

# Application Note

## SLG46880/1 Dynamic Memory Block

### AN-CM-236

#### **Abstract**

*The SLG46880 and SLG46881 introduce several new blocks that haven't appeared in previous GreenPAK devices. This application note describes the Dynamic Memory (DM) blocks and how to use them.*

*This application note comes complete with design files which can be found in the References section.*

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**SLG46880/1 Dynamic Memory Block**

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## SLG46880/1 Dynamic Memory Block

### 1 Terms and Definitions

ASM	Asynchronous state machine
DM	Dynamic memory

### 2 References

For related documents and software, please visit:

[GreenPAK™ Programmable Mixed-Signal Products | Renesas](#)

Download our free [GreenPAK™ Designer](#) software [1] to open the .gp 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 Electronics provides a complete library of application notes [4] featuring design examples as well as explanations of features and blocks within the IC.

- [1] [GreenPAK Designer Software](#), Software Download and User Guide, Renesas Electronics
- [2] [AN-CM-236 SLG46880/1 DM Block.gp](#), [GreenPAK](#) Design File, Renesas Electronics
- [3] [GreenPAK Development Tools](#), [GreenPAK](#) Development Tools Webpage, Renesas Electronics
- [4] [GreenPAK Application Notes](#), [GreenPAK](#) Application Notes Webpage, Renesas Electronics

## SLG46880/1 Dynamic Memory Block

### 3 Introduction

The main advantage of DM blocks is that they can be reconfigured to perform different functions in different states of the SLG46880/1's 12-state Asynchronous State Machine (ASM). This makes them a very flexible component, since they can be used one way in State 0 and another way in State 1.

### 4 DM Block Basics

There are 4 DM blocks in GreenPAK SLG46880/1. An unconfigured DM block is shown in Figure 1. All the DM blocks in the SLG46880/1 have the following resources:

- 2 look-up tables: a 3-bit LUT and a 2-bit LUT
- 2 multiplexers
- 1 CNT/DLY
- 1 Output block

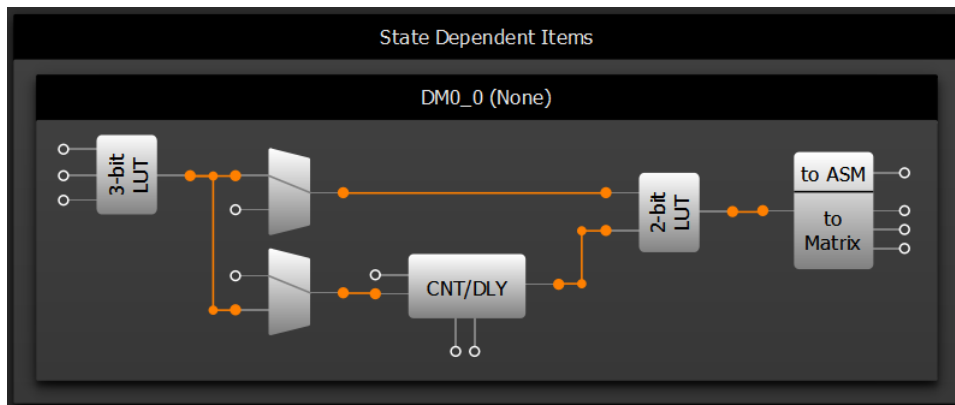


Figure 1. An Unconfigured DM Block

Figure 2 shows the same DM block with colored-in connectors. (These colors do not appear inside GreenPAK Designer, they are merely for illustrative purposes.) The Green connectors are inputs to the DM block from the Matrix. The orange connections are dedicated connections within the DM block, which cannot be changed or moved. The blue connectors are clock connections for the counter block. The purple connector can be used to trigger a state transition but is not a general matrix connection. The yellow connectors are matrix outputs from the DM block.

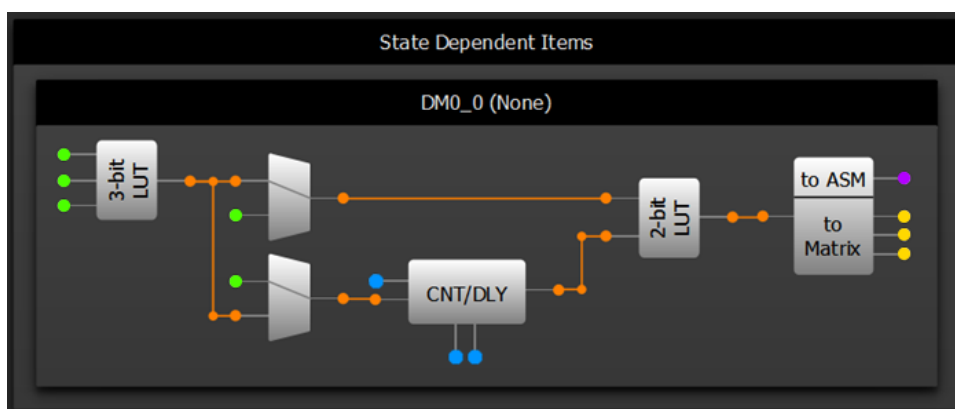


Figure 2. An Unconfigured DM Block with Colored Connections

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## 5 Creating new DM block configurations

To create a new DM block configuration, you'll need to select a DM block and open its properties panel, shown in Figure 3. Now you can create a new configuration for this DM block by clicking the "+" icon in the top right. At this point, you can rename the configuration if you wish and configure the DM block however you want, by using its properties panel. You can delete an unnecessary configuration by selecting it from the dropdown menu, and clicking the "-" button.

The screenshot shows the 'Properties' window for 'DM0\_0'. It includes a configuration dropdown, a configuration name field, an 'Outputs init. value' dropdown set to 'Low', and a truth table for a 3-bit LUT. The truth table has columns IN3, IN2, IN1, IN0, and OUT, with 16 rows of binary values. Below the truth table are 'Standard gates' options: 'Defined by user' (selected), 'All to 0', 'All to 1', 'Regular shape' (unchecked), and 'Invert'. At the bottom are 'Apply' and 'Cancel' buttons.

IN3	IN2	IN1	IN0	OUT
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	0

**Figure 3: DM Block Properties Panel**

Each DM block can have up to 6 different configurations. Any DM block configuration can be used in any of the ASM's 12 states, but only one configuration per DM block per state is permitted.

To use DM block with ASM or with blocks outside the ASM, connect ASM nReset block's nReset input to a non-GND signal.

Figure 4 shows how the resource manager bar indicates that one of the DM0\_0 configurations has been used. The number of configurations for DM0\_0 was increased from 0/6 to 1/6.

## SLG46880/1 Dynamic Memory Block

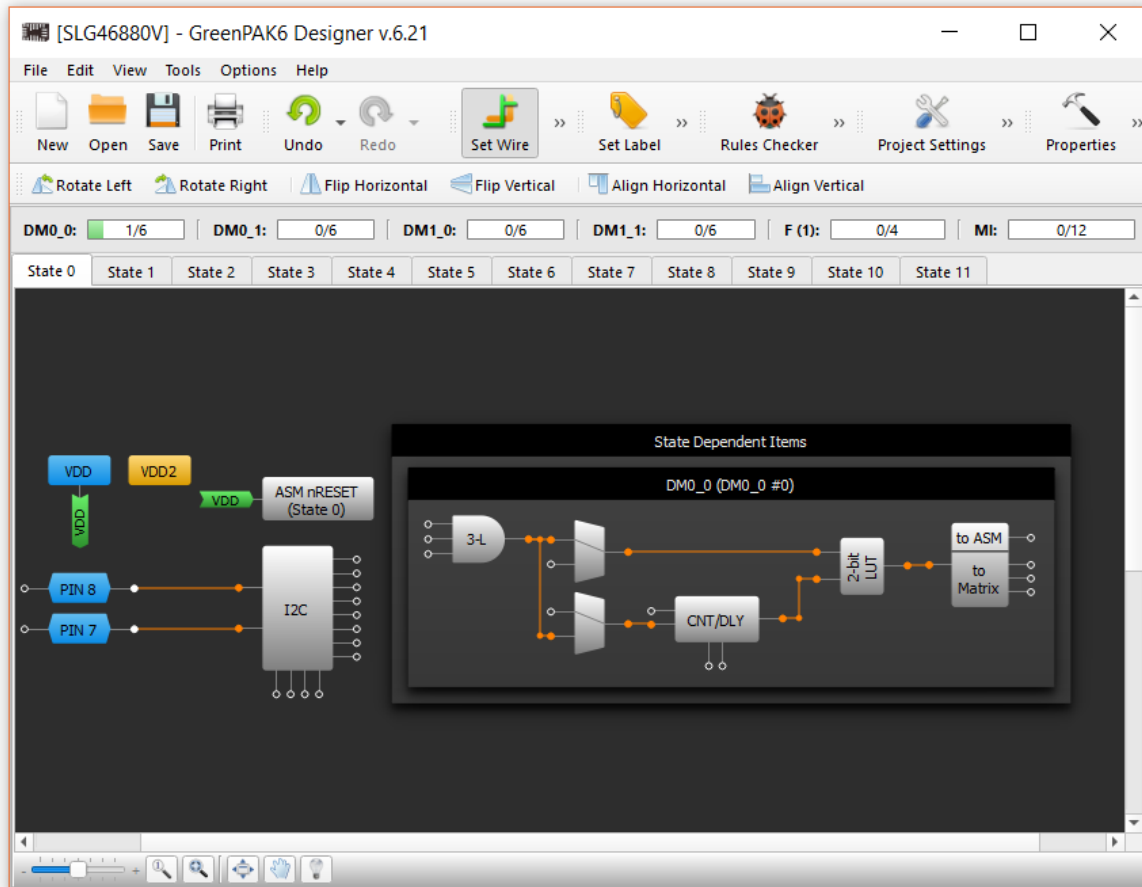


Figure 4: DM Block Configuration Counters

## 6 Use a DM Block to Trigger a State Transition

Figure 5 shows a few different ways to trigger a state transition. We've created new configurations for DM0\_0 and DM1\_0, and named them "myConfig" and "myConfig1". The top DM is simply used as a 3-bit AND gate, since the top mux passes the output of the AND gate through, and the 2-bit buffer passes it along to the outputs block. (The 2-bit LUT could have also been configured as a buffer for the CNT/DLY block.) The "to ASM connector is used to trigger a state transition from State 0 to State 1.

Similarly, a matrix connection from Pin5 is used to trigger a state transition from State 0 to State 2.

Finally, DM1\_0 is configured so that both muxes pass through the signal from Pin6. The counter is configured as a 100µs both edge delay, and the 2-bit LUT is an AND gate. Just like in DM0\_0, the output block is used to trigger another state transition.

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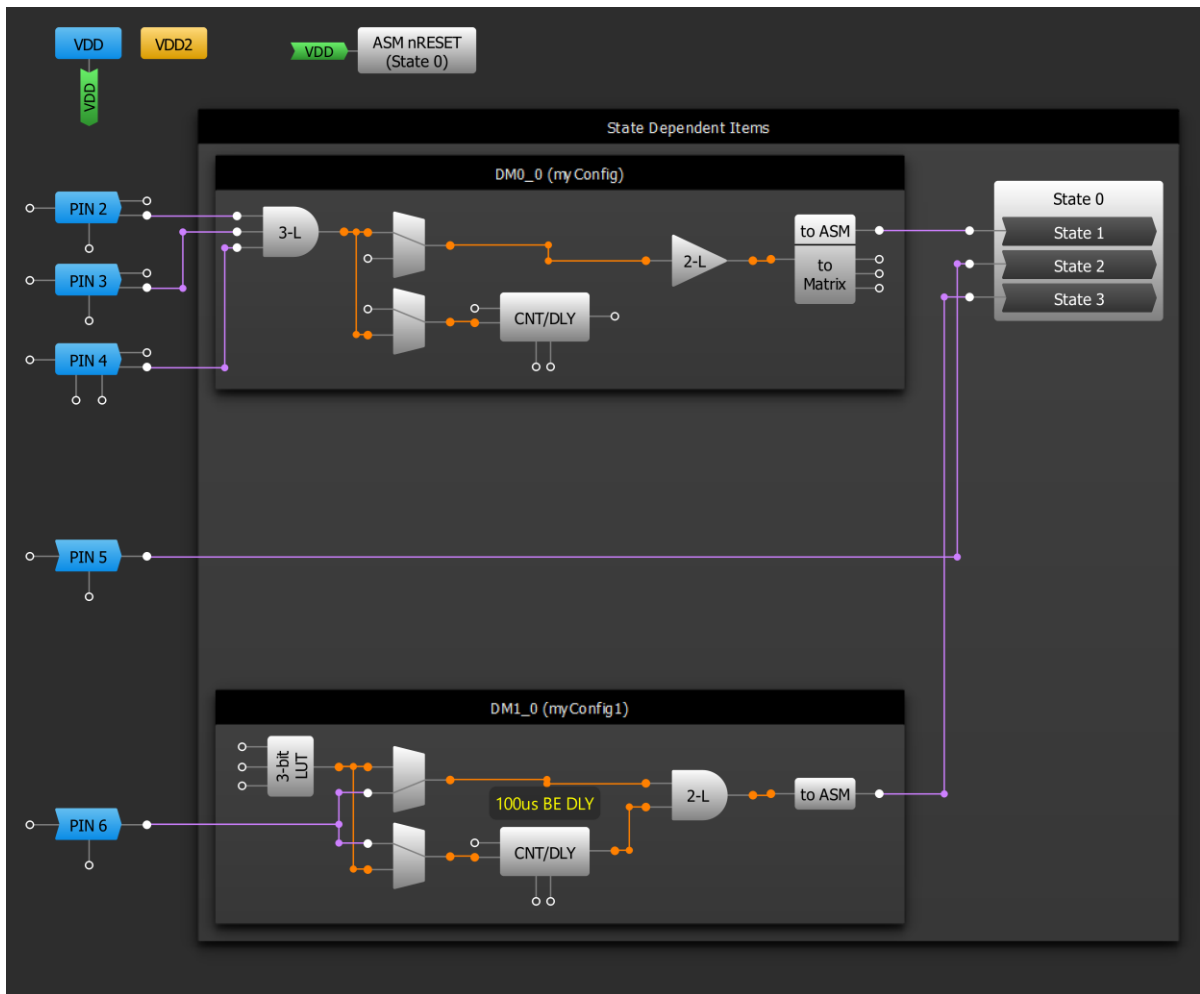


Figure 5: Different Ways to Trigger a State Transition

### 7 Using a DM Block to Interact with Blocks Outside the ASM

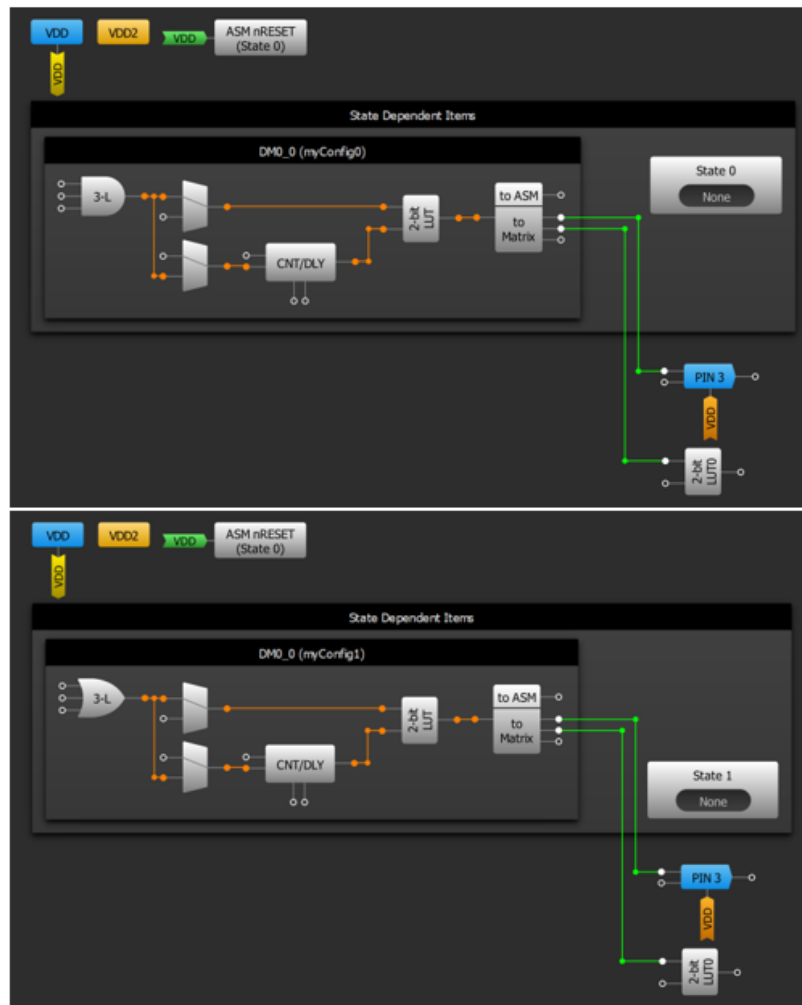
As you may have noticed in the previous section, DM0\_0's output block has 3 "to Matrix" outputs, while DM1\_0's output block doesn't have any matrix outputs. This holds true for DM0\_1 and DM1\_1 as well; DM0\_1 has 3 matrix outputs, while DM1\_1 has none.

The 3 "to matrix" outputs can be connected to any other matrix connectors, like pins, LUTs, DFFs, etc. This is shown in [Figure 6](#).

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**Figure 6: DM to Matrix Connections**

Note that once a connection has been made between a “to Matrix” pin and other blocks outside the State Machine area, it will exist in every state, regardless of which DM configuration is used. In [Figure 6](#), the top section shows myConfig0 of DM0\_0, which exists in State 0. The bottom section shows myConfig1 of DM0\_0, which exists in State 1. The top “to Matrix” connection in both configurations is connected to Pin3, while the middle one is connected to 2-bit LUT0.

Only one of those “to Matrix” connections can be “active” at any time.

There are 4 options in the properties panel menu for DM0\_0 and DM0\_1’s output block:

- Out0/1/2 keep
- Bypass to out0, out1/2 keep
- Bypass to out1, out0/2 keep
- Bypass to out2, out1/1 keep

These settings are used to determine which of the three outputs are active in each configuration. If the first option is selected, the output of the DM block’s 2-bit LUT will not be passed to any of the three “to Matrix” outputs. The value of those three signals will remain unchanged in that state.

However, if any of the other three options are used, the output of the DM block’s 2-bit LUT will be passed to out0, out1, or out2 respectively, and the value of the other two outputs will be kept unchanged.



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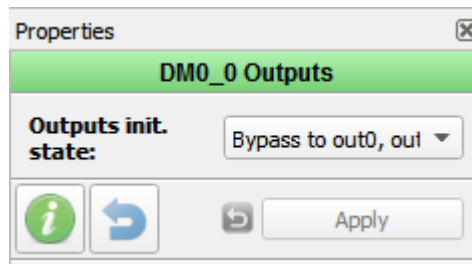


Figure 7: DM "to Matrix" Output Properties

## 8 Design Example

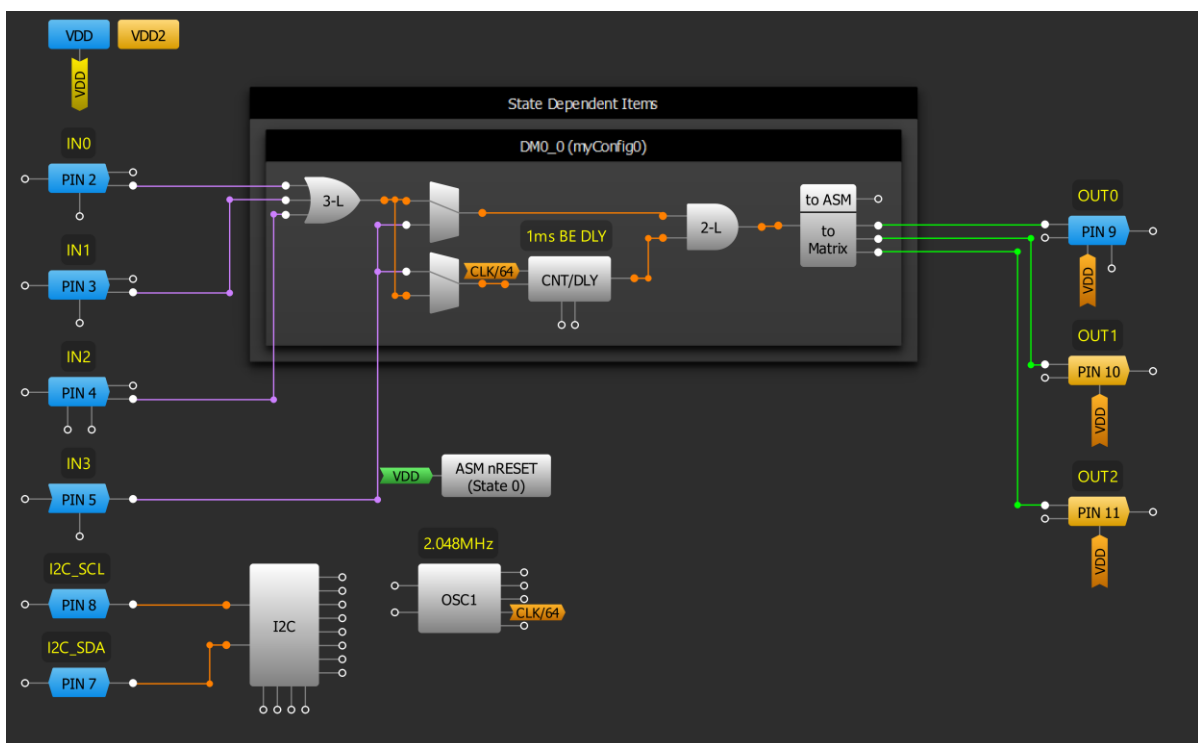


Figure 8: Design Example

In the above design example, the IN0, IN1, and IN2 are OR'd together. Meanwhile, IN3 is delayed by 1 ms and then AND'd with the output of the OR gate. The to Matrix block is configured so that the output of the DM block is sent to OUT0 in STATE0, while the values at OUT1 and OUT2 are kept.

## 9 Conclusion

Thanks to their reconfigurability, Dynamic Memory blocks in the GreenPAK SLG46880/1 are extremely flexible and can be used in a variety of ways. Once you get the hang of working with DM blocks, you'll be able to create more complex designs by piecing together different DM block configurations in different ASM states.

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**SLG46880/1 Dynamic Memory Block****Revision History**

Revision	Date	Description
1.0	19-Mar-2018	Initial Version

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### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

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