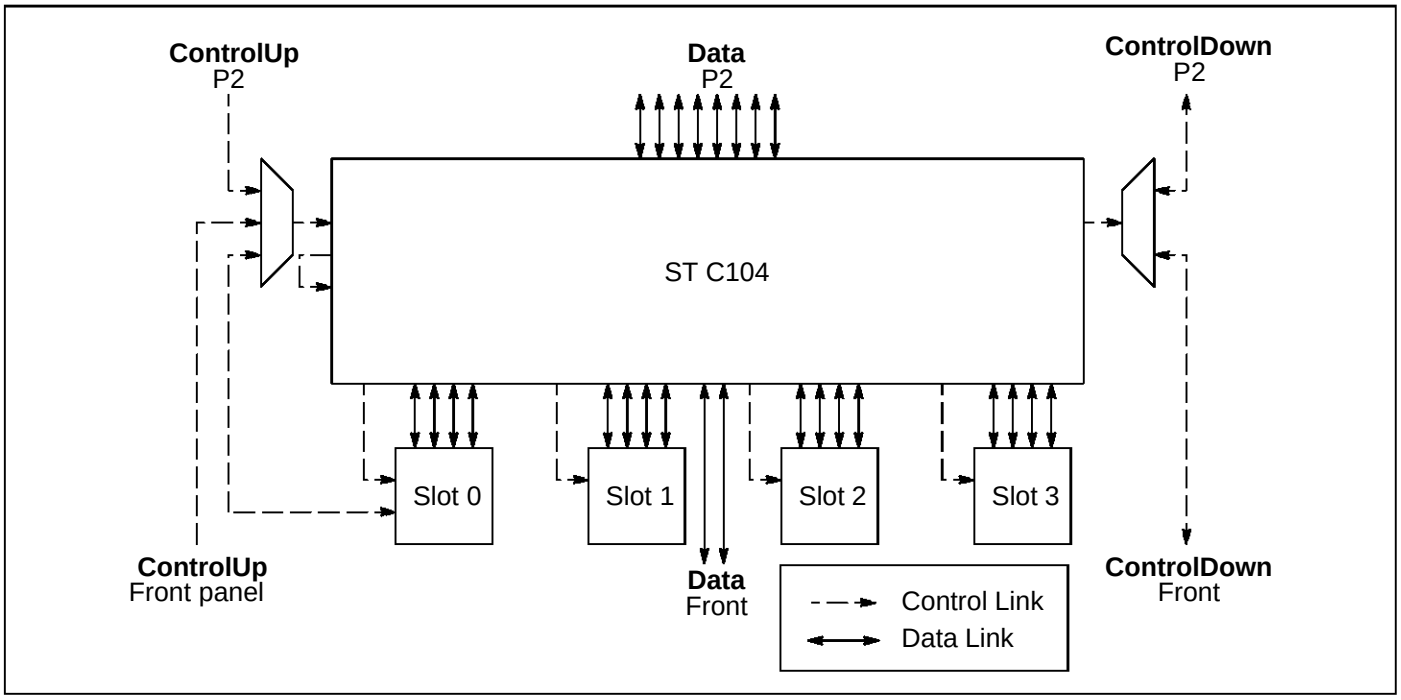
SGS-THOMSON MICROELECTRONICS

IMS B104

VME FORMAT HTRAM WITH DS–LINK ROUTING SWITCH



FEATURES

- VME compatible HTRAM motherboard
- 4, size 2, HTRAM slots to expand development systems for multiprocessor applications
- Control and data link routing using ST C104 device
- Differentially buffered front panel sockets for control and data links: compatible with INMOS development systems hardware
- Eight DS data links available via P2 backplane connector make it easy to use several boards to build larger systems
- Easy to connect to host computer interface board or network interface board
- Compatible with INMOS development systems hardware and software

DESCRIPTION

The IMS B104 is a VME format HTRAM motherboard. There are four HTRAM slots on the motherboard allowing up to four size 2 HTRAMs to be inserted. All DS data and Control links are connected via the ST C104 router, giving great flexibility of configuration and performance in IMS T9000 networks.

The IMS B104 is designed for use as part of a development system for parallel processing applications, or as part of a systems product.

A variety of off-board connections for control and data links make it easy to connect the IMS B104 to a host computer interface or to construct larger systems.

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1.1 IMS B104 specification

The IMS B104 is a 6U VME format HTRAM motherboard. There are four logical HTRAM slots on the motherboard allowing up to four size 2 HTRAMs to be inserted. All DS data and control links are connected via the ST C104 router, giving unparalelled flexibility in configuration and performance in IMS T9000 networks. The **ControlUp** DS-Link for the board is selected from either the front panel for external control, from the backplane or from slot 0 **ControlDown**. Similarly **ControlDown** for the motherboard can be accessed through the front panel or through the backplane.

Although totally compatible with standard VME backplanes and enclosures, the IMS B104 requires only appropriate power connections from the backplane and does not participate in any VME bus protocols or transactions.

The physical layout of the IMS B104 is shown in figure 1.1. There are eight physical HTRAM sockets on board, configured as four logical size 2 slots. The control link switching allows part population of these slots, and allows fault tolerant systems to be constructed.

Up to four size 2 HTRAMs, two size 4 HTRAMs, one size 8 HTRAM, or a mixture of size 2 and size 4 HTRAMs can be installed on the IMS B104.

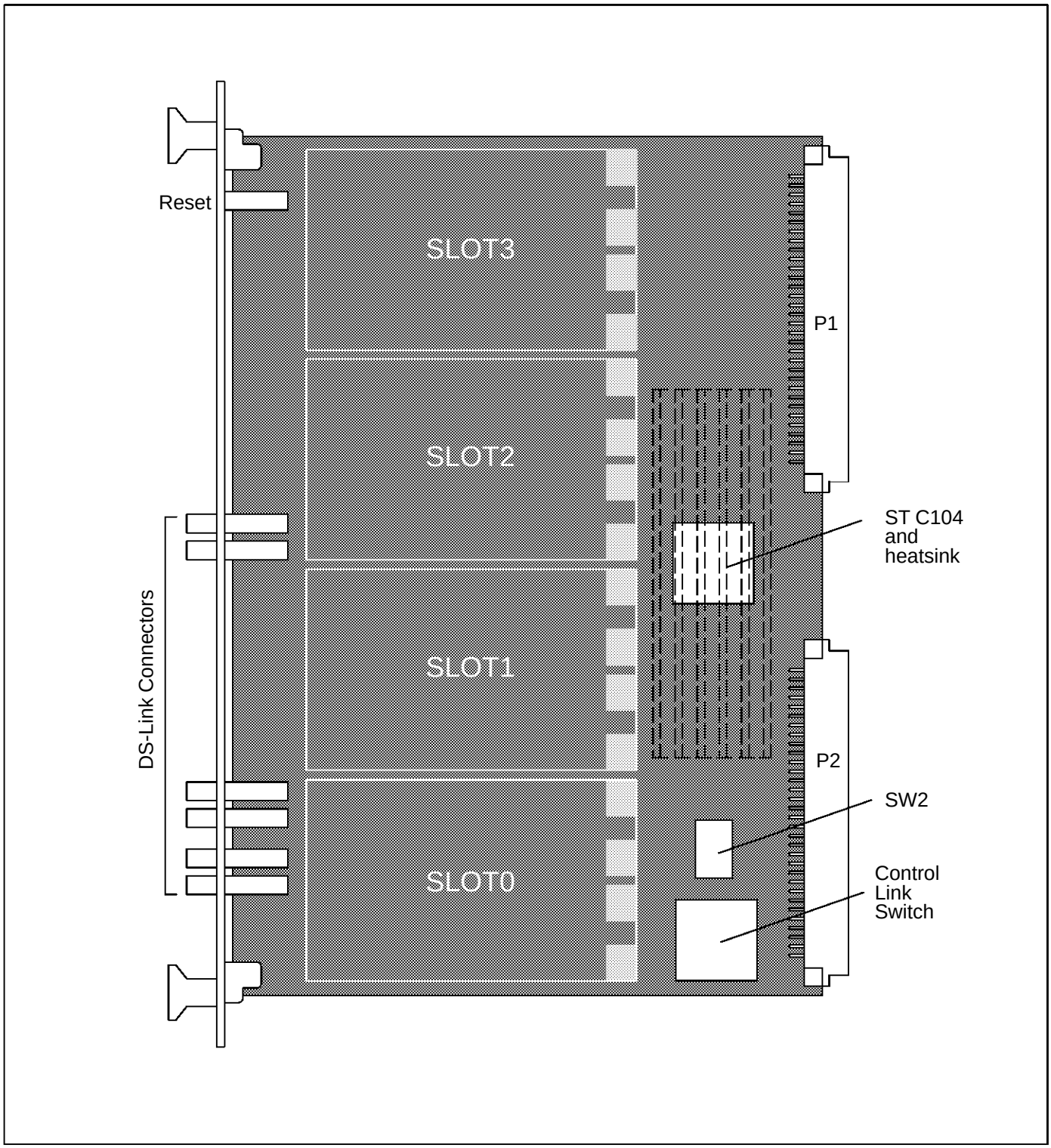

Figure 1.1 IMS B104

1.1.1 ST C104 and partitioning

The ST C104 is a 32-port dynamic message router: a device (such as an HTRAM) connected to one of its ports can communicate with a device connected to any one of its other ports (unless the ST C104 is partitioned – see below and [6]).

The ST C104 is referred to as a dynamic message router because, when a message arrives on one of its ports, it is routed automatically to the correct destination – there are no fixed paths.

The ST C104 on the IMS B104 must be used in a partitioned[1] mode to maintain strict separation between the control and data link networks. Partitioning allows the single ST C104 on the IMS B104 to safely implement message routing for both the control and data link networks – without any possibility of an application corrupting the system configuration. For more information on the ST C104 refer to [6].

1.1.2 Control link network

After a system of HTRAMs is reset it must be *configured*, and can then be loaded with an application program. This is done by means of a network of *Control Links*, separate from the data link network.

Each HTRAM has a **ControlUp** link connection. On the IMS B104, the **ControlUp** links from all of the HTRAMs are connected to the ST C104 link switch as shown in figure 1.2. This provides a tree-like connection from the **ControlUp** connection of the IMS B104 to each HTRAM, shown in schematic form in figure 1.1.

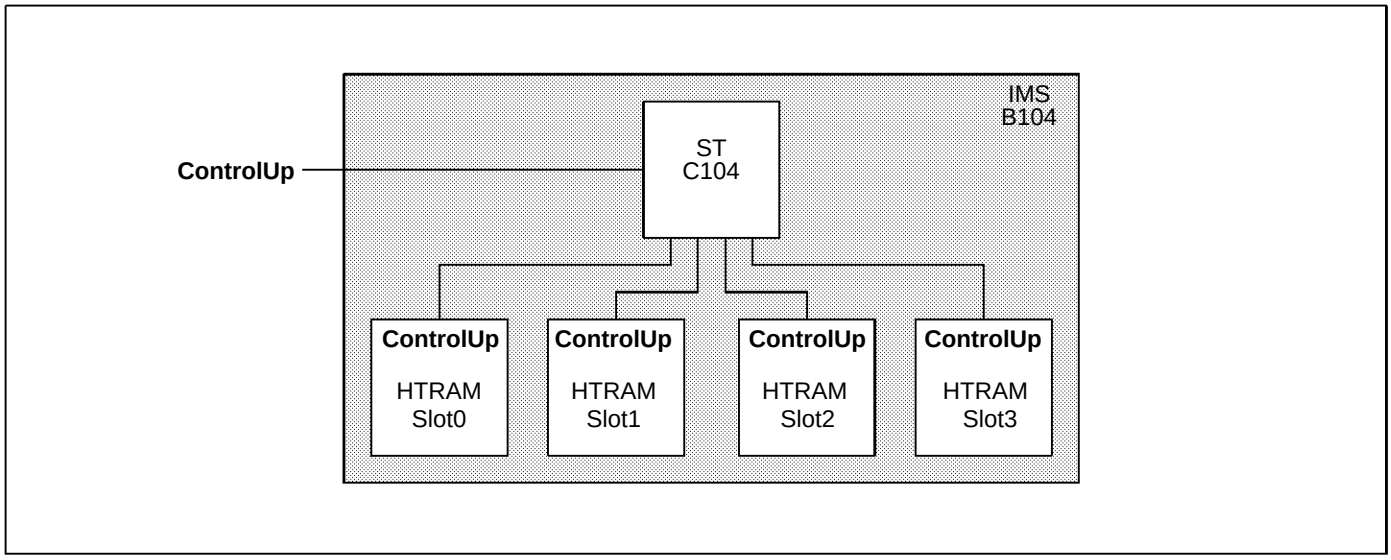

Figure 1.2 HTRAM to ST C104 connection

1 When the ST C104 is configured it can be ‘partitioned’ to operate as two or more separate routers. Messages from devices connected to one partition will then not be routed to devices connected to another partition

This means that a controlling system connected to **ControlUp** of the IMS B104 is able to send control messages to, and monitor each HTRAM separately, regardless of whether the other HTRAM slots are populated. It is also more fault-tolerant than a daisy-chained control link connection — if one HTRAM fails, the others can still be reached.

A switch (SW2) allows the source of **ControlUp** for the board to be selected between the front panel, the P2 backplane connector or slot 0 of the board itself. **ControlDown** can also be selected (by a switch) to appear either at the front panel connector or the P2 backplane connector. The appropriate settings of SW2 are shown in figure 1.3 and table 1.1.

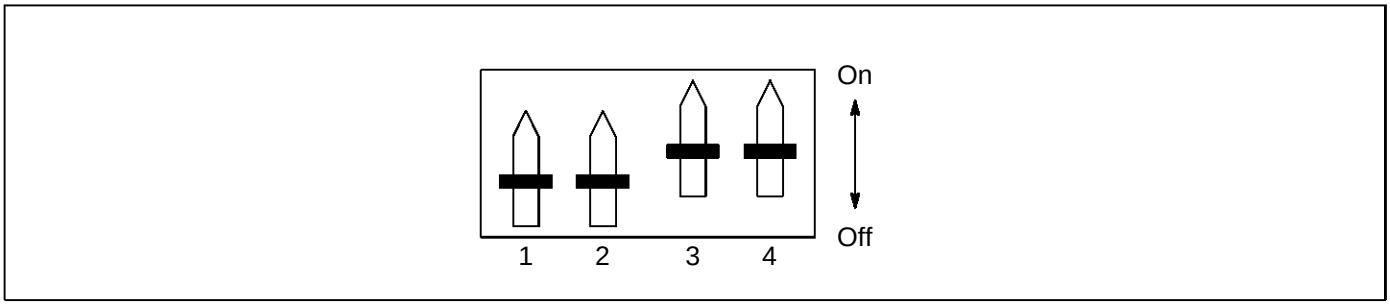

Figure 1.3 Switch SW2

SW2:1	SW2:2	Source for ST C104 Control Link Up
ON	ON	**ControlUp** from DS-Link connectors on front panel
ON	OFF	**ControlDown** from Slot 0
OFF	ON	**ControlUp** from VME_P2 backplane
OFF	OFF	Not valid

SW2:3	Destination of ST C104 Control Link Down (Link 30)
ON	**ControlDown** to VME_P2 backplane
OFF	**ControlDown** to DS-Link connectors on front panel

Note: SW2:4 has no effect on control routing

Table 1.1 SW2 Settings

Note:
Due to the switching arrangement of the control links on the IMS B104, it is not possible to run the T9000 control network reliably at speeds of greater than 50Mbit/s. This restriction should be reflected in the Network Description Language files for the system.

1.1.3 Data link network

The four data links from each HTRAM slot are connected to the ST C104 as shown in figure 1.2.

Thus an HTRAM on the IMS B104 can communicate with any other HTRAM on the same IMS B104, or on another board via the P2 and front panel connectors. The ST C104 provides a very flexible interconnection between HTRAMs on the same motherboard or between HTRAMs on different motherboards in a multiboard system.

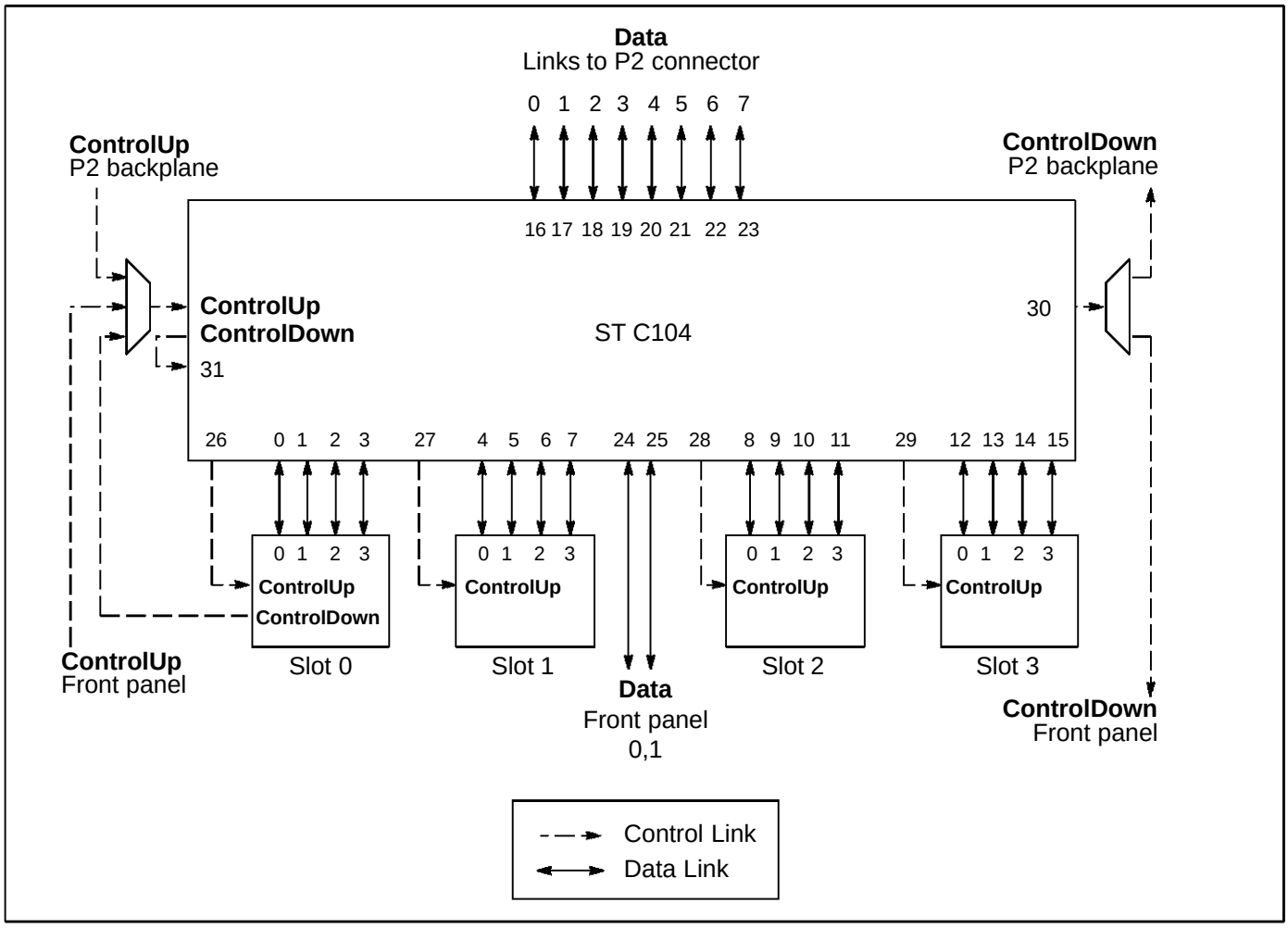

Figure 1.4 Control and data link connections via the ST C104

1.1.4 Configuring and controlling the IMS B104

The ST C104 on the IMS B104 must be configured before an application can be loaded and run. This is done automatically by INMOS software development tools. However, the tools require a description of the IMS B104 and any HTRAMs fitted, in the form of an NDL file. This describes the system using a simple ‘Network Description Language’.

An example of an NDL file describing a 4 HTRAM IMS B104 system is shown in section 1.1.5.

1.1.5 Example software description of HTRAM network (NDL file)

```
#INCLUDE ”stdndl.inc”

CONTROLPORT host :
HOST IS host[data] :
CONTROL IS host[control] :

ARC HostLink :
[3]NODE Node :
NODE RootNode :
NODE Switch :
NODE SwitchCONTROL :
NODE SwitchDATA :
NETWORK
  DO
    -- set default attributes
    SET DEFAULT (link.speed.multiply  := 10)
    SET DEFAULT (link.speed.divide    := [1])
    SET DEFAULT (control.speed.divide := [8])

    -- set device attributes for root node
    SET RootNode (type             := ”T9000”)
    SET RootNode (root             := TRUE)
    SET RootNode (local.rom        := FALSE)
    SET RootNode (pmi.config.inrom := FALSE)
    SET RootNode (cachesize        := 16)
    SET RootNode (memconfig        := RamMemoryFile)
    SET RootNode (memory           := RamMemoryRegions)

    -- set device attributes for reset of network
    DO i = 0 FOR SIZE Node
      DO
        SET Node[i] (type             := ”T9000”)
        SET Node[i] (local.rom        := FALSE)
        SET Node[i] (pmi.config.inrom := FALSE)
        SET Node[i] (cachesize        := 16)
        SET Node[i] (memconfig        := RamMemoryFile)
        SET Node[i] (memory           := RamMemoryRegions)

    -- set device attributes for switch
    SET Switch (type := ”C104”)

    SET Switch (link.speed.multiply := 20) -- 2x default to get desired speed due
to bug

    SET SwitchCONTROL (type := ”C104PARTITION”)
    SET SwitchCONTROL (node := Switch)
    SET SwitchCONTROL (links := [[26, 31]])

    SET SwitchDATA (type := ”C104PARTITION”)
    SET SwitchDATA (node := Switch)
    SET SwitchDATA (links := [[0, 15], [16, 23], [24, 25]])

    #INCLUDE ”b104-4.lbl” -- labelling generated automatically by indl

    -- connect control network
    CONNECT Switch[control.up] TO CONTROL
    CONNECT Switch[control.down] TO SwitchCONTROL[link][31]

    CONNECT SwitchCONTROL[link][26] TO RootNode[control.up]

    DO i = 0 FOR (SIZE Node)
      CONNECT SwitchCONTROL[link][26 + (i + 1)] TO Node[i][control.up]
```

```
      -- connect data network
      CONNECT SwitchDATA[link][24] TO HOST WITH HostLink

      DO j = 0 FOR 4
        CONNECT SwitchDATA[link][0 + j] TO RootNode[link][j]

      DO i = 0 FOR (SIZE Node)
        DO j = 0 FOR 4
          CONNECT SwitchDATA[link][0 + (((i + 1) * 4) + j)] TO Node[i][link][j]
:
```

1.1.6 Front panel connections

Control links, data links and reset connections are all available from connectors on the front panel. This allows the user to connect the IMS B104 to an interface in a host computer for loading code and data and also to connect to other boards when building larger systems.

Two data links, and the **ControlUp** and **ControlDown** connections for the board are differentially buffered and can be accessed via connectors on the front panel. An additional pair of connectors are provided for a hardware reset signal via a similar differential buffering scheme. The front panel layout is shown in figure 1.5.

Full details on the use of external DS-Link connections between separate pieces of equipment and the host reset connection standard are defined in [7].

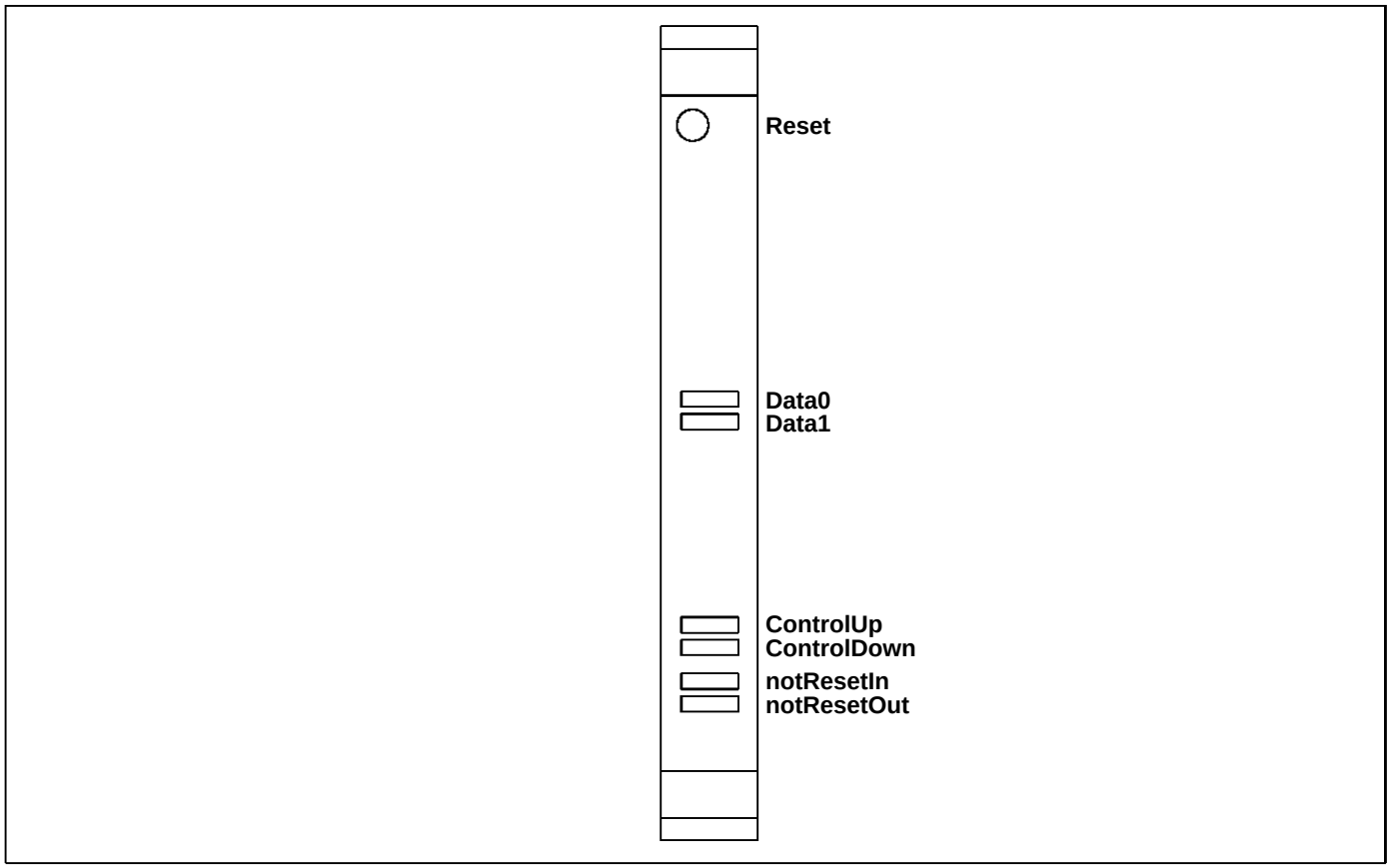

Figure 1.5 IMS B104 front panel

1.1.7 Connecting the IMS B104 to a host interface

The IMS B104 can be connected to a host computer interface, or network interface board, and used as part of a software development system.

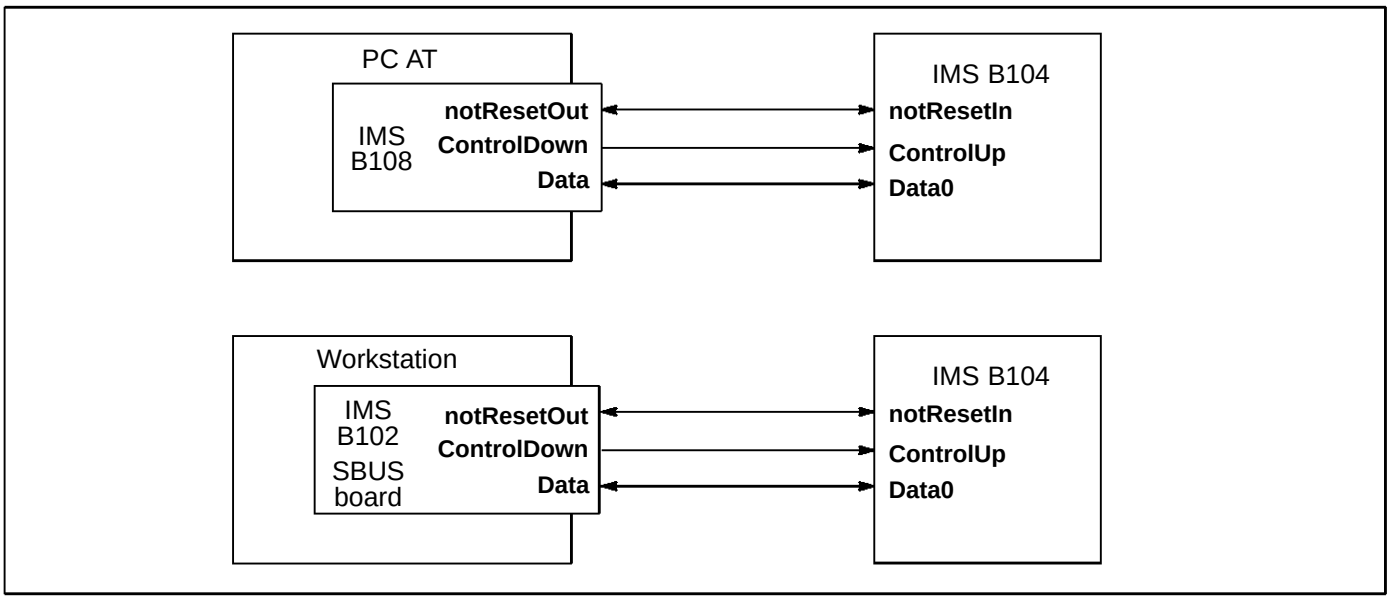

Figure 1.6 Connection to a host interface

When connecting to a host interface board, such as an SBUS or PC add-in board, this is most easily done using the connectors on the IMS B104 front panel (rather than the P2 connector). The IMS B104 must be configured to use the front panel connections. Three simple connections should be made as follows:

Host board	IMS B104
notResetOut	notResetIn
ControlDown	ControlUp
Data	Data0

Table 1.2

This allows the host board to reset and control the IMS B104 so that development system software running on the host computer can load, run and debug programs on HTRAMs on the IMS B104.

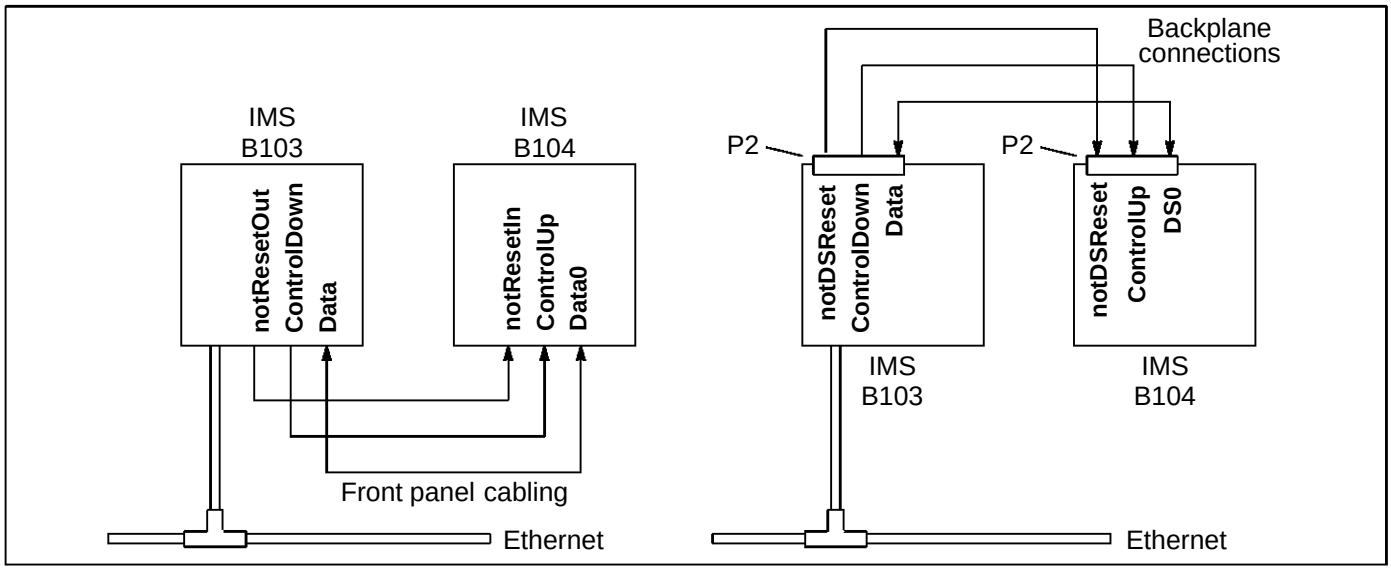

Figure 1.7 Connections to networks of interface boards

When connecting to a network interface board such as the IMS B103, the user has a choice of either: making the reset, control, and data link connections through the front panel connectors, or through the P2 connector of both boards (perhaps via a special backplane). In either case, the user must configure both boards to use the required connectors.

1.1.8 Building larger systems

Several IMS B104s can be connected together to build larger HTRAM systems:

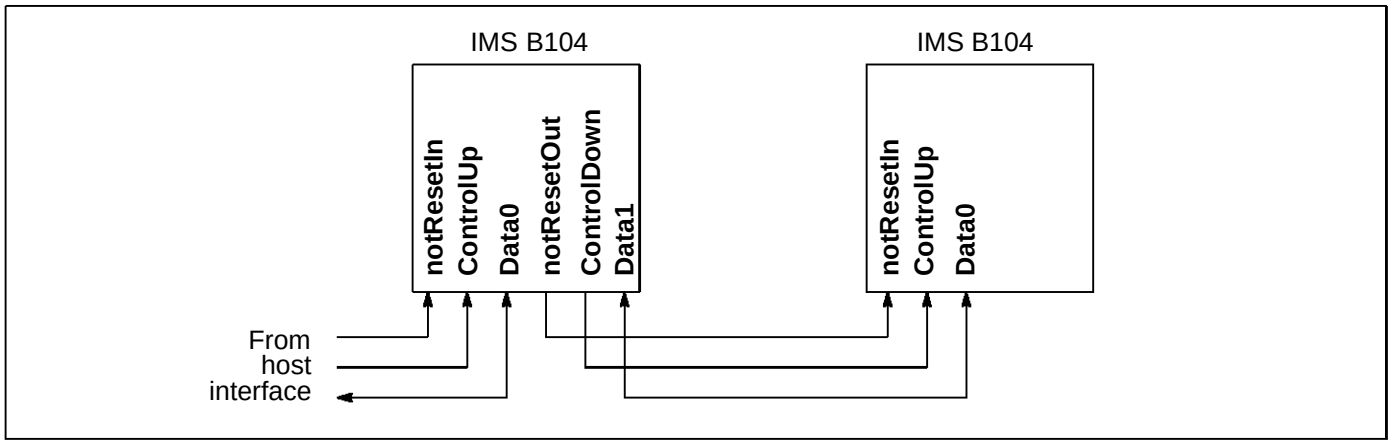

Figure 1.8

Connections between boards can be made either between the front panel connectors or through the P2 connectors. The boards must be configured to use the desired set of connections.

Simple systems using multiple B104s can be built using only front panel connections for data links. However, using the link connections on P2 allows more highly-connected networks to be built since more connections are available.

If connections are to be made through the P2 connectors, it is recommended that a controlled impedance (100Ω) backplane is used as the link signals are very high frequency, and therefore not suitable for connection with wire-wrap or similar techniques.

1.1.9 Installing HTRAMs

HTRAMs are installed as follows:

- Find the desired slot on the HTRAM motherboard
- Align the yellow triangle marked on the HTRAM PCB with the corresponding symbol on the HTRAM motherboard
- Insert the pins on the underside of the HTRAM into the sockets on the motherboard, and press home. (Take care to ensure that this is done with the correct alignment)
- Check that the fixing holes in the HTRAM are correctly aligned with the threaded posts on the motherboard
- Use M3 bolts, if required, to secure the HTRAM to the motherboard.

1.1.10 VMEbus

The IMS B104 does not have a VMEbus interface. Only VME ***SYSRESET** is used by the board. 'Jumpering' of the **IACK** and **BusGrant** VMEbus signals is provided. No other connections apart from power are made to the VMEbus backplane.

Pin	Row C	Row B	Row A
1			
2			
3			
4		***BG0IN**	
5		***BG0OUT**	
6		***BG1IN**	
7		***BG1OUT**	
8		***BG2IN**	
9	**GND**	***BG2OUT**	**GND**
10		***BG3IN**	
11		***BG3OUT**	**GND**
12	***SYSRESET**		
13			
14			
15			**GND**
16			
17			**GND**
18			
19			**GND**
20		**GND**	
21			*** IACKIN**
22			***IACKOUT**
23		**GND**	
24			
25			
26			
27			
28			
29			
30			
31	**+12V**		**–12V**
32	**+5V**	**+5V**	**+5V**

Note: All remaining pins are not connected

Figure 1.9 P1 connections

		C	B	A	
DS3	1	DIN	VCC	DOUT	DS4
	2	GND	GND	GND	
	3	SIN		SOUT	
	4	SOUT		SIN	
	5	GND		GND	
	6	DOUT		DIN	
DS2	7	DIN		DOUT	DS5
	8	GND		GND	
	9	SIN		SOUT	
	10	SOUT		SIN	
	11	GND		GND	
	12	DOUT	GND	DIN	
DS1	13	DIN	VCC	DOUT	DS6
	14	GND		GND	
	15	SIN		SOUT	
	16	SOUT		SIN	
	17	GND		GND	
	18	DOUT		DIN	
DS0	19	DIN		DOUT	DS7
	20	GND		GND	
	21	SIN		SOUT	
	22	SOUT	GND	SIN	
	23	GND		GND	
	24	DOUT		DIN	
ControlDown	25	DIN		DOUT	ControlUp
	26	SIN		SOUT	
	27	GND		GND	
	28	SOUT		SIN	
	29	DOUT		DIN	
	30	notDSRESET		RESERVED	
	31	VCC	GND	VCC	
	32	VCC	VCC	VCC	

Figure 1.10 P2 connector pinout

1.1.11 Reset

The IMS B104 supports several sources of reset for itself and for any HTRAMs mounted in its respective slot. The reset sources are:

- Power-on reset
- Front panel reset (from button)
- VME ***SYSRESET** (from backplane P1)
- **notDSRESET** (from backplane P2)
- Front panel Reset In connector.

notDSRESET can be used in conjunction with a special backplane to supply or receive reset services when used in a multiple board T9000 system environment. The function of **DSRESET** is two fold: either to supply **notDSRESET** to all T9000 boards connected on the special J2 backplane or to receive a reset from any other card that has asserted **notDSRESET** on the backplane.

In addition to the above the IMS B104 has connectors for external **notResetIn** and **notResetOut**, giving a host the ability to reset the IMS B104. This or any other reset, except ***SYSRESET**, performed upon the IMS B104 is propagated to **notResetOut**, allowing several IMS B104s to be reset from a single host. Further details on the **notResetIn** and **notResetOut** connections can be found in [7].

1.1.12 Power

The IMS B104 only requires a 5.0 Volt power supply, obtained through the VME P1 and P2 backplane connectors. The IMS B104 does not require 3.3 Volts to operate and does not supply 3.3 V to any of the HTRAM slots.

When plugged into a standard VME J1/J2 backplane the maximum allowable power dissipation of the IMS B104 at 60°C is 36W from the 5V power supply. This may limit the number of HTRAMs which can be fitted. However, additional power connections have been allocated on the VME P2 user defined pins and, when these are used in conjunction with a customised VME P2 backplane, the maximum allowable power dissipation is increased to 60W – allowing the IMS B104 to be fully populated with HTRAMs.

1.1.13 Mechanical details

The IMS B104 is designed in accordance with the VMEbus standard. The overall size of the board is 160mm by 233.35mm with a board thickness of 1.6mm. The supplied front panel width is 4HP, compatible with a board-to-board pitch in a card cage of 0.8''. Use of the IMS B104 with HTRAMs of height classes A and B results in an assembly that meets the VMEbus specification for a single width board. Note the front panel is required when operating the IMS B104 in a card cage, for mechanical rigidity, to maintain correct air flow for cooling and to provide EMC shielding.

1.1.14 Cooling requirements

Adequate forced air cooling must be provided to ensure that components and HTRAMS are kept within their operating temperature. Failure to do so may affect the reliability of the motherboard and associated HTRAMS. Air flow should run parallel to the board surface and parallel to the front panel.

The cooling airflow requirements for the IMS B104 itself are defined in table 1.3. The datasheets for individual HTRAMs should be consulted to determine the system cooling requirements.

1.1.15 Operating Ranges

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

Parameter	Min.	Typ.	Max.	Unit	Notes
Operating temperature	0		50	°C	
Airflow	0.5			m/s	1
+5V DC	4.875		5.25	V	
Power consumption (+5V DC)			13	W	2,3

1 It should be noted that adequate cooling airflow must be provided to maintain any fitted HTRAMs within their rated operating temperature.

2 Value shown is with **no** HTRAMs fitted.

3 All ST C104 links at 100Mbits/s.

Table 1.3 Operating Ranges

1.1.16 Absolute maximum ratings

Functionality at or above these limits is not implied. Stresses beyond the Absolute Maximum Ratings may cause permanent damage.

Parameter	Min.	Max.	Unit
Storage temperature	0	70	°C
Supply Voltage	0	7.0	V

Table 1.4 Absolute Maximum Ratings

1.2 Ordering information

Description	Order Number
VME format HTRAM motherboard with DS-Link routing	IMS B104-1

Table 1.5 Ordering information

The board is supplied with a copy of this datasheet. No cables or connectors are included, but these are available separately.

1.3 Field Support

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

1.4 References

1 *T9000 Transputer Hardware Reference Manual,* INMOS Ltd 1993

2 *HTRAM specification*, INMOS Ltd 1994

3 *T9000 Brochure,* INMOS Ltd 1993

4 *IEEE Standard for a Versatile Backplane Bus: VMEbus*, IEEE 1987

5 *IMS Dx394 T9000 ANSI C Toolset Datasheet,* INMOS Ltd, 1994
IMS Dx395 T9000 occam 2 Toolset datasheet, INMOS Ltd, 1994

6 *ST C104 Asynchronous Packet Switch Datasheet*, INMOS Ltd 1994, (42 1470 04)

7 *DS–Link Connector Standards and Cabling*, INMOS Ltd 1994, (42 1634 00)