74LS192 + 74LS48 Cruise Speed Control Solution

Updated truth tables including the added XOR green-correction gate and the reset-at-11 / reset-at-99 logic

This document is based on the uploaded electronic circuit solution. The system uses electronic components only: two 74LS192 decade counters, two 74LS48 BCD-to-seven-segment display drivers, common-cathode displays, a 74LS85 comparator, gate logic, an NE555 flashing red LED circuit, and automatic reset/limit logic.

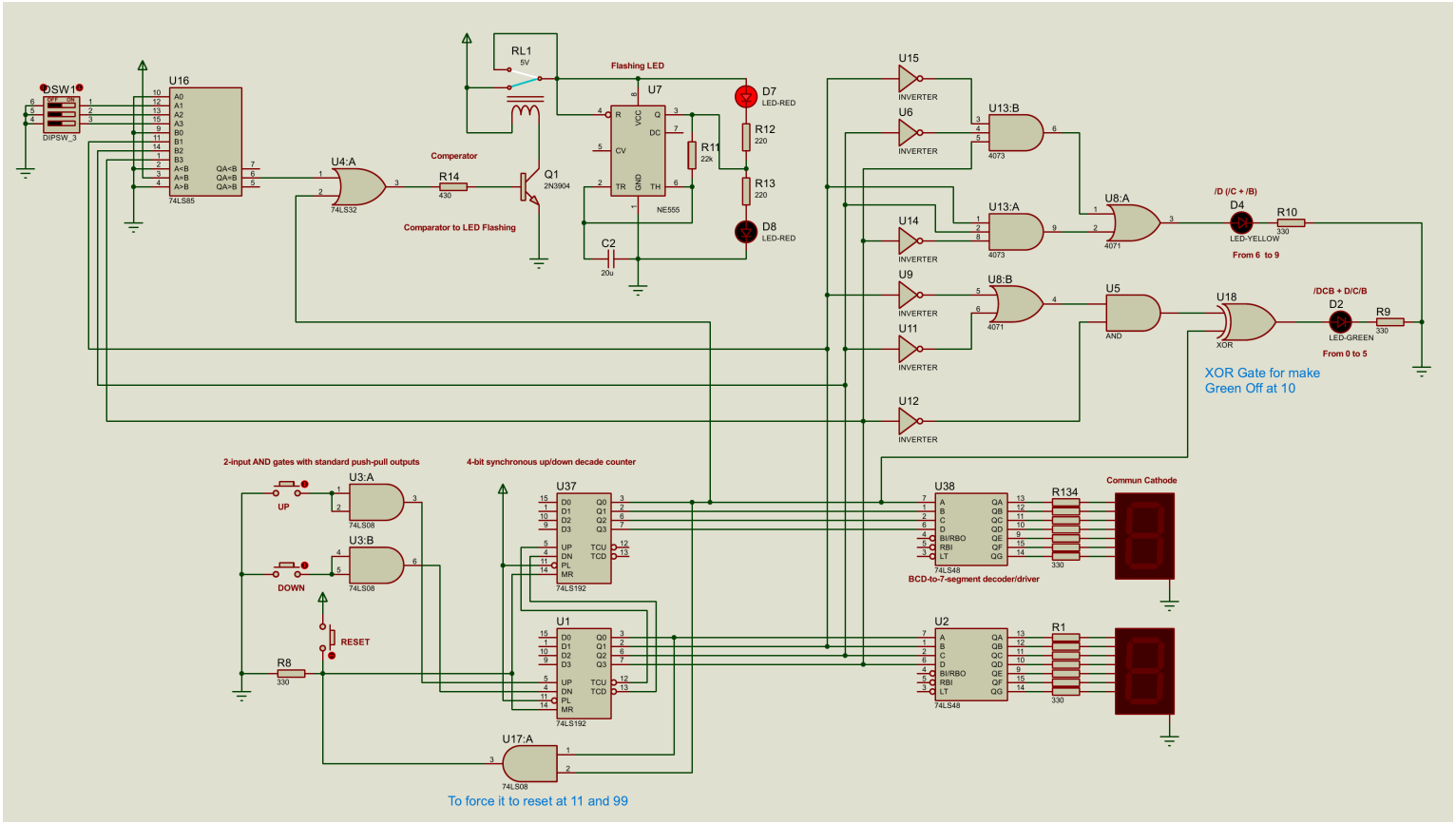

Figure 1: Updated 74LS192 / 74LS48 two-display cruise speed control circuit with green/yellow range logic, comparator warning, NE555 flashing red LEDs, and added reset/XOR correction notes.

Figure 2: Added detail images. Left: 74LS08 gate used to force reset at 11 and 99. Right: XOR gate used to force the green LED OFF at 10.

1. Additional Design Notes Included in the Truth Tables

Added item	How it is handled in the truth tables
XOR gate for green LED	The original green logic is corrected using an XOR stage so that the green LED is ON only for 00-05 and forced OFF at 10.
Reset at 11	The valid count is allowed to reach 10. When the next invalid state 11 is attempted, the reset/limit logic becomes active.
Reset at 99	The extra tens reset protection prevents the two-display counter from continuing into unwanted high values if the circuit is driven beyond the project range.
Project maximum	The operating table is therefore limited to 00-10, with 10 shown as the maximum speed.

2. Main Component Function Table

Component / label	Part	Function in this solution
U1 and U37	74LS192	Unit and tens BCD up/down decade counters.
U2 and U38	74LS48	BCD-to-seven-segment decoder/driver for common-cathode displays.
U3:A and U3:B	74LS08	UP and DOWN pulse conditioning using 2-input AND gates.
U16	74LS85	Compares current speed with selected cruise speed.
DSW1	DIPSW_3	Manual set-speed input for the comparator stage.
U13:A, U13:B, U8:A	4073 and 4071	Create yellow/amber detection for 06-09.
U5, U18	AND and XOR gates	Create corrected green output and force green OFF at 10.
U17:A	74LS08	Added reset logic to force reset at invalid 11 and high 99 condition.
Q1, RL1, U7	2N3904, 5 V relay, NE555	Enable and flash the red LED when the selected cruise speed is reached.

3. 74LS192 Counter Output Truth Table

The 74LS192 BCD 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 count	D	C	B	A	BCD D C B A	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

4. 74LS48 Common-Cathode Seven-Segment Truth Table

For the common-cathode display driven by the 74LS48, 1 means the segment is ON and 0 means the segment is OFF. Segment order is a b c d e f g.

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

5. Two-Display Operating Truth Table: 00 to 10

Speed	Tens BCD	Units BCD	Tens display	Units display	Green	Yellow	Meaning
00	0000	0000	0	0	1	0	Green range
01	0000	0001	0	1	1	0	Green range
02	0000	0010	0	2	1	0	Green range
03	0000	0011	0	3	1	0	Green range
04	0000	0100	0	4	1	0	Green range
05	0000	0101	0	5	1	0	Green range
06	0000	0110	0	6	0	1	Amber/yellow range
07	0000	0111	0	7	0	1	Amber/yellow range
08	0000	1000	0	8	0	1	Amber/yellow range
09	0000	1001	0	9	0	1	Amber/yellow range
10	0001	0000	1	0	0	0	Maximum speed displayed

6. Green / Yellow LED Logic Equations

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

Raw Green = NOT Yellow

Corrected Green = Raw Green XOR T10

T10 is the ten-display active state. For 00-09, T10 = 0. At 10, T10 = 1, so the XOR gate forces the corrected green output OFF.

Speed	D	C	B	A	T10	Yellow	Raw Green	Corrected Green	Output result
00	0	0	0	0	0	0	1	1	Green ON
01	0	0	0	1	0	0	1	1	Green ON
02	0	0	1	0	0	0	1	1	Green ON
03	0	0	1	1	0	0	1	1	Green ON
04	0	1	0	0	0	0	1	1	Green ON
05	0	1	0	1	0	0	1	1	Green ON
06	0	1	1	0	0	1	0	0	Yellow ON
07	0	1	1	1	0	1	0	0	Yellow ON
08	1	0	0	0	0	1	0	0	Yellow ON
09	1	0	0	1	0	1	0	0	Yellow ON
10	0	0	0	0	1	0	1	0	Both OFF

7. Added Reset / Limit Logic Truth Table

This logic is not the ordinary manual reset button. It is an automatic limiting reset used to keep the two-display counter inside the valid project range while still allowing the maximum speed 10 to be shown.

Present display	UP pulse	Reset at 11	Reset at 99	Action
00 to 08	1	0	0	Count normally upward.
09	1	0	0	Advance to 10; maximum speed is displayed.
10	1	1	0	Attempted 11 is blocked/reset.
11 attempted	X	1	0	Invalid value is cleared.
99 attempted/high state	X	X	1	Tens reset protection becomes active.
Any value	Manual reset = 1	X	X	Display returns to 00.

8. UP / DOWN / Reset Control Truth Table

UP	DOWN	Manual RESET	Automatic reset	Counter action	Display result
0	0	0	0	Hold	Same number remains displayed.
1 pulse	0	0	0	Count up	Display increases by 1.
0	1 pulse	0	0	Count down	Display decreases by 1.
1	1	0	0	Invalid/avoid	UP and DOWN together is not recommended.
X	X	1	X	Manual reset	Display returns to 00.
X	X	0	1	Automatic limit reset	Invalid state is cleared or blocked.

9. 74LS85 Comparator Truth Table

The red flashing output is enabled when the current speed is equal to or greater than the selected cruise speed.

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

Current speed condition	QA>B	QA=B	QA<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

DIP switch set-speed table:

Set speed	BCD D C B A	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. NE555 Flashing Red LED Truth Table

Comparator output F	Q1 / relay stage	NE555 state	Red LED state
0	OFF	Disabled or held reset	OFF
1	ON	Enabled astable mode	Flashing

11. Final Operating Summary

Condition	Green LED	Yellow LED	Red flashing LED	Display behaviour
Speed 00-05	ON	OFF	Depends on comparator set speed	Normal lower-speed range.
Speed 06-09	OFF	ON	Depends on comparator set speed	Amber/yellow range.
Speed 10	OFF	OFF	Flashing if selected speed has been reached	Maximum speed displayed.
Attempted 11	OFF after reset	OFF after reset	Depends after reset	Automatic reset/limit logic clears invalid state.
Attempted 99/high state	OFF after reset	OFF after reset	Depends after reset	Tens reset protection prevents unwanted high counts.