

CD40110 Two-Display Cruise Speed Control Solution

Updated truth tables with the full circuit figure plus the added XOR-green correction and automatic reset logic details

This PDF is based on the uploaded **One Counter.PDF** solution and incorporates the additional notes supplied later: the **XOR gate used to force the green LED OFF from 10 upward** and the **11 Reset / 99 Reset (Tens)** logic.

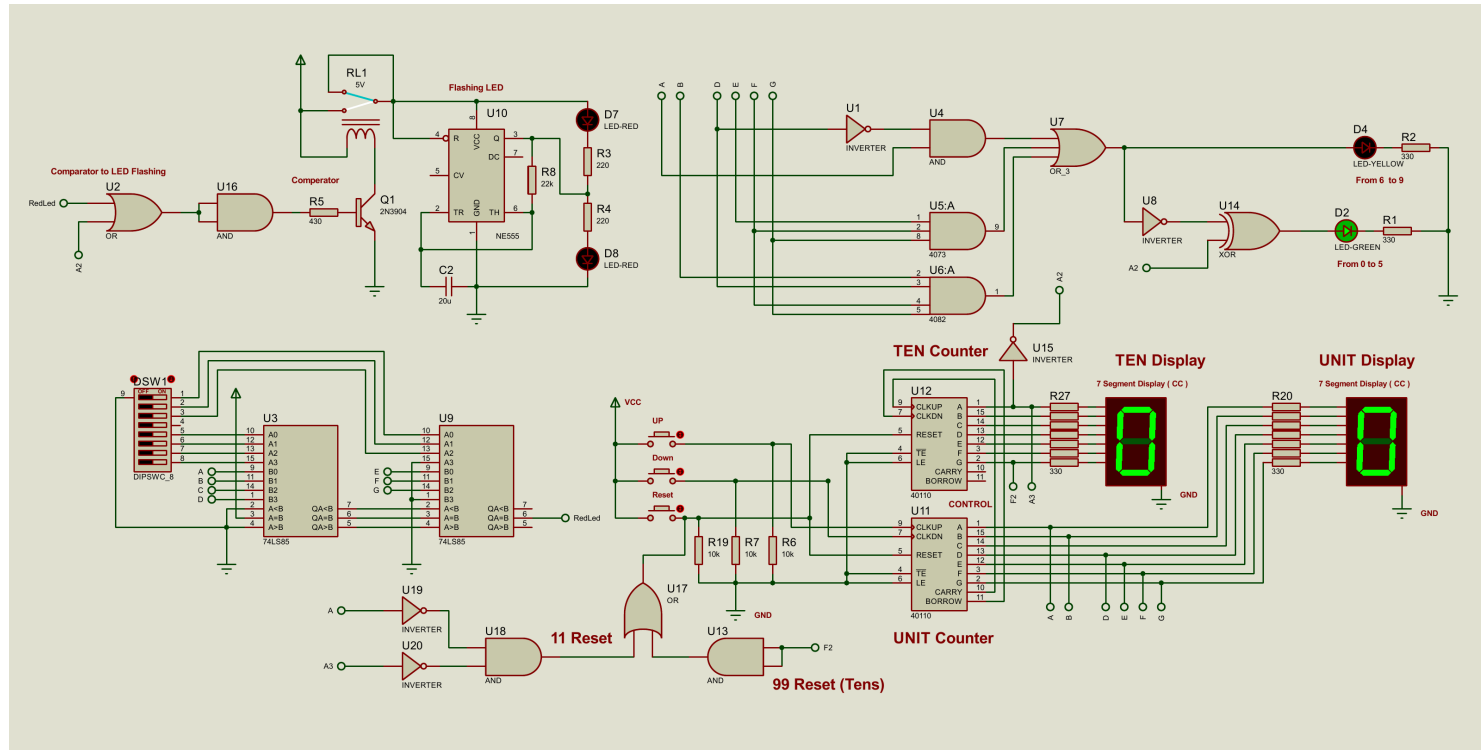


Figure 1: Main two-CD40110 cruise speed control circuit with unit counter, ten counter, comparator stage, green/yellow logic, NE555 flashing red LED, and reset limiting logic.

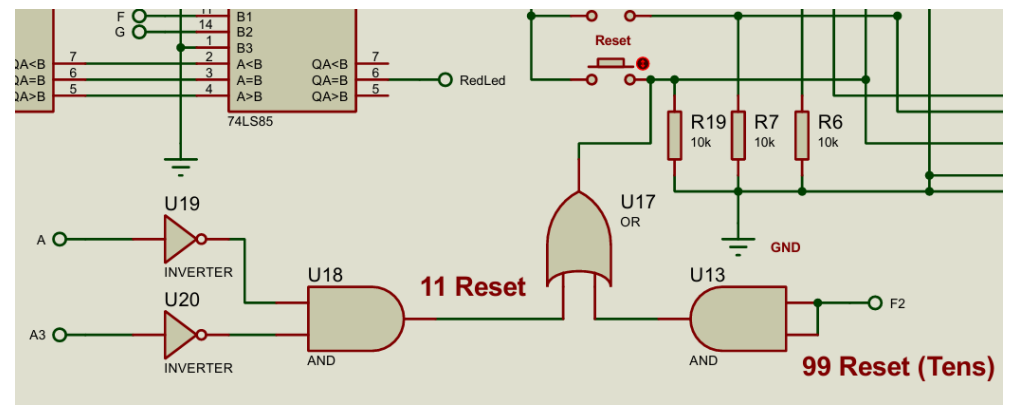
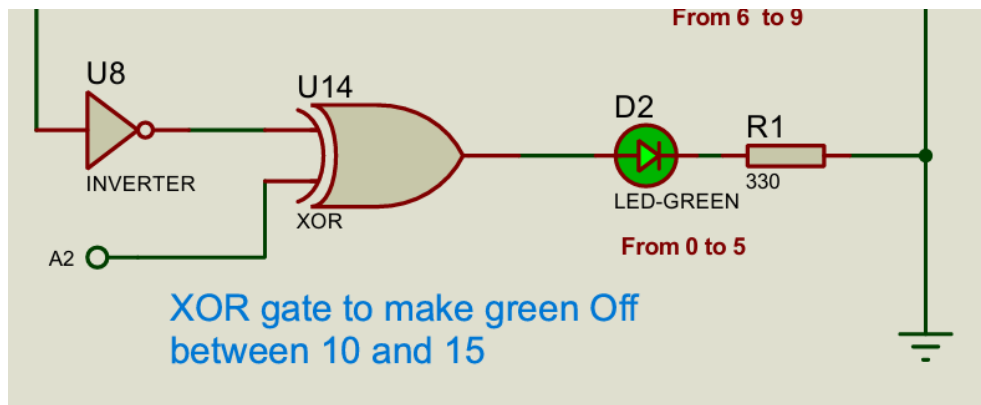


Figure 2: Added design notes. Left: XOR correction keeps the green LED OFF at 10 and above instead of allowing the inverted-yellow path to turn it back ON. Right: added automatic reset logic, showing the **11 Reset** detector and the **99 Reset (Tens)** control path.

1. Added Design Notes Interpreted from the New Images

Added item	Interpretation for the truth tables
XOR gate for green output	The raw green signal comes from NOT Yellow. Without correction, the green output can incorrectly become HIGH again for higher two-digit states. The XOR stage uses the tens-state signal to force Green = 0 at speed 10 and for higher states if they were attempted.
11 Reset	This logic detects the invalid next state after 10. When the count tries to move from 10 to 11, the 11 Reset signal becomes active and clears or blocks the invalid state.
99 Reset (Tens)	This additional control protects the tens counter/reset path so the ten-display logic does not continue into unwanted states. In the project context it supports the maximum-speed limiting action.
Project interpretation	The valid operating range for this report remains 00 to 10. Therefore the truth tables are presented for the valid range, but they also show how the added correction logic handles the attempted 11 state.

2. Main Component Function Table

Component / label	Function in this solution
U11 and U12 CD40110	Unit and tens counters with direct common-cathode seven-segment drive.
Green/yellow gate network	Creates the 00-05 green range and 06-09 yellow range.
U8 + U14 XOR correction	Forces the green LED OFF at 10 and above.
U3 and U9 74LS85	Compare current speed and selected set speed.
Q1 + RL1 + U10 NE555	Enable and flash the red warning LED when cruise speed is reached or exceeded.
U18, U17, U13	Automatic reset limiting logic for 11 Reset and 99 Reset (Tens).

3. LED Range Logic Equations

$Y1 = A \cdot \text{NOT } D$

$Y2 = E \cdot F \cdot G$

$Y3 = A \cdot B \cdot F \cdot G$

$\text{Yellow} = Y1 + Y2 + Y3$

$\text{Raw Green} = \text{NOT Yellow}$

$\text{Corrected Green} = \text{Raw Green XOR } T10$

T10 represents the active ten-digit state used by the added XOR gate. For the valid range 00-09, T10 = 0. At 10, T10 = 1, so the XOR gate forces the green indicator OFF.

Speed	T10	Unit digit	Yellow	Raw Green = NOT Yellow	Corrected Green	Result
00	0	0	0	1	1	Green ON
01	0	1	0	1	1	Green ON
02	0	2	0	1	1	Green ON
03	0	3	0	1	1	Green ON
04	0	4	0	1	1	Green ON
05	0	5	0	1	1	Green ON
06	0	6	1	0	0	Yellow ON
07	0	7	1	0	0	Yellow ON
08	0	8	1	0	0	Yellow ON
09	0	9	1	0	0	Yellow ON
10	1	0	0	1	0	Both OFF

4. CD40110 Segment Truth Table

For the common-cathode display used by the CD40110, 1 = segment ON and 0 = segment OFF. Segment order is A B C D E F G.

Digit	A	B	C	D	E	F	G	Pattern
0	1	1	1	1	1	1	0	1111110
1	0	1	1	0	0	0	0	0110000
2	1	1	0	1	1	0	1	1101101
3	1	1	1	1	0	0	1	1111001
4	0	1	1	0	0	1	1	0110011
5	1	0	1	1	0	1	1	1011011
6	1	0	1	1	1	1	1	1011111
7	1	1	1	0	0	0	0	1110000
8	1	1	1	1	1	1	1	1111111
9	1	1	1	1	0	1	1	1111011

5. Two-Digit Operating Truth Table (00 to 10)

Speed	Ten digit	Unit digit	Green LED	Yellow LED	Red LED	Meaning
00	0	0	1	0	Depends on comparator	0-5 green range
01	0	1	1	0	Depends on comparator	0-5 green range
02	0	2	1	0	Depends on comparator	0-5 green range
03	0	3	1	0	Depends on comparator	0-5 green range
04	0	4	1	0	Depends on comparator	0-5 green range
05	0	5	1	0	Depends on comparator	0-5 green range
06	0	6	0	1	Depends on comparator	6-9 yellow range
07	0	7	0	1	Depends on comparator	6-9 yellow range
08	0	8	0	1	Depends on comparator	6-9 yellow range
09	0	9	0	1	Depends on comparator	6-9 yellow range
10	1	0	0	0	Depends on comparator	10 maximum speed

6. Automatic Reset / Limit Truth Tables

The extra reset image indicates two related control ideas: **11 Reset** and **99 Reset (Tens)**. In the project report these are interpreted as protective limit logic around the allowed maximum display of 10.

Present state	UP pulse	11 Reset	Next state / action
00 to 08	1	0	Counts normally upward
09	1	0	Becomes 10
10	1	1	Invalid 11 is detected; reset/limit action occurs
11 (attempted)	X	1	Cleared or blocked
Any state	Manual Reset = 1	X	Returns to 00

Signal	Meaning
11 Reset	Active when the display tries to move past the valid maximum of 10 into 11.
99 Reset (Tens)	Additional tens-reset path used to keep the tens section within the intended operating range.

7. Comparator and Red Flashing Truth Tables

Comparator decision: **F = (Current speed > Set speed) + (Current speed = Set speed)**

Condition	QA>B	QA=B	QA<B	F	Red LED
Current < Set	0	0	1	0	OFF
Current = Set	0	1	0	1	Flashing
Current > Set	1	0	0	1	Flashing

Set speed	Meaning
06	Red flashes when current speed >= 06
07	Red flashes when current speed >= 07
08	Red flashes when current speed >= 08
09	Red flashes when current speed >= 09
10	Red flashes when current speed >= 10

Comparator F	Q1 / Relay / 555	Red LED state
0	Disabled	OFF
1	Enabled astable flashing	Flashing

8. Final Operating Summary

Condition	Green	Yellow	Red	Interpretation
00 to 05	ON	OFF	Depends on set speed	Normal lower-speed range
06 to 09	OFF	ON	Depends on set speed	Amber/yellow range
10	OFF	OFF	Flashing if set speed is reached	Maximum speed is displayed
Attempted 11	OFF	OFF	After reset depends on state	Additional reset logic clears or blocks the invalid value