

## Lab 03: Traffic Light

### Objectives: Traffic Light

In this lab, you will build a traffic light circuit.  
**This is a strictly individual task.**

### Recall

In the previous labs, you learned how to build various types of circuits using a clock, a counter, a ROM, and a seven-segment display. The clock set the tempo for our circuit. It tells the other components when to do their next operation. As its name suggests, the counter outputs an incremented number each time the clock ticks. The ROM is a memory where we can store a piece of information. The storage process is done only once, at building time, thus its content can't change at test time. The role of a ROM is to give the content of a location given its address. Therefore, ROMs have only one input (i.e. the address) and a single output (i.e. data). Finally, the seven-segment display displays whatever shape can be drawn with its segments.

In the example below, we build a simple traffic light with a clock, a counter, a splitter, and three LEDs. Figure 1 shows how these components are connected.

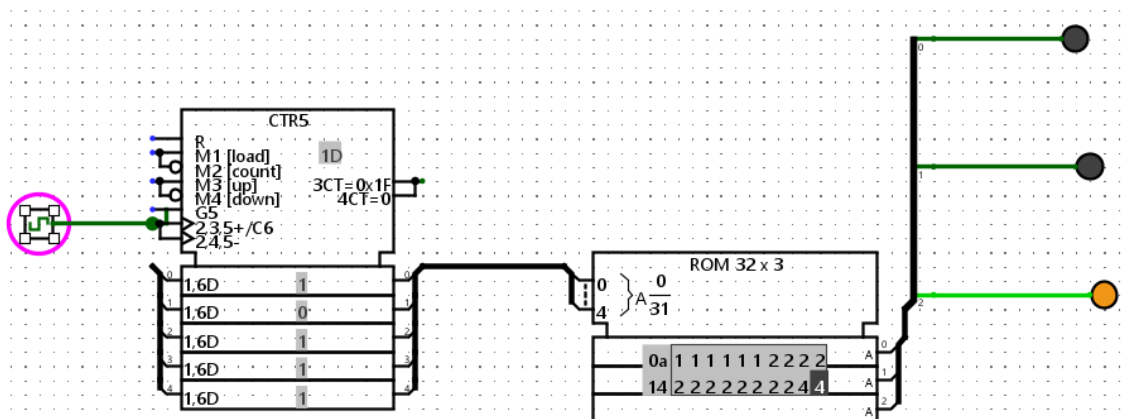


Figure 1: Simple Traffic Light Example

We want our circuit to light up the green LED for 16 clock cycles, 12 for the red, and 4 for the orange. Therefore, we edited the content of the ROM with 16 ones ("111..." 16 times), 12 twos, and 4 fours. Each time the clock ticks, the counter outputs a number, starting from zero. This number is

fed as an address to the ROM. The latter outputs whatever is in this address. For instance, “1” is output in binary as “001”. Using a splitter, we separate these bits into three single bits. The first one “1” goes to the green LED the second one “0” to the red LED, and the third one “0” goes to the orange LED. Thus, since we have 16 ones, it will light up the green LED for 16 clock cycles. The same idea applies to the red and orange LEDs.

## Assignment

Build a traffic light system with four sides. Each side has three colors (orange, green, and red) and two two-digit counters. On each side, the red light counter counts up to 16 seconds. For the green and orange lights, the other counter counts for up to 16 seconds too (12 seconds for green and 4 seconds for orange). When the light is red on two facing sides, the other sides are either green or orange, and vice-versa. Similarly, when the counter for red is counting the counter for green must stay at zero, and vice-versa. In total, you will have 12 LEDs and 16 7-segment displays. Three LEDs and four displays on each side.

You may need to build a new decoder for a two-digit number or use two of those you already built with a little tweak. **Use only one clock and one counter.**