

CD4029 + 74LS47 Cruise Speed Control Solution

Updated truth tables with the added XOR gate that forces the green LED OFF at 10

This PDF is based on the uploaded Project.PDF circuit. The design uses electronic components only: two CD4029 up/down counters, two 74LS47 common-anode display drivers, a 74LS85 comparator, logic gates, a transistor/relay stage, and an NE555 flashing red LED stage.

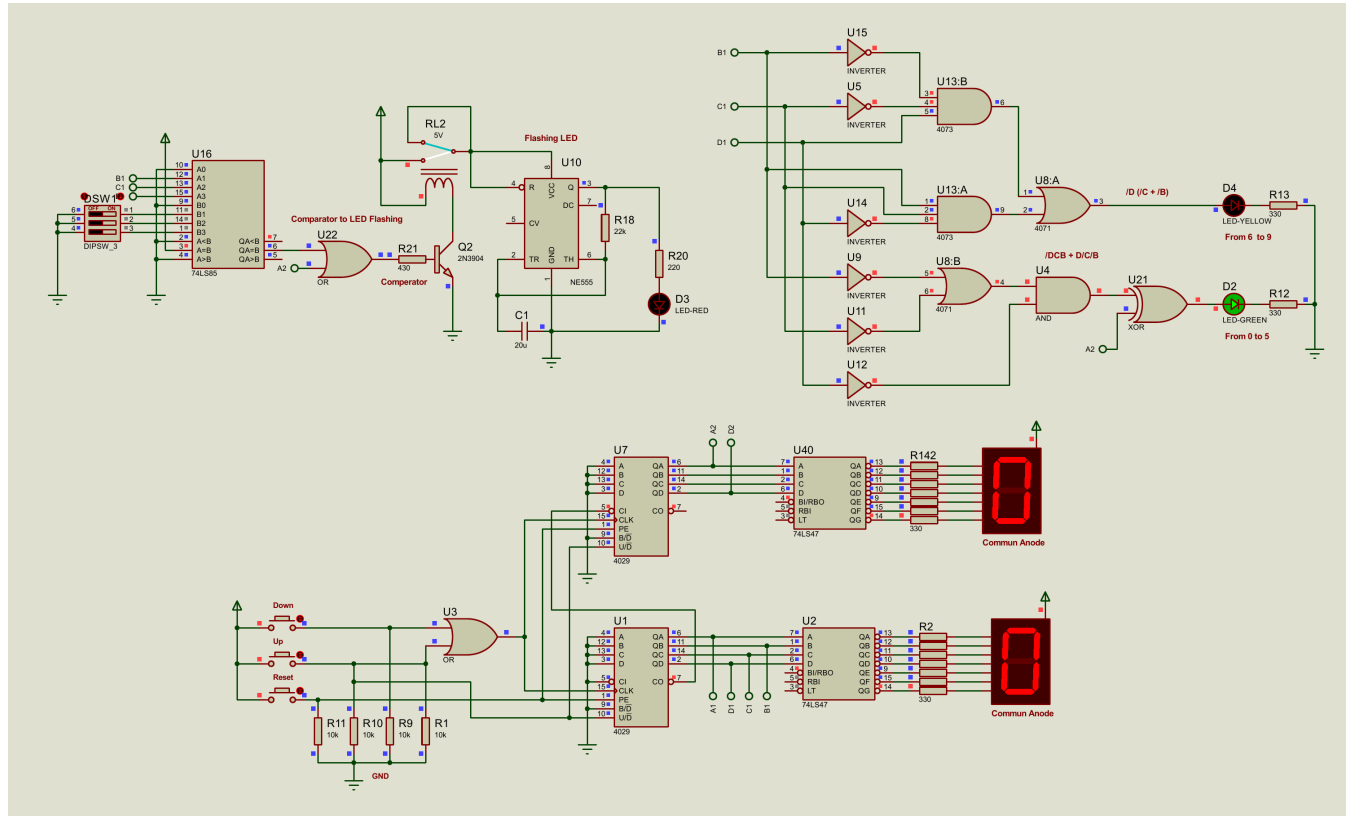


Figure 1: CD4029 two-display cruise speed control circuit with common-anode seven-segment displays, green/yellow range logic, comparator warning, and NE555 flashing red LED.

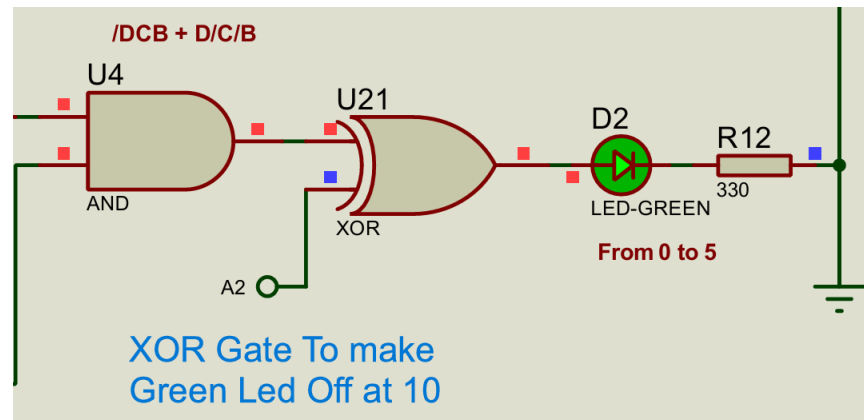


Figure 2: Added XOR correction. The XOR gate uses the ten-state signal A2 to force the green LED OFF at 10.

1. Added Design Note Included

Added item	Interpretation used in the updated truth tables
XOR gate U21	The raw green output is corrected by XORing it with A2. A2 is LOW for 00-09 and HIGH when the tens display reaches 1, therefore at 10 the green LED is forced OFF.
Green LED correction	Without this correction, the unit digit 0 at speed 10 can still satisfy the 0-5 green condition. The XOR stage prevents green from staying ON at maximum speed.
Valid project range	The truth tables are limited to 00-10 because the project requires the maximum speed 10 to be shown.

2. Main Component Function Table

Component / label	Part	Function in this solution
U1 and U7	CD4029	Two BCD up/down counters used for the unit and ten speed digits.
U2 and U40	74LS47	BCD-to-seven-segment drivers for common-anode displays.
Common-anode displays	7-segment displays	Show current speed from 00 to 10.
U3	OR gate	Combines UP/DOWN/RESET control paths for the counter clock/control section.
U13:A and U13:B	4073 AND gates	Generate yellow/amber range terms.
U8:A and U8:B	4071 OR gates	Combine logic conditions for the LED range signals.
U4 and U21	AND + XOR	Create corrected green output and force green OFF at 10.
U16	74LS85	Compares the selected set speed with the current display/speed signal.
Q2, RL2, U10	2N3904, relay, NE555	Enable the flashing red LED when the selected cruise speed is reached.

3. CD4029 Counter Output Truth Table

The BCD counter outputs are defined as A = LSB, B = second bit, C = third bit, and D = MSB.

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. CD4029 to 74LS47 Connection Table

CD4029 output	Logic name	74LS47 input	Purpose
QA	A / LSB	A	Least significant BCD bit.
QB	B	B	Second BCD bit.
QC	C	C	Third BCD bit.
QD	D / MSB	D	Most significant BCD bit.

5. 74LS47 Common-Anode Seven-Segment Truth Table

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

Decimal	BCD 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 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

7. Green / Yellow LED Logic with XOR Correction

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

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

Corrected Green = Raw Green XOR A2

A2 is the ten-state correction input used by the XOR gate. It is 0 for 00-09 and 1 at 10. This makes the green output turn OFF at the maximum speed 10.

Speed	D	C	B	A	A2	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

8. UP / DOWN / Manual Reset and Automatic Maximum Limit

UP	DOWN	Manual RESET	Automatic limit condition	Counter action	Display result
0	0	0	0	Hold	Same speed 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	Speed beyond 10	Automatic reset/limit	Invalid value is blocked or cleared.

Present display	UP pulse	Limit signal	Next display / action
00 to 08	1	0	Counts normally upward.
09	1	0	Advances to 10.
10	1	1	Further count is blocked or reset because 10 is the maximum speed.
Any value	Manual reset = 1	X	Returns to 00.

9. 74LS85 Comparator Truth Table

The comparator output enables the red flashing warning 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	1010	Red flashes when current speed >= 10

10. NE555 Flashing Red LED Truth Table

Comparator output F	Q2 / 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. XOR correction prevents green from being ON.
Current speed < Set speed	Range logic works normally	Range logic works normally	OFF	Cruise speed has not been reached.
Current speed = Set speed	Range logic works normally	Range logic works normally	Flashing	Cruise speed reached.
Current speed > Set speed	Range logic works normally	Range logic works normally	Flashing	Cruise speed passed; warning continues until maximum speed.