



# AN1338 APPLICATION NOTE

## Multiple Search Table Management Using the M7010 and M7020 Network Search Engines

### INTRODUCTION

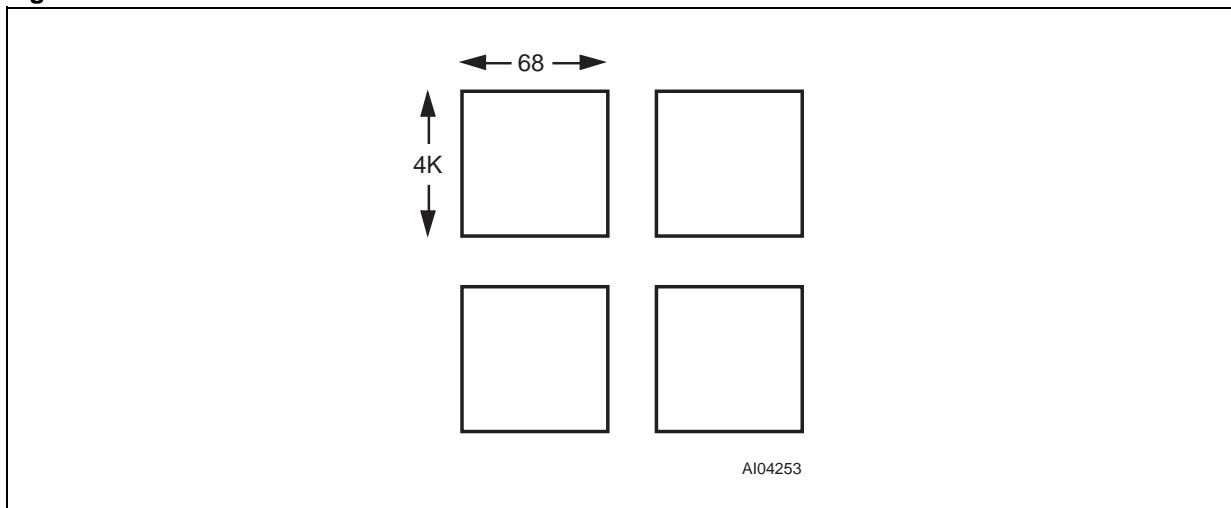
This Application Note explains how multiple search tables having variable widths can be configured within the M7010 and M7020 Search Engines. Since the internal architecture of the M7010 and M7020 is similar, the following discussion on the table management applies to both Search Engine devices. The table management has been simplified in the M7040 Search Engine and it is explained later in this Application Note.

### M7010 and M7020 Using Associative Processing Technology™ (APT)

The M7010 and M7020 are high-performance, pipelined, synchronous, Search Engines. The M7010 is organized as 8K x 136-bit, but can also be configured as 4K x 272-bit, 16K x 68-bit, or 32K x 34-bit (see Application Note “AN1339, 32-bit Applications Using the M7010, M7020 Network Search Engines”). The M7020 is organized as 16K x 136-bit, but can also be configured as 8K x 272-bit, 32K x 68-bit, or 64K x 34-bit (see Application Note “AN1339, 32-bit Applications Using the M7010, M7020 Network Search Engines”). The M7010 can sustain 83 million searches per second on any sub-field of a 68-bit or 136-bit field, making it the fastest Search Engine in the market. These high speed, high capacity chips can be employed in a variety of networking and communications applications that require fast searches of various tables.

A unique feature of the M7010 and M7020 is their flexibility and ability to configure multiple search tables of different widths within the same device. By comparing the desired information against the entire list of pre-stored entries simultaneously, The M7010 and M7020 provide performance advantage over other memory search algorithms, such as binary or tree-based searches, thereby giving orders-of-magnitude reduction in the search time.

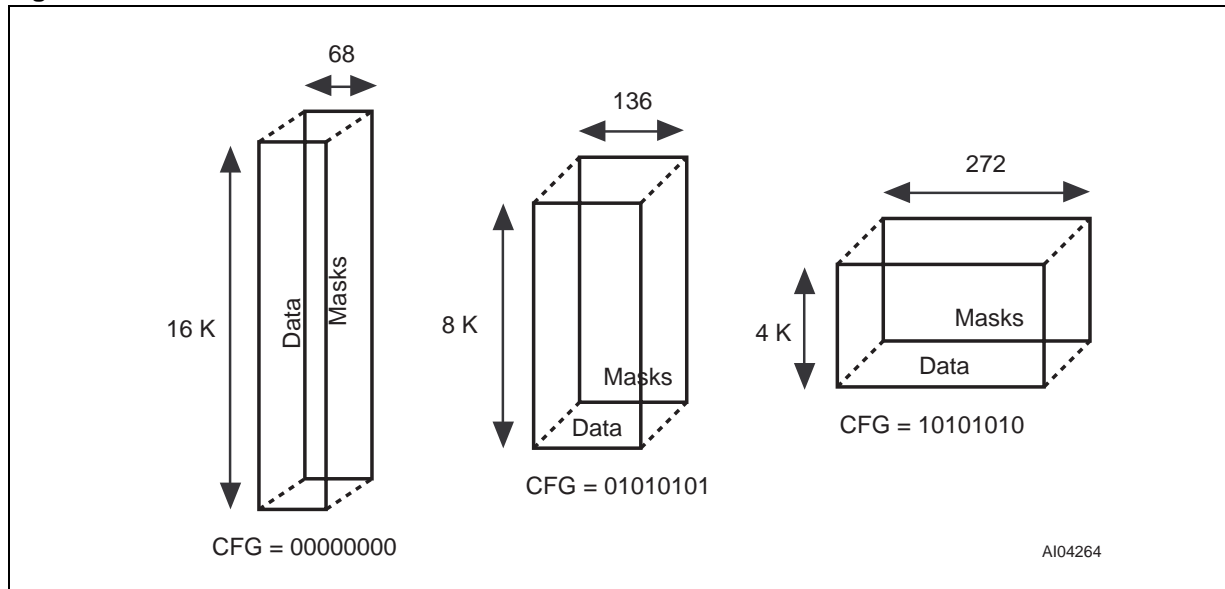
Figure 1. Four 68-bit wide Quadrants in M7010



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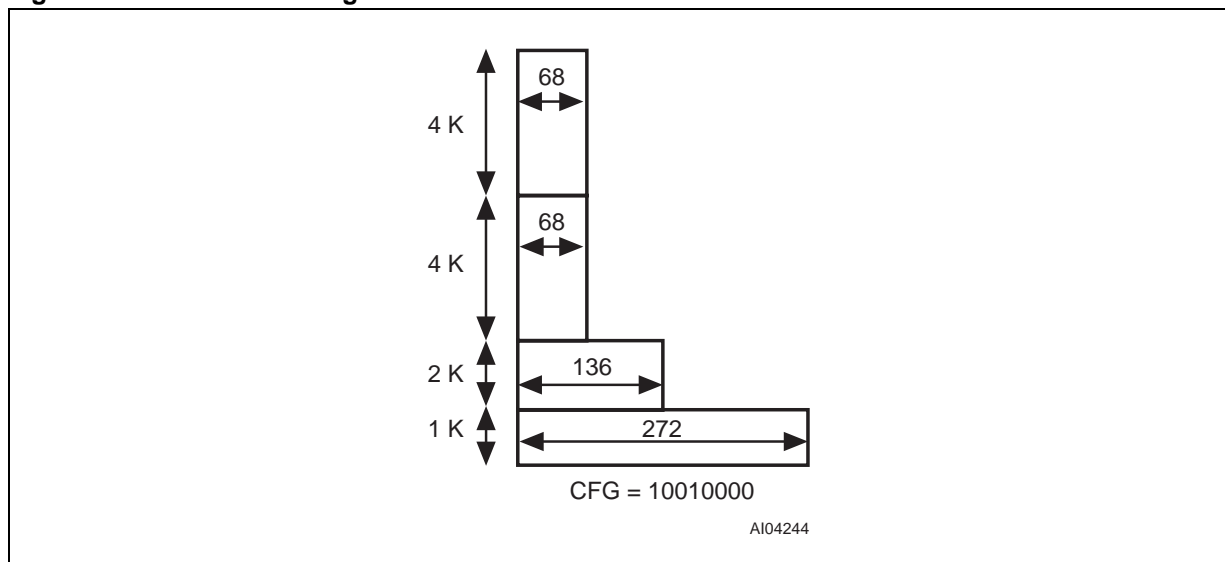
The M7010 consists of 16K x 68-bit storage cells referred to as data bits. There is a mask cell corresponding to each data cell. Three different configuration tables based on the value of the configuration bits [16:9] in the Command register of M7010 (see Figure 2). The M7020 consists of 32K x 68-bit storage cells.

**Figure 2. M7010 Structure**



The M7010 is internally divided into four quadrants of 4K x 68-bit, each of which can be arranged as 4K x 68-bit, 2K x 136-bit, or 1K x 272-bit. It can be configured to contain tables of different widths within the same device. A typical configuration with tables of different widths is shown below (see Figure 3).

**Figure 3. Multi-width Configurations for the M7010**



There are eight configuration bits in the command register, which are bits [16:9]. They are subdivided into 2 bits for each quadrant (see Table 1). The supported table widths are shown in Table 2.

**Table 1. Configuration Bits for Each Quadrant**

Quadrant	Command bits
Q1	10:9
Q2	12:11
Q3	14:13
Q4	16:15

**Table 2. Configuration Bits and Table Widths**

Command Bit	CFG bits for each Quadrant
00	4K x 68-bit
01	2K x 136-bit
10	1K x 272-bits

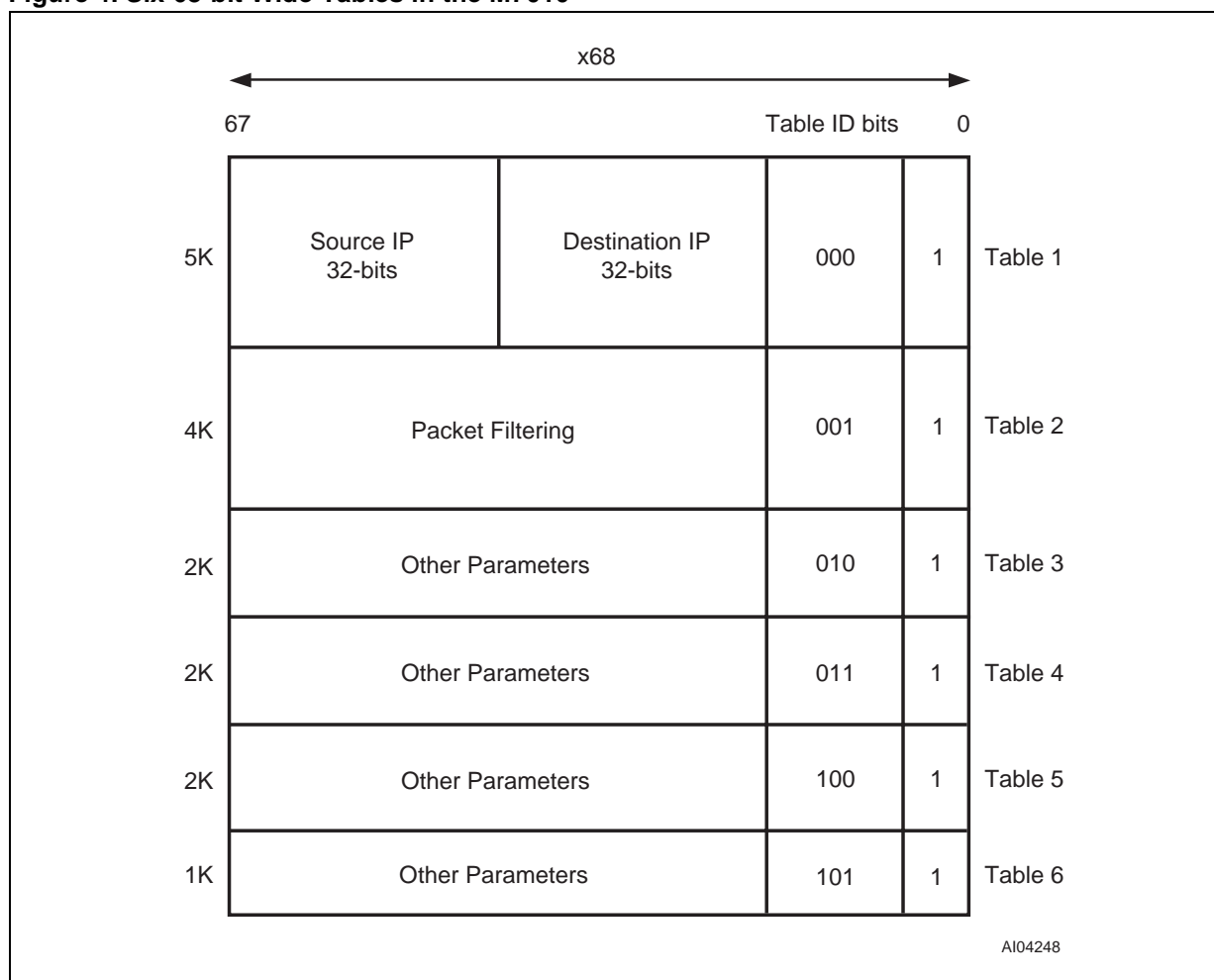
Initially, these configuration bits have values of 00000000. Each quadrant may be set to one of the three configurations (see Figure 2 on page 2).

**Logical Tables with Variable Widths Using the M7010 and M7020 Search Engines**

The M7010 and M7020 Search Engines can be configured to contain more than one logical table within the device. To accomplish this, it is necessary to assign Table Identifier bits. It is possible to create multiple tables within the device with the help of these Table ID bits. Please note that when creating several tables, the total number of bits in all tables combined may not exceed 1Mbit for the M7010 and 2Mbits for the M7020.

Figure 4 shows an example of maintaining six search tables, each of which having 68-bit width. In this case, the value of the configuration bits [16:9] is 00000000. Bits [3:1] are used as the Table Identifier bits. Bit 0 indicates whether the location is Full or Empty, as required by the Learn Mode. (See data sheets on the M7010 and M7020 for the description of Learn Mode).

**Figure 4. Six 68-bit Wide Tables in the M7010**



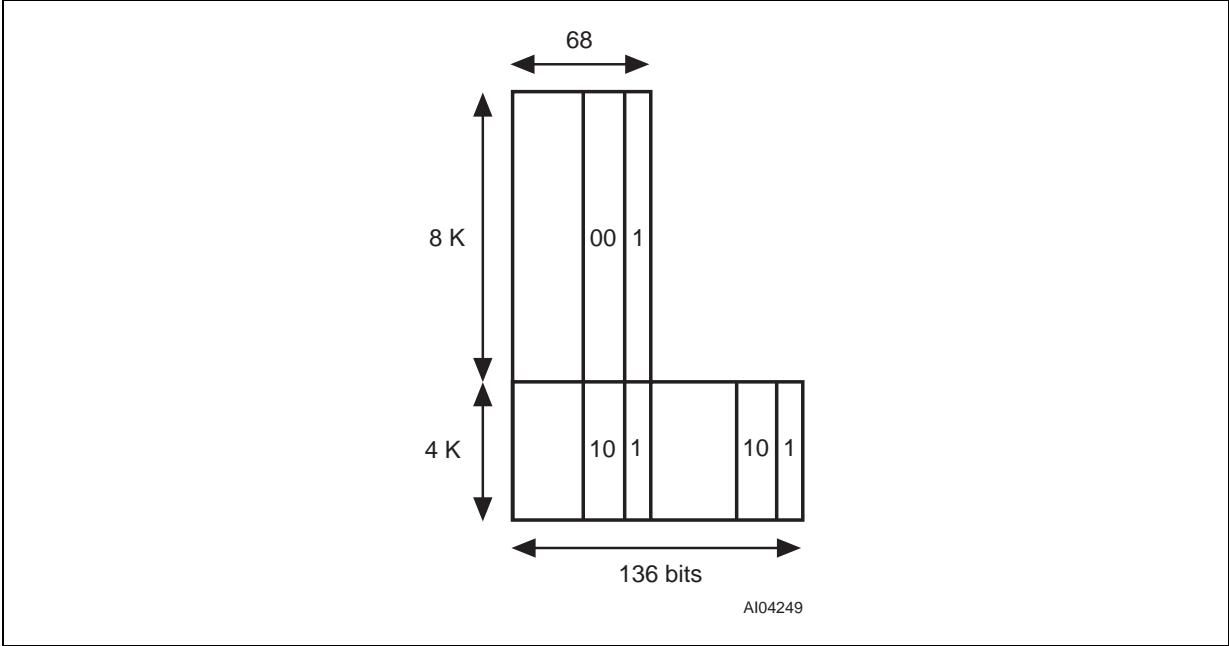
**Search Tables with multiple widths using M7010/20 Search Engines**

Here is another example of how to create Search Tables with two different widths (see Figure 5). The device is configured to contain two search tables, one is 8K x 68-bit wide and the other is 4K x 136-bit wide. The configuration bits [16:9] in this case are 01010000. As in the previous example, Bits [2:1] are assigned as the Table Identifier bits. Bit 0 in is used to indicate if the entry is Full or Empty as required by the Learn Mode (see data sheets on the M7010 and M7020 for description of Learn Mode).

For 136-bit wide table, it is necessary to enter the table ID bits [2:1] in both 68-bit wide quadrants, because the search starts in both 68-bit quadrants simultaneously.

Even though the search is intended in the 136-bit wide table, it is possible to find an erroneous match in the 68-bit quadrant, if the Table ID bits are not used in each 68-bit quadrant.

**Figure 5. 68-bit and 136-bit Wide Tables for the M7010**

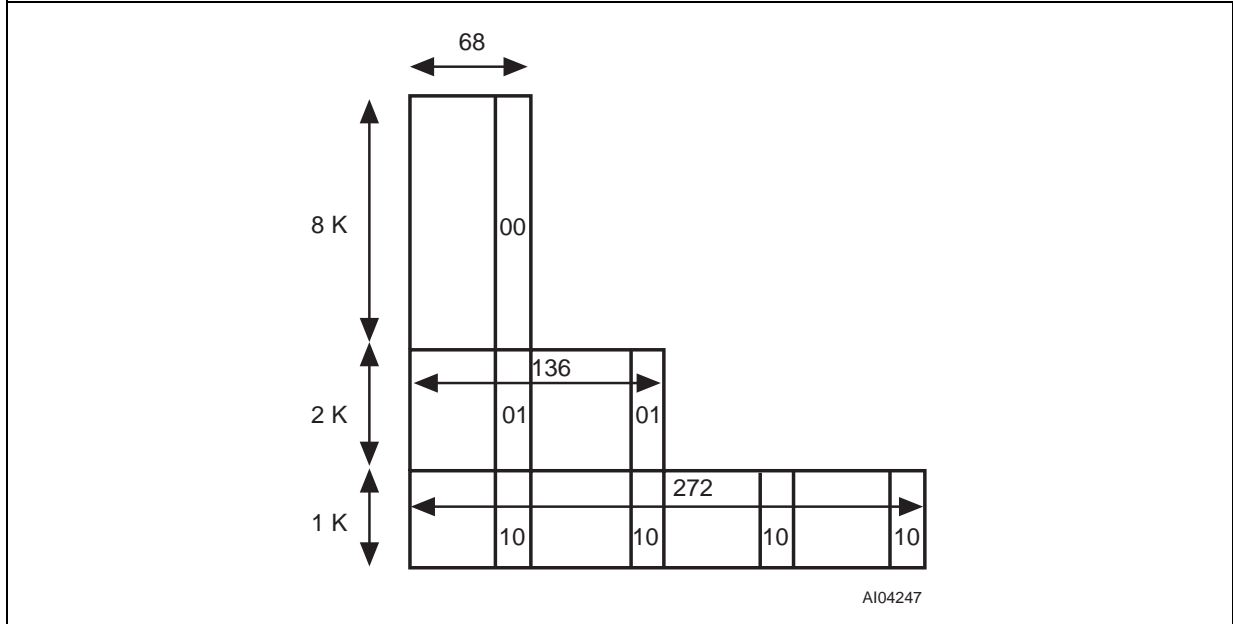


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Figure 6 shows an example of creating three tables with different widths. The configuration bits [16:9] in this example are 10010000. Bits [1:0] are assigned as the Table Identifier bits. In this example, the Learn mode is not used. Therefore, Bit 0 can be used as a Table ID bit.

As in the previous example, it is necessary to enter the Table ID bits in each of the 68-bit quadrants. Without doing this, an erroneous match can be found in any of the 68-bit wide table.

**Figure 6. Table Configuration with Different Widths for the M7010**



The STMicroelectronics M7010 and M7020 Search Engines offer the unique feature of allowing the creation of search tables of variable widths within the same device. This approach offers a cost-effective solution for small size applications. Another versatile feature is the depth cascading of several Search Engines. Depth cascading of up to eight devices will enable the formation of table sizes of 128K x 68-bit, 64K x 136-bits or 32K x 272 bits. Depth cascading can be further expanded by cascading up to 31 devices, whereby the table sizes can be expanded to 496 x 68-bit, 248K x 136 bits 124K x 272 bits. These numbers are for the M7010. When using the M7020, the depth of the memory doubles.

With the proliferation of the Internet related services such as VPN, QoS, and CoS, the demand on very large searches and look-ups is increasing. Consequently, the software search tables, which are slower and may become expensive with increasing search table sizes, cannot meet these requests.

Using ST Microelectronics Search Engine modules can further expand the table sizes when they are cascaded.

### CONTACT INFORMATION

If you have any questions or suggestions concerning the matters raised in this document, please send them to the following electronic mail addresses:

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