



Intel[®] 915G/915GV/910GL Express Chipset Memory Configuration Guide

White Paper

September 2004



INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL® PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. Intel products are not intended for use in medical, life saving, or life sustaining applications.

Intel may make changes to specifications and product descriptions at any time, without notice.

Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

The Intel® 915G/915GV/910GL Express chipset may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

Intel, Pentium and the Intel logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2004, Intel Corporation



Contents

1	Overview	5
1.1	Memory Technology Supported	5
1.2	Illegal Configurations.....	5
1.3	Valid Front Side Bus and Memory Speeds	6
1.4	ECC Support	6
2	Intel® 915G/915GV/910GL Express Chipset Memory Organization and Operating Modes	7
2.1	Single-Channel	7
2.2	Dual-Channel Asymmetric.....	8
2.3	Dual-Channel Symmetric	8
2.4	Mixed DRAM Memory Speeds	10

Figures

Figure 1. Single-Channel Memory Mode	7
Figure 2. Dual-Channel Asymmetric Memory Mode.....	8
Figure 3. Dual-Channel Symmetric Memory Mode.....	9
Figure 4. System Memory Mode Styles	9

Tables

Table 1. Memory Technology Support.....	5
Table 2. Valid Memory Configurations.....	6

Revision History

Revision Number	Description	Revision Date
-001	Initial Release.	June 2004
-002	<ul style="list-style-type: none">Updated to include Intel® 915GV Express chipset	August 2004
-003	<ul style="list-style-type: none">Updated to include Intel® 910GL Express chipset	September 2004



1 Overview

The Intel® 915G/915GV/910GL Express chipset Graphics Memory Controller Hub (GMCH) is Intel's first dual-channel DDR/DDR2 Memory Controller Hub with Intel® Flex Memory Technology. Intel has enhanced its memory architecture design to allow for maximum configuration flexibility while providing optimal performance when combined with DDR2-533 and an Intel® Pentium 4 processor in the Land Grid Array 775 (LGA775) package with 800 MHz front side bus.

This document details the 915G/915GV/910GL Express chipset GMCH memory configurations and organization. It is intended for a technical audience interested in learning about the simplified population rules introduced by Intel® Flex Memory Technology and the 915G/915GV/910GL Express chipset GMCH platform. This white paper will provide a brief background regarding the supported memory technologies and configurations, and then discuss the styles of memory organization and modes of operation.

1.1 Memory Technology Supported

The 915G/915GV/910GL Express chipset GMCH supports either DDR or DDR2 memory technologies in the following configurations

- DDR-333 (PC2700), DDR-400 (PC3200)
- DDR2-400 (PC3200), DDR2-533 (PC4300)

Table 1. Memory Technology Support

DRAM Technology	Smallest Increments (One SS DIMM)	Largest Increments (One DS DIMM)	Maximum Capacity (Four DS DIMMs)
256 Mb	128 MB	512 MB	2048 MB
512 Mb	256 MB	1024 MB	4096 MB
1 Gb	512 MB	2000 MB	8000 MB (Note 1)

NOTES: This exceeds a 32-bit address limit of 4 GB. In a 32-bit system, only the first 4 GB of memory will be accessible.

1.2 Illegal Configurations

The following configurations are not valid with the 915G/915GV/910GL Express chipset GMCH:

- 64-Mb and 128-Mb Memory Technology for DDR and DDR2
- 2-Gb and 4-Gb Memory Technology for DDR2
- x4, x32 DIMMS
- Double-sided x16 DIMMS
- Registered DIMMS

- No mixing of DDR and DDR2 DIMMS

1.3 Valid Front Side Bus and Memory Speeds

Table 2. Valid Memory Configurations

FSB	DRAM Data Rate	DRAM Type	Single Channel Peak Bandwidth	Dual Channel Peak Bandwidth
533 MHz	333 MT/s	DDR-DRAM	2.7 GB/s	5.4 GB/s
533 MHz	400 MT/s	DDR-DRAM	3.2 GB/s	6.4 GB/s
800 MHz	400 MT/s	DDR-DRAM	3.2 GB/s	6.4 GB/s
800 MHz	400 MT/s	DDR2 - DRAM	3.2 GB/s	6.4 GB/s
800 MHz	533 MT/s	DDR2 - DRAM	4.25 GB/s	8.5 GB/s

1.4 ECC Support

The Intel® 915G/915GV/910GL Express chipset GMCH **does not** support single-bit Error Correcting Code (or Error Checking and Correcting) on the DDR or DDR2 main memory interface. It will always operate in non-ECC mode with non-ECC and ECC DDR and DDR2 DIMMs.



2 Intel® 915G/915GV/910GL Express Chipset Memory Organization and Operating Modes

The Intel® 915G/915GV/910GL Express chipset GMCH memory interface is designed with Flex Memory Technology where it can be configured to support single-channel or dual-channel memory configurations and two modes of operation (DDR and DDR2).

Depending upon how the DIMMs are populated on each system memory channel, a number of different configurations can exist for DDR and DDR2:

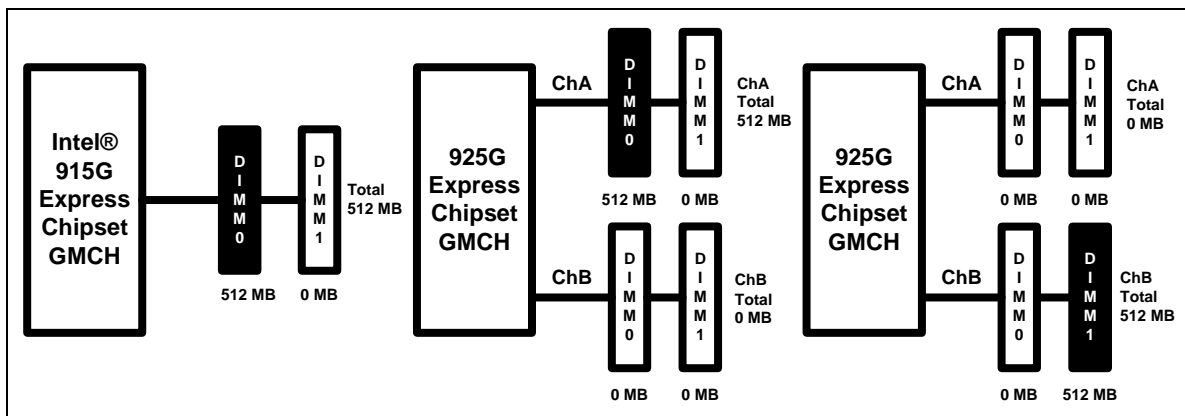
- Single-Channel – only one channel of memory is routed and populated, or if two-channels of memory are routed, but only one channel is populated; can be either channel A or channel B.
- Dual-Channel Asymmetric – both channels are populated, but each channel has a different amount (MB) of total memory.
- Dual-Channel Symmetric – both channels are populated where each channel has the same amount (MB) of total memory.

The following sections explain and show the different memory configurations that are supported by the 915G/915GV/910GL Express chipset.

2.1 Single-Channel

The system will enter single-channel mode when only one channel of memory is routed on the motherboard, or if two-channels of memory are routed, but only one channel is populated. In this configuration, all memory cycles are directed to a single channel.

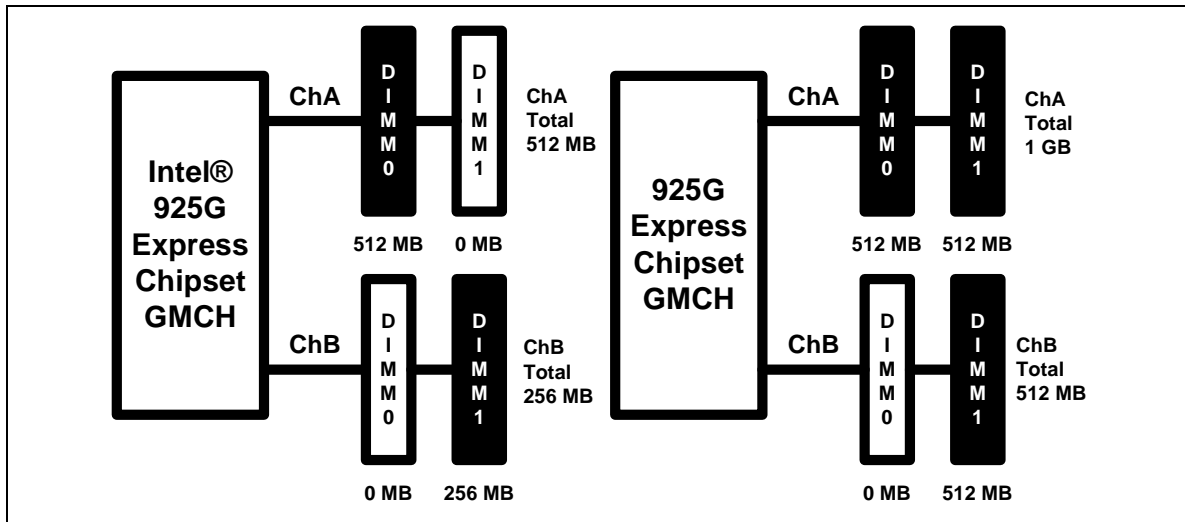
Figure 1. Single-Channel Memory Mode



2.2 Dual-Channel Asymmetric

This mode is entered when both memory channels are routed and populated with different amounts (MB) of total memory. This configuration allows addresses to be accessed in series across the channels starting in channel A until the end of its highest rank, then continue from the bottom of channel B to the top of the rank. Real world applications are unlikely to make requests that alternate between addresses that sit on opposite channels with this memory organization, so in most cases, bandwidth will be limited to that of a single channel.

Figure 2. Dual-Channel Asymmetric Memory Mode



2.3 Dual-Channel Symmetric

This mode allows the end user to achieve maximum performance on real applications by utilizing the full 64-bit dual-channel memory interface in parallel across the channels with the aid of Intel® Flex Memory Technology. The key advantage this technology brings is that the end user is only required to populate both channels with the same amount (MB) of total memory to achieve this mode. The DRAM component technology, device width, device ranks, and page size may vary from one channel to another.

Addresses are ping-ponged between the channels, and the switch happens after each cache line (64 byte boundary). If two consecutive cache lines are requested, both may be retrieved simultaneously, since they are guaranteed to be on opposite channels.



Figure 3. Dual-Channel Symmetric Memory Mode

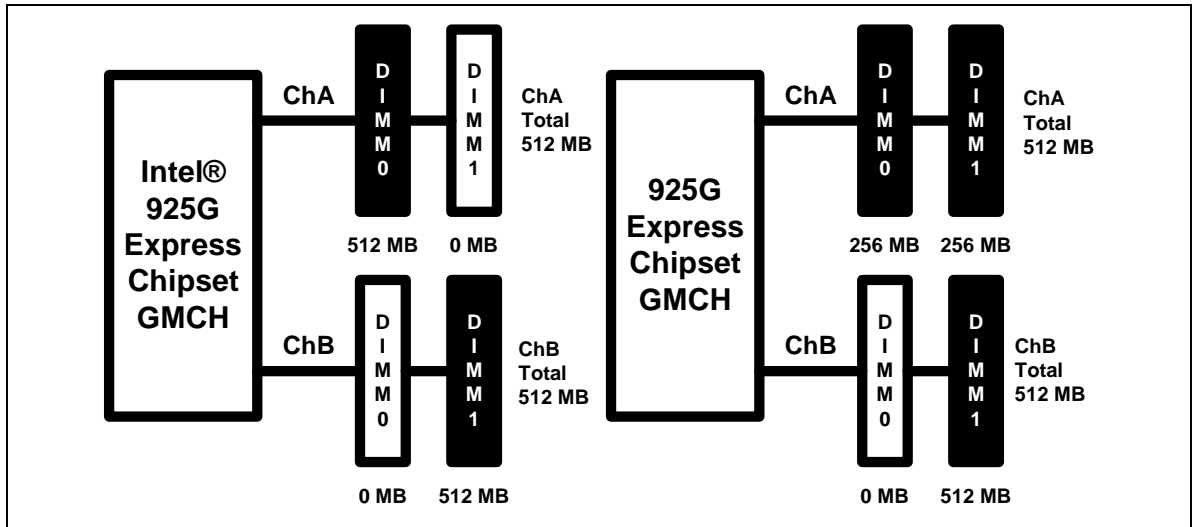
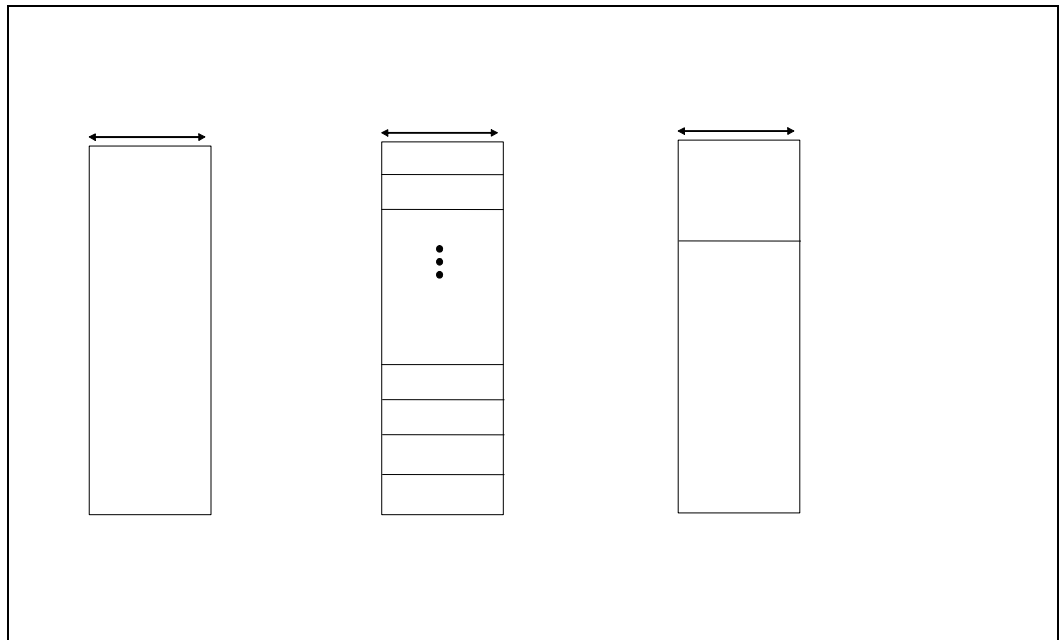


Figure 4. System Memory Mode Styles



2.4 Mixed DRAM Memory Speeds

The 915G/915GV/910GL Express chipset GMCH will accept mixed DDR or DDR2 speed populations, assuming the SPD on the DIMMS are programmed with the correct information and the BIOS is programmed as outlined in Intel's BIOS reference code.

In all operating modes (Single-Channel, Dual Channel Asymmetric, and Dual-Channel Symmetric) the frequency of the System Memory will be set to the lowest frequency of all DIMMs populated in the system, as determined through the SPD registers on the DIMMs.

For example, a DDR2-533 DIMM installed with a DDR2-400 DIMM should run at 400 MHz. The DDR2-533 DIMM should downshift to DDR2-400 timings, thus allowing the system to run at 400 MHz speeds. The DDR2-533 DIMM will only downshift to DDR2-400, if the timings for DDR2-400 are programmed in the DDR2-533 DIMM's SPD.