IMS B017
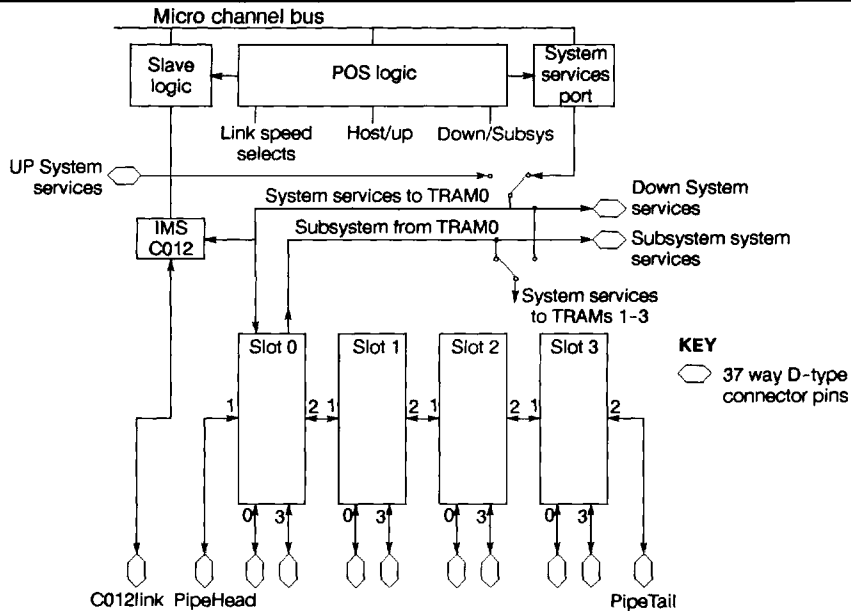## IBM PS/2 Motherboard

inmos®

Engineering Data

FEATURES

- IBM PS/2 Micro Channel bus format board
- Four TRAM slots accomodating size 1 or size 2 transputer modules
- Provides a gateway to larger transputer networks from MCA bus based systems
- Link adapter interface to the MCA bus

GENERAL DESCRIPTION

The IMS B017 is a TRAnsputer Module (TRAM) motherboard designed to plug into a Micro Channel bus. The board has four TRAM slots and an interface to the Micro Channel bus.

The Micro Channel bus interface provides a single INMOS serial link and a system services port. Software running on the Micro Channel based system can reset, analyse, communicate with, and monitor the error flag of a transputer network on or connected to the IMS B017. Data can be transferred to and from the link interface using programmed I/O.

The IMS B017 TRAM slots are connected into a pipeline using two of the four links from each slot. The remaining two links from each slot, and the pipeline head and tail links are connected to a 37 way D-type connector. This allows the links from each slot to be connected to each other, or to the links from other motherboards, to form transputer networks other than a pipeline.

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38.1   IMS B017 engineering data

38.1.1   Description

TRAM motherboards provide a number of slots into which TRAMs can be plugged. Each of these slots pro-
vides the necessary connections to power, clock, reset signals and the INMOS links. The motherboard
provides a method of connecting TRAMs together and may also include special circuitry to provide an inter-
face to something other than a transputer system. In the case of the IMS B017 this is an interface to the
Micro Channel bus. These motherboards can be used to build networks of transputers of arbitrary size and
are supported by a range of software products from INMOS.

The IMS B017 has four TRAM slots and is able to accommodate both size 1 and size 2 TRAMs. The interface
to the Micro Channel bus includes a single INMOS link and a system services port. A link adapter is used
to convert from the serial INMOS link format to parallel Micro Channel bus format and vice versa. Software
running on the Micro Channel system can communicate with, analyse, reset and monitor the error flag of
a transputer network on or connected to the IMS B017. Data can be transferred to and from the link interface
using programmed I/O. Interrupts can be generated on link events or on error being asserted, freeing the
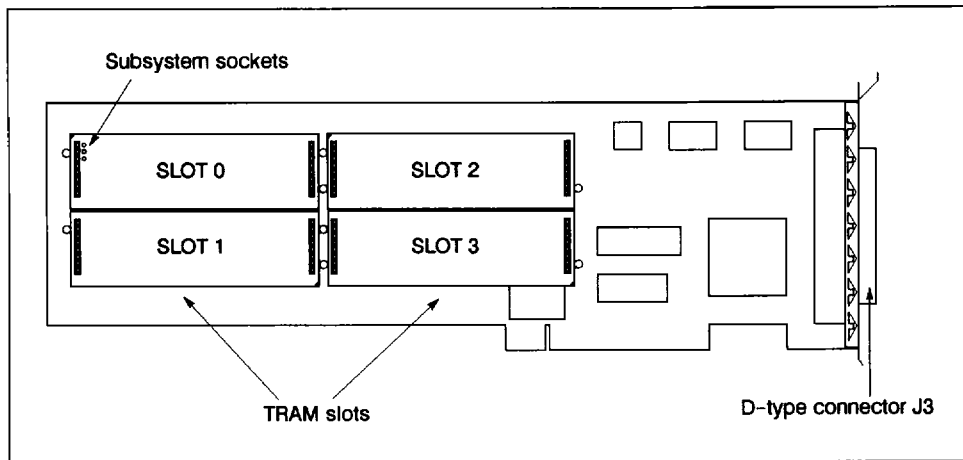processor from polling the IMS B017 to detect these events.

Figure 38.1   Top view of the IMS B017

38.1.2   TRAM Slots

The IMS B017 has four locations for TRAMs to be plugged into, called TRAM slots. Each slot can accommo-
date a size 1 TRAM. Size 2 TRAMs can be fitted, occupying two slots. Each of the four slots on the IMS B017
has connections for four INMOS links. Links are numbered 0 to 3 and slots, in the case of the IMS B017,
are numbered 0 to 3.

The four slots on the IMS B017 are connected into a pipeline, using links 1 and 2 from each slot. So slot
0, link 2 is connected to slot 1, link 1; slot 1, link 2 is connected to slot 2, link 1 and so on.

In some cases not all of the slots of the IMS B017 will have TRAMs fitted. Even if they are covered by a
TRAM they may not be connected to it electrically. In this case to maintain the pipeline connection *pipe-
jumpers* must be used, plugged into each un-occupied slot, or the TRAM covering that slot. These pipe-
jumpers connect link 1 to link 2 of the same slot. They are plugged into the pin 1 end of the TRAM slot, with
the triangle marked on the corner. The pipejumpers have a mark on them which must be pointing towards
the pin 1 marker triangle.

The two unconnected links, slot 0, link 1 and slot 3, link 2, at the ends of the slot pipeline are referred to
as *pipehead* (slot 0, link 1) and *pipetail* (slot 3, link 2). *Pipetail*, *pipehead*, links 0 and 3 from each slot, and
the link from the IMS C012 are taken out to the 37 way D-type connector, J3, at the back of the board.

By connecting links together on J3, networks of transputers can be set up on the IMS B017. These networks can also extend onto multiple IMS B017s, or onto other transputer boards, by connecting the links on J3 to the links coming out to an external connector on the other boards.

The INMOS link connections between the slots, J3, and the C012Link from the IMS C012 are shown in figure 38.2.
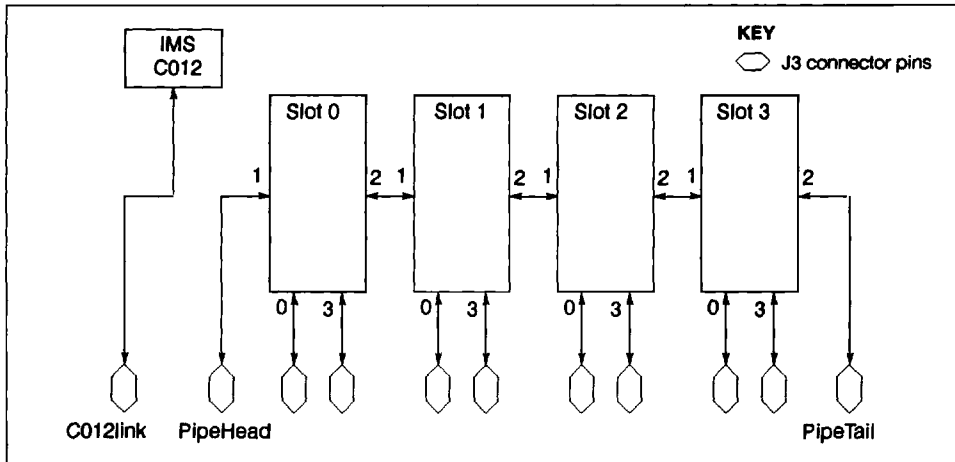

Figure 38.2   INMOS link connections on the IMS B017

38.1.3   System Services

On all INMOS board products the term 'system services' refers to the collection of the reset, analyse and error signals. On the IMS B017 the system services for the TRAM in slot 0 can be connected to either the UP system services from another board or the system services controlled by the PS/2 bus interface. System services for other TRAMs can be connected to the same source as TRAM 0 or to the subsystem port of TRAM 0. As shown on the block diagram the Down and Subsystem services are bought out to the 37 way D-type connector, allowing this hierachy to be extended to multi board systems.

38.1.4   Micro Channel bus interface

The Micro Channel (MC) bus has become a de-facto standard after appearing in the IBM Personal System/2 (PS/2) machines. Since then a number of other machines have been released that incorporate the Micro Channel bus. The IMS B017 has been designed to work when plugged into a Micro Channel bus slot in a PS/2 but should also operate correctly in other Micro Channel based systems.

The bus interface on the IMS B017 performs four functions :

1   Providing the Programmable Option Select (POS) registers used by the PS/2 setup utilities in controlling the configuration of the IMS B017.

2   Converting the 8 bit parallel transfers on the Micro Channel bus to serial INMOS link transfers, and vice versa.

3   Providing a system services port.

4   Generating interrupts on events on the link interface or when transputer error has been asserted.
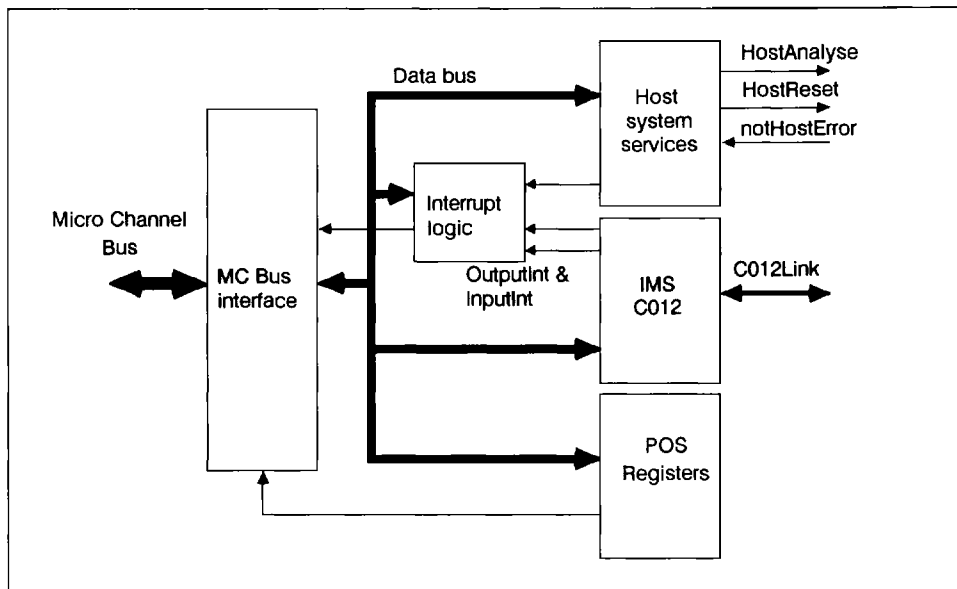
Figure 38.3   Micro Channel bus interface block diagram

A block diagram of the Micro Channel bus interface is given in figure 38.3. To enable control of the bus interface functions from software running on the Micro Channel based system, the MC bus interface has a number of registers mapped into the I/O address space of the Micro Channel bus (separate from the memory address space). Details of these are given in [1].

Link Interface

An IMS C012 link adaptor is used as the basis of the link interface on the IMS B017. Detailed information on this device can be found in [2]. This device performs the parallel data to serial INMOS link conversions in both directions in a similar fashion to a UART device used on an RS232 interface. The link coming from the link adaptor is labelled C012Link in figure 38.3. The IMS C012 has four registers which can be written to or read by the Micro Channel bus, more information is given in [1].

Host system services

A port is provided by the Micro Channel bus interface to allow software on the MC based system to provide 'system services' to transputers connected to the IMS B017, either as TRAMs plugged into the board or transputers on other boards. The port appears as two registers in the I/O map of the Micro Channel. In addition an extra register, the *Error Status/Interrupt Control register* allows the state of the notError signals from each of the TRAM slots to be monitored. The system services port and the error status register function is described in [1].

Interrupts

The IMS B017 can generate an interrupt on the Micro Channel bus when one of the following events occurs:

- notHostError is asserted

- The OutputInt signal from the IMS C012 is asserted

- The InputInt signal from the IMS C012 is asserted

Generation of interrupts on each of these events is controlled by two interrupt enable bits in the Output Status register and Input Status register, and bit 0 of the *Error Status/Interrupt Control register*. Setting a bit to one in one of these registers enables interrupts on the event corresponding to that bit.

38.1.5   Configuration

Configuration of the IMS B017 is carried out by installing any TRAMs required on the board, selecting options by using the system configuration utilities supplied by IBM with the PS/2, and by making connections to the 37 way D-type, J3, on the back of the board. Further information on setting the IMS B017 configuration is given in [1].

38.1.6   Specifications

Mechanical Details

The IMS B017 is a PS/2 Micro Channel adaptor format board and is nominally 322mm by 108mm by 21mm overall. The PCB thickness is nominally 1.6 mm. The board includes a metal PS/2 I/O bracket through which the 37 way D-type J3 passes. This bracket serves two functions, to ensure the board is held rigidly at the edge connector end and to maintain the integrity of the shielding of the PS/2. To enable the bracket to perform these functions it must be securely fixed to the backpanel metalwork of the PS/2 by a screw on the outside of the case.

The IMS B017 weighs 150g without any TRAMs fitted.

Thermal Information

The IMS B017 with no TRAMs installed will dissipate not more than 2W.

When installing the IMS B017 in a PS/2 consideration needs to be given to cooling airflow not only across the IMS B017 itself but also any TRAMs fitted to it. It is the responsibility of the user to ensure that the operating environment limits for the IMS B017 listed in table 38.1 are not exceeded. This will not occur as long as there are not a large number of high dissipation boards also present in the PS/2.

To ensure good airflow in the PS/2 the blank backpanels should be present in any slots that are empty.

Operating and Storage Environments

The IMS B017 is designed to be operated and stored in the environments in table 38.1.

Parameter	Operating	Storage
Ambient air temperature	0 to +50°C	–55 to +85°C
Relative Humidity	95% non condensing	95% non condensing
Thermal Shock	<0.08°C/s	<0.15°C/s
Altitude	–300 to +3000m	–300 to +16000m

Table 38.1   Environmental details

Electrical Details

The IMS B017 only requires a +5 V dc supply which must be between 4.75V and 5.25V with less than 50mV peak-peak noise and ripple between DC and 10MHz. The IMS B017 does not incorporate protection against incorrect power supplies. Major damage will result from connecting a supply to the board which is outside its power supply range. The IMS B017 with no TRAMs installed will draw a current of no more than 400mA.

The maximum power consumption of the IMS B017 is 2W. The power loading specification of the Micro Channel bus should be adhered to when considering which TRAMs are to be fitted.

38.1.7   Memory Map

Addresses	Register
Board base address + #00	Link adaptor input data register

Board base address + #01	Link adaptor output data register
Board base address + #02	Link adaptor input status register
Board base address + #03	Link adaptor output status register
Board base address + #10	Reset/Error register
Board base address + #11	Analyse register
Board base address + #12	Error status/Interrupt control register

1   Board base address can be set to #0150 or #0200

Table 38.2   IMS B017 memory map

38.1.8 Connector Pin Assignments

J3 pin assignments

Pin	Signal		Pin	Signal
			1	GND
20	notUpReset		2	notUpAnalyse
21	notUpError		3	Slot0Out0
22	Slot0In0		4	Slot0Out3
23	Slot0In3		5	GND
24	Slot1Out0		6	Slot1In0
25	Slot1Out3		7	Slot1In3
26	Slot2Out0		8	Slot2In0
27	GND		9	Slot2Out3
28	Slot2In3		10	Slot3Out0
29	Slot3In0		11	Slot3Out3
30	Slot3In3		12	GND
31	C012LinkOut		13	C012LinkIn
32	PipeHeadOut		14	PipeHeadIn
33	notSubSystemReset		15	notSubSystemAnalyse
34	notSubSystemError		16	PipeTailOut
35	PipeTailIn		17	NC
36	NC		18	notDownReset
37	notDownAnalyse		19	notDownError

Figure 38.4   Pin assignments for the 37 way D-type connector, J3

38.1.9 References

1   IMS B017 User Guide and Reference Manual, Inmos Limited, 1990

2   The Transputer Databook, second edition, IMS C012 engineering data, Inmos Limited, 1990

3   *Personal System/2 Hardware Interface Technical Reference,*
International Business Machines Corporation, 1988.

38.1.10 Ordering Information

Description	Order number
IMS B017 IBM PS/2 Motherboard	IMS B017–1*
IMS S217:IMSB017 driver for PS/2	Included in IMSB017

Table 38.3   Ordering Information

*Includes IMS S217 driver for PS/2