Transputer FarmCard
Technical Manual

PERIHELION

Handbook for the Perihelion FarmCard F104

Issue 2 — July 1989

1   INSTALLATION

The Perihelion F104 FarmCard is a printed circuit board containing up to four INMOS Transputers and associated fast RAM. FarmCards can be installed in an Atari Transputer Workstation (ATW), in a Polyhedron cabinet, or in a user's own enclosure.

Installation in an Atari TransputerWorkstation

The Issue 3 ATW has provision for a vertical expansion plane to be plugged into the motherboard. Expansion cards fit horizontally into the expansion plane and are supported by moulded card guides. The Issue 4 ATW has three slots on its motherboard into which FarmCards can be plugged vertically.

The installation procedure is as follows:

1   Switch off the power to the ATW
2   Remove the cover of the ATW
3   Plug the expansion plane into the ATW motherboard if this is necessary
4   Plug the FarmCard into the expansion plane
5   Connect any links (including the diagnostic bus) required between the FarmCard and the ATW
6   Connect any links required to other FarmCards

Connector J11 on each FarmCard is provided for connection to a crossbar switch card via the backplane in the Polyhedron cabinet and ATW issue 4.

Installation in a Perihelion enclosure

1   Switch off the power to the enclosure
2   Remove the cover of the enclosure
3   Plug the FarmCard into the motherboard

4   Connect any links required to other FarmCards (if no crossbar is fitted)
5   Fit crossbar card if appropriate.

2   PRODUCT OVERVIEW

2.1   Key Features

- Up to 4 INMOS Transputers — T800, T425, or T414, clocked at 20 MHz
- 4 Mbytes DRAM — 1 Mbyte per node
- External memory interface in 4 cycles (200 ns)
- Powerful diagnostic bus; nodes can be independently reset or analysed
- Reset, Analyse and Activity LEDs
- Can be used with C004 crossbar switch or manually configured

2.2   Product description

Each Perihelion FarmCard contains a "farm" of INMOS Transputers, and each Transputer has its own dedicated RAM. The cards are designed to give expansion capability to any system which has a spare INMOS link interface. There is no inherent limit to the number of FarmCards that can be interconnected, and thus massive computing power can be obtained at very low cost. Several different FarmCards are available with differing processor types, numbers of processors, and memory sizes.

2.2.1   Processors

FarmCards can be supplied with either T800, T425, or T414 processors fitted. All processors are configured to run at 20MHz but the on-board wire links allow other speeds to be factory-selected.

2.2.2 Links

Each processor has four fast (20 Mbit/s) serial links to provide inter-processor communication. The link configuration is determined by the user and is subject to very few restrictions. Some links are pre-wired; the remaining un-committed links are available both on individual 5-pin link connectors for manual patching or on a 42-way edge connector allowing C004 crossbar switches to be used to route the links electronically.

2.2.3 Diagnostic aids

Each processor is provided with LEDs which indicate the status of the processor (RESET, ANALYSE and external RAM ACTIVITY) for diagnostic and debugging purposes.

Diagnostic LEDs

There is a set of three diagnostic LEDs associated with each processor. These are:

    RESET   (red)

— lights whenever the processor's reset pin is set high (for example, by control signals on the diagnostic bus).

    ANALYSE   (yellow)

— lights when ANALYSE is set high via the diagnostic bus.

    ACTIVITY   (green)

— lights whenever the processor reads or writes to external memory (including refresh cycles).

Reset switch

— resets all processors on the card and on all cards.

Each FarmCard incorporates a diagnostic bus. This allows any one or all processors to be reset or analysed remotely. This bus is connected both to a pin-header and to the 42-way link connector. The diagnostic bus is daisychained to further FarmCards in multi-card systems; however great the number of FarmCards in a system, each processor can be independently controlled.

2.2.4 Memory

The RAM associated with each processor is organised as a linear memory map with the processor on-chip memory overlaying the very bottom of the address range. External memory is accessed in four clock cycles. Normally, cards are supplied configured for 20 MHz operation, giving a 200 ns cycle-time.

2.2.5 Physical

The printed circuit board size is similar to IBM PC expansion cards, being 125 mm wide by 340 mm long. The cards fit the expansion plane of an Atari ATW; alternatively they can be fitted in a Polyhedron rack unit with integral mains power supply for stand-alone use.

2.2.2 F104 outline product specification

Type of processor	T800/T425/T414
Number of processors	4
RAM size per processor (Mbyte)	1
On-board link configuration	Square
Uncommitted links/processor	2
Processor clock frequency (MHz) (higher speeds available later)	20
Power consumption	12W typ.; 20W max at 5V
Card size	125 mm x 340 mm

3. MEMORY MAP

The Perihelion FarmCard has a very simple memory map since each node has access only to its own local RAM. There are no I/O locations.

Maps for the T800/T425 and the T414 are shown overleaf.

T800/T425 nodes
Machine Map

Byte address		Occam Word address
7FFF FFFC		3FFF FFFF
	Repeated RAM	
8010 0FFF		0004 03FF
	1 Mbyte External RAM	
8000 0FFF		0000 03FF
	Internal RAM	
8000 0000		0000 0000

T414 nodes
Machine Map

Byte address		Occam Word address
7FFF FFFC		3FFF FFFF
	Repeated RAM	
8010 07FF		0004 01FF
	1 Mbyte External RAM	
8000 07FF		0000 01FF
	Internal RAM	
8000 0000		0000 0000

4. LINKS

The connection of the links between the Transputers is shown below.
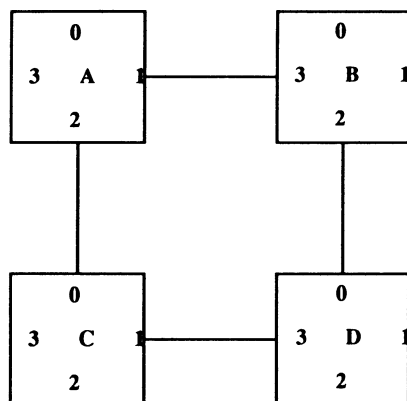
All spare links are bought out to the board edge and to the expansion connector (for connection to a crossbar board). See Appendix A for details of the connectors.

5. DIAGNOSTIC BUS

These signals for all Transputers can be controlled individually or collectively using two signals, namely FAST and SLOW. Control is achieved by setting a value on the SLOW line and then cycling FAST. The signals FAST and SLOW enter the FarmCard through J9 and also via the short edge connector from the ATW or Polyhedron bus. FarmCards can be daisychained together via the backplane bus, or manually by chaining J10 of one FarmCard to J9 of the next.

To control one transputer:

set SLOW low and generate X pulses on FAST
(where X is twice the maximum number of nodes in the system)
set SLOW high and pulse FAST once
set SLOW low and generate (2n-1) pulses on FAST
(where n is the node number)
set SLOW high and generate (FN) pulses on FAST
(where (FN) is given in the table below)
set SLOW low and generate 5 pulses on FAST
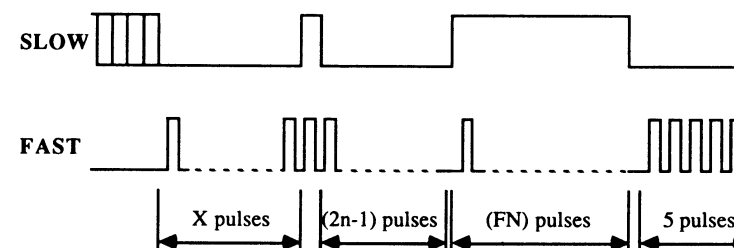
To control all Transputers:

set SLOW high and generate X pulses on FAST
(where X is twice the maximum number of nodes in the system)
set SLOW low and pulse FAST once
set SLOW high and generate (FN) pulses on FAST
(where (FN) is given in the table below)
set SLOW low and generate 5 pulses on FAST
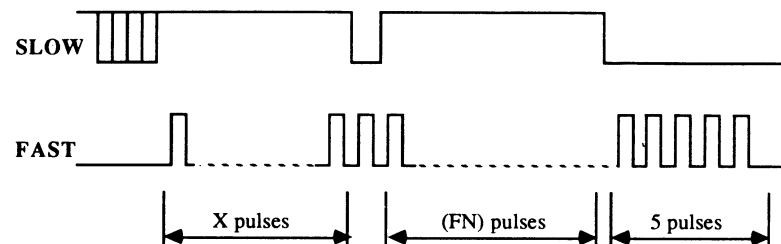
Functions

The value of FN referred to on the preceding page varies according to the desired function:

(FN)	Function
1	Clear RESET and ANALYSE
2	Clear RESET and set ANALYSE high
3	Set RESET high and clear ANALYSE
4	Set RESET and ANALYSE high

Transputer node numbering

In a diagnostic bus chain, the first node is number one for the purposes of diagnostic activity. Subsequent nodes, which may be Transputer or crossbar boards, are numbered 2, 3, 4, and so on, consecutively.

On an F104 FarmCard, the four nodes are in the order A, B, C, and D so that if an F104 is the first item in a diagnostic bus dasiychain, the numbering would run as follows: A=1, B=2, C=3, and D=4.

APPENDIX A

Connectors

Link	Connector
A0	J1
A3	J2
B0	J3
B1	J4
C2	J5
C3	J6
D1	J7
D2	J8

Link Connectors   J1-J 8   (5 way pin header)

Pin	Function
1	GND
2	NC
3	Link Out
4	Link In
5	GND

Diagnostic bus connector J9 (Bus in) (9 way pin header)

Pin	Function	
1	L	
2	GND	
3	FIN	(FAST)
4		(polarising key)
5	GSIN	(SLOW)
6	GRIN	Global reset (active low)
7	NC	
8	E	Daisychained error signal (output)
9	GND	

Diagnostic bus connector J10 (Bus out) (9 way pin header)

Pin	Function
1	LSLO
2	GND
3	FSTO
4	NC
5	GS
6	GRST
7	(polarising key)
8	BEI
9	GND

Expansion bus connector J11 (124 pin edge connector)

This connector is used purely for providing power and ground connections to the FarmCard.
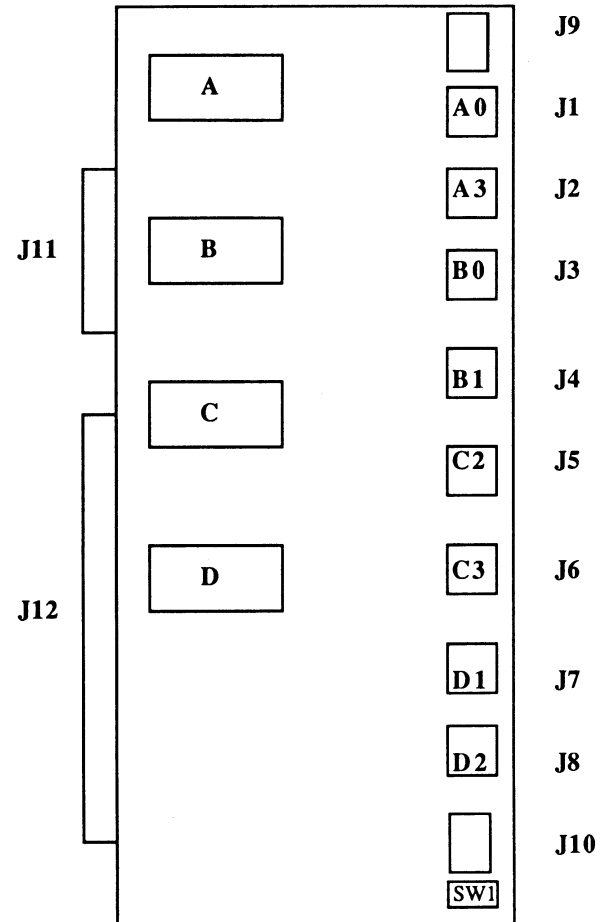
Solder side		*Parts side*	
+5V on pins:	3	+5V on pins:	5
	4		66
	39		101
	41		102
			103
GND on pins:	7	GND on pins:	68
	9		70
	10		72
	15		77
	20		82
	25		87
	30		92

Note that pin 105 (BUSGIN) is connected to pin 106 (BUSGOUT).

Combined link/diagnostic connector J12 (42 pin edge connector)

Solder side		Parts side	
Ground-----o	1	22 o-----	xdL2in
Ground-----o	2	23 o-----	xdL2out
Ground-----o	3	24 o-----	xdL1in
Ground-----o	4	25 o-----	xdL1out
Ground-----o	5	26 o-----	xcL3in
Ground-----o	6	27 o-----	xcL3out
Ground-----o	7	28 o-----	xcL2in
Ground-----o	8	29 o-----	xcL2out
Ground-----o	9	30 o-----	xbL1in
Ground-----o	10	31 o-----	xbL1out
Ground-----o	11	32 o-----	xbL0in
Ground-----o	12	33 o-----	xbL0out
Ground-----o	13	34 o-----	xaL0in
Ground-----o	14	35 o-----	xaL3out
Ground-----o	15	36 o-----	xaL0in
Ground-----o	16	37 o-----	xaL0out
E-----------o	17	38 o-----	BEI
GRIN-------o	18	39 o-----	GRST
GSIN-------o	19	40 o-----	GS
FIN--------o	20	41 o-----	FSTO
L-----------o	21	42 o-----	LSLO

Layout drawing

A

A0   J9

A0   J1

A3   J2

B

B0   J3

B1   J4

C

C2   J5

C3   J6

D

D1   J7

D2   J8

J10

SW1

J11

J12

Link connection block diagram (4-processor cards)

1 Mb RAM	2 0	
	Processor A	J1
	1 3	J2

1 Mb RAM	3 0	J3
	Processor B	
	2 1	J4

1 Mb RAM	0 2	J5
	Processor C	
	1 3	J6

1 Mb RAM	3 1	J7
	Processor D	
	0 2	J8
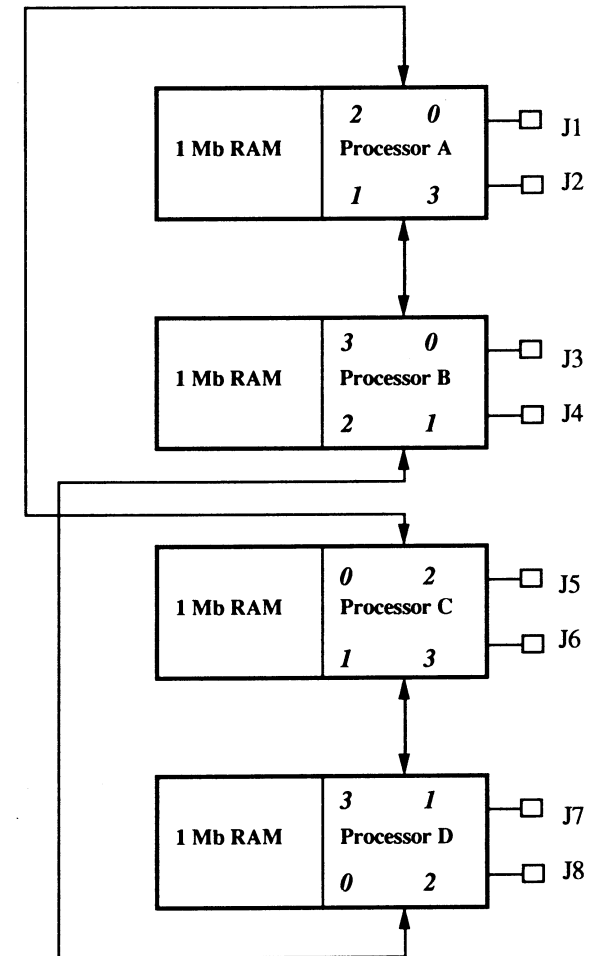
APPENDIX B

Link Speed Selection

Each Transputer node of the Perihelion FarmCard is provided with three jumper positions which control the data rate of its link connections. The jumpers are designated JP11-13 for Node A, JP21-23 for Node B, and so on.

Their functions are laid out in the following table. In the table, 'ON' means jumper in place, and 'OFF' means jumper removed.

JP11 LinkOSpecial	JP12 LinkSpecial	JP13 Link123Special	Speed (Mbits/s) link0	links 1,2,3
ON	ON	ON	10	10
ON	ON	OFF	10	5
ON	OFF	ON	10	10
ON	OFF	OFF	10	20
OFF	ON	ON	5	10
OFF	ON	OFF	5	5
OFF	OFF	ON	20	10
OFF	OFF	OFF	20	20