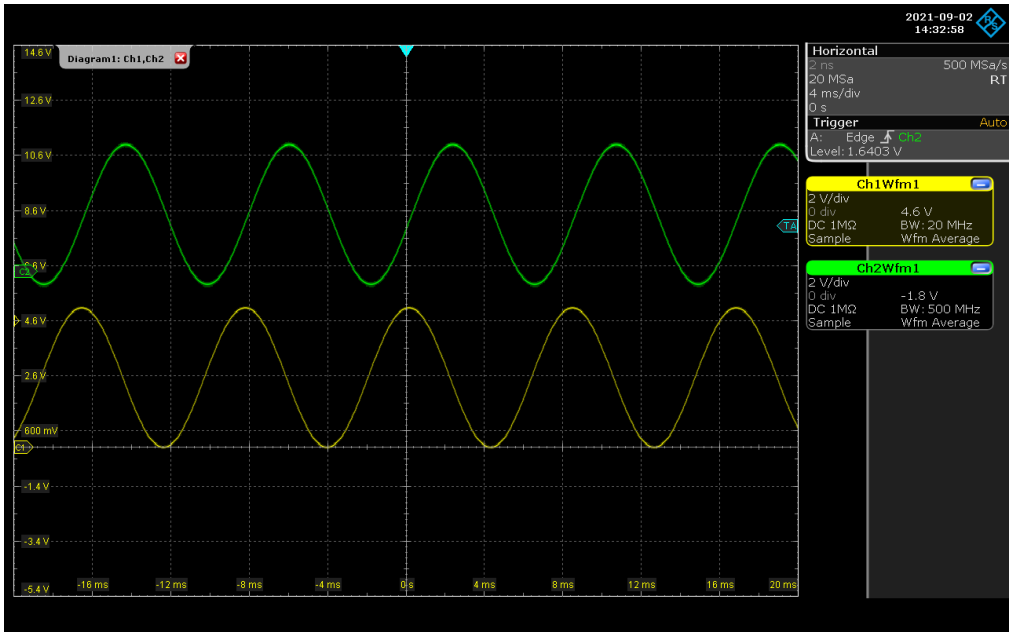

Figure 7. Counter-clockwise rotation

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From above figures show PT outputs signal are in sine wave, to easier distinguish which PT outputs signal generate first, a non-symmetrical Schmitt Trigger can be added behind PT output, because non-symmetrical Schmitt Trigger can transform sine wave to square wave when sine wave is higher or lower to specific voltage threshold. How to calculate specific voltage threshold can be reference to Analog ALS application note.

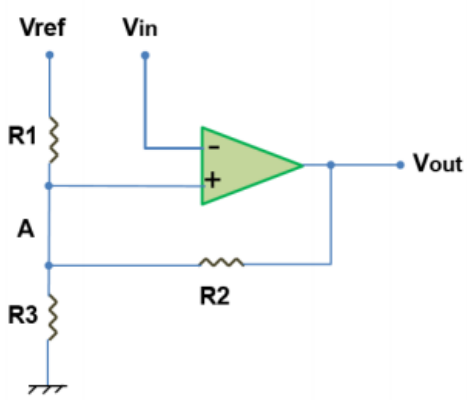


Figure 8. Non-Symmetrical Schmitt Trigger

Let V_{ref} = 5V and R1=R2=R3=10kΩ, when sine wave rises around 3.33V that square wave become low voltage level. When sine wave lowers to around 1.66V that square wave become high voltage level. Figure 9 show code wheel rotates clockwise waveform and figure 10 show code wheel rotates counter-clockwise waveform with CH1 is PT2 output and CH2 is PT1.

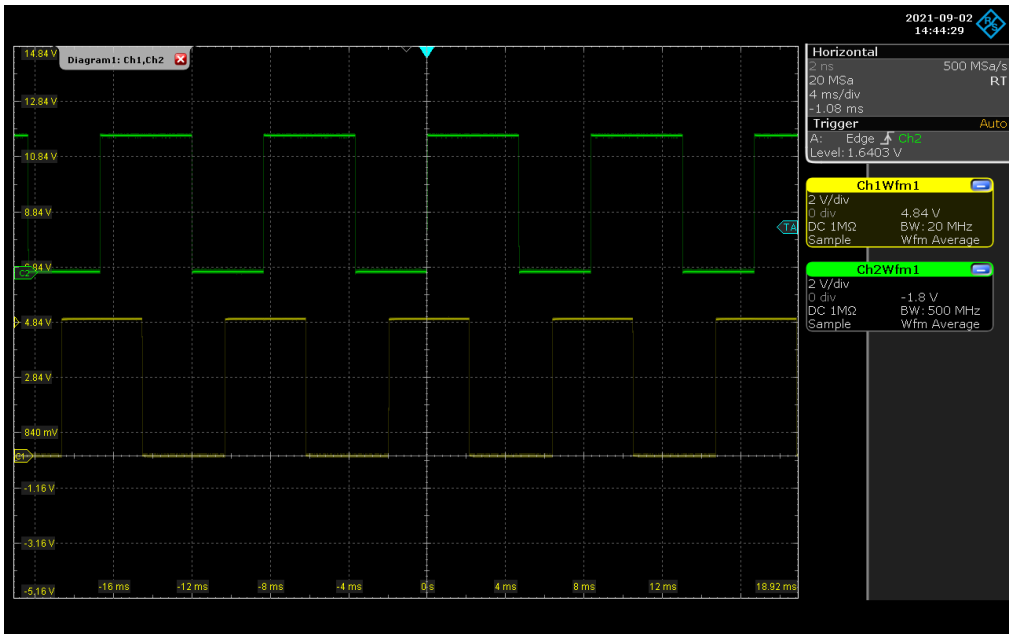


Figure 9. Clockwise rotation

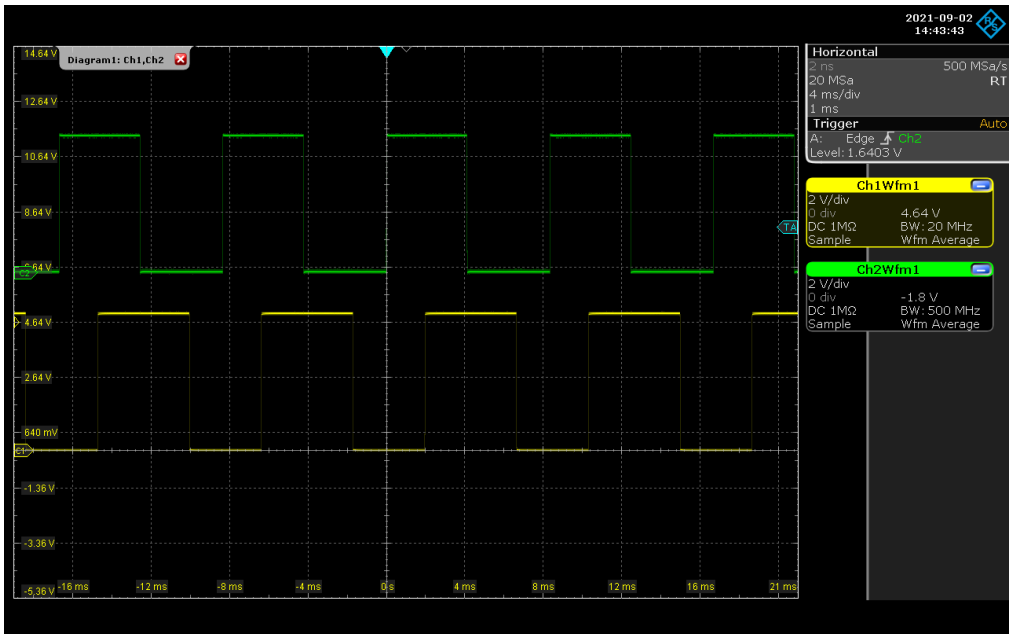


Figure 10. Counter-Clockwise rotation

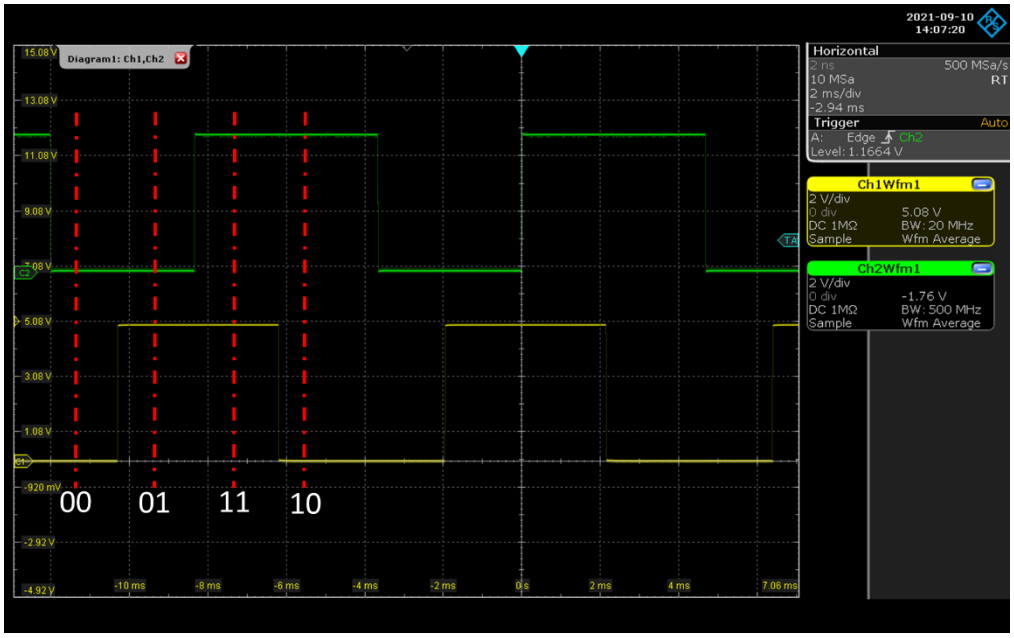
In addition, using digital method to see code wheel current rotation direction. As shown in Table 1, when code wheel rotates clockwise, it starts with 00 next to 01, then 11, and finally 10. When code wheel rotates counter-clockwise, it starts with 00 next to 10, then 11, and finally 01.

Clockwise : 00 ➔ 01 ➔ 11 ➔ 10

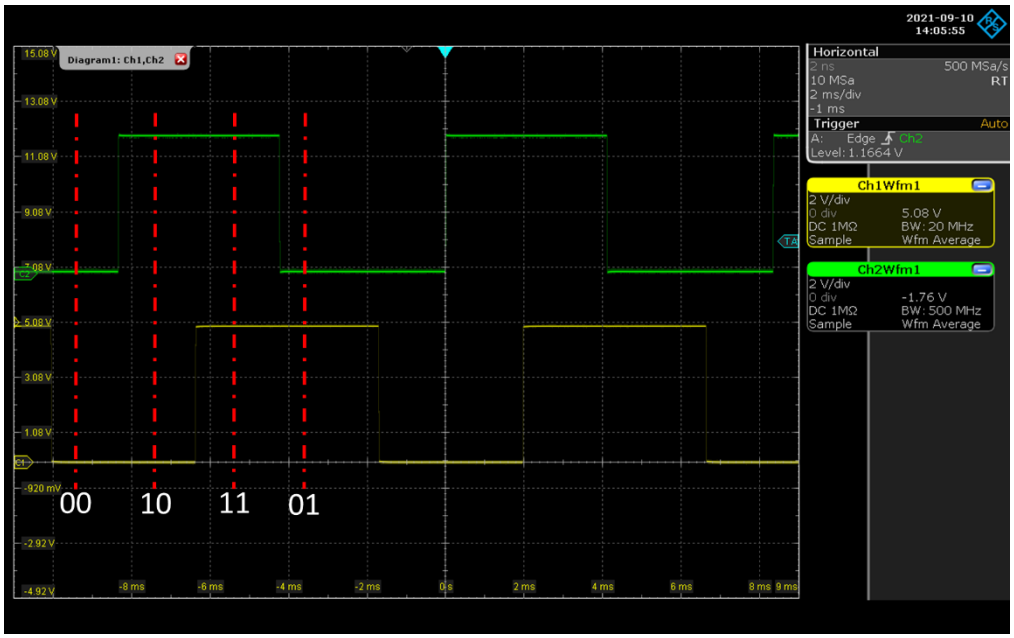
Counter-Clockwise : 00 ➔ 10 ➔ 11 ➔ 01

Table 1. Rotation direction detection using digital method

Figure 11 shown clockwise rotation in digital method and Figure 12 shown counter-clockwise rotation in digital method.



Picture 11. Clockwise rotation



Picture 12. Counter-Clockwise rotation

The information in this application manual is only for customers' design reference. Please verify when actually use it. If have any other questions, please contact Everlight for further technical support.