Project V07 Preliminary Truth Tables

Incomplete 74LS90 + 7447 two-display counter, with the planned additions required for the CSS370S cruise-speed-control project

The uploaded circuit currently shows a basic two-display counter made from two 74LS90 decade counters and two 7447 BCD-to-seven-segment drivers. Because the project is still incomplete, the tables separate the current counter/display function from the planned cruise-control additions.

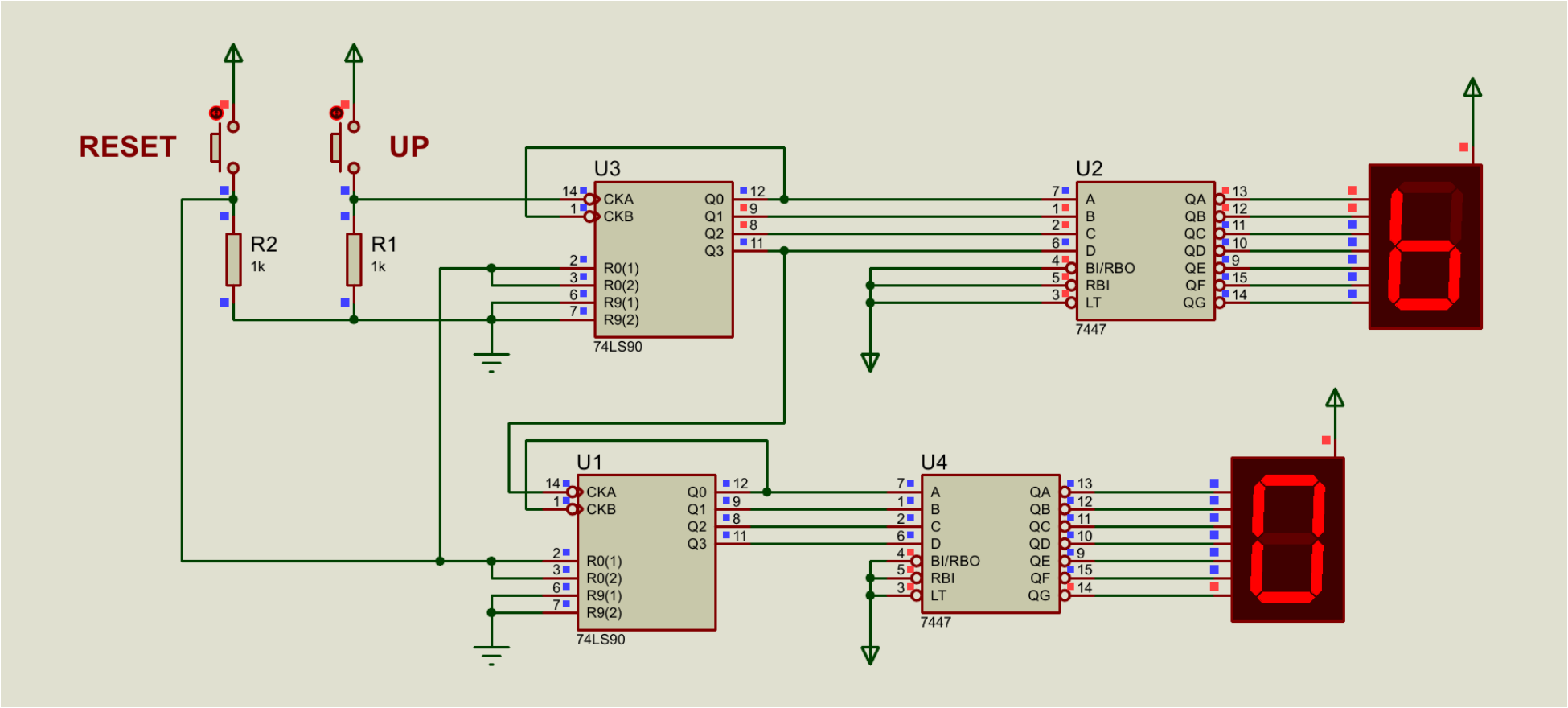

Figure 1: Current Project V07 incomplete circuit using two 74LS90 counters, two 7447 display drivers, UP input, RESET input, and two common-anode seven-segment displays.

1. Circuit Interpretation and Missing Additions

Item	Interpretation
Current circuit	Two 74LS90 decade counters drive two 7447 display drivers. The uploaded schematic currently shows UP and RESET only.
Current display function	The circuit can act as a basic two-digit up counter. Without extra limiting, a two-counter 74LS90 system can continue beyond 10.
Missing cruise requirements	The circuit still needs green 0-5, yellow 6-9, flashing red comparator warning, maximum-speed handling at 10, and logic-based cruise reset.
Planned correction	A ten-state signal A2 and an invalid 11 detector should be added so that speed 10 is displayed, then the next invalid state is reset or blocked.
Important limitation	The current circuit does not yet show a DOWN control path. If decreasing speed is required, an additional down-counting solution or a different counter stage must be added.

2. Planned Main Component Function Table

Component / label	Part	Function
U1 and U3	74LS90	Current unit and tens decade counters for the two-display counter.
U2 and U4	7447 / 74LS47	BCD-to-seven-segment drivers for common-anode displays. Outputs are active LOW.
RESET input	Push-button	Manual reset for initialising/testing the counter.
UP input	Push-button	Clock input for increasing the displayed count.
To be added	Logic gates	Green/yellow range logic for 0-5 and 6-9.
To be added	XOR/inhibit gate	Prevents green from turning ON at speed 10 or invalid high states.
To be added	74LS85	Compares current speed with selected set speed.
To be added	NE555 + driver	Flashes the red LED when selected speed is reached.
To be added	Reset/limit logic	Allows 10 to display, then resets/blocks attempted 11 or higher invalid counts.

3. Current 74LS90 Counter Control Truth Table

UP pulse	RESET	Counter action	Display result
0	0	Hold	Same value remains displayed.
1 pulse	0	Count up	Display increases by 1.
X	1	Reset active	Display returns to 00.
Repeated UP pulses	0	Normal decade count	Without limit logic, the display may continue beyond 10.

4. 74LS90 BCD Counter Truth Table

The 74LS90 outputs are treated as A = Q0, B = Q1, C = Q2 and D = Q3. A is the least significant bit and D is the most significant bit.

Decimal	Q3/D	Q2/C	Q1/B	Q0/A	BCD DCBA	Display
0	0	0	0	0	0000	0
1	0	0	0	1	0001	1
2	0	0	1	0	0010	2
3	0	0	1	1	0011	3
4	0	1	0	0	0100	4
5	0	1	0	1	0101	5
6	0	1	1	0	0110	6
7	0	1	1	1	0111	7
8	1	0	0	0	1000	8
9	1	0	0	1	1001	9

5. 7447 Common-Anode Display Truth Table

For the 7447 / 74LS47 driver connected to a common-anode display, 0 means the segment is ON and 1 means the segment is OFF.

Digit	BCD DCBA	a	b	c	d	e	f	g	Display
0	0000	0	0	0	0	0	0	1	0
1	0001	1	0	0	1	1	1	1	1
2	0010	0	0	1	0	0	1	0	2
3	0011	0	0	0	0	1	1	0	3
4	0100	1	0	0	1	1	0	0	4
5	0101	0	1	0	0	1	0	0	5
6	0110	0	1	0	0	0	0	0	6
7	0111	0	0	0	1	1	1	1	7
8	1000	0	0	0	0	0	0	0	8
9	1001	0	0	0	0	1	0	0	9

6. Proposed 00 to 10 Cruise-Speed Operating Truth Table

This is the intended Project V07 operating range after the missing cruise-speed logic is added. The current circuit must be limited so that 10 is visible and the next invalid state is reset or blocked.

Speed	Tens BCD	Units BCD	Tens display	Units display	Green	Yellow	Red warning	State
00	0000	0000	0	0	1	0	Comparator	Low range
01	0000	0001	0	1	1	0	Comparator	Low range
02	0000	0010	0	2	1	0	Comparator	Low range
03	0000	0011	0	3	1	0	Comparator	Low range
04	0000	0100	0	4	1	0	Comparator	Low range
05	0000	0101	0	5	1	0	Comparator	Low range
06	0000	0110	0	6	0	1	Comparator	Higher range
07	0000	0111	0	7	0	1	Comparator	Higher range
08	0000	1000	0	8	0	1	Comparator	Higher range
09	0000	1001	0	9	0	1	Comparator	Higher range
10	0001	0000	1	0	0	0	Flashing at max/set	Maximum speed

7. Planned Green and Yellow Indicator Logic

Yellow = (NOT D . C . B) + (D . NOT C . NOT B)

Green base = NOT D . (NOT C + NOT B)

Final Green = Green base XOR A2

A2 is the planned tens-active signal. It is 0 from 00 to 09 and becomes 1 at 10. Therefore the XOR/inhibit stage switches the green LED OFF at maximum speed.

Speed	Unit DCBA	A2/Tens	Yellow	Green base	Final green	Indicator result
00	0000	0	0	1	1	Green ON
01	0001	0	0	1	1	Green ON
02	0010	0	0	1	1	Green ON
03	0011	0	0	1	1	Green ON
04	0100	0	0	1	1	Green ON
05	0101	0	0	1	1	Green ON
06	0110	0	1	0	0	Yellow ON
07	0111	0	1	0	0	Yellow ON
08	1000	0	1	0	0	Yellow ON
09	1001	0	1	0	0	Yellow ON
10	0000	1	0	1	0	Green/yellow OFF

8. Planned Automatic Reset / Maximum-Speed Limit Truth Table

Display state	Valid?	Reset/limit signal	Action
00 to 08	Valid	0	Normal upward counting.
09	Valid boundary	0	Next UP pulse moves the display to 10.
10	Valid maximum	0	Maximum speed remains visible.
11 attempted	Invalid	1	Automatic reset or blocking action returns display to 00 or prevents 11.
99 / high state	Invalid	1 recommended	High-state reset protection should prevent continued counting.
Manual RESET	Testing/start-up	1	Display returns to 00.

9. Planned Comparator and Red Flashing Truth Tables

The planned comparator warning should enable red flashing when the current speed is equal to or greater than the selected set speed.

F = (Current speed > Set speed) + (Current speed = Set speed)

Current speed condition	A>B	A=B	A<B	F	Red LED
Current speed < Set speed	0	0	1	0	OFF
Current speed = Set speed	0	1	0	1	Flashing
Current speed > Set speed	1	0	0	1	Flashing

Set speed	Reference code	Meaning
6	0110	Red flashes when current speed >= 6
7	0111	Red flashes when current speed >= 7
8	1000	Red flashes when current speed >= 8
9	1001	Red flashes when current speed >= 9
10	Tens A2=1, unit=0000	Red flashes when current speed >= 10

10. Planned NE555 Flashing Red LED Truth Table

Warning enable	Transistor/relay stage	NE555 state	Red LED state
0	OFF	Disabled or reset held	OFF
1	ON	Astable flashing mode	Flashing

11. Final Preliminary Operating Summary

Condition	Green LED	Yellow LED	Red LED	Display behaviour
Current incomplete circuit	Not added	Not added	Not added	Basic two-digit UP counter only.
After additions: 00 to 05	ON	OFF	Depends on comparator	Low speed range.
After additions: 06 to 09	OFF	ON	Depends on comparator	Higher speed range.
After additions: 10	OFF	OFF	Flashing if warning condition active	Maximum speed visible.
Attempted 11	OFF after reset	OFF after reset	Reset/controlled	Automatic cruise reset/limit required.

Project V07 completion note: before the final GA1 report is written, the schematic should be updated to include the missing range LEDs, comparator warning stage, NE555 flashing stage, XOR/inhibit correction, and automatic 11 reset/limit circuit.