ASM Counter with Display
SLG46537

The application note gives step-by-step guidelines for creating ASM counter with display using a SLG46537V device. A unique set of components of the SLG46537 allows the creation of such a system.

The application note comes complete with design files which can be found in the Reference section.

Contents

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1. Terms and Definitions

ASM	Asynchronous State Machine
DFF	D Flip-Flop
LUT	Look-Up Table
RAM	Random Access Memory

2. References

For related documents and software, please visit:

GreenPAK Programmable Mixed-Signal Products | Renesas

Download our free Go Configure Software hub [1] to open the .gp5 files [2] and view the proposed circuit design. Use the GreenPAK development tools [3] to freeze the design into your own customized IC in a matter of minutes. Renesas provides a complete library of application notes [4] featuring design examples as well as explanations of features and blocks within the Renesas IC.

[1] Go Configure Software Hub, Software Download and User Guide, Renesas Electronics

[2] AN-1110 ASM Counter with Display.gp, GreenPAK Design File, Renesas Electronics

[3] GreenPAK Development Tools, GreenPAK Development Tools Webpage, Renesas Electronics

[4] Application Notes, GreenPAK Application Notes Webpage, Renesas Electronics

3. Introduction

Sometimes it may be necessary to display some digits on a 7-segment display indicator. This can be easily accomplished with a GreenPAK SLG46537V IC thanks to 8-states Asynchronous State Machine (ASM) with configurable outputs for every state.

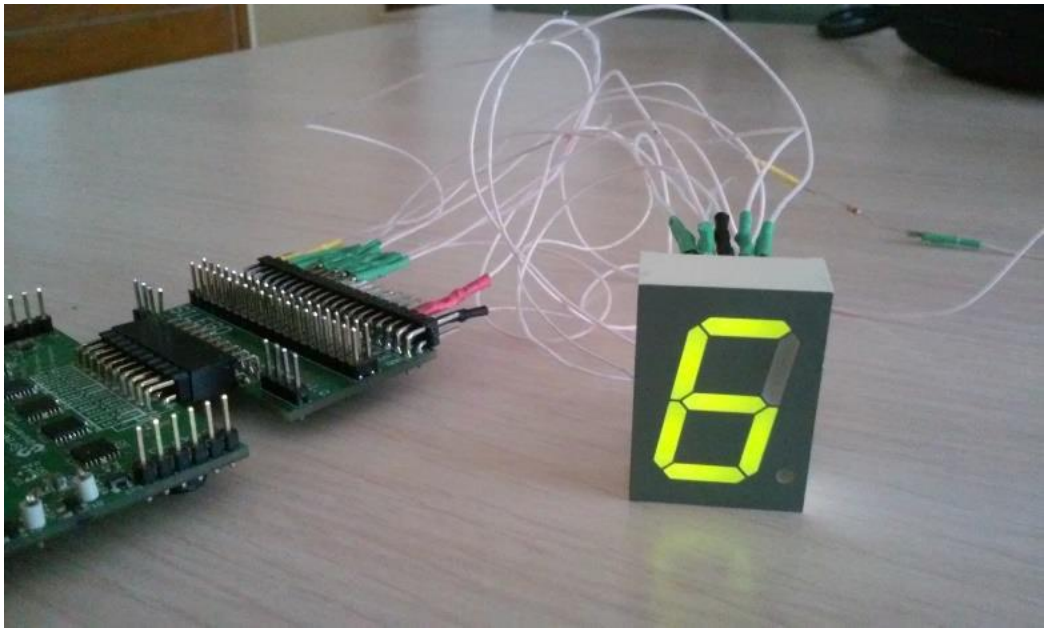

Figure 1. ASM counter appearance

4. ASM Counter Circuit Design

If we use a 7-segment indicator, we need only 7 logic signals to output any digit by switching on the necessary segments. To do this we may configure 7 of 8 ASM outputs (High or Low) for each state (0..7) in such a way to display some numbers (see Figure 2, Figure 1).

To output number “1” we need to switch on segments B and C, “2” – A, B, G, E, D and so on.

Let’s connect indicators’ anodes (3 and 8 on the Figure 2) to the Vdd and control the indicator applying Low level to segments’ cathodes to switch them on and High level to switch them off.

ASM outputs configuration and outputs: segments connection scheme is shown in Figure 4.

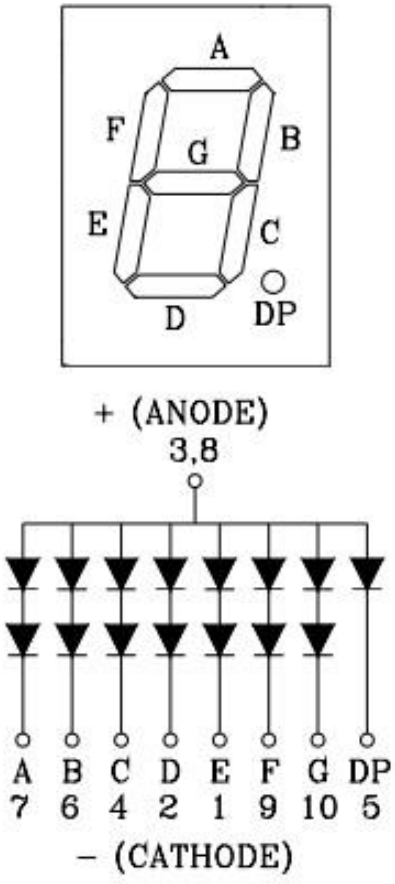

Figure 2. 7- segments Indicator

Such a system is able to display 8 digits: 0, 1, 2, 3, 4, 5, 6 and 7.

PIN#3 is used to switch system On/Off.

To switch ASM on we need to apply High level signal on its nReset input. After ASM reset it starts operating from the initial state (state 0 in our case).

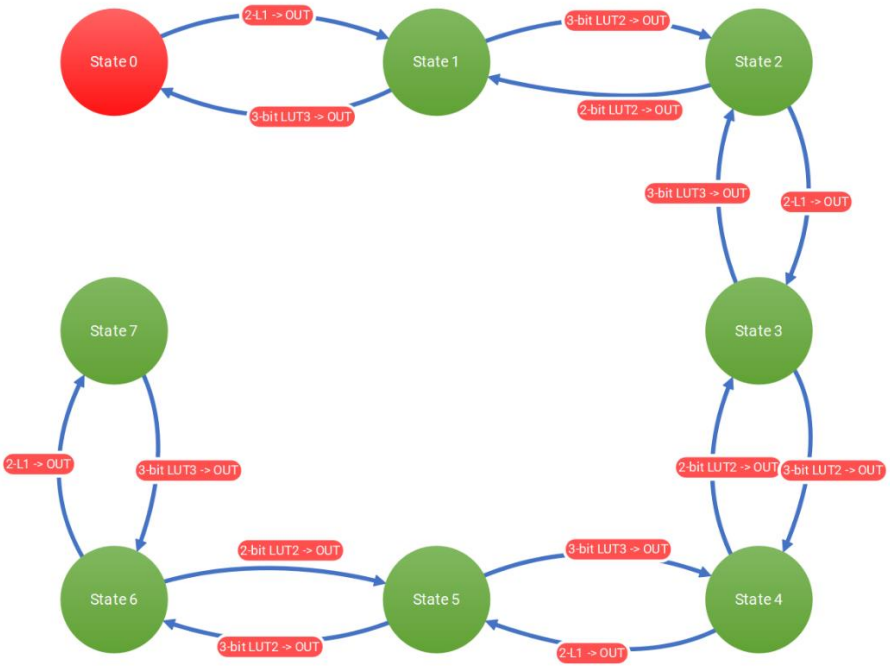

Figure 3. ASM State diagram

ASM state diagram is displayed in Figure 3.

From each state we can move to the next or previous state depending on PIN#4 (Up/Down) level, so it is possible to count up or down.

ASM state transition happens on a High level input signal. If we use one button for transitions and connect it directly, we may jump over some states even if we use an edge detector.

That's why it is necessary to use a circuit which consists of the DFF and LUTs and makes transitions only on the rising edge of the Button (PIN#2) pressing. Each time the Button is pressed, DFF's output will change from High (for even states) to Low (for odd states) and vice versa. 2-L1 and 2-L2 LUTs are used to monitor DFF3 output and Up/Down – PIN#4 input. They initiate transitions from even states: 2-L1 - from lower to higher, 2-L2 – from higher to lower. 3-bit LUTs (3-L2 and 3-L3) have similar function, but in addition, they check 2-bit LUTs (mentioned above) outputs and initiate transitions from odd states: 3-L2 – from lower to higher, 3-L3 – from higher to lower.

State name	Connection Matrix Output RAM							
	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0
State 0	0	0	0	0	0	0	1	0
State 1	0	1	1	0	1	0	1	1
State 2	0	0	0	0	1	1	0	0
State 3	0	0	1	0	1	0	0	0
State 4	0	1	1	0	0	0	0	1
State 5	0	0	1	1	0	0	0	0
State 6	0	0	0	1	0	0	0	0
State 7	1	0	1	0	1	0	1	1

Segment		A	E	B	F	C	G	D
ASM Out	7	6	5	4	3	2	1	0

Figure 4. ASM RAM Configuration

To indicate overload, we may use a 5th input (DP) of the 7-segment display, and ASM Out 7, which isn't used for digits' indication. Let's configure this output to be High in the last state (see Figure 4) and configure 3-L4 to latch High, when ASM is in the last state and DFF3 output is High, which means we tried to move into the next after the last state. This LUT will be unlatched on the Low level from the ASM Out 7 (any state except for the last one). Filter 0 is used as an inverter, because active level for this indicator is Low.

Figure 5. Different digits displayed

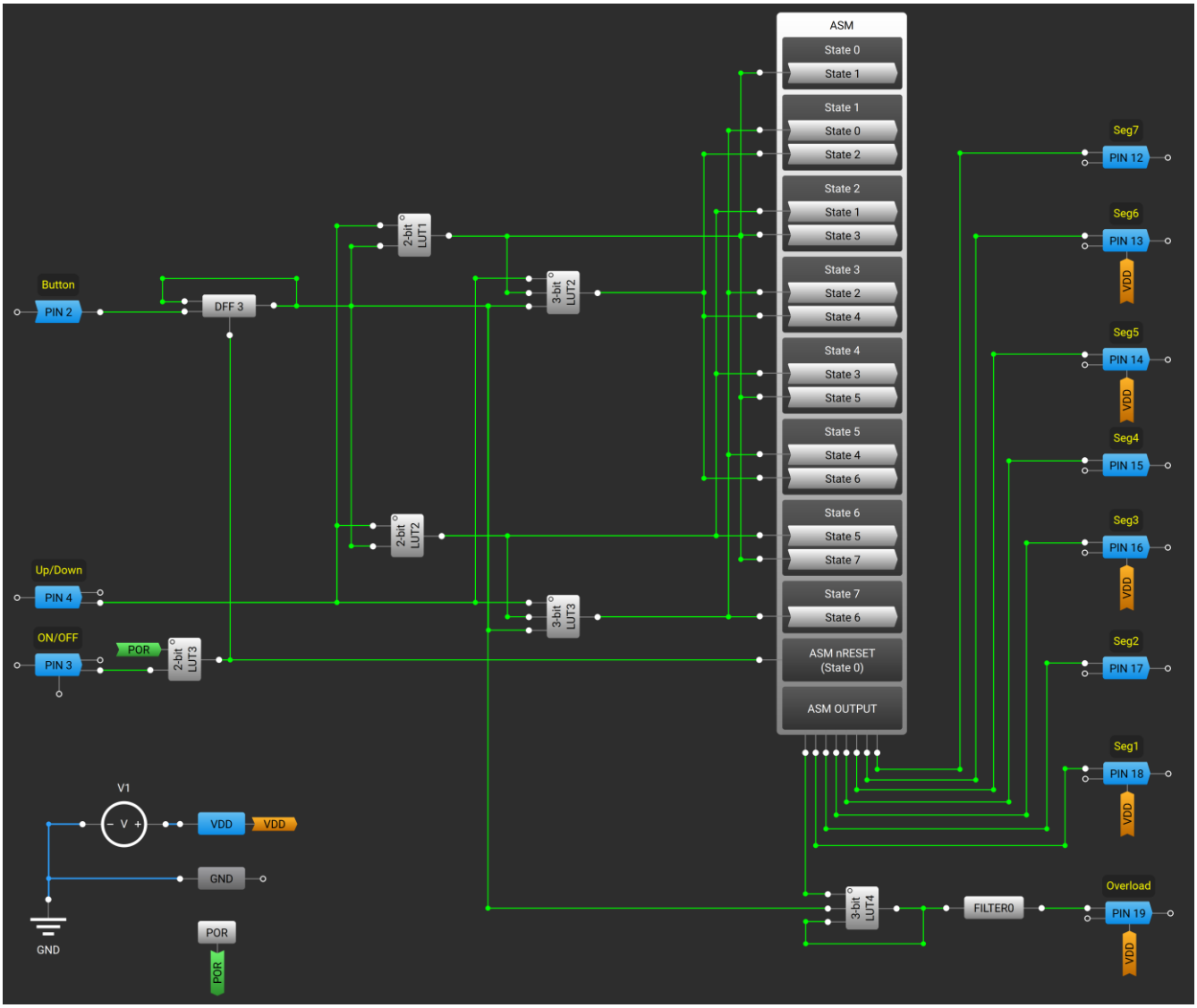

Figure 6. ASM Counter circuit design

5. Conclusion

This article demonstrates one more example of Asynchronous State Machine application and how easy we can build a simple up/down counter with indication on a 7-segment display.

6. Revision History

Revision	Date	Description
1.00	June 6, 2016	Initial release.
2.00	April 27, 2026	The part number has been changed from SLG46531V to SLG46537V.

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