

<b>Unit / Module Description:</b>	VME64 carrier with 4 TIM sites
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# **User Manual**

## **for**

# **SMT329**

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# 1 Introduction

The Smt329 is a VME four-site module carrier developed to provide access to TIM Modules over the VME64 (parallel) and VXS (serial) busses. It is backward compatible with the SMT328, and can replace the SMT328 with no software modifications. By implementing the VME64 2eSST standard it offers up to 320M bytes/sec (2.56G bits/sec) across the VME bus, while 8 VXS ports offer up to 2.5G bits/sec each, making a VXS total of up to 20G bits/sec.

The SMT329 has 8M bytes of high speed static ram arranged as 1M by 64 bits, with a read or write speed of at least 1G bytes/sec throughput for 64 bit transfers.

Buffered front panel JTAG ports allow control and debug of all 4 TIM modules simultaneously, and multiple SMT329s.

All communications apart from JTAG and comms ports are controlled by a single Virtex 4 FPGA.

The 6 comms ports on each TIM (3 reset to out and 3 reset to in), and 2 comms ports on the Virtex 4 (2 reset to out), are connected to a crossbar switch which allows a static configuration to specify which of the 14 reset to out ports is connected to each of the 12 reset to in ports. The switch is implemented in a Xilinx Spartan 3 FPGA. The switch topology is stored in NVRAM and copied to the switch at board reset by the Virtex4.

The 2 RSL ports on each TIM are connected to Virtex4 Rocketio ports.

Four 1 Gigabit Ethernet ports are available on the VME P2 connector.

Two TIM sites have global bus interfaces to the Virtex4 for access to the static ram and VME bus.

For use in legacy VME racks, SMT329 can be assembled with no P0 connector, and an on board 3.3V PSU. It does not guarantee to support 2eVME or 2eSST and does not support VXS, but it does retain the four Gigabit Ethernet ports on the P2 connector.

## **2 Related Documents**

### **2.1 Referenced Documents**

SMT 328 User Guide 7p1

SMT329 Product Specification 20Dec05

### **2.2 Applicable Documents**

TIM-40 Module Specification (1993)

ANSI/VITA 1.1-1997 American National Standard for VME64 Extensions

ANSI/VITA 1-1994 (R2002) American National Standard for VME64

2eSST ANSI/VITA 1.5-2003

VITA 41.0-200x VXS standard

SN74VMEH22501A data sheet Texas Instruments SCES620 – DECEMBER 2004

## 3 Acronyms, Abbreviations and Definitions

### 3.1 Acronyms and Abbreviations

#### C60

The terms C60, C64xx and TMS320C64xx are used interchangeably throughout this document.

### 3.2 Definitions

#### Register Descriptions

The format of registers is described using diagrams of the following form:

31–24	23–16	15–8	7–0
	LEVEL		
R,00000000	RW,10000000	R,00000000	R,10000000

The digits at the top of the diagram indicate bit positions within the register and the central section names bits or bit fields. The bottom row describes what may be done to the field and its value after reset. Shaded fields are reserved and should only ever be written with zeroes.

R = Readable by the CPU

W = Writeable by the CPU

RW = Readable and writeable by the CPU

Binary digits indicate the value of the field after reset.

#### **Byte Addressing**

All byte addresses are “Big Endian”. This is defined as follows:

Decreasing numeric significance with increasing memory addresses.

So for the register definition shown above:

Bits 31-24 = Byte Address 0

Bits 23-16 = Byte Address 1

Bits 15-8 = Byte Address 2

Bits 7-0 = Byte Address 3

Care must be taken when using an Intel (PC) little endian based VME host controller, to ensure the use of either hardware or software byte swapping when accessing the SMT329 over the VME bus.

#### **VME64 and legacy VME systems**

A VME64 system meets the ANSI/VITA specification for VME64, with 160 pin backplane connectors and a 3.3 Volt backplane supply.

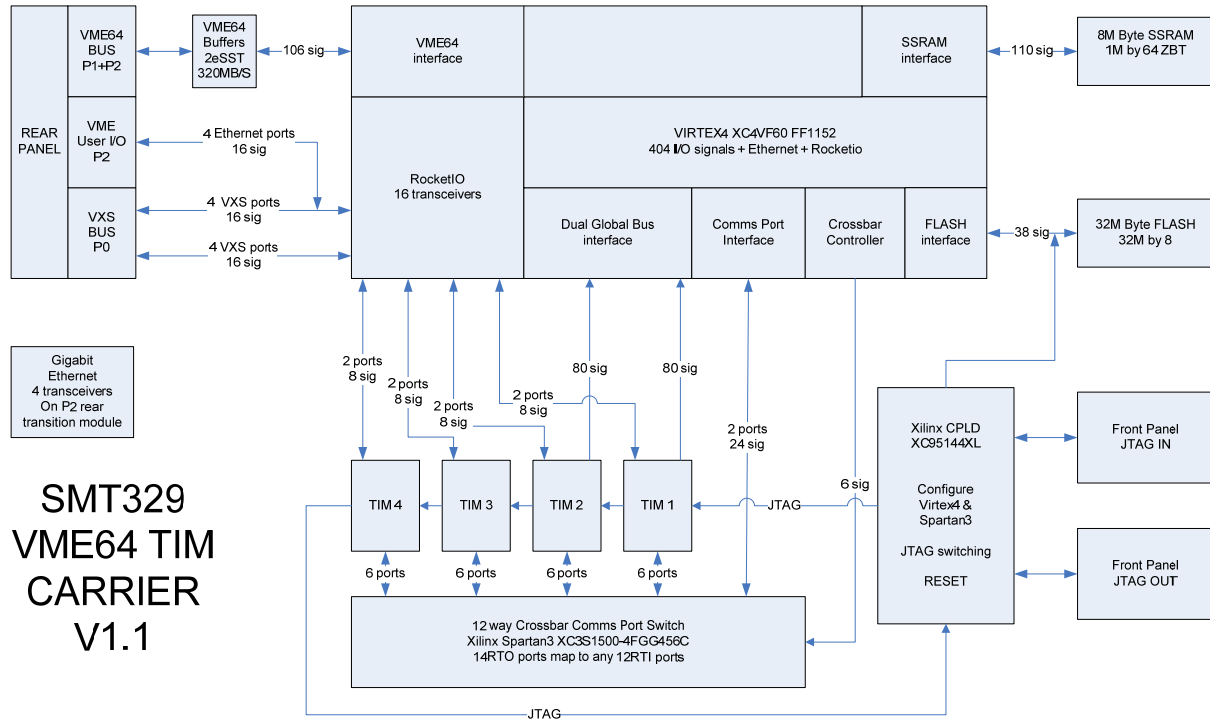


A "legacy" VME system meets the ANSI/VITA specification for VME, with 96 pin backplane connectors and NO 3.3 Volt backplane supply.

The SMT329 is always fitted with 160 pin connectors, which are designed to successfully mate with either a VME64 system or a legacy VME system.

# 4 Functional Description

## 4.1 Block Diagram



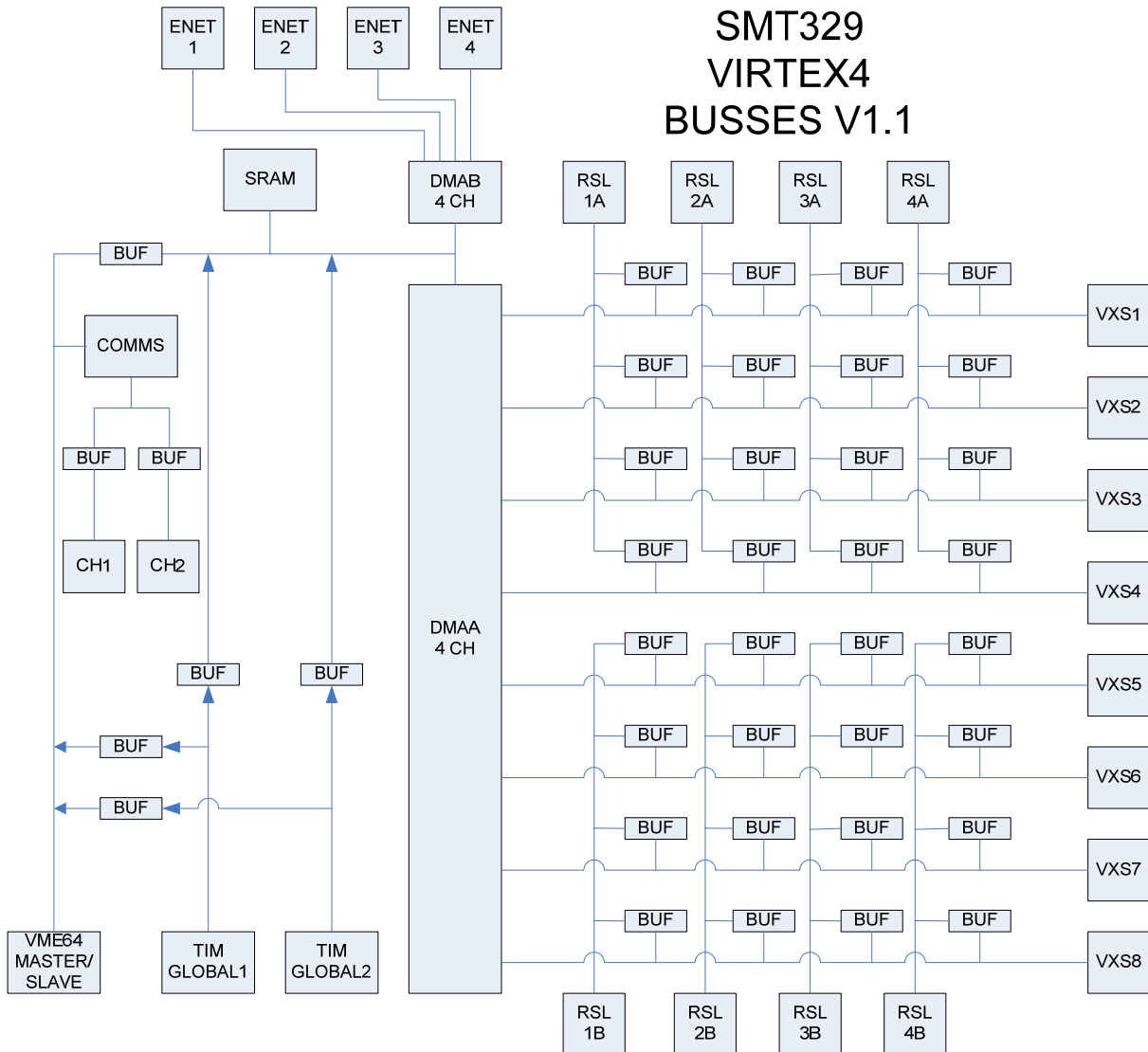
SMT329  
VME64 TIM  
CARRIER  
V1.1

Figure 1: SMT329 Architecture

## 4.2 Module Description

Figure 1 shows the SMT329 block diagram. There are 4 single width or 2 double width TIM sites. All communications apart from the comms port switching are routed through the Xilinx Virtex4 fpga, including all VME and SRAM i/o. Comms port cross bar switching is performed by a Xilinx Spartan3. Loading the configuration data into the 2 fpgas and managing the JTAG interface are performed by a Xilinx CPLD.

## 4.2.1 Virtex 4



**Figure 2: SMT329 Virtex4 internal bus architecture**

Figure 2 shows the SMT329 bus architecture within the Virtex4. This is backwards compatible with SMT328, with the addition of a 4 channel Ethernet DMA engine, a 4 channel Rocketio DMA engine, and a Rocketio cross bar switch matrix.

Table 1 below shows the actual implementation of the parallel bus connectivity for the VME slave, TIM global 1, TIM global 2, DMAA, DMAB. These 5 separate bus masters each have fully dedicated connections to an arbitrating bus switch, which can connect all 5 masters to any 5 slaves out of the 8 available, AT THE SAME TIME. This architecture avoids the traditional bottle neck problems associated with a single bus, which is used by one master at a time.

Master	Slave	S1	S2	S3	S4	S5	S6	S7	S8
		VME& Reset	Control & DMA	Flash	Sram	VME Master	Comms	RSLA	RSLB
M1	VME Slave	Y	Y	Y	Y	N	Y	Y	Y
M2	TIM Global1	N	Y	Y	Y	Y	N	Y	Y
M3	TIM Global2	N	Y	Y	Y	Y	N	Y	Y
M4	DMAA	N	N	N	Y	Y	N	Y	Y
M5	DMAB	N	N	N	Y	Y	N	Y	Y

**Table 1: SMT329 Virtex4 internal bus architecture**

There are exceptions to the permitted connectivity indicated by “Y” for connection permitted and “N” for no connection.

Revision 1 of the Virtex 4 configuration, provides functional equivalence with the SMT328, which it replaces. Subsequent releases of the Virtex 4 configuration will provide support for the following additional functions:

VME64 burst transfer modes.

VME 2eSST transfer modes.

RSL TIM interfaces.

1G bit Ethernet connectivity.

DMA to and from the SRAM.

VXS connectivity.

Subsequent revisions of the Virtex 4 configuration will be made available on the Sundance WEB site along with a utility for updating their flash images on the SMT329. Updates to this manual will accompany new firmware releases.

## 4.2.2 Spartan 3

The SMT329 comms port mapping is performed by a cross bar switch implemented in a Xilinx Spartan3 fpga. The cross bar switch has 12 Reset To In (RTI) ports and 14 Reset To Out (RTO) ports.

Table 2 below illustrates the architecture:

	RTI	0	1	2	3	4	5	6	7	8	9	10	11
RTO		T1C3	T1C4	T1C5	T2C3	T2C4	T2C5	T3C3	T3C4	T3C5	T4C3	T4C4	T4C5
0	T1C0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
1	T1C1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	T1C2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	T2C0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	T2C1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	T2C2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	T3C0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	T3C1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	T3C2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	T4C0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	T4C1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11	T4C2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12	VXC1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
13	VXC2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

**Table 2: SMT329 Spartan 3 comms port switch internal architecture**

This switch has no connectivity restrictions.

The connectivity map is loaded by the CPLD directly from flash memory following power on, after the Spartan 3 configuration is loaded, but before the Virtex 4 configuration is loaded. This connectivity map can be changed by the user, who uses a flash programming utility to write a new map into the flash. This map is then loaded into the Spartan 3 the next time the SMT329 is powered on.

### 4.2.2.1 Comms Switch Map

The map has 12 entries, each of which defines which RTI is connected to which RTO. So entry 1 defines which RTO is connected to RTI 1, and entry 12 defines which RTO is connected to RTI 12. Each entry has a value in the range 0 to 13 as there are 14 RTO ports. Each entry must be different.

The map itself is embedded in a normal text file, and the whole text file is stored in the flash, so that the map can be accompanied by any descriptive text, up to a maximum file size of 64K bytes. The map is identified in the text by the keyword “**SMT329MAP**”.

The SMT329 flash can be programmed from either the VME bus or by a TIM in either slot 1 or 4. The map is loaded from the flash into the Spartan3 fpga by the CPLD, immediately after the SMT329 power is stable following switch on. The map can not be loaded at any other time. The map must load without error for the cross bar switch to work correctly. The Spartan3 performs the following data validation checks before enabling the switch:

1. All entries are in the range 0 to 13.
2. No entry is the same.

If either of these criteria are not met, the switch will not be enabled.

#### 4.2.2.2 Comms Switch Map port connectivity

The 12 RTI ports and 14 RTO ports are connected as follows:

Switch port	RTI port	RTO port
0	T1C3	T1C0
1	T1C4	T1C1
2	T1C5	T1C2
3	T2C3	T2C0
4	T2C4	T2C1
5	T2C5	T2C2
6	T3C3	T3C0
7	T3C4	T3C1
8	T3C5	T3C2
9	T4C3	T4C0
10 (0xA)	T4C4	T4C1
11 (0xB)	T4C5	T4C2
12 (0xC)	not connected	VXC1 (VME port 1)
13 (0xD)	not connected	VXC2 (VME port 2)

#### 4.2.2.3 Comms Switch Map Example 1

This example duplicates the default connectivity of the SMT328, and is loaded in the flash during SMT329 production, filename "s329map.txt" :

```
SMT329MAPCAB012345D78
```

```
SUNDANCE SMT329 STANDARD COMMS PORT MAP MIMICS SMT328
```

```
DATE: 17-DEC-06
```

```
COMPANY: SUNDANCE
```

```
AUTHOR: SEC
```

```
Connect SMT329 to mimic a standard SMT328
```

Entry	Value	Description
1	12 = 0xC	T1C3 (RTI) to VXC1 (RTO)
2	10 = 0xA	T1C4 (RTI) to T4C1 (RTO)
3	11 = 0xB	T1C5 (RTI) to T4C2 (RTO)
4	0 = 0x0	T2C3 (RTI) to T1C0 (RTO)
5	1 = 0x1	T2C4 (RTI) to T1C1 (RTO)
6	2 = 0x2	T2C5 (RTI) to T1C2 (RTO)
7	3 = 0x3	T3C3 (RTI) to T2C0 (RTO)
8	4 = 0x4	T3C4 (RTI) to T2C1 (RTO)
9	5 = 0x5	T3C5 (RTI) to T2C2 (RTO)
10	13 = 0xD	T4C3 (RTI) to VXC2 (RTO)
11	7 = 0x7	T4C4 (RTI) to T3C1 (RTO)
12	8 = 0x8	T4C5 (RTI) to T3C2 (RTO)

```
The map file is stored in the flash in ascii
```

```
and has a keyword identifier immediately before the map data of  
"SMT329MAP"
```

```
This is the map which is duplicated at the top of the file:
```

```
SMT329MAPCAB012345D78
```

```
-END-
```

The very first line begins with the map keyword "SMT329MAP", although it can appear anywhere in the text. This is immediately followed by "CAB012345D78" which is the actual map. The descriptive text which follows explains each map entry.

#### 4.2.2.4 Comms Switch Map Example 2

This example is used for testing, and with the correct TIM software implements a spiral which allows loop back testing of all ports on all tims at once. Filename "S329MAPSPIRAL1.txt" :

SMT329MAPCAB012345678

SUNDANCE SMT329 SPIRAL1 TEST COMMS PORT MAP

This map implements a spiral connection of comms ports to allow testing all comms ports from VME port 1.

It can not test VME port 2.

DATE: 17-DEC-06

COMPANY: SUNDANCE

AUTHOR: SEC

This is the 328 equivalent map:

Entry	Value	Description
1	12 = 0xC	T1C3 (RTI) to VXC1 (RTO)
2	10 = 0xA	T1C4 (RTI) to T4C1 (RTO)
3	11 = 0xB	T1C5 (RTI) to T4C2 (RTO)
4	0 = 0x0	T2C3 (RTI) to T1C0 (RTO)
5	1 = 0x1	T2C4 (RTI) to T1C1 (RTO)
6	2 = 0x2	T2C5 (RTI) to T1C2 (RTO)
7	3 = 0x3	T3C3 (RTI) to T2C0 (RTO)
8	4 = 0x4	T3C4 (RTI) to T2C1 (RTO)
9	5 = 0x5	T3C5 (RTI) to T2C2 (RTO)
10	13 = 0xD	T4C3 (RTI) to VXC2 (RTO)
11	7 = 0x7	T4C4 (RTI) to T3C1 (RTO)
12	8 = 0x8	T4C5 (RTI) to T3C2 (RTO)

This is the spirial test map:

Entry	Value	Description
1	12 = 0xC	T1C3 (RTI) to VXC1 (RTO)
2	10 = 0xA	T1C4 (RTI) to T4C1 (RTO)
3	11 = 0xB	T1C5 (RTI) to T4C2 (RTO)
4	0 = 0x0	T2C3 (RTI) to T1C0 (RTO)
5	1 = 0x1	T2C4 (RTI) to T1C1 (RTO)
6	2 = 0x2	T2C5 (RTI) to T1C2 (RTO)
7	3 = 0x3	T3C3 (RTI) to T2C0 (RTO)
8	4 = 0x4	T3C4 (RTI) to T2C1 (RTO)
9	5 = 0x5	T3C5 (RTI) to T2C2 (RTO)
10	6 = 0x6	T4C3 (RTI) to T3C0 (RTO)
11	7 = 0x7	T4C4 (RTI) to T3C1 (RTO)
12	8 = 0x8	T4C5 (RTI) to T3C2 (RTO)

It assumes the following software routing in the TIMs:



```

TIM1-3:
C3=>C0
C4=>C1
C5=>C2
TIM4:
C3=>C1
C4=>C2
C5=>C5 (loop back)
The map file is stored in the flash in ascii
and has a keyword identifier immediately before the map data of "SMT329MAP"
This is the map which is duplicated at the top of the file:
SMT329MAPCAB012345678
-END-

```

The very first line begins with the map keyword "SMT329MAP", although it can appear anywhere in the text. This is immediately followed by "CAB012345678" which is the actual map. The descriptive text which follows explains each map entry.

#### 4.2.2.5 Comms Switch Map Programming

The map text file can be programmed from either the VME or from TIM slot 1 or slot 4. The VME controller map write program is written for a Xycom XVME-660 PC host running DOS, and will need porting to any other environment. The TIM map write program is written for an SMT395, but will also run on an SMT365 and some other TIMs, unchanged.

The source code for both programs is available for information only. Extreme care is required if these programs are modified, as damage to the other contents of the SMT329 flash may result in complete failure of the board, as the flash also contains the configuration images for both the Spartan3 and the Virtex4.

Note that the red front panel LED is on, and the VME bus signal SYSFAIL is driven low, when the Virtex4 has not been configured. This state will continue indefinitely if the flash is corrupted, but should normally only be seen briefly immediately after switch on.

In order to provide user protection from flash corruption, 2 separate security features are implemented, in addition to the write sequence security built into the flash device:

1. A 32 bit KEY register must be loaded with the flash write key to enable writes to the flash.
2. The flash has been divided into a factory and a user area. The user flash programming tool only writes to the user area, the factory area remains unchanged. This means that it should always be possible to set the SMT329 to the standard map (example 1) by switching to the factory flash area. The flash area used by the CPLD after power on, is controlled by the DIP switch SW2 bit 4 as follows:

SW2/4 OFF = Factory area (UVB4 = 1)  
SW2/4 ON = User area (UVB4 = 0)

#### 4.2.2.6 Comms Switch Map Diagnostic Port and Error Detection

An 8 bit diagnostic read only port is provided by the Spartan3. This port operates by setting an 8 bit register address, then reading the 8 bit register value. The following registers are currently defined:

<b>Register address</b>	<b>Description</b>
00	Map entry 0 + 0x80 if transmitting
01	Map entry 1 + 0x80 if transmitting
02	Map entry 2 + 0x80 if transmitting
03	Map entry 3 + 0x80 if transmitting
04	Map entry 4 + 0x80 if transmitting
05	Map entry 5 + 0x80 if transmitting
06	Map entry 6 + 0x80 if transmitting
07	Map entry 7 + 0x80 if transmitting
08	Map entry 8 + 0x80 if transmitting
09	Map entry 9 + 0x80 if transmitting
0A	Map entry A + 0x80 if transmitting
0B	Map entry B + 0x80 if transmitting
0C	0x0C
0D	0x0D
0E	0x0E
0F	0x0F
10	RTO 0 is connected to this RTI + 0x80 if transmitting
11	RTO 1 is connected to this RTI + 0x80 if transmitting
12	RTO 2 is connected to this RTI + 0x80 if transmitting
13	RTO 3 is connected to this RTI + 0x80 if transmitting
14	RTO 4 is connected to this RTI + 0x80 if transmitting
15	RTO 5 is connected to this RTI + 0x80 if transmitting
16	RTO 6 is connected to this RTI + 0x80 if transmitting
17	RTO 7 is connected to this RTI + 0x80 if transmitting
18	RTO 8 is connected to this RTI + 0x80 if transmitting
19	RTO 9 is connected to this RTI + 0x80 if transmitting

1A	RTO A is connected to this RTI + 0x80 if transmitting
1B	RTO B is connected to this RTI + 0x80 if transmitting
1C	RTO C (VXC1) is connected to this RTI + 0x80 if transmitting
1D	RTO D (VXC2) is connected to this RTI + 0x80 if transmitting
1E	0X1E
1F	0X1F
20	Error map 0
21	Error map 1
22	Spartan3 FPGA revision MSB
23	Spartan3 FPGA revision LSB
24 to FF	<returns the register address>

The error maps are bit maps which have an error bit for each map entry:

Error map 0 has error bits for map entry 7 to 0

Error map 1 has bits 7-4 set to 0, then error bits for map entry 0xB to 8.

Both error maps must be 0 for the switch to be enabled.

The register address is set and the register value read from a single byte address.

Both the VME bus controller and either TIM1 or TIM4 can access it at these addresses:

VME I/O space address offset = 0xDF

TIM I/O space address = 0xC0000102

### 4.2.3 CPLD

The CPLD performs 3 primary functions: It loads the fpga configurations and comms port switch map from flash, immediately after power on. It also manages the JTAG switching required to maintain an intact serial data stream with any number of TIM slots occupied. It also controls the low level board reset.

The flash is divided into a user area and a factory area. An SMT329 is shipped with both these areas containing a Spartan 3 configuration, a standard comms port map, and a Virtex 4 configuration. The user can choose which area is used by the CPLD to load from, by setting DIP switch SW2 bit 4 as follows:

SW2/4 OFF	= Factory area	(UVB4 = 1)
SW2/4 ON	= User area	(UVB4 = 0)

If the CPLD fails to configure an FPGA using the user area data, it will then try loading from the factory area.

### **4.3 TIM Global Bus Resources**

There are three main global bus resources available to TIMs on this motherboard. These are the 32 bit VME bus, the 8 Megabyte static ram (sram), and the board control registers.

The VME bus is directly accessible to the TIMs without reducing the availability of the sram to any other internal sram requestor.

The TIMs can access the sram with zero wait states for burst transfers, after arbitration for the sram bus.

Access to the global resources is selected by an arbitration state machine. Resources remain granted to the last resource master after the cycle has finished so that contiguous transfers proceed without further arbitration. Arbitration only occurs when two (or more) possible bus masters are requesting the same resource.

Because the TIMs have direct access to the VME bus, the risk of deadlock that was present in the SMT328 is now removed. This is because the VME bus arbiter, on another VME bus board, is the only arbiter in the path to granting bus master access to the VME bus for the TIM, whereas on SMT328 the VME bus arbiter and the sram bus arbiter both had to grant access.

## 4.4 VME Interface

The VME interface uses the P1 connector and the center row (B) of the P2 connector for additional data and address lines. The interface forms a complete D8/16/32/64 master/slave. The SMT329 does not support slot 0 operation or unaligned transfers.

Rows A and C of the P2 connector are connected to 4 of the Virtex4 RSL transmit receive pairs. This allows the fitting of a rear transition PCB to support external high speed serial interfaces such as 1M bit Ethernet, on both VME64 and legacy VME systems.

A central P0 connector is a factory fitted option which allows connection to a back plane which supports the VXS standard. The P0 connector has 4 fixed RSL transmit receive pairs.

The VME64 bus is buffered with SN74VMEH22501A transceivers from TI which are specially designed to be compliant with VME64, 2eVME protocols in VME64x (ANSI/VITA 1.1) and 2eSST protocols in VITA 1.5. With proper design of a 21-slot VME64 system, a designer can achieve 320-Mbyte transfer rates on linear backplanes and, possibly up to 1-Gbyte/sec transfer rates on the VME320 backplane.

For legacy VME systems without a 3.3 Volt supply, SMT329 can be assembled with an on board 3.3V PSU. In a legacy VME system the SMT329 does not guarantee to support 2eVME or 2eSST and does not support VXS, but it does retain the four Gigabit Ethernet ports on the P2 connector.

The use of high speed transfer modes (2eVME and 2eSST) on legacy backplanes VME is not supported, and may or may not function reliably.

The VME master interface can be used by either TIM1 or TIM4 global bus, and by DMAA and DMAB.

The SMT329 VME slave interface allows direct access by the current VME bus master to 7 out of the 8 available SMT329 slaves, as shown in table 1 above. It has 3 separately decoded VME bus address spaces, divided as follows:

Name	VME space	Size in Bytes	Description
VME configuration	A16	64	Identification and programmable base addresses for I/O and SRAM. Board Reset.
I/O	A32	256	Comm-port, Board Reset, Control, Flash
I/O2	A32	768	DMA, RSL
SRAM	A32	8M	Static Ram

The A16 VME configuration base address is set with an 8 way DIP switch labelled SW1. This sets the value to compare to VME A6-A13, with VME A14-A15 always compared to 1 in order to generate a board decode. This A16 address space contains board identification registers and a pair of 16 bit registers which must be loaded with the base address of the I/O and SRAM spaces.

### 4.4.1 VME slave interface to VME config and reset registers

These registers are decoded in the VME A16 space, which means that the VME address modifiers must be set to either of the following:

Hex Code	VME space	Function
2D	A16	Short supervisory access
29	A16	Short non privileged access

The VME address bits are decoded as follows:

VME bit	Address	Compare to	Comment
15		1	Must be high
14		1	Must be high
13		SW1/1	On = 0 Off = 1
12		SW1/2	On = 0 Off = 1
11		SW1/3	On = 0 Off = 1
10		SW1/4	On = 0 Off = 1
9		SW1/5	On = 0 Off = 1
8		SW1/6	On = 0 Off = 1
7		SW1/7	On = 0 Off = 1
6		SW1/8	On = 0 Off = 1
5-1		-	Select individual registers

Note that VME address bits A16 and above are ignored.

Example: SW1 switches 1-7 set to off, switch 8 set to on gives a VME A16 base address of 0xff80.

VME address bits 5 and below decode the following 16 bit wide registers:

Offset (hex)	Register
00-01	Board ID
02-03	Device type
04-05	Status / Control
06-07	SRAM base address
08-09	I/O base address
0A-3B	Unused

3C-3D	Virtex4 code revision
3E-3F	Manufacturer ID

#### 4.4.1.1 VME Board ID Register (address 00-01)

The bit definitions for this register are:

15-12	11-0
ID1	ID2
R, 0101	R, 0000 0111 1011

Always reads as 507B hex.

#### 4.4.1.2 VME Device Type Register (address 02-03)

The bit definitions for this register are:

15-12	11-0
Memory Size 8	Model Code 329
R, 1000	R, 0001 0100 1001

Memory size is defined as the number of significant bits in an A32 address used to specify the sram base address.

So this register reads as: 0x8149

#### 4.4.1.3 VME Master Status and Control Register (address 04-05)

The bit definitions for the VME Master Status and Control register are:

15	14-4	3	2-1	0
A32 Enabled		Ready		Reset board
RW, 0	R,000 0000 0001	R, x	R, 10	RW, 0

Bit 15 is cleared by a board reset so that the A32 base address registers can be initialised before A32 enable is set. A32 enable MUST be set to allow A32 access to the rest of the board.

**If this bit is clear (0) then no A32 access will be decoded and a bus error will occur for all A32 read/write cycles.**

It is very strongly recommended that all VME bus cycles have some form of BUS\_ERROR checking enabled, as it is an essential error reporting feature which should not be ignored.



Note that a VME bus error is generated by the VME slot 0 controller after a timeout period, not by the SMT329.

The SMT329 can be reset at any time by the VME controller setting bit 0. As this bit is itself cleared by a board reset, it will always read as 0.

The Ready bit is driven by the TIM config signal which indicates when all TIMs are ready following a reset.

**4.4.1.4 VME Sram Base Address Register (address 06-07)**

This 16-bit register defines the base address of the sram for A32 addressing modes. The most significant 9 bits of this register (D15-7) are compared to VME address signals A31-23. VME address signals A22-A1 decode bytes in the 8M byte SRAM. The least significant 7 bits of this register are not used.

**4.4.1.5 VME I/O Base Address Register (address 08-09)**

This 16-bit register is used to set the base address (in 256 byte blocks) of the I/O address space.

This 16 bit base address is compared to the incoming A32 address bits A23-8, while bits A31-24 are compared to FF hex. A match decodes a 256 byte space which is further decoded to access the various devices in the I/O address space.

The 256 byte space is functionally equivalent to the I/O space in the SMT328. This space can be expanded in the SMT329 by 768 bytes to a total size of 1024 bytes. This expansion is software enabled, to maintain backwards compatibility. When the full 1024 byte space is enabled, bits 0 and 1 of this VME I/O base address register are ignored.

**4.4.1.6 VME Virtex 4 code revision**

This 16 bit read only register reports the current revision of Virtex4 FPGA code.

**4.4.1.7 VME Sub-class Register (1E)**

The bit definitions for this 16-bit read only register are given below:

The bit definitions for this register are:

15	14-12	11-0
	Sub class	ID3
R, 0	R, 001	R, 0000 0111 1011

Always reads as 107B hex.

#### 4.4.2 VME slave interface to the I/O registers

This I/O address space occupies 256 bytes for the basic I/O functions, and a further 768 byte I/O<sup>2</sup> space can be software enabled, to provide VME access to the expanded functions such as DMA and RSL interfaces.

The I/O space has a base address set by the VME controller in the VME configuration register "I/O Offset Register".

This address space is decoded in the VME A32 space, which means that the VME address modifiers must be set to either of the following:

Hex Code	VME space	Function
0D	A32	Extended supervisory data access
09	A32	Extended non privileged data access

The VME address bits are decoded as follows for the basic 256 byte I/O space:

VME Address bit	Compare to	Comment
31-24	1	Must be high
23-8	I/O Base D15-0	16 bit I/O Base programmed by the VME controller
7-1	-	Select individual registers in 256 byte space

The VME address bits are decoded as follows for the full 1024 byte I/O space:

VME Address bit	Compare to	Comment
31-24	1	Must be high
23-10	I/O Base D15-2	14 bit I/O Base programmed by the VME controller
9-1	-	Select individual registers in 1024 byte space

Individual I/O register addresses are detailed in the following table:

<b>Area</b>	<b>VME offset</b>	<b>TIM address</b>	<b>Peripheral</b>	<b>Read/Write</b>
Reserved	00-7C	None	-	-
COMM	80-83	None	Comm-port data	Read/write
COMM	84-87	None	Comm-port data	Read/write
COMM	88-8C	None		
COMM	90-93	None	Comm-port status	Read/write
COMM	94-BC	None		
RST	C0-C3	None	Reset board	Read/Write
RST	C4-CC	None		
FLASH	D0-D3	C000 0100	Flash data	Read/Write
FLASH	D4-D7	C000 0101	Flash address	Read/Write
FLASH	D8-DB	C000 0102	Flash Key	Read/Write
FLASH	DC-DF	C000 0103	SP3 diagnostic	Read/Write
CONTROL	E0-E3	C000 0000	Control 1	Read/Write
CONTROL	E4-E7	C000 0001	Control 2	Read/Write
CONTROL	E8-EB	C000 0002	Control 3	Read/Write
CONTROL	EC-EF	C000 0003	Control 4	Read/Write
CONTROL	F0-F3	C000 0004	Status 1	Read
CONTROL	F4-F7	C000 0005	Control 6	Read/Write
CONTROL	F8-FB	C000 0006	Control 7	Read/Write
CONTROL	FC-FF	C000 0007	Reserved	-
I/O2	100-3FF	C000 0200- C000 02FF	DMA & RSL	Read/Write

Note that I/O2 must be software enabled to be available to the VME bus. When it is disabled, the SMT329 will not respond to addresses in this area, and a VME bus error will result.

Actual DMA and RSL addresses in the IO2 space will be defined in a subsequent release of this manual and Virtex4 configuration.

#### **4.4.3 VME slave interface to the SRAM**

The sram is organised to allow the VME bus master to perform D8, D16, D32 or D64 cycles, and word swapping buffers are included for this purpose. Transfers can be single, or burst using either 2eVME or 2eSSTT. This address space occupies 8M bytes, and has a base address set by the VME controller in the VME configuration register "SRAM Base Address".

This address space is decoded in the VME A32 space, which means that the VME address modifiers must be set to either of the following:

Hex Code	VME space	Function
0D	A32	Extended supervisory data access
09	A32	Extended non privileged data access

The VME address bits are decoded as follows:

VME bit	Address	Compare to	Comment
31-23		SRAM Base D15-7	SRAM Base is programmed by the VME controller
22-0		-	Select byte address in the 8M byte SRAM

The VME interface to the SRAM supports byte write.

#### 4.4.4 TIM Global bus interface to the I/O registers

This address space occupies global bus addresses in the following region:

0xC000 0000 to 0xC0FF FFFF.

Individual I/O register addresses are detailed in the following table:

Area	VME offset	TIM address	Peripheral	Read/Write
FLASH	D0-D3	C000 0100	Flash data	Read/Write
FLASH	D4-D7	C000 0101	Flash address	Read/Write
FLASH	D8-DB	C000 0102	Flash Key	Read/Write
FLASH	DC-DF	C000 0103	SP3 diagnostic	Read/Write
CONTROL	E0-E3	C000 0000	Control 1	Read/Write
CONTROL	E4-E7	C000 0001	Control 2	Read/Write
CONTROL	E8-EB	C000 0002	Control 3	Read/Write
CONTROL	EC-EF	C000 0003	Control 4	Read/Write
CONTROL	F0-F3	C000 0004	Status 1	Read
CONTROL	F4-F7	C000 0005	Control 6	Read/Write
CONTROL	F8-FB	C000 0006	Control 7	Read/Write
CONTROL	FC-FF	C000 0007	Reserved	-
I/O2	100-3FF	C000 0200- C000 02FF	DMA & RSL	Read/Write

Actual DMA and RSL addresses in the IO2 space will be defined in a subsequent release of this manual and Virtex4 configuration.

#### 4.4.5 TIM Global bus interface to the VME bus master

This address space occupies global bus addresses in the following region:

0xC100 0000 to 0xC13F FFFF.

A global bus cycle in this address space causes a corresponding VME bus cycle. The VME master takes the global bus address and shifts it left 2 bits to create a byte address. Bits 23-2 of this byte address are mapped directly to the VME bus address. It then takes the 8 bit VME high address in Control register 4 to generate VME address bits 31-24, and the VME A1 bit in Control register 4 is mapped to VME bus address A1. The following table details this process:

<b>VME address bit</b>	<b>Global address bit</b>	<b>Control 4 register bit</b>	<b>Description</b>
31-24	-	31-24	High 8 bits
23-2	21-0	-	Middle 22 bits
1	-	16	A1
0	-	17	A0 / -Lword

The VME address modifiers, DS0 and DS1 are copied directly from control register 4. The VME bus request level is also specified in control register4.

So a TIM can directly address 16M bytes in the VME bus address space.

Note that the TIM global bus does not support byte addressing, so transfers to and from the VME bus are always 32 bits wide.

#### **4.4.6 TIM Global bus interface to the SRAM**

This address space occupies global bus addresses in the following region:

0xDFE0 0000 to 0xDFFF FFFF.

This space occupies 2M 32 bit words or 8M bytes.

Note that the TIM global bus does not support byte addressing, so transfers to and from the sram are always 32 bits wide.

## 4.5 I/O Registers

The I/O registers are divided into 4 groups: Comm, RST, Flash, Control.

### 4.5.1 Comm Port Interface

Each TIM module has up to 6 byte-wide communications ports. Following a reset, 3 of these comm ports are in output mode, and the other 3 are in input mode. The Virtex4 has 2 comm ports which reset to output. TIM sites (1 to 4) have six numbered comm ports: Ports 0 to 2 are reset to output, and 3 to 5 are reset to input.

The Virtex4 Comm Port interface provides a route by which a VME host can talk to a TIM comm-port, using a byte wide bi-directional parallel data bus and 4 handshake signals. Both D16 and D32 accesses are allowed. This logic and associated circuitry includes fifo buffering on reads and writes. The Virtex4 reset to out comm ports which are connected to this interface can be switched to any TIM reset to in comm port through the comm port switch. There are 2 comm port channels (VXS0 & VXS1) from the Virtex4 to the comm port switch. The switch can connect each of these 2 channels to a different reset to in port on a TIM. Note that there is only 1 VME comm port interface, and that a software controlled switch allows dynamic switching of the VME comm port interface between VXS0 and VXS1.

All registers are 32 bits wide. The following address / register map is used:

VME IO base offset address	Register	Read Write	Description
80-83	Comm port Data	R/W	Data I/O port
84-87	Comm port Data	R/W	Data I/O port
90-93	Comm port Status1	R	General status
94-97	Comm port Status2	R	Receive fifo status
98-9B	Comm port Status3	R	Transmit fifo status
9C-9F	Reserved	-	-

There is only one comm port interface, and its data register is accessible at both addresses indicated in the table above.

#### 4.5.1.1 Comm Port Data register

The comm port data register is accessible as a D16 resource by first writing the upper data bits (31 to 16) to address

IO base + 0x84-0x85,

and then the lower data bits to address

IO base + 0x86-0x87.

This register, when read, contains the next 32 bit word received from the comm port. Writing to this register causes a 32 bit word to be sent to the comm port. The receive and transmit sections of this register are separate and each includes a 512 deep by 32 bit wide fifo.

The SMT329 implements 2 separate comms port channels between the Virtex4 and the Spartan3 comms port switch. These channels are multiplexed inside the Virtex4 so that either one may be active at any given moment. Independent hand shake control is provided for each channel, although there is only 1 receive fifo and 1 transmit fifo. This means that channel switching can be done at any time, with no loss of data. Transfers simply halt on the disabled comms port, and remain frozen until that comms port is enabled.

#### 4.5.1.2 Comm Port Status1 register

The status1 register is accessible by the VME host at address

IO base + 0x90-0x93. The bit definitions for this register are:

31	30	29	28	27	26	25	24
Token1	Idle1	Token2	Idle2	Rxalemp	Rxalfull	Rxemp	Rxfull
R, 1	R, 0	R, 1	R, 0	R, 1	R, 0	R, 1	R, 0

23	22	21	20	19	18	17	16
Rxderr	Rxwrerr	Txalemp	Txalfull	Txemp	Txfull	Txderr	Txwrerr
R, 1	R, 0	R, 1	R, 0	R, 1	R, 0	R, 1	R, 0

15	14	13	12	11	10	9	8
				-Txfull	-Rxemp	-Txfull	-Rxemp
R, 0	R, 0	R, 0	R, 0	R, 1	R, 0	R, 1	R, 0

7	6	5	4	3	2	1	0
R, 0	R, 0	R, 0	R, 0	R, 0	R, 0	R, 0	R, 0

Bit Mnemonic	Description
Token1	Comms port VXC1 has the transmit token
Idle1	Comms port VXC1 is idle
Token2	Comms port VXC2 has the transmit token
Idle2	Comms port VXC2 is idle
Rxalemp	Receive fifo almost empty (has 128 entries left)



Rxalfull	Receive fifo almost full (has 128 empty entries)
Rxemp	Receive fifo is empty
Rxfull	Receive fifo is full
Rxderr	Receive fifo read while fifo empty
Rxwrerr	Receive fifo write while fifo full
Txalemp	Transmit fifo almost empty (has 128 entries left)
Txalfull	Transmit fifo almost full (has 128 empty entries)
Txemp	Transmit fifo is empty
Txfull	Transmit fifo is full
Txderr	Transmit fifo read while fifo empty
Txwrerr	Transmit fifo write while fifo full

The receive fifo not empty bit (-Rxemp) becomes set when a receive word is in the comm port data receive fifo. When all the comm port data in the receive fifo is read, this bit is reset.

When the transmit fifo not full bit (-Txfull) is set, it indicates that the VME host can write a new 32 bit word to the comm port data register for later transmission to the comm port.

#### 4.5.1.3 Comm Port Status2 register

The status2 register is accessible by the VME host at address IO base + 0x94-0x97. The bit definitions for this register are:

31-28	30-16	15-12	28
	Rxrdcount		Rxwrcount
R, 0000	R, 0	R, 0000	R, 0

Bit Mnemonic	Description
Rxrdcount	Receive fifo read pointer
Rxwrcount	Receive fifo write pointer

This status register is intended for diagnostic use only.

#### 4.5.1.4 Comm Port Status3 register

The status3 register is accessible by the VME host at address IO base + 0x98-0x9B. The bit definitions for this register are:

31-28	30-16	15-12	28
	Txrdcount		Txwrcount
R, 0000	R, 0	R, 0000	R, 0

Bit Mnemonic	Description
Txrdcount	Transmit fifo read pointer
Txwrcount	Transmit fifo write pointer

This status register is intended for diagnostic use only.

#### 4.5.2 Reset (RST) register

This special control register is accessed in VME A32 IO space as either D16 or D32. It can be accessed as D16 at address:

IO base + 0xC2

It can be accessed as D32 at address:

IO base + 0xC0

Only bit-4 is defined, and if this bit is set by the VME host, it causes all TIM sites, comm-port buffers, and other motherboard logic to become reset. The board remains in such a state until this bit is cleared by the VME host. This reset is the **same** bit as defined in VME Master Status and Control register bit-0.

Note that a board reset clears the “A32 enable” bit in the VME Master Status and Control register, which means this I/O Reset register is no longer available to the VME bus. For this reason it is recommended that the board reset (bit 0) in the VME Master Status and Control register is used to reset the board, as this register is always available.

#### 4.5.3 Flash control interface

The AMD/Spansion S29GL256N10TFIR10 32M byte flash stores the connectivity bit map for the Spartan3 comms port cross bar switch and the logic configuration data for both the Virtex4 and the Spartan3.

The flash can be controlled by either the CPLD or the Virtex4. The flash data bus is connected to the CPLD, the Virtex4 and the Spartan3. Following power on, the CPLD performs the following:

- Load the Spartan3 configuration data from the flash.
- Load the Spartan3 comms port switch map from the flash.
- Load the Virtex4 configuration data from the flash.
- Release control of the flash to the Virtex4.

In order to provide user protection from flash corruption the flash has been divided into a factory and a user area. The user flash programming tool only writes to the user area, the factory area remains unchanged. The active flash area is controlled by the DIP switch SW2 bit 4, which sets where in the flash the CPLD will begin reading configuration data from:

- SW2/4 OFF = Factory area (UVB4 = 1)
- SW2/4 ON = User area (UVB4 = 0)

The Virtex4 implements a register based interface to the flash, in which the flash address is set in a 32 bit address register, and the data is read from or written to an 8 bit register.

It also implements a flash key register, which must be set to a specific 32 bit value to allow writing to the flash.

Using the shared flash 8 bit data bus, the Virtex4 also implements a diagnostic port to the Spartan3. Please refer to the SMT329 Comm port map description for further details of this diagnostic only interface.

The following table shows the registers available in the flash I/O area, and their addresses from both the VME and TIM global busses:

Area	VME offset	TIM address	Peripheral	Bits	Read/Write
FLASH	D3	C000 0100	Flash data	8	Read/Write
FLASH	D4-D7	C000 0101	Flash address	32	Read/Write
FLASH	D8-DB	C000 0102	Flash Key	32	Read/Write
FLASH	DF	C000 0103	SP3 diagnostic	8	Read/Write

Data can be read from the flash by setting the flash address register then reading from the 8 bit data register.

Data can be written to the flash by first setting the flash key register, then setting the address, then writing to the 8 bit data register. The write process can be monitored by polling the data register. See the AMD/Spansion data sheet for details.

It is very strongly recommended that only Sundance provided software is used to write to the flash. If both user and factory flash areas are corrupted the SMT329 will remain in the “fail” state indefinitely. This is the state when the Virtex4 has not been configured, and is indicated by the front panel red LED, and the VME bus signal –SYSFAIL being driven low. To recover from complete flash corruption, a Xilinx programming pod attached to LK1 is required to load the Virtex4, after which the flash may be correctly programmed.

#### 4.5.4 IO Control and Status registers

There are 6 IO control and status registers, which control interrupts, comm port channel switching, VME master cycles, activity indicators, and provide interrupt status.

Individual I/O register addresses are detailed in the following table:

Area	VME offset	TIM address	Title	Read/Write
CONTROL	E0-E3	C000 0000	Control 1	Read/Write
CONTROL	E4-E7	C000 0001	Control 2	Read/Write
CONTROL	E8-EB	C000 0002	Control 3	Read/Write
CONTROL	EC-EF	C000 0003	Control 4	Read/Write
CONTROL	F0-F3	C000 0004	Status 1	Read
CONTROL	F4-F7	C000 0005	Control 6	Read/Write
CONTROL	F8-FB	C000 0006	Control 7	Read/Write
CONTROL	FC-FF	C000 0007	Reserved	-

##### 4.5.4.1 Control Registers 1 & 2 = TIM Sites 1 & 4 Interrupt Masks

The SMT329 can generate an interrupt to either TIM1 or TIM4 using the signal IIOF1. These registers provide mask bits to allow software to enable and disable different interrupt sources.

Control register 1 contains the interrupt masks for TIM 1.

Control register 2 contains the interrupt masks for TIM 4.

Each register has the following bits:

31-16	15-9	8	7-1	0
		VME bus error		Soft int
R, 0000 0000	R, 0000 000	RW, 0	R, 0000000	RW, 0

VME Bus Error is latched when the VME bus error mask bit for either TIM1 or TIM4 is set. Therefore both must be cleared to unlatch 'VME Bus Error', and at least 1 must be set to latch 'VME Bus Error'.

The software interrupt (soft int) will always generate an interrupt when it is unmasked.

Note that a TIM must execute an 'IACK' instruction to external memory before any TIM interrupts can be generated. This is usually done by the TIM start up firmware.

#### 4.5.4.2 Control Register 3 = VME Interrupt Masks

A VME interrupt can be generated by any of the following sources:

TIM sites 1 and 4 signal IIOF0

Comm port interface

Software

The interrupt level is selected by bits 12-10 of Control Register 4. This VME interrupt is masked or enabled by control register 3 bits.

31-16	15-11	10	9	8-3	2	1	0
		TIM4 IIOF0	TIM1 IIOF0		Comm port -Txfull	Comm port -Rxemp	Soft int
R, 0000 0000	R, 0000 0	RW, 0	RW, 0	R, 000000	RW, 0	RW, 0	RW, 0

#### 4.5.4.3 Control Register 4 = VME bus master cycle control

Some of the signals generated by the VME bus master are statically defined in this 32 bit register. It also controls which comm port interface is enabled.

31-24	23-18	17	16
VME A31-24	VME AM5-0	VME A0/LWORD	VME A1
R, 0000 0000	R, 000000	R, 0	R, 0

15	14-13	12-10	9	8	7-0
VXC1/2	VME BRxx	VME IntLev	DS1	DS0	VME Iack
R, 0	R, 00	R, 000	R, 0	R, 0	R, 0000000

Bit Mnemonic	Description
VME A32-24	VME bus master address bits 32-24
VME AM5-0	VME bus master address modifier bits 5-0
VME A0/LWORD	VME bus master address bit A0/lword

VME A1	VME bus master address bit A1
VXC1/2	Comms port control: 0 = VXC1, 1 = VXC2.
VME BRxx	VME bus master bus request level
VME IntLev	VME interrupt level
DS1	VME data strobe 1
DS0	VME data strobe 0
VME Iack	VME interrupt vector

#### 4.5.4.4 Control Register 5 = General Status Register

This status register provides access to the raw interrupt signals, which can be used for polling or inside interrupt service routines to check which interrupt is active.

31-11	10	9	8	7-3	2	1	0
	TIM4 IIOF0	TIM1 IIOF0	VME bus error		Comm port -Txfull	Comm port -Rxemp	
R	R, 0	R, 0	R, 0	R	R, 0	R, 0	R

#### 4.5.4.5 Control Register 6 = Green LED activity indicators

There are 2 front panel green leds: led5 at the top and led6 at the bottom. These are intended as a diagnostic aid by providing a visual indication of a large number of different activities on the SMT329. Each led has a number of specific activities associated with it, and control register 6 acts as a mask to enable or disable these activities from illuminating the led. Generally led5 (at the top) illuminates when there is VME bus communication with the SMT329, and is controlled by mask bits 31-16. Led6 (bottom) illuminates when there is TIM activity on the SMT329, and is controlled by mask bits 15-0. The (un)mask bits available are:

31	30	29	28	27	26	25	24
Soft		TIM4 Control	TIM4 Flash	TIM4 SRAM	TIM4 VME Master	TIM4 IIOF0	TIM4 IIOF1

RW, 0	RW, 0	RW, 1	RW, 1	RW, 1	RW, 1	RW, 0	RW, 0
23	22	21	20	19	18	17	16
		TIM1 Control	TIM1 Flash	TIM1 SRAM	TIM1 VME Master	TIM1 IIOF0	TIM1 IIOF1
RW, 0	RW, 0	RW, 1	RW, 1	RW, 1	RW, 1	RW, 0	RW, 0
15	14	13	12	11	10	9	8
Soft	Comm port -Rxemp	Comm port -Txfull					VME Config
RW, 0	RW, 0	RW, 0	RW, 0	RW, 0	RW, 0	RW, 0	RW, 1
7	6	5	4	3	2	1	0
VME Comms	VME Reset		VME Control	VME Flash	VME SRAM	VME bus error	VME Interrupt
RW, 1	RW, 1	RW, 1	RW, 1	RW, 1	RW, 1	RW, 1	RW, 1

A mask bit must be set for the activity to illuminate the led.

The bits titled “soft” allow software to indicate activity, since setting these bits forces the led on continuously.

The minimum time an led can be illuminated is 250mS.

#### 4.5.4.6 Control Register 7 = VME High Speed Bus Master cycle control

This 32-bit control register controls the 2eVME and 2eSST high speed bus master transfer modes. For backwards compatibility with SMT328, this register has no effect following a board reset, until it is enabled by software.

Register bits are: (To be determined)

## 4.6 Static RAM (sram)

The 8M byte sram is composed of a pair of 1M by 32 bit wide zero bus turnaround (ZBT) synchronous static rams, making a single 1M by 64 bit sram. This can be accessed as D8, D16, D32 or D64 via the VME data bus. It can only be accessed in the A32 address space. The base address of this memory is set by the VME sram offset register, and it resides on a 8Mbyte boundary. The memory supports 64 bit burst transfers with a peak read or write rate of over 1G byte/sec. Smaller width transfers achieve correspondingly lower throughputs.

The TIM global busses always perform 32 bit reads and writes.

## 4.7 JTAG Debugging Logic

An external Jtag controller can be used to access the Tim sites via the front panel Jtag IN connector. The external controller can drive the JTAG scan chain through all TIM modules. If a module is not present then the modules SENSE signal is used to enable a switch inserted in the TDO/TDI (JTAG Data In and Data Out) scan chain to bypass that module. Two connectors are present on the front panel. One is the scan chain out, and the other is the scan chain in. Both connector are disabled when disconnected. This arrangement allows multiple boards to be debugged with a single JTAG controller by connecting a special cable from the Jtag out of one SMT329 to the Jtag in of the next SMT329.

The JTAG IN connector (nearest the PCB) has the following signals:

TDI, TDO, TRST, TMS, TCK, TCK\_RET, EMU0, EMU1, GND, PD(+5v), RESETIN, CONFIG.

RESETIN is a board reset input, which is ORed with the VME bus reset to generate the local SMT329 board reset.

CONFIG is a bidirectional signal which indicates when high that all modules have finished configuration following a reset, and can commence normal operation.

The JTAG OUT connector (furthest from the PCB) has the following signals:

TDI, TDO, TRST, TMS, TCK, TCK\_RET, EMU0, EMU1, GND, SENSE, RESETOUT, CONFIG.

RESETOUT is a buffered copy of the SMT329 board reset signal, which will reset the next SMT329.

SENSE is pulled down on the SMT329 so that if the JTAG OUT is connected to another SMT329 JTAG IN then the SENSE line is pulled high by the connection to PD(+5v). This disables the JTAG OUT bypass, so that the next SMT329 is included in the JTAG scan chain.

All outputs and inputs from and to the JTAG IN and OUT connectors are passed through buffers, except CONFIG, EMU0 and EMU1 which are global open collector signals. Both the JTAG in and out connectors are 3M 20-way, part number 10220-5212JL.



**Pin connections to XDS510 14 way JTAG header sorted by Jtag in pin number:**

Jtag in PIN	329 Signal	329 In/Out	329 Source	14 Way Pin	14 Way Signal	XDS510 In/Out
1	JITDO	IN	IC26/9	3	TDI	OUT
2	0V	-	-	4	GND	
3	JITDI	OUT	IC27/26	7	TDO	IN
4	0V	-	-			
5	JITMS	IN	IC26/7	1	TMS	OUT
6	0V	-	-	8	GND	
7	JITCK	IN	IC26/8	11	TCK	OUT
8	0V	-	-	10	GND	
9	JITCK1	OUT	IC27/29	9 (note 2)	TCK_RET	IN
10	0V	-	-	12	GND	
11	-JITRST	IN	IC26/6	2	-TRST	OUT
12	0V	-	-	(note 1)		
13	-JIRESETX	IN	IC26/5	-	-	-
14	PD1AMP	OUT	F5/1	5	PD	IN
15	-JIDET	IN	IC26/4	(note 1)	-	-
16	-CONFIG	IN/OUT	IC26/14	-	-	-
17	JEMU0	OUT	IC26/2	13	EMU0	IN/OUT
18	JEMU1	OUT	IC26/12	14	EMU1	IN/OUT
19	JIU1	IN/OUT	IC26/15	-	-	-
20	JIU2	IN/OUT	IC26/16	-	-	-

**Note1:** -JIDET (pin 15) is wired directly to 0V (pin 12) inside the plug.

**Note2:** A 33 Ohm damping resistor must be attached to J27 pin 9, the other end is then attached to the 14 way cable pin 9 to drive TCK\_RET.

#### 4.8 TIM Sites

There are 4 TIM sites numbered 1 to 4. Sites 1 and 4 have the optional 80 way global connector to allow TIM access to the sram and VME bus.

### 4.8.1 TIM Connectors

The global connector (J3) contains the full set of TIM global bus signals. For accesses by the TIM to the global bus, the most significant address bit, A31 is a '1'. This bit is not an output pin but used internally on a TIM.

The bottom, or secondary, connector (J2) is used only for comm-ports, power and user definable connections (UDP 7 to 12). The user-definable pins are not implemented on this motherboard. Comm-ports 1, 2, 4 and 5 are on this connector.

The top, or primary, connector (J1) is used for the remaining two comm-ports (0 and 3), power, interrupts, control and JTAG. Both plus and minus 12v are supplied by the motherboard to these top connectors. The JTAG signals are derived from the external JTAG source (see JTAG section).

An external 50MHz clock is supplied to all TIM sites by the SMT329, which should be used for optimum global bus performance. The SMT329 uses the TIM H1 clock output to time the generation of the ready signal which it outputs to the TIM.

A power supply of +3.3 Volts is present at both TIM mounting holes. This can be connected to the TIM by using metal bolts.

Refer to the TIM-40 Module Specification from Texas Instruments for exact connector placement. Adjacent TIM sites are separated by exactly 2.6".

## 4.9 ROCKETIO

The Virtex4 has a total of 16 Rocketio transceivers: 4 are connected to the VXS channels on the centre VME P0 connector, 4 are connected to the VME P2 connector for 1G Ethernet, and 8 are connected to the TIM RSL ports. A cross bar switch is implemented in the Virtex4 which allows any RSL A port to be connected to VXS ports 1-4, and any RSL B port to be connected to VXS ports 5-8. In addition it can connect any Rocketio port to 1 of the 4 DMA channels, so that data can be streamed to or from the sram. The cross bar switch topology is strictly point to point, and is determined by a bit map held in the FLASH, which is only loaded into the crossbar switch following a board reset. Dynamic connectivity changes are not supported. All DMA and communications protocol control must be performed by an intelligent TIM module using the global bus. Note that 4 of the VXS transceivers are shared with Gigabit Ethernet, and this is set at board assembly, so the required option must be stated when ordering.

Programming details are in development and will be released as soon as they are finalised.

## 4.10 Gigabit Ethernet

The Virtex4 has 4 Gigabit Ethernet controllers which are directly connected to user defined I/O pins on row C of the VME P2 connector. These signals are passed through the P2 connector on the motherboard to a transition module which is fitted to the back of the motherboard. This transition module has the Ethernet transceivers, the magnetic isolation and the RJ45 connectors.

Each Ethernet controller has a dedicated DMA controller which can stream data to or from the sram at full Ethernet speed of 1G bit/sec.

Programming details are in development and will be released as soon as they are finalised.

**4.11 DMA controllers**

There are a total of 8 DMA channels on the SMT329. These are divided into 2 groups of 4 called DMAA and DMAB. All DMA channels have the same register set and control features including programmable interrupt generation. All perform 64 bit I/O to the sram.

Programming details are in development and will be released as soon as they are finalised.

**4.12 Power Supplies**

Connections are made to the following back plane power signals through VME connector P1: +12V, -12V, +5V, and optionally the +3.3V supply on a VME64 back plane.

The +/-12V supplies are fed directly to the TIMs, they are not used anywhere else on the board. The +5V supply is also fed to the TIMs, and used for most of the logic, and to feed a DC-DC converter which can generate +3.3V for legacy VME systems with 96 way back plane connectors. Optionally the SMT329 obtains the +3.3V supply from the VME64 160 pin 5 row P1 connector using the row D pins.

The +3.3V DC-DC controller is a TPS5602IDBT from Texas Instruments, which also generates +1.2V to supply the Virtex4 and Spartan3. The power distribution is through a dedicated +3.3V power plane so the voltage drop here is minimal. The power plane distributes +3.3V to all 4 TIM sites through the metal TIM fixing posts. It is designed to supply 10 AMPS maximum.

When using the on board +3.3V DC-DC, it is essential to maintain adequate air flow, to prevent over heating. Failure to cool the board properly at high current levels could result in premature failure, and / or premature current limiting.

For this reason the preferred +3.3V supply option is directly from the VME64 back plane, with the on board +3.3V supply disabled, as this reduces the cooling requirement. These options are set during assembly as follows:

<b>+3.3V Source</b>	<b>R42</b>	<b>F2</b>	<b>Description</b>
Internal	Not fitted	Not fitted	Enable DC-DC, disconnect back plane
VME64	OR	MCR10A	Disable DC-DC, connect back plane with 10A fuse.

## 4.13 Interface Description

### 4.13.1 Mechanical Interface

The board conforms to the VME standard for a 'Double Height' board. This is:  
160.0 (+0, -0.3) mm by 233.35 (+0, -0.3) mm.

The board occupies 1 or 2 VME slots depending on the height of the TIM modules fitted.

The SMT329 board layout is similar SMT328. To aid routing the top 2 TIM sites have been rotated together through 180 degrees.

The VME P0 connector present on the VXS version of the SMT329, was not present on SMT328.

The front panel comm port connectors on SMT328 have been removed.

### 4.13.2 Electrical Interface

The VME64 bus interface is through the standard 160 way DIN back plane connectors, designated P1 and P2: Harting 02 01 160 1101.

The VXS bus interface is through the standard 105 way metric back plane connector designated P0: Tyco 1410147-2.

TIMs 1,2,3,4 are each interfaced through TIM-40 connectors J1 and J2: Hirose FX4C-80S-1.27DSA.

TIMs 1 and 4 are additionally interfaced through TIM-40 connector J3: Hirose FX4C-80S-1.27DSA.

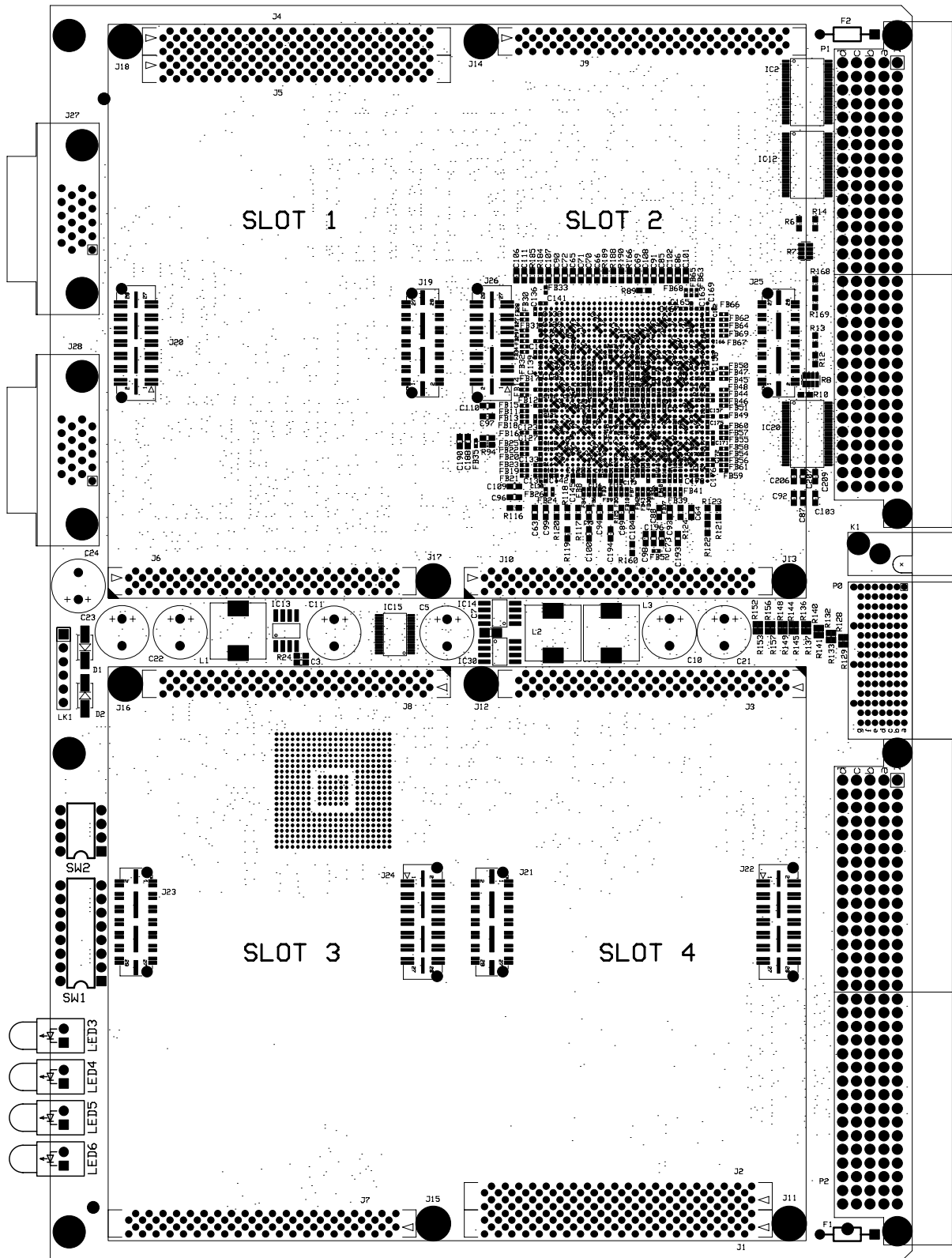
JTAGIN (J27) and JTAGOUT (J28) are each interfaced through 3M 20 way mini "D" connectors: N10220-5212PC.

Xilinx programming header LK1 is a 0.1 inch pitch 6 way gold plated pin header.

# 5 Footprint

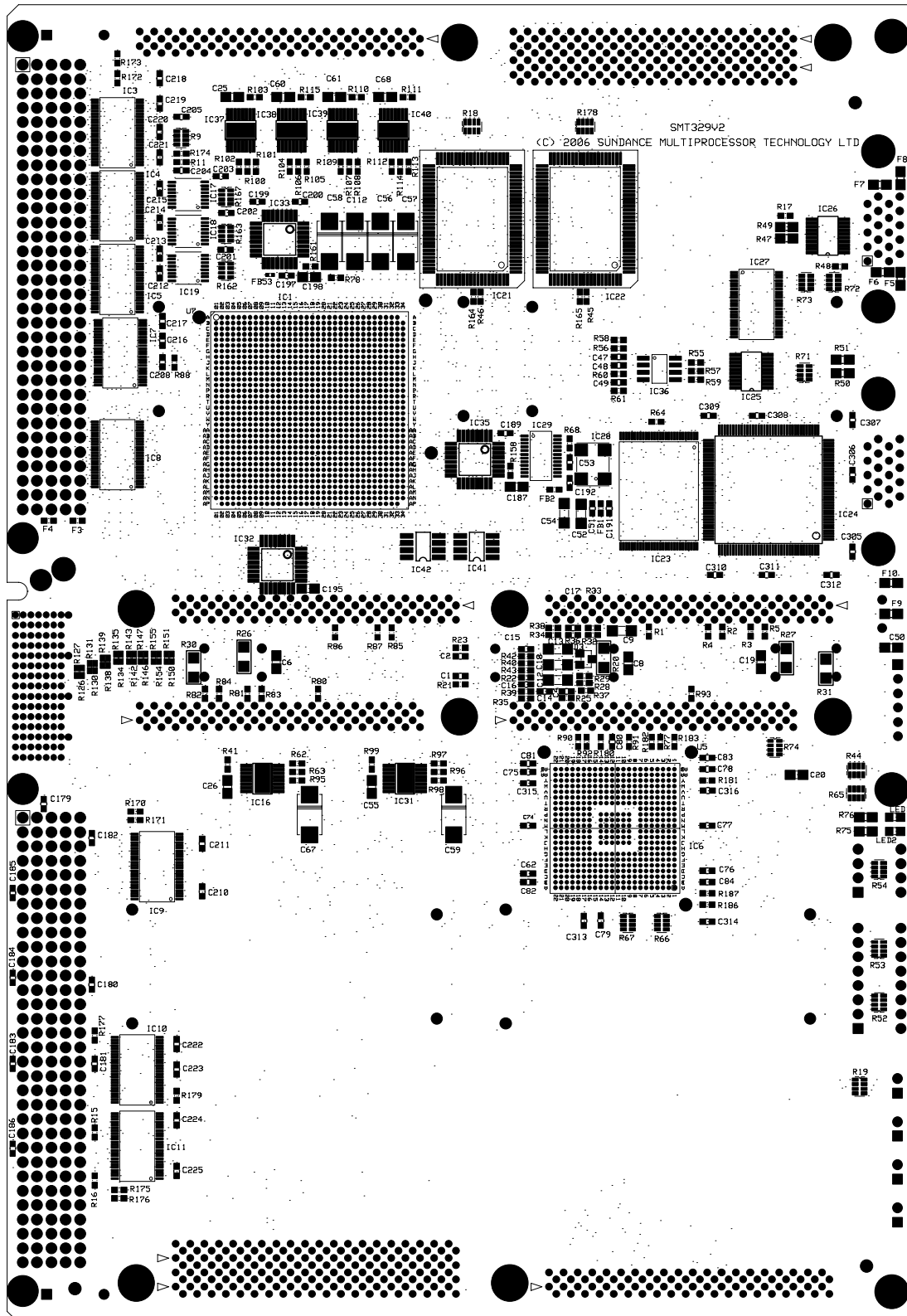
## 5.1 Top View

SMT329V2 SMT329V2  
16JUL06 16JUL06  
COMP.MASKCDP.MASK



## 5.2 Bottom View

SMT329V2 SMT329V2  
16JUL06 16JUL06  
SOLD.PRINT SOLD.MASK



## 6 Pinout

### 6.1.1.1 VME P1 Connector

Position	Row Z	Row A	Row B	Row C	Row D
1	nc	D00	-BBSY	D08	+5V
2	GND	D01	-BCLR	D09	GND
3	nc	D02	nc	D10	nc
4	GND	D03	-BG0IN	D11	nc
5	nc	D04	-BG0OUT	D12	nc
6	GND	D05	-BG1IN	D13	nc
7	nc	D06	-BG1OUT	D14	nc
8	GND	D07	-BG2IN	D15	nc
9	nc	GND	-BG2OUT	GND	nc
10	GND	SYSCLK	-BG3IN	-SYSFAIL	GA0
11	nc	GND	-BG3OUT	-BERR	GA1
12	GND	-DS1	-BR0	-SYSRESET	+3V3
13	nc	-DS0	-BR1	A0/-LWORD	GA2
14	GND	WRITE	-BR2	AM5	+3V3
15	nc	GND	-BR3	A23	GA3
16	GND	-DTACK	AM0	A22	+3V3
17	nc	GND	AM1	A21	GA4
18	GND	-AS	AM2	A20	+3V3
19	nc	GND	AM3	A19	nc
20	GND	-IACK	GND	A18	+3V3
21	nc	-IACKIN	nc	A17	nc
22	GND	-IACKOUT	nc	A16	+3V3
23	nc	AM4	GND	A15	nc
24	GND	A07	-IRQ7	A14	+3V3
25	nc	A06	-IRQ6	A13	nc
26	GND	A05	-IRQ5	A12	+3V3
27	nc	A04	-IRQ4	A11	nc
28	GND	A03	-IRQ3	A10	+3V3
29	nc	A02	-IRQ2	A09	nc
30	GND	A01	-IRQ1	A08	+3V3
31	nc	-12V	nc	+12V	GND
32	GND	+5V	+5V	+5V	+5V

### 6.1.1.2 VME P2 Connector

Position	Row Z	Row A	Row B	Row C	Row D
1	UD0	nc	+5V	nc	nc
2	GND	reserved	GND	nc	nc
3	UD1	nc	-RETRY	GND	nc
4	GND	GND	A24	reserved	nc
5	UD2	TXPA_110_P2	A25	RXPA_109_P2	nc
6	GND	TXNA_110_P2	A26	RXNA_109_P2	nc
7	UD3	reserved	A27	GND	nc
8	GND	RXPA_110_P2	A28	TXPA_109_P2	nc
9	UD4	RXNA_110_P2	A29	TXNA_109_P2	nc
10	GND	GND	A30	GND	nc
11	UD5	RXPB_110_P2	A31	TXPB_109_P2	nc
12	GND	RXNB_110_P2	GND	TXNB_109_P2	nc
13	UD6	reserved	+5V	reserved	nc
14	GND	TXPB_110_P2	D16	RXPB_109_P2	nc
15	UD7	TXNB_110_P2	D17	RXNB_109_P2	nc
16	GND	GND	D18	GND	nc
17	UD8	nc	D19	nc	nc
18	GND	nc	D20	nc	nc
19	UD9	reserved	D21	reserved	nc
20	GND	nc	D22	nc	nc
21	UD10	nc	D23	nc	nc
22	GND	GND	GND	GND	nc
23	UD11	VSPARE1	D24	VSPARE2	nc
24	GND	nc	D25	nc	nc
25	nc	reserved	D26	GND	nc
26	GND	nc	D27	nc	nc
27	nc	nc	D28	nc	nc
28	GND	GND	D29	GND	nc
29	nc	nc	D30	nc	nc
30	GND	nc	D31	GND	nc
31	nc	GND	GND	nc	nc
32	GND	nc	+5V	nc	nc



### 6.1.1.3 VME P0 Connector

<b>Pos</b>	<b>Row G</b>	<b>Row F</b>	<b>Row E</b>	<b>Row D</b>	<b>Row C</b>	<b>Row B</b>	<b>Row A</b>
1	SE1_P0	GND	TXNA_113	TXPA_113	GND	RXNA_113	RXPA_113
2	GND	TXNB_113	TXPB_113	GND	RXNB_113	RXPB_113	GND
3	SE2_P0	GND	TXNA_112	TXPA_112	GND	RXNA_112	RXPA_112
4	GND	TXNB_112	TXPB_112	GND	RXNB_112	RXPB_112	GND
5	nc	GND	nc	nc	GND	nc	nc
6	GND	nc	nc	GND	nc	nc	GND
7	nc	GND	nc	nc	GND	nc	nc
8	GND	nc	nc	GND	nc	nc	GND
9	nc	GND	nc	nc	GND	nc	nc
10	GND	nc	nc	GND	nc	nc	GND
11	nc	GND	nc	nc	GND	nc	nc
12	GND	TXNA_110	TXPA_110	GND	RXNA_110	RXPA_110	GND
13	SE7_P0	GND	TXNB_110	TXPB_110	GND	RXNB_110	RXPB_110
14	GND	TXNA_109	TXPA_109	GND	RXNA_109	RXPA_109	GND
15	SE8_P0	GND	TXNB_109	TXPB_109	GND	RXNB_109	RXPB_109

### 6.1.1.4 JTAGIN header sorted by J27 pin number:

This table also shows the connections to a standard 14 pin XDS510 JTAG controller header:

J27 PIN	329 Signal	329 In/Out	329 Source	14 Way Pin	14 Way Signal	XDS510 In/Out
1	JITDO	IN	IC26/9	3	TDI	OUT
2	0V	-	-	4	GND	
3	JITDI	OUT	IC27/26	7	TDO	IN
4	0V	-	-			
5	JITMS	IN	IC26/7	1	TMS	OUT
6	0V	-	-	8	GND	
7	JITCK	IN	IC26/8	11	TCK	OUT
8	0V	-	-	10	GND	
9	JITCK1	OUT	IC27/29	9 (note 2)	TCK_RET	IN
10	0V	-	-	12	GND	
11	-JITRST	IN	IC26/6	2	-TRST	OUT
12	0V	-	-	(note 1)		
13	-JIRESETX	IN	IC26/5	-	-	-
14	PD1AMP	OUT	F5/1	5	PD	IN
15	-JIDET	IN	IC26/4	(note 1)	-	-
16	-CONFIG	IN/OUT	IC26/14	-	-	-
17	JEMU0	OUT	IC26/2	13	EMU0	IN/OUT
18	JEMU1	OUT	IC26/12	14	EMU1	IN/OUT
19	JIU1	IN/OUT	IC26/15	-	-	-
20	JIU2	IN/OUT	IC26/16	-	-	-

**Note1:** -JIDET (pin 15) is wired directly to 0V (pin 12) inside the plug.

**Note2:** A 33 Ohm damping resistor must be attached to J27 pin 9, the other end is then attached to the 14 way cable pin 9 to drive TCK\_RET.

### 6.1.1.5 JTAGOUT header sorted by J28 pin number:

J28 PIN	329 Signal	329 In/Out
1	JOTDI	OUT
2	0V	-
3	JOTDO	IN
4	0V	-
5	JOTMS	OUT
6	0V	-
7	JOTCK	OUT
8	0V	-
9	JOTCKO	IN
10	0V	-
11	-JOTRST	OUT
12	0V	-
13	- JORESETX	OUT
14	JODET	IN
15	GND	OUT
16	-CONFIG	IN/OUT
17	JEMU0	OUT
18	JEMU1	OUT
19	JOU1	IN/OUT
20	JOU2	IN/OUT

### 6.1.1.6 LK1 Xilinx header

LK1 PIN	SIGNAL
1	VCC
2	GND
3	TCK
4	TDO
5	TDI
6	TMS

## 7 Support Packages

An SMT329 comms port switch map programming tool for both the VME host, and a TIM, are available from Sundance support.

## 8 Physical Properties

Dimensions	160.0 by 233.35 mm	
Weight	306 Grammes	
Supply Voltages	+12V, -12V, +5V, +3.3V	
Max Supply Current	+12V	1A fused (F3)
	+5V	7A fused (F1)
	+3.3V	10A fused (F2)
	-12V	1A fused (F4)
MTBF	TBD	

## 9 Safety

This module presents no hazard to the user when in normal use.

## 10 EMC

This module is designed to operate from within an enclosed host system, which is build to provide EMC shielding. Operation within the EU EMC guidelines is not guaranteed unless it is installed within an adequate host system.

This module is protected from damage by fast voltage transients originating from outside the host system which may be introduced through the output cables.

-END-