FEATURES

- Easy to use system supercomponent module
- Integral low profile heatsink
- IMS T9000 processor provides up to 120MIPS and 15MFLOPS (30MHz processor).
- 16Mbytes fast, cacheable DRAM.
- On-board configuration ROM.
- Size 2 HTRAM, compatible with HTRAM motherboards.
- Easily interfaced with other HTRAMs or IMS T9000s to build powerful multiprocessor systems.
- 4 DS data links each provide 100Mbits/s communication with other IMS T9000s or HTRAMs.
- Compilers and development tools available for ANSI C, C++, and occam 2.

DESCRIPTION

The IMS B933 is a second generation transputer module (HTRAM), which integrates the high performance IMS T9000 microprocessor with 16Mbytes of fast DRAM. The memory is organised as two 64-bit wide banks, both of which are cacheable. The memory system performs automatic page mode accesses whenever possible to provide maximum memory bandwidth.

An on-board ROM provides for local configuration of the IMS T9000 programmable memory interface and cache, and also contains identification data.

The IMS B933 is part of a family of HTRAMs and HTRAM motherboards and is an ideal building block for multiprocessor systems based on the IMS T9000.

The IMS B933 complies fully with the HTRAM Specification.
1.1 Introduction

The IMS B933 is a second generation transputer module (HTRAM), which integrates the high performance IMS T9000 microprocessor with 16Mbytes of fast DRAM. The memory is organised as two 64-bit wide banks, both of which are cacheable. The memory system performs automatic page mode accesses whenever possible to provide maximum memory bandwidth. An on-board ROM provides for local configuration of the IMS T9000 programmable memory interface and cache, and also contains identification data. The IMS B933 is part of a family of HTRAMs and HTRAM motherboards and is an ideal building block for multiprocessor systems based on the IMS T9000. The IMS B933 complies fully with the HTRAM Specification [1].

1.2 The IMS B933 specification

The IMS B933 is a size 2 HTRAM, which integrates the high performance IMS T9000 microprocessor with 16Mbytes of fast DRAM. The memory is organised as two 64-bit wide banks (connected to banks 2 and 3 of the IMS T9000), both of which are cacheable. The memory system performs automatic page mode accesses whenever possible to provide maximum memory bandwidth. An on-board ROM provides for local configuration of the IMS T9000 programmable memory interface and cache, and also contains identification data.

![Figure 1.1 IMS B933 dimensions](image)

Note: For full information on component height refer to [1].
1.2.1 Memory configuration

The memory organisation of the IMS B933 optimises performance of the IMS T9000 and its cache subsystem. The memory appears as two contiguous 8Mbyte banks on a 64bit wide data bus. The memory system performs automatic page mode accesses whenever possible to optimise memory bandwidth. The memory map of the IMS B933 is shown in figure 1.2.

![Figure 1.2 IMS B933 memory map](image)
1.3 Interface Signals

The interface signals are as follows. Full electrical details can be found in [1] and [2].

![Figure 1.3 Size 2 HTRAM pinout configuration](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Row a</th>
<th>Row b</th>
<th>Row c</th>
<th>Row d</th>
<th>Row g</th>
<th>Row h</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ClkIn</td>
<td>N/C</td>
<td>TDI</td>
<td>notTRST</td>
<td>EventIn0</td>
<td>EventOut0</td>
</tr>
<tr>
<td>2</td>
<td>L0SIn</td>
<td>GND</td>
<td>V5V0</td>
<td>L2SOut</td>
<td>EventIn1</td>
<td>EventOut1</td>
</tr>
<tr>
<td>3</td>
<td>L0DIn</td>
<td>N/C</td>
<td>CUpSIn</td>
<td>L2DOut</td>
<td>EventIn2</td>
<td>EventOut2</td>
</tr>
<tr>
<td>4</td>
<td>L0DOut</td>
<td>V3V3</td>
<td>GND</td>
<td>L2DIn</td>
<td>EventIn3</td>
<td>EventOut3</td>
</tr>
<tr>
<td>5</td>
<td>L0SOut</td>
<td>N/C</td>
<td>CUpDIn</td>
<td>L2SIn</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>L1SIn</td>
<td>N/C</td>
<td>CUpDOut</td>
<td>L3SOut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>L1DIn</td>
<td>V5V0</td>
<td>GND</td>
<td>L3DOut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>L1DOut</td>
<td>N/C</td>
<td>CUpSOut</td>
<td>L3DIn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>L1SOut</td>
<td>GND</td>
<td>V3V3</td>
<td>L3SIn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Reset</td>
<td>TMS</td>
<td>TCK</td>
<td>V5V0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>N/C</td>
<td>TDO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>N/C</td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1 IMS B933 Pinout reference
<table>
<thead>
<tr>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ClkIn</td>
<td>5MHz clock: the IMS T9000 generates its own high speed clocks.</td>
</tr>
<tr>
<td>LxDIn, LxSIn, LxDOOut, LxSOut</td>
<td>The IMS B933 has four data links, connected directly to the corresponding IMS T9000 data links. Each data link consists of four signals, for example link 0 consists of L0DIn, L0SIn, L0DOOut, L0SOut, and is data link 0 of the IMS T9000. Unused links may be left unconnected. Link connections should be designed as 100Ω transmission lines: no termination is required at either end, as the drivers and receivers are designed to work with unterminated lines.</td>
</tr>
<tr>
<td>CUpDIn, CUpSIn, CUpDOOut, CUpSOut</td>
<td>The Control Up link is Clink0 of the IMS T9000. It is used at system start time to initialize the IMS T9000, and must be connected to a suitable source of control messages: for example the Control Down link of another HTRAM in a daisy chain control architecture.</td>
</tr>
<tr>
<td>CDnDIn, CDnSIn, CDnDOOut, CDnSOut</td>
<td>The Control Down link is Clink1 of the IMS T9000. The Control Down link may be used to drive the Control Up link of another HTRAM or Clink0 of an IMS T9000, in a daisy chain control architecture. Control Down may be left unconnected if daisy chain control is not being used, or for the last HTRAM in a control chain.</td>
</tr>
<tr>
<td>TMS, TCK, TDI, TDO, notTRST</td>
<td>These form an IEEE1149.1 test access port (TAP). The TAP on the IMS B933 is not implemented: TMS and TCK must be tied high, notTRST must be tied low, TDI should be tied high or connected to the TDO pin of another HTRAM. TDO may be left unconnected or connected to the TDI pin of another HTRAM. Pull-ups/pull-downs of up to 10kΩ may be used.</td>
</tr>
<tr>
<td>V5V0</td>
<td>The IMS B933 requires a 5.0V power supply to be connected to the V5V0 and GND pins: all of these pins should be connected.</td>
</tr>
<tr>
<td>V3V3</td>
<td>The IMS B933 does not require a 3.3V power supply to be connected to the V3V0 pins: these pins are not electrically connected on the IMS B933.</td>
</tr>
<tr>
<td>GND</td>
<td>Signal reference and power supply return pins.</td>
</tr>
<tr>
<td>EventIn0–3</td>
<td>Event (Interrupt) Inputs of the IMS T9000. Unused EventIn pins may be left unconnected as there is a pull-down resistor on each input.</td>
</tr>
<tr>
<td>EventOut0–3</td>
<td>Event Outputs of the IMS T9000. These signals function as Interrupt acknowledge signals in response to the corresponding EventIn, or can be used as outputs depending on the programming of the IMS T9000.</td>
</tr>
</tbody>
</table>

Table 1.2 Signal descriptions
1.4 Configuration and ID ROM

All HTRAMs have an ID ROM which can be used to identify the HTRAM in an assembled system. The identification data format is defined in [1]. The identification data for the IMS B933 is shown in table 1.3. For details on how to access this data, please refer to [1].

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IdDataHeader</td>
<td>#44495448</td>
</tr>
<tr>
<td>IdDataVersion</td>
<td>#00000001</td>
</tr>
<tr>
<td>VendorString</td>
<td>SGS-THOMSON Microelectronics Limited</td>
</tr>
<tr>
<td>HTRAMtype</td>
<td>IMS B933-XXV</td>
</tr>
<tr>
<td>Serial Number</td>
<td>Unique per device</td>
</tr>
<tr>
<td>NumObjects</td>
<td>Subject to change</td>
</tr>
<tr>
<td>Objects</td>
<td>IMS_htram_NDL</td>
</tr>
<tr>
<td></td>
<td>IMS_htram_MEM</td>
</tr>
<tr>
<td></td>
<td>IMS_selftest_CODE</td>
</tr>
</tbody>
</table>

Note: HTRAM type include: XX – speed variant  
V – manufacturing variant

Table 1.3 ID ROM data

This ROM also contains a configuration program to initialize the PMI bank address, PMI strobe timing, and Cache subsystems of the IMS T9000. The configuration program can be caused to execute by issuing a Reboot command to the Control Up link of the IMS B933 during system initialization. The configuration program terminates by sending an Error message to the control process. The initialization of other IMS T9000 subsystems is system dependent, and should be made by a controlling process over the control up link.

1.5 Software Support

Toolsets are available for developing applications for single and multiprocessor systems in a variety of languages, including ANSI C, C++, and occam 2. The Toolsets contain a comprehensive collection of software development tools, such as:

- Optimizing compilers
- Tools for creating and loading multi-processor programs
- Extensive libraries
- Mixed language programming support
- Powerful debugging and profiling tools for single and multiprocessor systems.

The Toolsets are available for a variety of host systems, including Sun-4 and IBM PC. Please refer to the appropriate data sheets for full details on the IMS T9000 Toolset products, and development platform hardware requirements.
1.6 Summary of Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTRAM type</td>
<td>IMS B933</td>
<td></td>
</tr>
<tr>
<td>Processor type and speed</td>
<td>IMS T9000-xx</td>
<td>1</td>
</tr>
<tr>
<td>Memory size</td>
<td>16</td>
<td>Mbyte</td>
</tr>
<tr>
<td>Cache size</td>
<td>16</td>
<td>Kbyte</td>
</tr>
<tr>
<td>Memory organisation</td>
<td>Two 64-bit banks</td>
<td></td>
</tr>
<tr>
<td>Memory cycle time</td>
<td>2–5</td>
<td>Cycles</td>
</tr>
<tr>
<td>Cache Configuration</td>
<td>from local ROM</td>
<td></td>
</tr>
<tr>
<td>PMI Configuration</td>
<td>from local ROM</td>
<td></td>
</tr>
<tr>
<td>StartFromROM</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Test Access Port</td>
<td>inactive</td>
<td></td>
</tr>
<tr>
<td>Application specific pins</td>
<td>EventIn/EventOut</td>
<td></td>
</tr>
<tr>
<td>HTRAM size</td>
<td>2 (56mm 90mm)</td>
<td></td>
</tr>
<tr>
<td>Height class</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>34</td>
<td>g</td>
</tr>
</tbody>
</table>

Notes:

1  Note that XX denotes processor speed variation

2  Dependent upon the type of memory access being performed

Table 1.4 Specification

1.6.1 Operating Ranges

Functionality is not guaranteed outside the Operating Ranges. Operation beyond the Operating Ranges is not recommended and may affect device reliability.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>0</td>
<td>50</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Airflow</td>
<td>TBD</td>
<td>2</td>
<td>m/s</td>
<td></td>
</tr>
<tr>
<td>V5V0</td>
<td>4.75</td>
<td>5.25</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Input Voltage (any input)</td>
<td>0</td>
<td>V5V0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Power consumption (V5V0)</td>
<td>5</td>
<td>TBD</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>Power consumption (V3V3)</td>
<td>n/a</td>
<td>TBD</td>
<td>W</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.5 Operating Ranges
1.6.2 Absolute Maximum Ratings

This is a stress rating only and functional operation of the HTRAM at these, or any other conditions beyond the operating range is not implied. Stresses beyond the Absolute Maximum Ratings may cause permanent damage.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>0</td>
<td>70</td>
<td>°C</td>
</tr>
<tr>
<td>V5V0 relative to GND</td>
<td>0</td>
<td>7.0</td>
<td>V</td>
</tr>
<tr>
<td>Voltage on any pin relative to GND</td>
<td>−0.5</td>
<td>V5V0+0.5</td>
<td>V</td>
</tr>
</tbody>
</table>

Table 1.6 Absolute Maximum Ratings

1.7 Ordering Information

Please contact your local sales office or distribution representative for ordering information.

<table>
<thead>
<tr>
<th>Description</th>
<th>Order Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>16Mbyte HTRAM</td>
<td>IMS B933–XX</td>
</tr>
</tbody>
</table>

Table 1.7 Ordering information

XX refers to processor speed variants. Consult your sales representative for details.

1.8 Field Support

INMOS products are supported worldwide through SGS-THOMSON Sales Offices and authorized distributors.

1.9 References

1. HTRAM Specification, INMOS Ltd 1994 (42 1567 01)


3. IMS Dx394 T9000 ANSI C Toolset datasheet, INMOS Ltd 1994

4. IMS Dx395 T9000 occam 2 Toolset datasheet, INMOS Ltd 1994

5. T9000 Brochure, INMOS Ltd 1993

6. The Transputer Development and IQ systems Databook INMOS Ltd (72 TRN 219 01)