

CSS370S GA1 Project 2026

Truth Tables for 74LS192 / 74LS47 Two-Display Cruise Speed Control Solution

This document gives the report-ready truth tables for the uploaded electronic circuit solution. The design uses electronic components only, with no microcontroller and no PLC. The system displays speeds from 00 to 10, switches the green LED ON for 0-5, switches the yellow LED ON for 6-9, and enables the flashing red LED when the selected cruise speed is reached or when maximum speed is reached.

Figure 1 introduces the complete simulated circuit used for the truth-table development.

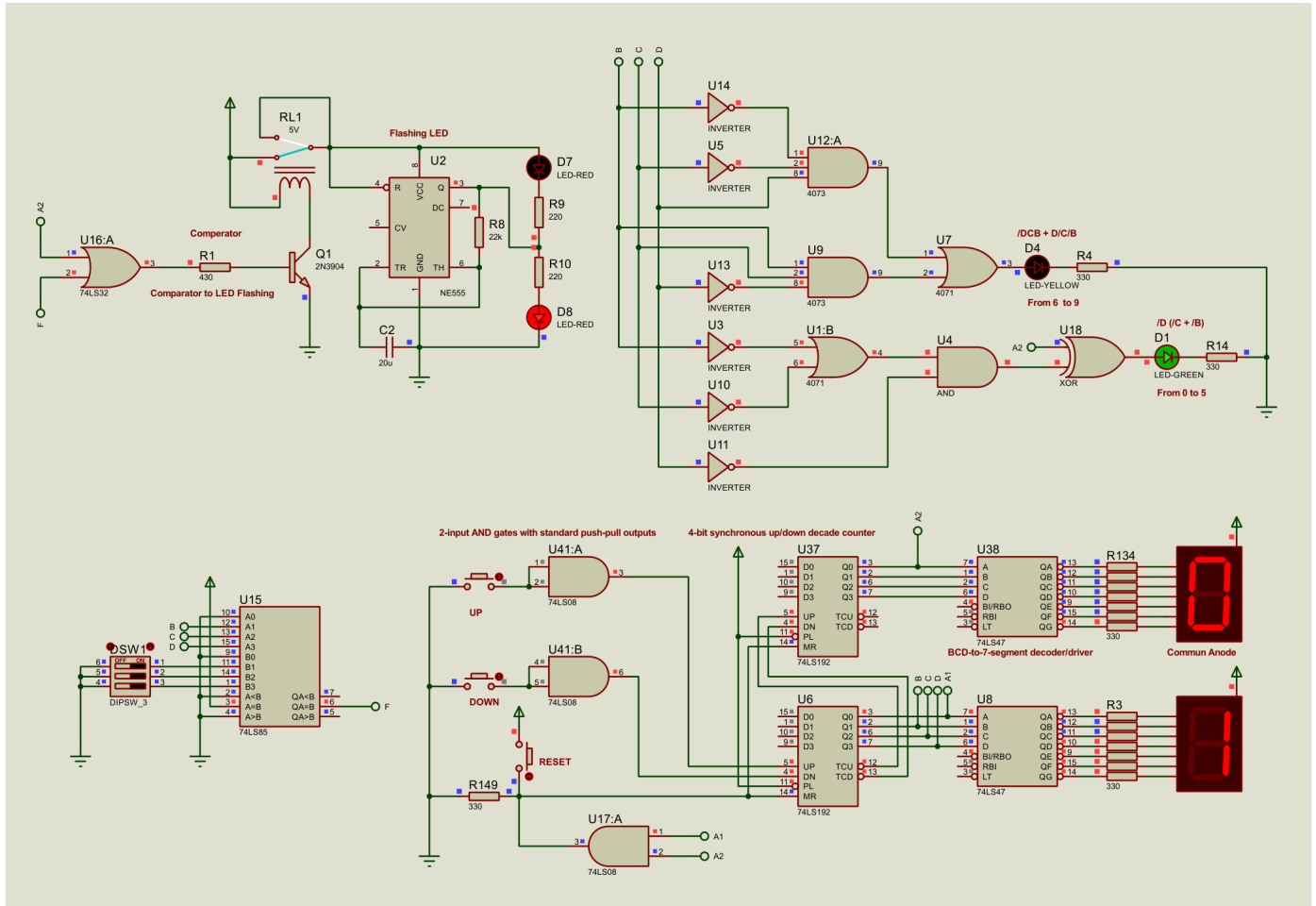


Figure 1: Uploaded 74LS192 / 74LS47 two-display cruise speed control circuit.

1. Circuit Interpretation Used for the Truth Tables

The circuit is interpreted as a two-digit electronic cruise speed display. U6 and U37 are 74LS192 decade up/down counters. U8 and U38 are 74LS47 BCD-to-seven-segment drivers connected to common-anode displays. The unit counter produces A1, B1, C1 and D1, while the tens counter produces A2. The green/yellow section uses BCD logic from the unit digit and the tens-bit A2. The comparator output F and the tens-bit A2 are ORed before driving the transistor, relay and NE555 flashing stage.

Component / label	Part	Function in this solution
U6	74LS192	Unit up/down decade counter. Produces the unit display value 0-9.
U37	74LS192	Tens up/down decade counter. Produces the tens display value; A2 becomes HIGH at display 10.
U8	74LS47	BCD-to-seven-segment decoder/driver for the unit common-anode display.
U38	74LS47	BCD-to-seven-segment decoder/driver for the tens common-anode display.
U41:A, U41:B	74LS08	Two-input AND gates used in the UP and DOWN control path.
U17:A	74LS08	Automatic reset detector. Detects the 11 condition using A1 and A2.
U15	74LS85	4-bit comparator used to compare current speed with the selected cruise/reference speed.
DSW1	DIPSW_3	Manual set-speed input for the comparator section.
U16:A	74LS32	OR gate producing the red-enable logic: RedEnable = F + A2.
U2	NE555	Astable flashing circuit for the red warning LED.
Q1 and RL1	2N3904 + relay	Transistor and relay driver for enabling the NE555 flashing path.
U7, U1:B	4071 OR gates	OR logic for yellow and green range conditions.
U9, U12:A	4073 AND gates	Three-input AND terms for the yellow 6-9 detection.
U3, U5, U10, U11, U13, U14	Inverters	Create NOT B, NOT C and NOT D signals for the range logic.
U18	XOR	Forces green OFF when A2 = 1 so that speed 10 is not indicated as 0-5.
D1, D4, D7/D8	LEDs	Green low-speed LED, yellow higher-speed LED and flashing red warning LEDs.

2. Counter Control Truth Table

Table 1 gives the push-button control operation for the two 74LS192 counters.

UP button	DOWN button	RESET input	Counter action	Display result
0	0	0	Hold	Same speed remains displayed
1 pulse	0	0	Count up	Display increases by 1
0	1 pulse	0	Count down	Display decreases by 1
1	1	0	Invalid / avoid	Unstable or ambiguous control condition
X	X	1	Reset active	Display returns to 00

3. 74LS192 Counter Pin / Signal Table

Table 2 links the important 74LS192 pins to the logic names used in the report.

74LS192 pin	Label	Use in this circuit
5	UP	Receives the count-up pulse.
4	DN	Receives the count-down pulse.
14	MR	Master reset input; driven by the reset path and automatic reset detector.
11	PL	Parallel load input. Kept inactive during normal counting.
15, 1, 10, 9	D0, D1, D2, D3	Preset data inputs. Not used for normal counting in this truth-table explanation.
3	Q0 / A	Least significant BCD output. Unit output is A1; tens output is A2.
2	Q1 / B	Second BCD output.
6	Q2 / C	Third BCD output.
7	Q3 / D	Most significant BCD output.
12	TCU	Terminal count up output used when cascading counters.
13	TCD	Terminal count down output used when cascading counters.

4. 74LS192 BCD Counter Truth Table

Table 3 defines the BCD pattern used by each 74LS192 decade counter.

Decimal count	D	C	B	A	BCD D C B A
0	0	0	0	0	0000
1	0	0	0	1	0001
2	0	0	1	0	0010
3	0	0	1	1	0011
4	0	1	0	0	0100
5	0	1	0	1	0101
6	0	1	1	0	0110
7	0	1	1	1	0111
8	1	0	0	0	1000
9	1	0	0	1	1001

5. 74LS47 Common-Anode Display Truth Table

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

Decimal	D C B A	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. Two-Display 00 to 10 Operating Truth Table

Table 5 shows the intended display range. Speeds 0-5 turn the green LED ON, speeds 6-9 turn the yellow LED ON, and speed 10 is treated as maximum speed. The red LED depends on the comparator output F, but A2 also enables red flashing at the maximum-speed condition.

Speed	Tens D C B A	Unit D C B A	A2	Green	Yellow	Red flashing condition	Display meaning
0	0000	0000	0	1	0	Flashes if F = 1	Low range
1	0000	0001	0	1	0	Flashes if F = 1	Low range
2	0000	0010	0	1	0	Flashes if F = 1	Low range
3	0000	0011	0	1	0	Flashes if F = 1	Low range
4	0000	0100	0	1	0	Flashes if F = 1	Low range
5	0000	0101	0	1	0	Flashes if F = 1	Low range
6	0000	0110	0	0	1	Flashes if F = 1	Higher range
7	0000	0111	0	0	1	Flashes if F = 1	Higher range
8	0000	1000	0	0	1	Flashes if F = 1	Higher range
9	0000	1001	0	0	1	Flashes if F = 1	Higher range
10	0001	0000	1	0	0	ON / flashing because A2 = 1	Maximum speed shown

7. Green and Yellow LED Logic Equations

The unit-digit BCD outputs are used for the normal 0-9 range detection. The tens bit A2 is then used to prevent the green LED from remaining ON when the display reaches 10.

Signal	Logic equation	Purpose
Yellow	$Yellow = (NOT\ D \cdot C \cdot B) + (D \cdot NOT\ C \cdot NOT\ B)$	Turns ON for unit digits 6, 7, 8 and 9.
Green base	$GreenBase = NOT\ D \cdot (NOT\ C + NOT\ B)$	Detects unit digits 0, 1, 2, 3, 4 and 5.
Final green	$Green = GreenBase\ XOR\ A2$	Green remains ON for 0-5, but becomes OFF at 10 because A2 = 1.
Red enable	$RedEnable = F + A2$	Red flashes when the comparator reaches set speed or when maximum speed 10 is reached.
Automatic 11 reset	$Reset11 = A1 \cdot A2$	When the count attempts 11, the circuit resets back to 00.

8. Full LED Range Truth Table

Table 7 verifies the range indicators from 0 to 10.

Speed	A2	Unit D C B A	GreenBase	Green = GreenBase XOR A2	Yellow	Indicator result
0	0	0000	1	1	0	Green ON
1	0	0001	1	1	0	Green ON
2	0	0010	1	1	0	Green ON
3	0	0011	1	1	0	Green ON
4	0	0100	1	1	0	Green ON
5	0	0101	1	1	0	Green ON
6	0	0110	0	0	1	Yellow ON
7	0	0111	0	0	1	Yellow ON
8	0	1000	0	0	1	Yellow ON
9	0	1001	0	0	1	Yellow ON
10	1	0000	1	0	0	Maximum speed: green OFF, yellow OFF, red enabled by A2

9. Automatic Reset / Maximum-Speed Truth Table

Table 8 shows how the design can display 10 and then reset when the next count attempts 11.

Tens display	Unit display	A2	A1	Reset11 = A1.A2	Circuit action
00 to 09	0 to 9	0	X	0	Normal counting and display operation
10	0	1	0	0	Maximum speed is displayed; red flashing is enabled by A2
11 attempt	1	1	1	1	Automatic reset activates and display returns to 00

10. 74LS85 Comparator Truth Table

The comparator output F is HIGH when the current speed has reached or passed the selected cruise speed.

Current-speed condition	A > B	A = B	A < B	F = (A>B) + (A=B)	Red LED result before A2 override
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

11. Set-Speed DIP Switch Truth Table

Table 10 gives report-ready set-speed reference values for the cruise-speed range 6-9.

Set speed	D	C	B	A	Binary D C B A	Meaning
6	0	1	1	0	0110	Red flashes when current speed $\geq$ 6
7	0	1	1	1	0111	Red flashes when current speed $\geq$ 7
8	1	0	0	0	1000	Red flashes when current speed $\geq$ 8
9	1	0	0	1	1001	Red flashes when current speed $\geq$ 9

12. Comparator-to-Red-Flashing Enable Truth Table

In this solution, U16:A combines the comparator output F with the tens bit A2.

F from comparator	A2 tens bit	RedEnable = F + A2	Meaning
0	0	0	Below set speed and not at maximum: red LED OFF
1	0	1	Selected cruise speed reached/passed: red LED FLASHING
0	1	1	Maximum speed 10 reached: red LED FLASHING
1	1	1	Comparator reached and maximum speed active: red LED FLASHING

13. NE555 Flashing LED Truth Table

Table 12 gives the final flashing-stage operation after the transistor and relay enable path.

RedEnable input	Q1 transistor	Relay RL1	NE555 state	Red LED state
0	OFF	OFF / not energised	Disabled	OFF
1	ON	ON / energised	Enabled astable mode	FLASHING

14. Final Operating Summary

Condition	Green LED	Yellow LED	Flashing red LED	Display result
Speed 0-5 and F = 0	ON	OFF	OFF	00 to 05 displayed
Speed 0-5 and F = 1	ON	OFF	FLASHING	Cruise set speed has been reached within low range
Speed 6-9 and F = 0	OFF	ON	OFF	06 to 09 displayed
Speed 6-9 and F = 1	OFF	ON	FLASHING	Cruise set speed has been reached within higher range
Speed 10	OFF	OFF	FLASHING	Maximum speed displayed
Attempted speed 11	OFF during reset	OFF during reset	Reset action	Automatic reset returns display to 00