

# ROD Operations Manual

## APPENDIX B: ROD VME Access Registers

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Revision History	
July 12, 2002	First Draft
August 12, 2002	Added Flash Memory Command Algorithms, VME Byte Order
April 2, 2004	Updated version coming soon

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## APPENDIX B: ROD VME Access Registers

### VME Chipset

The ROD uses the CY7C960A as a slave controller in I/O mode, and CY7C964 interface chips as bus transceivers.

### VME Address Map

The VMEbus Address Decoding Block is implemented in the PRM FPGA and decodes the ROD memory map into Regions as required by the VMEbus Interface.

#### VME Address/ROD Region Decoder

The ROD uses 32 bits of address LA(31:0).

LA(31:24) are compared to the Geographical Address GA to select the active ROD board. The Rods occupy slots 5 - 12 and 14 - 21, the geographical address of each board is as follows:

```
Slot 5  -> GA/LA[31:24] = "00000101" (05h)
Slot 6  -> GA/LA[31:24] = "00000110" (06h)
Slot 7  -> GA/LA[31:24] = "00000111" (07h)
Slot 8  -> GA/LA[31:24] = "00001000" (08h)
Slot 9  -> GA/LA[31:24] = "00001001" (09h)
Slot 10 -> GA/LA[31:24] = "00001010" (0Ah)
Slot 11 -> GA/LA[31:24] = "00001011" (0Bh)
Slot 12 -> GA/LA[31:24] = "00001100" (0Ch)
Slot 13 -> TIM
Slot 14 -> GA/LA[31:24] = "00001110" (0Eh)
Slot 15 -> GA/LA[31:24] = "00001111" (0Fh)
Slot 16 -> GA/LA[31:24] = "00010000" (10h)
Slot 17 -> GA/LA[31:24] = "00010001" (11h)
Slot 18 -> GA/LA[31:24] = "00010010" (12h)
Slot 19 -> GA/LA[31:24] = "00010011" (13h)
Slot 20 -> GA/LA[31:24] = "00010100" (14h)
Slot 21 -> GA/LA[31:24] = "00010101" (15h)
```

If the matching is true, then LA(23:20) is used to decode the function specific ROD Region Map, and the valid map is returned to the VMEbus Interface IC (CY7C960A).

#### ROD Memory Map to Region Map

REGION(2:0) = "000", ROD Master DSP Host Port - CS\_N(1)

GA0XXXXX - HPI Control register

GA2XXXXX - HPI Address register

REGION(2:0) = "001", ROD Master DSP Host Port - CS\_N(1)

GA4XXXXX - HPI Data register, address auto increment

GA6XXXXX - HPI Data register, no address auto increment

REGION(2:0) = "010", FPGA Program Reset Manager - CS\_N(2)

GACXXXXX - PRM Registers

All other values for bits 23:20 result in no operation on the selected ROD.

REGION(2:0) = "011" to "111" - NOP

### ROD VME Data Transfer Format

The VME Interface document defines all data byte transfers as Big Endian. The ROD transfers data as words only, does not support byte access.

## APPENDIX B: ROD VME Access Registers

### ROD Master DSP Host Port

A detailed description of the Host Port can be found in the **TMS320C6000 Peripherals Reference Guide**, Literature Number: SPRU190D February 2001. Much of the text below is pasted directly from the above-mentioned document.

The Master DSP HPI Registers are located as follows on the ROD:

Description	Address	Access	Width
Master DSP: HPIC, Host Port Interface Control Register	{BA}000000	RW	32
			Bit Value
			Value
Bits[31: 0]: HPIC			

The HPIC register is normally the first register accessed to set configuration bits and initialize the interface. The HPIC is organized as a 32-bit register whose high half word and low half word contents are the same. On a host write, both half words must be identical. The lower half word is the write register, and the upper half word is the status register. No storage is allocated for the read-only reserved values. Only CPU writes to the lower half word affect HPIC values and HPI operation.

31-21	20	19	18	17	16
Reserved	FETCH	HRDY	HINT	DSPINT	HWOB
15-5	4	3	2	1	0
Reserved	FETCH	HRDY	HINT	DSPINT	HWOB

**HWOB:** Half Word Ordering Bit

If HWOB = 1, the first half word is least significant. If HWOB = 0, the first half word is most significant. HWOB affects both data and address transfers. Only the host can modify this bit. HWOB must be initialized before the first data or address register access.

**DSPINT:** The host processor-to-CPU/DMA interrupt.

**HINT:** DSP-to-Host Interrupt

The inverted value of this bit determines the state of the CPU HINT output.

**HRDY:** Ready Signal to Host

Not masked by HCS (as the HRDY pin is). If HRDY = 0, the internal bus is waiting for an HPI data access request to finish.

**FETCH:** Host Fetch Request

The value read by the host or CPU from this register field is always 0. The host writes a 1 to this bit to request a fetch into HPID of the word at the address pointed to by HPIA. The 1 is never actually written to this bit, however.

Description	Address	Access	Width
Master DSP: HPIA	{BA}200000	RW	32
			Bit Value
			Value
Host Port Interface Address Register			
Bits[31: 0]: HPIA			

The HPIA contains the address of the memory accessed by the HPI at which the current access occurs. This address is a 30-bit word address, so the two LSBs are unaffected by HPIA writes and are always read as 0. The C62x/C67x HPIA register is only accessible by the host. It is not mapped to the DSP memory.

Description	Address	Access	Width
Master DSP: HPID++	{BA}400000	RW	32
			Bit Value
			Value
Host Port Interface Data Register with Auto Increment			
Bits[31: 0]: HPID++			

## APPENDIX B: ROD VME Access Registers

Description	Address	Access	Width
Master DSP: HPID	{BA}600000	RW	32
Host Port Interface Data Register no Auto Increment		Bit Value	
Bits[31: 0]: HPID		Value	

### Host Access Sequences

The host begins HPI accesses by performing the following tasks in this order:

- 1) Initializing the HPIC register
- 2) Initializing the HPIA register
- 3) Writing data to or reading data from HPID register

Reading from or writing to HPID initiates an internal cycle that transfers the desired data between the HPID register and the DMA auxiliary channel in the C620x/C670x. For the 16-bit HPI, the PRM FPGA handles the D32 to D16 access. The host is able to access the 16 bit wide HPI with a single 32 bit wide cycle.

### Initialization of HPIC and HPIA

Before any data access, the HPIC and HPIA must be initialized. On the C62x/C67x, only the host has access to the HPIA register. Before accessing data, the HWOB bit of the HPIC register and the HPIA must be initialized (in this order, because HWOB affects the HPIA access). The ROD requires that the HWOB bit be set to a value of '1'. After initializing HWOB, the host can write to HPIA.

### HPID Read/Write Access in Fixed Address Mode

A read or write cycle to the HPID no Auto Increment Register will access a register on the ROD at the specific address set in the HPIA register.

### HPID Read/Write Access in Auto Increment Mode

The auto increment feature results in efficient sequential host accesses. For both HPID read and write accesses, this removes the need for the host to load incremented addresses into HPIA. For read accesses, the data pointed to by the next address is fetched immediately after the completion of the current read. Because the intervals between successive reads are used to pre-fetch data, the latency for the next access is reduced. For the C62x/C67x pre-fetching also occurs after a host write of FETCH = 1 to the HPIC register. If the next HPI access is an HPID read, then the data is not re-fetched and the pre-fetched data is sent to the host. Otherwise, the HPI must wait for the pre-fetch to finish.

### VME D32 to DSP D16 HPI Interface: Host Port To VME D32 Algorithm

The communication from the Host VME interface is specified as D32. The ROD Master DSP host port is a D16 component. To access the DSP as per the ROD requirements, an interface circuit shall be implemented in the FPGA PRM to allow D32 block transfers to and from the host.

#### Write Algorithm

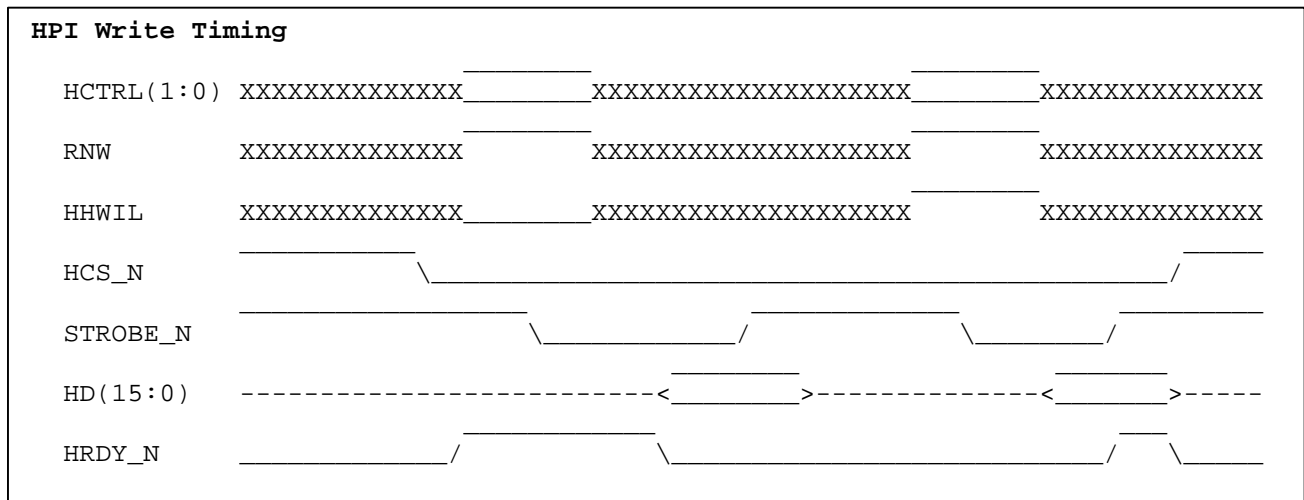
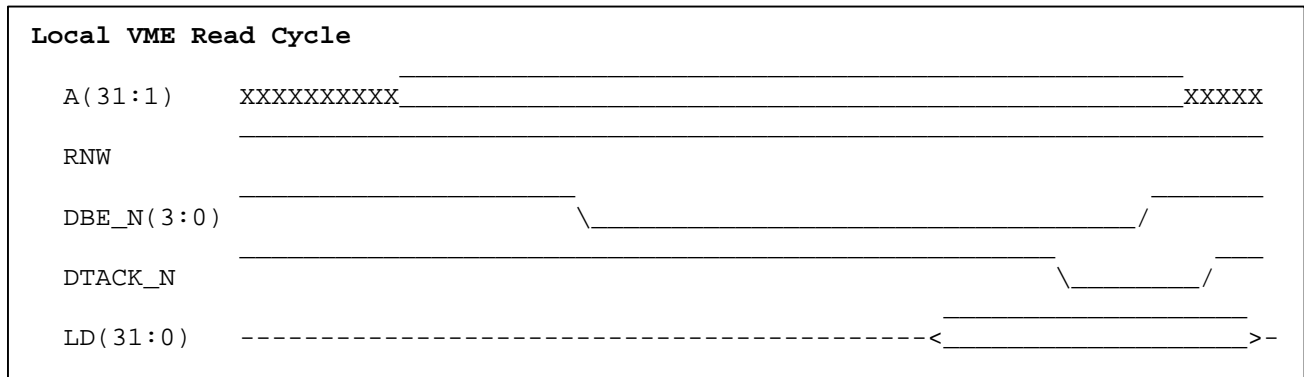
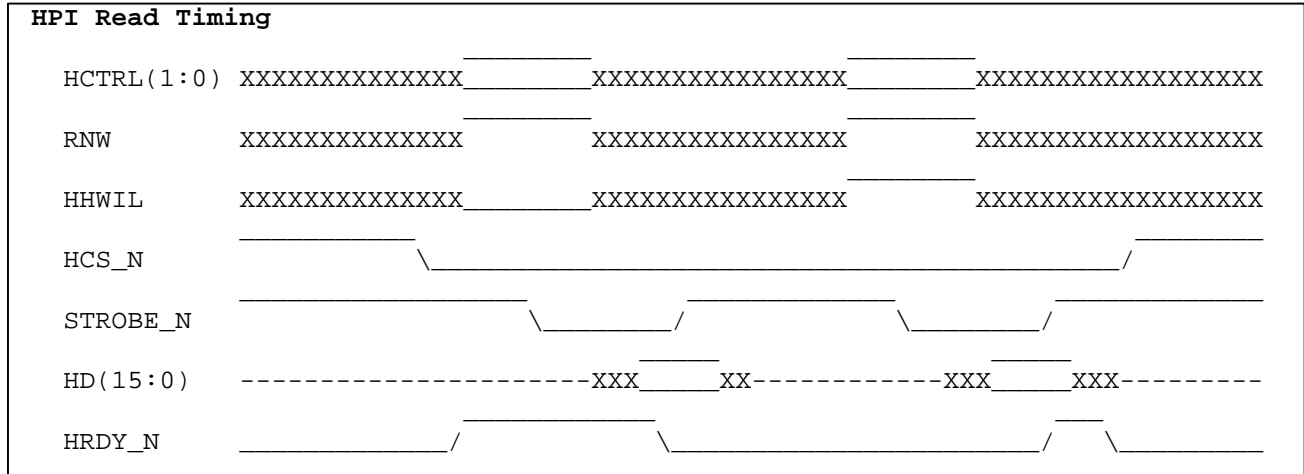
If RNW=0, and A(24:20)=DSP access, then DTACK\_N will be set to a value of 1 to hold off completion of the VME cycle, D(31:0) will be latched into registers in the PRM when DBE\_N(3:0) transitions to 0. HHWIL will be asserted low and D(15:0) will be placed on the HPI data bus, STROBE\_N will transition to active, and stay low until HRDY\_N transitions from high to low. D(31:16) will be placed on the HPI data bus (D(15:0)), HHWIL will be asserted high, and STROBE\_N will transition to active to write the second half-word into the DSP. The state machine will clear STROBE\_N, and will wait for HRDY\_N to return low before clearing DTACK\_N.

#### Read Algorithm

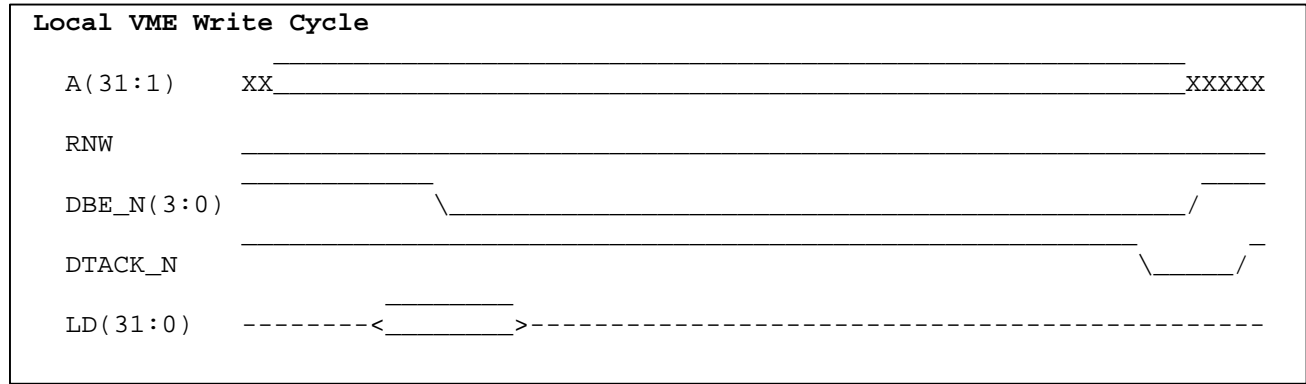
If RNW=1, and A(24:20)=DSP access, then DTACK\_N will be set to a value of 1 to hold off completion of the VME cycle. HHWIL will be asserted low, and then STROBE\_N will transition from high to low. When HRDY\_N transitions from high

## APPENDIX B: ROD VME Access Registers

to low, the data on the HPI data bus will be latched into the lower half word register in the PRM on the rising edge of STROBE\_N. HHWIL will be set high, and STROBE\_N will be asserted low again, and the second half-word will be latched into the PRM data register that maps to D(31:16) on the rising edge of STROBE\_N. After HRDY\_N transitions from high to low, D(31:0) will be placed on the LVME data bus and DTACK\_N will be asserted low to complete the VME cycle.



## APPENDIX B: ROD VME Access Registers



### Functional Procedure: Block Transfer Read from Slave DSP0 CE3 SDRAM to Host

Function	VME Register	Data Value	Notes
Write HWOB Value to Slave0 HPIC	MDSP HPIA 0x{BA}200000	0x00780000	These steps are performed by the Master DSP after a reset, and are not required.
	MDSP HPID 0x{BA}600000	0x00010000	
Write first address location of the block to the Slave HPIA	MDSP HPIA 0x{BA}200000	0x00780004	This location is the first address in CE3 Memory space
	MDSP HPID 0x{BA}600000	0x03000000	
Write Address of the Slave DSP HPID++ to the Master DSP HPIA address	MDSP HPIA 0x{BA}200000	0x00780008	Slave 0 HPID++ Register
Read from the Master DSP HPID	MDSP HPID 0x{BA}600000	Read Data	The Address value used for the Master DSP HPID register can increment from 0x600000 to 0x7FFFFFFF.

### Functional Procedure: Block Transfer Write from the Host to Slave DSP0 CE3 SDRAM

Function	VME Register	Data Value	Notes
Write HWOB Value to Slave0 HPIC	MDSP HPIA 0x{BA}200000	0x00780000	These steps are performed by the Master DSP after a reset, and are not required.
	MDSP HPID 0x{BA}600000	0x00010000	
Write first address location of the block to the Slave HPIA	MDSP HPIA 0x{BA}200000	0x00780004	This location is the first address in CE3 Memory space
	MDSP HPID 0x{BA}600000	0x03000000	
Write Address of the Slave DSP HPID++ to the Master DSP HPIA address	MDSP HPIA 0x{BA}200000	0x00780008	Slave 0 HPID++ Register
Write to the Master DSP HPID	MDSP HPID 0x{BA}600000	Data	The Address value used for the Master DSP HPID register can increment from 0x600000 to 0x7FFFFFFF.



## APPENDIX B: ROD VME Access Registers

### Program Reset Manager

Description	Address	Access	Width
<b>PRM: FPGA Configuration Control Register</b>	<b>{BA}C00000</b>	<b>RW</b>	<b>7</b>
All bits in the Register are Self-Clearing, unless noted otherwise.		<b>Bit Value</b>	
		<b>1</b>	<b>0</b>
<b>Bit 0: Configure ROD Controller FPGA</b> If this bit is set, the ROD Controller FPGA will be erased and programmed with a Configuration Bit Stream.		Configure Controller	Idle
<b>Bit 1: Configure Formatter A&amp;B</b> If this bit is set, the ROD Formatter FPGA chips will be erased and programmed with a Configuration Bit Stream.		Configure Formatters	Idle
<b>Bit 2: Configure Formatter A&amp;B</b> If this bit is set, the ROD Formatter FPGA chips will be erased and programmed with a Configuration Bit Stream.		Configure Formatters	Idle
<b>Bit 3: Configure EFB</b> If this bit is set, the ROD Event Fragment Builder FPGA will be erased and programmed with a Configuration Bit Stream.		Configure EFB	Idle
<b>Bit 4: Configure Router</b> If this bit is set, the ROD Router FPGA will be erased and programmed with a Configuration Bit Stream.		Configure Router	Idle
<b>Bit 5: Configure All</b> If this bit is set, all of FPGA chips on the ROD will be erased and programmed with a Configuration Bit Stream.		Configure All	Idle
<b>Bit 6: Configure Override</b> Bit 6 is used to override the configuration of the ROD. This function is used when the ROD will not exit Configuration Mode automatically. It allows the user to access all of the Flash memories on the ROD in the case that a configuration problem occurs or if the board is powered on for the first time with blank Flash Memories. <b>THIS BIT IS NOT SELF-CLEARING</b>		Override Configure	Idle

Description	Address	Access	Width
<b>PRM: FPGA Reset Control Register</b>	<b>{BA}C00004</b>	<b>RW</b>	<b>7</b>
All bits in the Register are Self-Clearing, unless noted otherwise.		<b>Bit Value</b>	
		<b>1</b>	<b>0</b>
<b>Bit 0: Reset ROD Controller FPGA</b> If this bit is set, the ROD Controller FPGA will be reset.		Reset	Idle
<b>Bit 1: Reset Formatter A</b> If this bit is set, the Bank A Formatter FPGA chips will be reset.		Reset	Idle
<b>Bit 2: Reset Formatter B</b> If this bit is set, the Bank B Formatter FPGA chips will be reset.		Reset	Idle
<b>Bit 3: Reset EFB</b> If this bit is set, the Event Fragment Builder FPGA will be reset.		Reset	Idle
<b>Bit 4: Reset Router</b> If this bit is set, the Router FPGA will be reset.		Reset	Idle
<b>Bit 5: Reset All</b> If this bit is set, all of FPGA chips on the ROD will be reset.		Reset	Idle
<b>Bit 6: Hold all FPGAs in Reset</b> If this bit is set, all of FPGA chips on the ROD will be held in reset. <b>THIS BIT IS NOT SELF-CLEARING</b>		Reset	Idle

Description	Address	Access	Width
<b>PRM: DSP Reset Control Register</b>	<b>{BA}C00008</b>	<b>RW</b>	<b>8</b>
Bits 1 to 6 in the Register are Self-Clearing		<b>Bit Value</b>	
		<b>1</b>	<b>0</b>
<b>Bit 0: MDSP Boot Mode Select</b>		HPI Boot	ROM Boot
<b>Bit 1: Reset Master DSP</b> If this bit is set, the Master DSP will be reset.		Reset	Idle
<b>Bit 2: Reset Slave DSP0</b> If this bit is set, Slave DSP0 will be reset.		Reset	Idle
<b>Bit 3: Reset Slave DSP1</b> If this bit is set, Slave DSP1 will be reset.		Reset	Idle
<b>Bit 4: Reset Slave DSP2</b> If this bit is set, Slave DSP2 will be reset.		Reset	Idle
<b>Bit 5: Reset Slave DSP3</b> If this bit is set, Slave DSP1 will be reset.		Reset	Idle
<b>Bit 6: Reset ROD</b> If this bit is set, all DSP and FPGA chips on the ROD will be reset.		Reset	Idle

## APPENDIX B: ROD VME Access Registers

Description	Address	Access	Width
<b>PRM: Flash Control Register</b>	{BA}C0000C	RW	3
All bits in the Register are Self-Clearing			
		Bit Value	
		1	0
<b>Bit 0: Read Flash Direct VME</b> This bit is set to perform a read from the Flash Memory. The data from one read cycle will be stored in the Flash Data Register until the next read operation is performed. The address location to be read must first be loaded into the FLASH Address Register. The data can be read from the FLASH Data Read Register when the cycle is complete.		Read	NOP
<b>Bit 1: Write Flash Direct VME</b> This bit is set to perform a write from the Flash Memory. The address location and data to be written must first be loaded into the FLASH Address and Write Data Register. This bit is used when erasing sectors of the Flash Memory. This write mode allows the user complete control of the write cycle because the PRM does not add any of the unlock commands when this bit is set.		Write	NOP
<b>Bit 2: Write Flash PRM Control</b> This bit is set to perform a write to the Flash Memory with the data stored in the Flash Data Register. This write allows the PRM to control the unlock algorithm of the Flash. This operation requires the correct destination address and data are written to their respective locations before it is set. The address location and data to be written must first be loaded into the FLASH Address and Write Data Register.		Write	NOP

Description	Address	Access	Width
<b>PRM: Flash Address and Write Data Register</b>	{BA}C00010	RW	32
This register is used to transfer the FLASH Address location and write data with one VME access. The Address data is located in bits LD(23:0), and the Write Data is located in bits LD(31:24). A read cycle only requires a valid address; the PRM ignores the data field in this case.			
		Bit Value	
<b>Bits[31:24]: FLASH Memory Write Data</b>		Value	
<b>Bits[23: 0]: FLASH Memory Address Data</b>		Value	

### Address Location Map Table: RevC ROD FLASH Memory

FLASH 0		FLASH 1		FLASH 2	
Begin	End	Begin	End	Begin	End
0xE00000	0xE7FFFF	0xE80000	0xEFFFFFFF	0xF00000	0xF7FFFF

### Address Location Map Table: RevC ROD FPGA Configuration Data

Location File		ROD Controller		Formatters		EFB		Router	
Begin	End	Begin	End	Begin	End	Begin	End	Begin	End
E00000	E000FF	E01000	E79E63	E80000	ED232F	ED3000	F25327	F26000	F5F3D7

### Address Location Map Table: RevE ROD FLASH Memory

FLASH 0	
Begin	End
0xE00000	0xFFFFFFFF

### Address Location Map Table: RevE ROD FPGA Configuration Data

ROD Controller		Formatters		EFB		Router	
Begin	End	Begin	End	Begin	End	Begin	End
E00000	E78E63	E80000	EF8E65	F00000	F52327	F80000	FD2327

## APPENDIX B: ROD VME Access Registers

PRM: ROD Miscellaneous Status Register	{BA}C00014	R	4
		Bit Value	
		1	0
Bit 0: ROD Clock Select Status		Internal	BOC
Bit 1: ROD Clock DLL Locked		DLL Locked	Fail
Bit 2: VME Clock DLL Locked		DLL Locked	Fail
Bit 3: ROD Busy		ROD Busy	OK
Bit 4: ROD Type In		Pixel	SCT
Bit 5: Formatter Type In(0) (Pixel Only)			
Bit 6: Formatter Type In(1) (Pixel Only)			
Bit 7: Slink LFF		Error	OK
Bit 8: Slink LDOWN		Error	OK
Bit 9: DSP0 Detect In		DSP0 Present	DSP0 Out
Bit 10: DSP1 Detect In		DSP1 Present	DSP1 Out
Bit 11: DSP2 Detect In		DSP2 Present	DSP2 Out
Bit 12: DSP3 Detect In		DSP3 Present	DSP3 Out
Bit 13: MDSP HRDY_N		HPI Busy	HPI Ready
Bit 14: LVME LACK N			

Description	Address	Access	Width
PRM: FPGA Configuration Status Register	{BA}C00020	R	6
		Bit Value	
		1	0
Bit 0: ROD Controller FPGA Configuration Done		Done	Fail
Bit 1: Formatter A Configuration Done		Done	Fail
Bit 2: Formatter B Configuration Done		Done	Fail
Bit 3: EFB Configuration Done		Done	Fail
Bit 4: Router Configuration Done		Done	Fail
Bit 5: Configuration Active If this bit is set, the PRM is in Configuration mode. While this bit is true, the VME is not able to access the FLASH Memory.		Configure Mode	Normal

Description	Address	Access	Width
PRM: FPGA Reset Status Register	{BA}C00024	R	6
		Bit Value	
		1	0
Bit 0: ROD Controller FPGA Reset Control Signal State		OK	Reset
Bit 1: Formatter A Reset Control Signal State		OK	Reset
Bit 2: Formatter B Reset Control Signal State		OK	Reset
Bit 3: EFB Reset Control Signal State		OK	Reset
Bit 4: Router Reset Control Signal State		OK	Reset

Description	Address	Access	Width
PRM: DSP Reset Status Register	{BA}C00028	R	6
All bits in the Register are Self-Clearing		Bit Value	
		1	0
Bit 0: Not Used		OK	Reset
Bit 1: Master DSP Reset Control Signal State		OK	Reset
Bit 2: Slave DSP0 Reset Control Signal State		OK	Reset
Bit 3: Slave DSP1 Reset Control Signal State		OK	Reset
Bit 4: Slave DSP2 Reset Control Signal State		OK	Reset
Bit 5: Slave DSP3 Reset Control Signal State		Reset	Idle

Description	Address	Access	Width
PRM: FPGA INIT_N Status Register	{BA}C00024	R	6
Indicates the state of the FPGA INIT bit. If the bit is true, and the DONE is true, then the FPGA chips are operating.		Bit Value	
		1	0
Bit 0: ROD Controller FPGA INIT_N Control Signal State		OK	Clear
Bit 1: Formatter A INIT_N Control Signal State		OK	Clear
Bit 2: Formatter B INIT_N Control Signal State		OK	Clear
Bit 3: EFB INIT_N Control Signal State		OK	Clear
Bit 4: Router INIT_N Control Signal State		OK	Clear

## APPENDIX B: ROD VME Access Registers

Description	Address	Access	Width
<b>PRM: Flash Status Register</b>	{BA}C00030	R	3
All bits in the Register are Self-Clearing		<b>Bit Value</b>	
		1	0
<b>Bit 0: Read Flash Direct VME Status</b>		Read	NOP
<b>Bit 1: Write Flash Direct VME Status</b>		Write	NOP
<b>Bit 2: Write Flash PRM Control Status</b>		Write	NOP

Description	Address	Access	Width
<b>PRM: FPGA Configuration Halt Status Register</b>	{BA}C00034	R	6
Indicates the state of the FPGA configuration. If the bit is true, the FPGA configuration failed.		<b>Bit Value</b>	
		1	0
<b>Bit 0: ROD Controller FPGA Configuration Halt Signal State</b>		Fail	OK
<b>Bit 1: Formatter A Configuration Halt Signal State</b>		Fail	OK
<b>Bit 2: Formatter B Configuration Halt Signal State</b>		Fail	OK
<b>Bit 3: EFB Configuration Halt Signal State</b>		Fail	OK
<b>Bit 4: Router Configuration Halt Signal State</b>		Fail	OK

Description	Address	Access	Width
<b>PRM: ROD Serial Number</b>	{BA}C00038	R	32
		<b>Bit Value</b>	
<b>Bits[ 9: 0]: Serial Number</b>		Value	
<b>Bits[15:12]: FPGA Code Version</b>		Value	
<b>Bits[23:16]: ROD Board Revision</b>		Value	
<b>Bits[31:24]: ROD ID</b>		ADh	

Description	Address	Access	Width
<b>PRM: Flash Data Read Register</b>	{BA}C0003C	R	8
		<b>Bit Value</b>	
<b>Bits[7:0]: FLASH Memory READ Data</b> Byte Order [Bits(7:0)->Bits(31:24)]		Value	

## APPENDIX B: ROD VME Access Registers

### FPGA Configuration Flash Memory Write/Control Information **REV C ONLY**

#### Part Number:

SST39VF040-90-4C-NH, 512Kx8 Flash Memory, 90ns, 10K min cycle, 32-pin PLCC

#### Device Operation

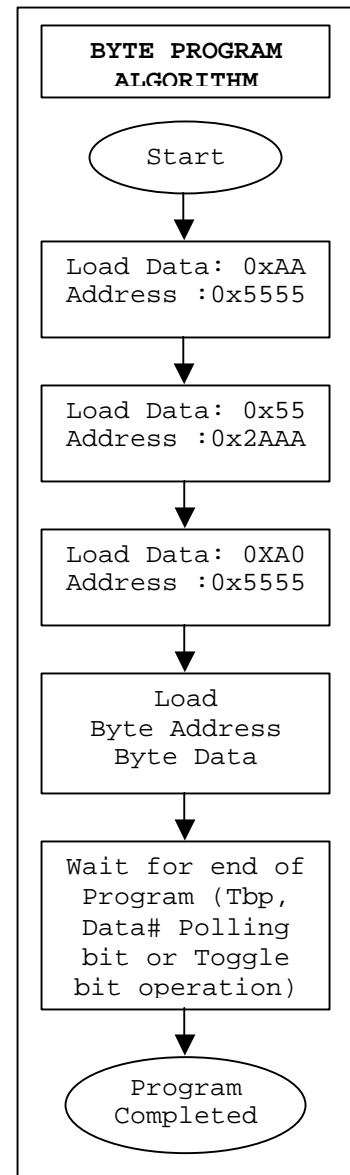
Commands are used to initiate the memory operation functions of the device. Commands are written to the device using standard microprocessor write sequences. A command is written by asserting WE# low while keeping CE# low. The address bus is latched on the falling edge of WE# or CE#, whichever occurs last. The data bus is latched on the rising edge of WE# or CE#, whichever occurs first.

#### Read

The Read operation of the SST39VF040 device is controlled by CE# and OE#, both have to be low for the system to obtain data from the outputs. CE# is used for device selection. When CE# is high, the chip is deselected and only standby power is consumed. OE# is the output control and is used to gate data from the output pins. The data bus is in high impedance state when either CE# or OE# is high.

#### Byte-Program Operation

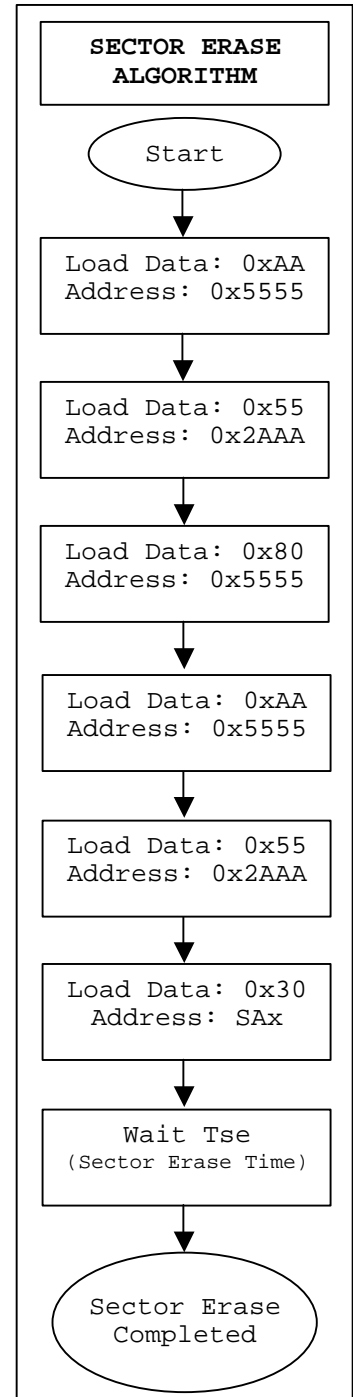
The SST39VF040 are programmed on a byte-by-byte basis. Before programming, the sector where the byte exists must be fully erased. The Program operation is accomplished in three steps. The first step is the three-byte load sequence for Software Data Protection. The second step is to load byte address and byte data. During the Byte-Program operation, the addresses are latched on the falling edge of either CE# or WE#, whichever occurs last. The data is latched on the rising edge of either CE# or WE#, whichever occurs first. The third step is the internal Program operation which is initiated after the rising edge of the fourth WE# or CE#, whichever occurs first. The Program operation, once initiated, will be completed, within 20  $\mu$ s. During the Program operation, the only valid reads are Data# Polling and Toggle Bit. During the internal Program operation, the host is free to perform additional tasks. Any commands written during the internal Program operation will be ignored.



## APPENDIX B: ROD VME Access Registers

### Sector-Erase Operation

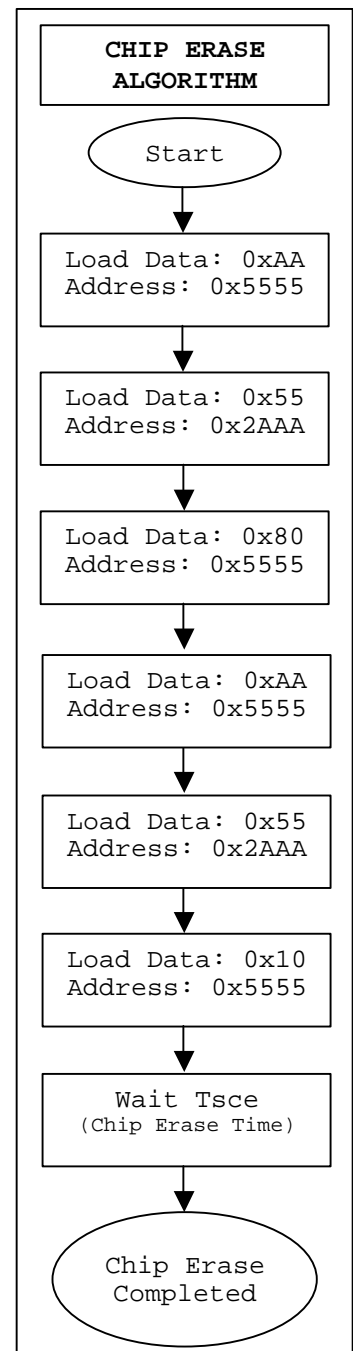
The Sector-Erase operation allows the system to erase the device on a sector-by-sector basis. The sector architecture is based on uniform sector size of 4 KByte. The Sector-Erase operation is initiated by executing a six-byte command sequence with Sector-Erase command (30H) and sector address (SA) in the last bus cycle. The sector address is latched on the falling edge of the sixth WE# pulse, while the command (30H) is latched on the rising edge of the sixth WE# pulse. The internal Erase operation begins after the sixth WE# pulse. The End-of-Erase can be determined using either Data# Polling or Toggle Bit methods. Any commands written during the Sector-Erase operation will be ignored.



## APPENDIX B: ROD VME Access Registers

### Chip-Erase Operation

The SST39VF040 device provides a Chip-Erase operation, which allows the user to erase the entire memory array to the '1's state. This is useful when the entire device must be quickly erased. The Chip-Erase operation is initiated by executing a six-byte Software Data Protection command sequence with Chip-Erase command (10H) with address 5555H in the last byte sequence. The internal Erase operation begins with the rising edge of the sixth WE# or CE#, whichever occurs first. During the internal Erase operation, the only valid read is Toggle Bit or Data# Polling. Any commands written during the Chip-Erase operation will be ignored.



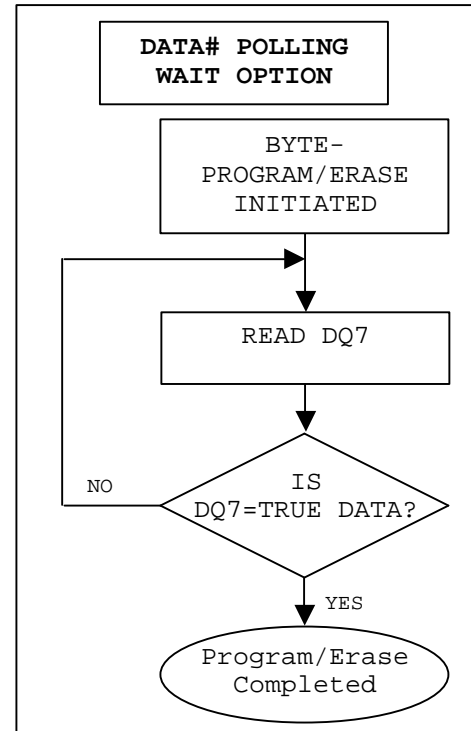
### Write Operation Status Detection

The SST39VF040 device provides two software means to detect the completion of a Write (Program or Erase) cycle, in order to optimize the system write cycle time. The software detection includes two status bits: Data# Polling (DQ7) and Toggle Bit (DQ6). The End-of-Write detection mode is enabled after the rising edge of WE# which initiates the internal Program or Erase operation. The actual completion of the nonvolatile write is asynchronous with the system; therefore, either a Data# Polling or Toggle Bit read may be simultaneous with the completion of the Write cycle. If this occurs, the system may possibly get an erroneous result (i.e., valid data may appear to conflict with either DQ7 or DQ6). In order to prevent spurious rejection, if an erroneous result occurs, the software routine should include a loop to read the accessed location an additional two (2) times. If both reads are valid, then the device has completed the Write cycle, otherwise the rejection is valid.

## APPENDIX B: ROD VME Access Registers

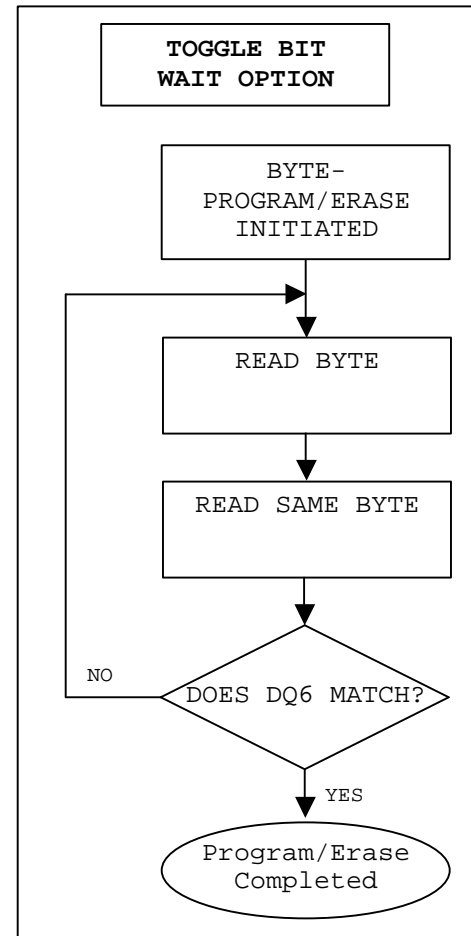
### Data# Polling (DQ7)

When the SST39VF040 is in the internal Program operation, any attempt to read DQ7 will produce the complement of the true data. Once the Program operation is completed, DQ7 will produce true data. Note that even though DQ7 may have valid data immediately following completion of an internal Write operation, the remaining data outputs may still be invalid: valid data on the entire data bus will appear in subsequent successive Read cycles after an interval of 1 $\mu$ s. During internal Erase operation, any attempt to read DQ7 will produce a "0". Once the internal Erase operation is completed, DQ7 will produce a "1". The Data# Polling is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector- or Chip-Erase, the Data# Polling is valid after the rising edge of sixth WE# (or CE#) pulse.



### Toggle Bit (DQ6)

During the internal Program or Erase operation, any consecutive attempts to read DQ6 will produce alternating '0's and '1's, i.e., toggling between 0 and 1. When the internal Program or Erase operation is completed, the toggling will stop. The device is then ready for the next operation. The Toggle Bit is valid after the rising edge of fourth WE# (or CE#) pulse for Program operation. For Sector- or Chip-Erase, the Toggle Bit is valid after the rising edge of sixth WE# (or CE#) pulse.



## APPENDIX B: ROD VME Access Registers

### Software Data Protection (SDP)

The SST39040 provide the JEDEC approved Software Data Protection scheme for all data alteration operation, i.e., Program and Erase. Any Program operation requires the inclusion of a series of three-byte sequence. The three-byte load sequence is used to initiate the Program operation, providing optimal protection from inadvertent Write operations, e.g., during the system power-up or power-down. Any Erase operation requires the inclusion of six-byte load sequence. These devices are shipped with the Software Data Protection permanently enabled. During SDP command sequence, invalid commands will abort the device to read mode, within TRC.

### Product Identification

The Product Identification mode identifies the devices as the SST39VF040 and manufacturer as SST. This mode may be accessed by software operations. Users may use the Software Product Identification operation to identify the part (i.e., using the device ID) when using multiple manufacturers in the same socket.

Manufacturer's ID: 0000H BFH

Device ID: SST39LF/VF040 0001H D7H

### Product Identification Mode Exit/Reset

In order to return to the standard Read mode, the Software Product Identification mode must be exited. Exit is accomplished by issuing the Software ID Exit command sequence, which returns the device to the Read operation. Please note that the Software ID Exit command is ignored during an internal Program or Erase operation.

**TABLE 1: FLASH SOFTWARE COMMAND SEQUENCE**

Flash Software Command Sequence												
Command Sequence	1st Bus Write Cycle		2nd Bus Write Cycle		3rd Bus Write Cycle		4th Bus Write Cycle		5th Bus Write Cycle		6th Bus Write Cycle	
	ADDR <sup>(1)</sup>	DATA	ADDR <sup>(1)</sup>	DATA	ADDR <sup>(1)</sup>	DATA	ADDR <sup>(1)</sup>	DATA	ADDR <sup>(1)</sup>	DATA	ADDR <sup>(1)</sup>	DATA
Byte-Program	0x5555	0xAA	0X2AAA	0X55	0X5555	0XA0	BA <sup>(2)</sup>	DATA				
Sector Erase	0x5555	0xAA	0X2AAA	0X55	0X5555	0X80	0x5555	0xAA	0X2AAA	0X55	SAX <sup>(3)</sup>	0X30
Chip Erase	0x5555	0xAA	0X2AAA	0X55	0X5555	0X80	0x5555	0xAA	0X2AAA	0X55	0X5555	0X10
Software ID Entry <sup>(4,5)</sup>	0x5555	0xAA	0X2AAA	0X55	0X5555	0X90						
Software ID Exit <sup>(6)</sup>	0xXX	0XF0										
Software ID Exit <sup>(6)</sup>	0x5555	0xAA	0X2AAA	0X55	0X5555	0XF0						

1. Address format A14-A0 (Hex),  
Addresses AMS-A15 can be VIL or VIH, but no other value, for the Command sequence.  
AMS = Most significant address  
AMS = A15 for SST39LF/VF512, A16 for SST39LF/VF010, A17 for SST39LF/VF020, and A18 for SST39LF/VF040
2. BA = Program Byte address
3. SAX for Sector-Erase; uses AMS-A12 address lines
4. The device does not remain in Software Product ID mode if powered down.
5. With AMS-A1 = 0; SST Manufacturer's ID = BFH, is read with A0 = 0,  
SST39LF/VF040 Device ID = D7H, is read with A0 = 1
6. Both Software ID Exit operations are equivalent.