

Introduction

The XPS SYSMON ADC IP Core is a 32-bit slave peripheral that connects to the PLB (Processor Local Bus) and provides the controller interface for System Monitor (SYSMON) hard macro on Virtex-5 and Virtex-6 family of FPGAs. This document describes the specifications for XPS SYSMON ADC IP Core. It is assumed that user is familiar with SYSMON hard macro. For information on SYSMON hard macro, see the System Monitor user guide mentioned in [Reference Documents](#) section.

Features

- Connects as a 32-bit slave on PLB V4.6 buses of 32, 64, or 128 bits
- Uses dedicated System Monitor (SYSMON) hard macro on Virtex-5 and Virtex-6 devices
- Supports 10-bit, 200-kSPS (kilo-Samples Per Second) Analog-to-Digital Converter (ADC)
- Supports on-chip monitoring of supply voltages and temperature
- Supports 1 dedicated high bandwidth differential analog-input pair and 16 auxiliary low bandwidth differential analog-input pairs
- Supports automatic alarms based on user defined limits
- Supports optional interrupt request generation

LogiCORE™ Facts		
Core Specifics		
Supported Device Family	Virtex®-5, Virtex-6	
Version of Core	xps_sysmon_adc	v2.00a
Resources Used		
	Min	Max
Slices	Refer to the Table 13 , Table 14	
LUTs		
FFs		
Block RAMs	N/A	
Special Features	N/A	
Provided with Core		
Documentation	Product Specification	
Design File Formats	VHDL	
Constraints File	N/A	
Verification	N/A	
Instantiation Template	N/A	
Reference Designs & Application Notes	N/A	
Additional Items	N/A	
Design Tool Requirements		
Xilinx Implementation Tools	ISE® 11.1i or later	
Verification	ModelSim SE/EE 6.4b or later	
Simulation	ModelSim SE/EE 6.4b or later	
Synthesis	XST 11.1i or later	
Support		
Provided by Xilinx, Inc.		

Functional Description

The top-level block diagram for the XPS SYSMON ADC IP Core is shown in **Figure 1**.

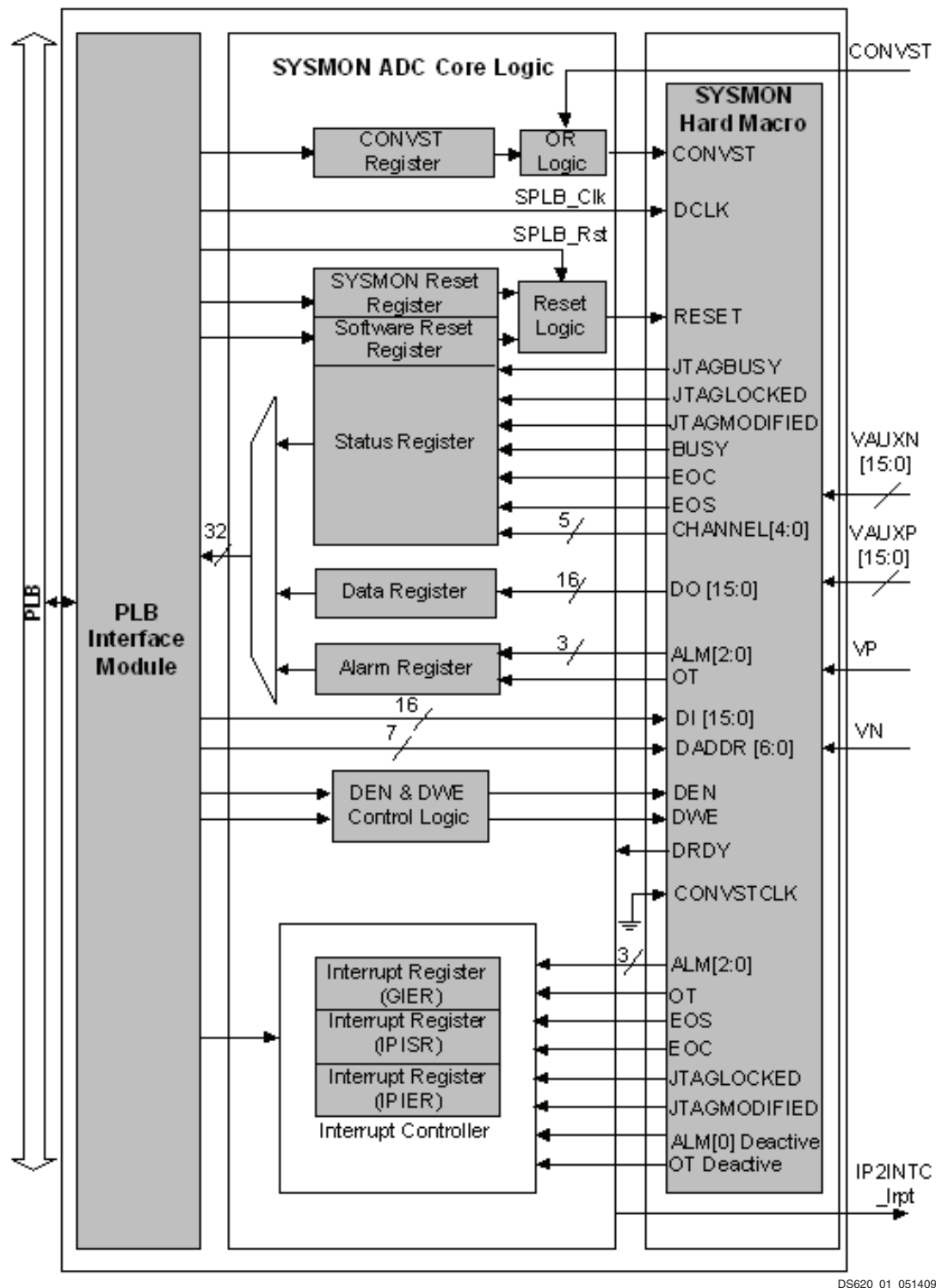


Figure 1: Block Diagram of XPS SYSMON ADC IP Core

The XPS SYSMON ADC IP Core consists of following major blocks.

- PLB Interface Module
- SYSMON ADC Core Logic
- SYSMON Hard Macro

PLB Interface Module

The PLB Interface Module provides the interface to the PLB. Read and write transactions at the PLB are translated into equivalent SYSMON ADC Core Logic and SYSMON hard macro transactions. The register interfaces of the SYSMON ADC Core Logic connect to the PLB Interface Module. The PLB Interface Module also provides an address decoding service.

SYSMON ADC Core Logic

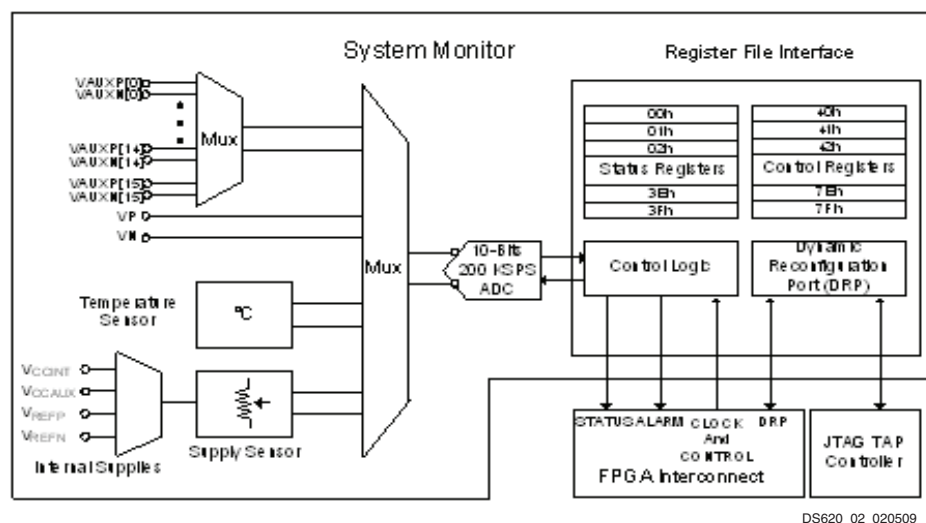
The SYSMON ADC Core Logic provides necessary address decoding logic, control signal generation and interface between PLB and SYSMON hard macro. The read/write requests along with the address and data (in case of write) from the PLB Interface Module are transferred to either Dynamic Reconfiguration Port (DRP) registers of SYSMON hard macro or local registers in the IP along with the necessary control signals like DEN and DWE.

The SYSMON ADC Core Logic supports including/excluding Interrupt Controller based on generic C_INCLUDE_INTR. If C_INCLUDE_INTR = 1 then the Interrupt Controller is included in the design.

The SYSMON hard macro can be accessed via both JTAG TAP (Test Access Port) and XPS SYSMON ADC IP Core. When simultaneous access of the SYSMON hard macro occurs, JTAGLOCKED port can be asserted high by JTAG TAP. In this scenario the XPS SYSMON ADC IP Core will not be allowed to do any read/write access from/to DRP. When JTAGLOCKED port is again de-asserted through JTAG TAP, XPS SYSMON ADC IP Core can do read/write operation from/to DRP.

This functionality is specially useful in applications where user is configuring DRP through JTAG TAP and does not want fabric (XPS SYSMON ADC IP Core) to alter the configuration. User can make JTAGLOCKED = '1' through JTAG TAP which blocks any read/write transactions from/to DRP through fabric and thus ensures a non-destructive access through JTAG TAP.SYSMON Hard Macro

The SYSMON hard macro is present in every Virtex-5 and Virtex-6 FPGA. The block diagram for the System Monitor ADC hard macro on a Virtex-5 FPGA is shown in Figure 2.



The XPS SYSMON ADC IP core is built around dedicated System Monitor hard macro on Virtex-5 and Virtex-6 device family. The hard macro uses 10-bit, 200-KSPS ADC internally for conversion of various analog data. The XPS SYSMON ADC IP Core is used to measure die temperature and voltage. Additionally, the XPS SYSMON ADC IP Core provides analog to digital conversion of up to 17 external channels. From a user point of view, the core is defined as a XPS SYSMON ADC which can operate to monitor on-chip voltage and temperature and/or external analog voltages.

The SYSMON hard macro consists of Register File Interface (RFI) which in turn consists of Status and Control registers. Status registers are read-only and contain the results of analog-to-digital conversion of the on-chip sensors and external channels. The status registers also store the maximum and minimum temperature and VCCAUX/VCCINT voltages. The control registers are used to configure the SYSMON hard macro operation. SYSMON hard macro functionality (ADC operating modes, Channel Sequencer, and Alarm limits) is controlled through these registers. The first three registers in the control register block are also called as Configuration Registers, used to configure SYSMON hard macro operating modes. In addition to RFI of hard macro, the XPS SYSMON ADC IP Core consists a set of local register and optional interrupt registers.

The SYSMON hard macro provides channel sequencing, averaging and filtering functions. Many of the 16 bit registers are not defined in SYSMON hard macro RFI. Accessing a location which is undefined, returns undefined value.

In the SYSMON hard macro, a channel sequencer allows the user to specify the channels monitored but the sequence order is fixed. Users can specify an averaging filter to reduce noise. There are programmable alarm thresholds for the on-chip sensors and if an on chip temperature or voltage is enabled and outside the specified limit an alarm is activated.

Structurally, the XPS SYSMON ADC IP Core consists of the SYSMON hard macro, the PLB Interface Module, Optional Interrupt Source Controller Module, Soft Reset Module, SYSMON Reset Register and additional logic to interface to the core. The Soft Reset Module provides a way for resetting the entire IP without disturbing the entire system. The SYSMON Reset Register is provided to reset the SYSMON hard macro only.

All read and write operations to the configuration and limit registers are synchronized to DCLK (DCLK input of SYSMON hard macro is connected to SPLB_Clk). SYSMON hard macro has a internal clock divider which divides DCLK by any integer ranging from 2- 255 to generate ADCCLK. ADCCLK is an internal clock used by the ADC. Because an internal clock divider is provided, DCLK frequency can be in the range of 2 MHz to 200 MHz. Please refer the Virtex-5 and Virtex-6 FPGA data sheets for maximum operating frequency of SYSMON ADC.

The SYSMON hard macro operates either in event driven or continuous sampling mode. In event driven sampling mode, the conversion process is initiated on rising edge of CONVST. The XPS SYSMON ADC supports this operation by providing a rising edge signal on external CONVST port or by writing into CONVST Register. In continuous sampling mode, the ADC continuous to carry out a conversion on the selected analog inputs as long as the ADCCLK (DCLK) is present. For more information on SYSMON hard macro please refer the System Monitor user guide mentioned in [Reference Documents](#) section.

XPS SYSMON ADC Design Parameters

To allow the user to obtain a XPS SYSMON ADC IP Core that is uniquely tailored for the system, certain features can be parameterized in the XPS SYSMON ADC design. This allows the user to configure a design that utilizes the resources required by the system only and that operates with the best possible performance. The features that can be parameterized are as shown in [Table 1](#).

Table 1: XPS SYSMON ADC Design Parameters

Generic	Feature/Description	Parameter Name	Allowable Values	Default Value	VHDL Type
System Parameters					
G1	Target FPGA family	C_FAMILY	"virtex5", "virtex6"	"virtex5"	string
PLB Parameters					
G2	PLB base address	C_BASEADDR	Valid Address ⁽¹⁾	None ⁽²⁾	std_logic_vector
G3	PLB high address	C_HIGHADDR	Valid Address ⁽¹⁾	None ⁽²⁾	std_logic_vector
G4	PLB least significant address bus width	C_SPLB_AWIDTH	32	32	integer
G5	PLB data width	C_SPLB_DWIDTH	32, 64, 128	32	integer
G6	Shared bus topology	C_SPLB_P2P	0 = Shared bus topology ⁽³⁾	0	integer
G7	PLB master ID bus Width	C_SPLB_MID_WIDTH	$\log_2(\text{C_SPLB_NUM_MASTERS})$ with a minimum value of 1	1	integer
G8	Number of PLB masters	C_SPLB_NUM_MASTERS	1 - 16	1	integer
G9	Width of the slave data bus	C_SPLB_NATIVE_DWIDTH	32	32	integer
G10	Burst support	C_SPLB_SUPPORT_BURSTS	0 = No burst support ⁽⁴⁾	0	integer
XPS SYSMON ADC Parameters					
G11	Include/Exclude interrupt support	C_INCLUDE_INTR	0 = Exclude interrupt support 1 = Include interrupt support	1	integer
G12	File name for Analog input stimuli	C_SIM_MONITOR_FILE	string	Design.txt	string

Notes:

1. The range C_BASEADDR to C_HIGHADDR is the address range for the XPS SYSMON ADC. This range is subject to restrictions to accommodate the simple address decoding scheme that is employed: The size, C_HIGHADDR - C_BASEADDR + 1, must be a power of two and must be at least 0x400 to accommodate all XPS SYSMON ADC registers. However, a larger power of two may be chosen to reduce decoding logic. C_BASEADDR must be aligned to a multiple of the range size.
2. No default value will be specified to ensure that an actual value appropriate to the system is set.
3. Point to point bus topology is not supported.
4. Burst is not supported.

XPS SYSMON ADC I/O Signals

The XPS SYSMON ADC I/O signals are listed and described in [Table 2](#).

Table 2: XPS SYSMON ADC I/O Signal Descriptions

Port	Signal Name	Interface	I/O	Initial State	Description
System Signals					
P1	SPLB_Clk	System	I	-	PLB clock
P2	SPLB_Rst	System	I	-	PLB reset, active high
P3	IP2INTC_Irpt	System	O	0	Interrupt control signal from XPS SYSMON ADC
PLB Interface Signals					
P4	PLB_ABus[0 : 31]	PLB	I	-	PLB address bus
P5	PLB_PAVValid	PLB	I	-	PLB primary address valid
P6	PLB_masterID[0 : C_SPLB_MID_WIDTH - 1]	PLB	I	-	PLB current master identifier
P7	PLB_RNW	PLB	I	-	PLB read not write
P8	PLB_BE[0 : (C_SPLB_DWIDTH/8) - 1]	PLB	I	-	PLB byte enables
P9	PLB_size[0 : 3]	PLB	I	-	PLB size of requested transfer
P10	PLB_type[0 : 2]	PLB	I	-	PLB transfer type
P11	PLB_wrDBus[0 : C_SPLB_DWIDTH - 1]	PLB	I	-	PLB write data bus
Unused PLB Interface Signals					
P12	PLB_UABus[0 : 31]	PLB	I	-	PLB upper address bits
P13	PLB_SAVValid	PLB	I	-	PLB secondary address valid
P14	PLB_rdPrim	PLB	I	-	PLB secondary to primary read request indicator
P15	PLB_wrPrim	PLB	I	-	PLB secondary to primary write request indicator
P16	PLB_abort	PLB	I	-	PLB abort bus request
P17	PLB_busLock	PLB	I	-	PLB bus lock
P18	PLB_MSize[0 : 1]	PLB	I	-	PLB data bus width indicator
P19	PLB_lockErr	PLB	I	-	PLB lock error
P20	PLB_wrBurst	PLB	I	-	PLB burst write transfer
P21	PLB_rdBurst	PLB	I	-	PLB burst read transfer
P22	PLB_wrPendReq	PLB	I	-	PLB pending bus write request
P23	PLB_rdPendReq	PLB	I	-	PLB pending bus read request
P24	PLB_wrPendPri[0 : 1]	PLB	I	-	PLB pending write request priority

Table 2: XPS SYSMON ADC I/O Signal Descriptions (Contd)

Port	Signal Name	Interface	I/O	Initial State	Description
P25	PLB_rdPendPri[0 : 1]	PLB	I	-	PLB pending read request priority
P26	PLB_reqPri[0 : 1]	PLB	I	-	PLB current request priority
P27	PLB_TAttribute[0 : 15]	PLB	I	-	PLB transfer attribute
PLB Slave Interface Signals					
P28	Sl_addrAck	PLB	O	0	Slave address acknowledge
P29	Sl_SSize[0 : 1]	PLB	O	0	Slave data bus size
P30	Sl_wait	PLB	O	0	Slave wait
P31	Sl_rearbitrate	PLB	O	0	Slave bus re-arbitrate
P32	Sl_wrDAck	PLB	O	0	Slave write data acknowledge
P33	Sl_wrComp	PLB	O	0	Slave write transfer complete
P34	Sl_rDBus[0 : C_SPLB_DWIDTH - 1]	PLB	O	0	Slave read data bus
P35	Sl_rDAck	PLB	O	0	Slave read data acknowledge
P36	Sl_rDComp	PLB	O	0	Slave read transfer complete
P37	Sl_MBusy[0 : C_SPLB_NUM_MASTERS - 1]	PLB	O	0	Slave busy
P38	Sl_MWtErr[0 : C_SPLB_NUM_MASTERS - 1]	PLB	O	0	Slave write error
P39	Sl_MRdErr[0 : C_SPLB_NUM_MASTERS - 1]	PLB	O	0	Slave read error
Unused PLB Slave Interface Signals					
P40	Sl_wrBTerm	PLB	O	0	Slave terminate write burst transfer
P41	Sl_rdWdAddr[0 : 3]	PLB	O	0	Slave read word address
P42	Sl_rdBTerm	PLB	O	0	Slave terminate read burst transfer
P43	Sl_MIRQ[0 : C_SPLB_NUM_MASTERS - 1]	PLB	O	0	Master interrupt request
XPS SYSMON ADC IP Core Interface Signals					
P44	VAUXP[15 : 0]	SYSMON	I	-	Positive auxiliary differential analog inputs

Table 2: XPS SYSMON ADC I/O Signal Descriptions (Contd)

Port	Signal Name	Interface	I/O	Initial State	Description
P45	VAUXN[15 : 0]	SYSMON	I	-	Negative auxiliary differential analog inputs
P46	CONVST	SYSMON	I	-	Convert Start input port is used to control the sampling instant on the ADC input and is used only in event-driven sampling mode. This port will be auto connected to ground internally, if not in use.
P47	ALARM[2:0]	SYSMON	O	0	SYSMON hard macro Alarm output signals

XPS SYSMON ADC Parameter - Port Dependencies

The dependencies between the XPS SYSMON ADC IP Core design parameters and I/O signals are described in Table 3.

Table 3: XPS SYSMON ADC Parameter-Port Dependencies

Generic or Port	Name	Affects	Depends	Relationship Description
Design Parameters				
G5	C_SPLB_DWIDTH	P8, P11, P34	-	Affects the number of bits in data bus
G7	C_SPLB_MID_WIDTH	P6	G8	This value is calculated as: $\log_2(\text{C_SPLB_NUM_MASTERS})$ with a minimum value of 1
G8	C_SPLB_NUM_MASTERS	P37, P38, P39, P43	-	Affects the number of PLB masters
I/O Signals				
P6	PLB_masterID[0 : C_SPLB_MID_WIDTH - 1]	-	G7	Width of the PLB_masterID varies according to C_SPLB_MID_WIDTH
P8	PLB_BE[0 : (C_SPLB_DWIDTH/8) - 1]	-	G5	Width of the PLB_BE varies according to C_SPLB_DWIDTH
P11	PLB_wrDBus[0 : C_SPLB_DWIDTH - 1]	-	G5	Width of the PLB_wrDBus varies according to C_SPLB_DWIDTH
P34	SI_rdbus[0 : C_SPLB_DWIDTH - 1]	-	G5	Width of the SI_rdbus varies according to C_SPLB_DWIDTH
P37	SI_MBus[0 : C_SPLB_NUM_MASTERS - 1]	-	G8	Width of the SI_MBus varies according to C_SPLB_NUM_MASTERS
P38	SI_MWrErr[0 : C_SPLB_NUM_MASTERS - 1]	-	G8	Width of the SI_MWrErr varies according to C_SPLB_NUM_MASTERS
P39	SI_MRdErr[0 : C_SPLB_NUM_MASTERS - 1]	-	G8	Width of the SI_MRdErr varies according to C_SPLB_NUM_MASTERS
P43	SI_MIRQ[0 : C_SPLB_NUM_MASTERS - 1]	-	G8	Width of the SI_MIRQ varies according to C_SPLB_NUM_MASTERS

XPS SYSMON ADC Register Descriptions

Table 4 shows the XPS SYSMON ADC IP Core registers and their corresponding addresses.

Table 4: XPS SYSMON ADC IP Core Registers

Base Address + Offset (hex)	Register Name	Access Type	Default Value (hex)	Description
XPS SYSMON ADC Local Register Grouping				
C_BASEADDR + 0x00	Software Reset Register (SRR)	Write ⁽¹⁾	N/A	Software reset register
C_BASEADDR + 0x04	Status Register (SR)	Read ⁽²⁾	N/A	Status register
C_BASEADDR + 0x08	Alarm Output Status Register (AOSR)	Read ⁽²⁾	0x0	Alarm output status register
C_BASEADDR + 0x0C	CONVST Register (CONVSTR)	Write ⁽¹⁾	N/A	ADC convert start register ⁽³⁾
C_BASEADDR + 0x10	SYSMON Reset Register (SYSMONRR)	Write ⁽¹⁾	N/A	SYSMON hard macro reset register
XPS SYSMON ADC Interrupt Controller Register Grouping				
C_BASEADDR + 0x5C	Global Interrupt Enable Register (GIER)	R/W	0x0	Global interrupt enable register
C_BASEADDR + 0x60	IP Interrupt Status Register (IPISR)	R/TOW ⁽⁴⁾	N/A	IP interrupt status register
C_BASEADDR + 0x68	IP Interrupt Enable Register (IPIER)	R/W	0x0	IP interrupt enable register
SYSMON Hard Macro Register Grouping⁽⁵⁾				
C_BASEADDR + 0x200	Temperature	Read ⁽⁶⁾	N/A	The 10-bit MSB justified result of on-chip temperature measurement is stored in this register
C_BASEADDR + 0x204	V _{CCINT}	Read ⁽⁶⁾	N/a	The 10-bit MSB justified result of on-chip V _{CCINT} supply monitor measurement is stored in this register
C_BASEADDR + 0x208	V _{CCAUX}	Read ⁽⁶⁾	N/A	The 10-bit MSB justified result of on-chip V _{CCAUX} Data supply monitor measurement is stored in this register

Table 4: XPS SYSMON ADC IP Core Registers (Contd)

Base Address + Offset (hex)	Register Name	Access Type	Default Value (hex)	Description
C_BASEADDR + 0x20C	V _P /V _N	R/W ⁽⁷⁾	0x0	When read: The 10-bit MSB justified result of A/D conversion on the dedicated analog input channel (V _P /V _N) is stored in this register When written: Write to this register will reset the SYSMON hard macro. No specific data is required. Applicable only when the Virtex-6 device is targeted.
C_BASEADDR + 0x210	V _{REFP}	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the reference input V _{REFP} is stored in this register
C_BASEADDR + 0x214	V _{REFN}	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the reference input V _{REFN} is stored in this register
C_BASEADDR + 0x218 to C_BASEADDR + 0x21C	Undefined	N/A	Undefined	These locations are unused and contain invalid data
C_BASEADDR + 0x220	Supply Offset	Read ⁽⁶⁾	N/A	The calibration coefficient for the supply sensor offset is stored in this register
C_BASEADDR + 0x224	ADC Offset	Read ⁽⁶⁾	N/A	The calibration coefficient for the ADC offset calibration is stored in this register
C_BASEADDR + 0x228	Gain Error	Read ⁽⁶⁾	N/A	The calibration coefficient for the gain error is stored in this register
C_BASEADDR + 0x22C to C_BASEADDR + 0x23C	Undefined	N/A	Undefined	These locations are unused and contain invalid data
C_BASEADDR + 0x240	V _{AUXP} [0]/ V _{AUXN} [0]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 0 is stored in this register
C_BASEADDR + 0x244	V _{AUXP} [1]/ V _{AUXN} [1]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 1 is stored in this register
C_BASEADDR + 0x248	V _{AUXP} [2]/ V _{AUXN} [2]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 2 is stored in this register
C_BASEADDR + 0x24C	V _{AUXP} [3]/ V _{AUXN} [3]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 3 is stored in this register
C_BASEADDR + 0x250	V _{AUXP} [4]/ V _{AUXN} [4]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 4 is stored in this register

Table 4: XPS SYSMON ADC IP Core Registers (Contd)

Base Address + Offset (hex)	Register Name	Access Type	Default Value (hex)	Description
C_BASEADDR + 0x254	V _{AUXP} [5]/ V _{AUXN} [5]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 5 is stored in this register
C_BASEADDR + 0x258	V _{AUXP} [6]/ V _{AUXN} [6]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 6 is stored in this register
C_BASEADDR + 0x25C	V _{AUXP} [7]/ V _{AUXN} [7]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 7 is stored in this register
C_BASEADDR + 0x260	V _{AUXP} [8]/ V _{AUXN} [8]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 8 is stored in this register
C_BASEADDR + 0x264	V _{AUXP} [9]/ V _{AUXN} [9]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 9 is stored in this register
C_BASEADDR + 0x268	V _{AUXP} [10]/ V _{AUXN} [10]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 10 is stored in this register
C_BASEADDR + 0x26C	V _{AUXP} [11]/ V _{AUXN} [11]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 11 is stored in this register
C_BASEADDR + 0x270	V _{AUXP} [12]/ V _{AUXN} [12]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 12 is stored in this register
C_BASEADDR + 0x274	V _{AUXP} [13]/ V _{AUXN} [13]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 13 is stored in this register
C_BASEADDR + 0x278	V _{AUXP} [14]/ V _{AUXN} [14]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 14 is stored in this register
C_BASEADDR + 0x27C	V _{AUXP} [15]/ V _{AUXN} [15]	Read ⁽⁶⁾	0x0	The 10-bit MSB justified result of A/D conversion on the auxiliary analog input 15 is stored in this register
C_BASEADDR + 0x280	Max Temp	Read ⁽⁶⁾	N/A	The 10-bit MSB justified maximum temperature measurement
C_BASEADDR + 0x284	Max V _{CCINT}	Read ⁽⁶⁾	N/A	The 10-bit MSB justified maximum V _{CCINT} measurement
C_BASEADDR + 0x288	Max V _{CCAUX}	Read ⁽⁶⁾	N/A	The 10-bit MSB justified maximum V _{CCAUX} measurement
C_BASEADDR + 0x28C	Undefined	N/A	Undefined	This location is unused and contains invalid data
C_BASEADDR + 0x290	Min Temp	Read ⁽⁶⁾	N/A	The 10-bit MSB justified minimum temperature measurement

Table 4: XPS SYSMON ADC IP Core Registers (Contd)

Base Address + Offset (hex)	Register Name	Access Type	Default Value (hex)	Description
C_BASEADDR + 0x294	Min V _{CCINT}	Read ⁽⁶⁾	N/A	The 10-bit MSB justified minimum V _{CCINT} measurement
C_BASEADDR + 0x298	Min V _{CCAUX}	Read ⁽⁶⁾	N/A	The 10-bit MSB justified minimum V _{CCAUX} measurement
C_BASEADDR + 0x29C to C_BASEADDR + 0x2F8	Undefined	N/A	Undefined	These locations are unused and contain invalid data
C_BASEADDR + 0x2FC	Flag Register	Read ⁽⁶⁾	N/A	The 16-bit register gives general status information of ALARM, OT, Disable information of SYSMON and information whether the SYSMON is using internal reference voltage or external reference voltage
C_BASEADDR + 0x300	Configuration Register 0	R/W ⁽⁹⁾	0x0	SYSMON Configuration register 0
C_BASEADDR + 0x304	Configuration Register 1	R/W ⁽⁹⁾	0x0	SYSMON Configuration register 1
C_BASEADDR + 0x308	Configuration Register 2	R/W ⁽⁹⁾	0x1E00	SYSMON Configuration register 2
C_BASEADDR + 0x30C to C_BASEADDR + 0x31C	Test register 0 to 4	N/A	N/A	SYSMON Test register 0 to 4 (for factory test only)
C_BASEADDR + 0x320	Sequence Register 0	R/W	0x0	SYSMON Sequence register 0 (ADC channel selection)
C_BASEADDR + 0x324	Sequence Register 1	R/W	0x0	SYSMON Sequence register 1 (ADC channel selection)
C_BASEADDR + 0x328	Sequence Register 2	R/W	0x0	SYSMON Sequence register 2 (ADC channel averaging enable)
C_BASEADDR + 0x32C	Sequence Register 3	R/W	0x0	SYSMON Sequence register 3 (ADC channel averaging enable)
C_BASEADDR + 0x330	Sequence Register 4	R/W	0x0	SYSMON Sequence register 4 (ADC channel analog-input mode)
C_BASEADDR + 0x334	Sequence Register 5	R/W	0x0	SYSMON Sequence register 5 (ADC channel analog-input mode)
C_BASEADDR + 0x338	Sequence Register 6	R/W	0x0	SYSMON Sequence register 6 (ADC channel acquisition time)
C_BASEADDR + 0x33C	Sequence Register 7	R/W	0x0	SYSMON Sequence register 7 (ADC channel acquisition time)
C_BASEADDR + 0x340	Alarm Threshold Register 0	R/W	0x0	The 10-bit MSB justified alarm threshold register 0 (Temperature Upper)
C_BASEADDR + 0x344	Alarm Threshold Register 1	R/W	0x0	The 10-bit MSB justified alarm threshold register 1 (V _{CCINT} Upper)

Table 4: XPS SYSMON ADC IP Core Registers (Contd)

Base Address + Offset (hex)	Register Name	Access Type	Default Value (hex)	Description
C_BASEADDR + 0x348	Alarm Threshold Register 2	R/W	0x0	The 10-bit MSB justified alarm threshold register 2 (V _{CCAUX} Upper)
C_BASEADDR + 0x34C	Alarm Threshold Register 3	R/W ^(9,10)	0x0	The 12-bit MSB justified alarm threshold register 3 (OT Upper)
C_BASEADDR + 0x350	Alarm Threshold Register 4	R/W	0x0	The 10-bit MSB justified alarm threshold register 4 (Temperature Lower)
C_BASEADDR + 0x354	Alarm Threshold Register 5	R/W	0x0	The 10-bit MSB justified alarm threshold register 5 (V _{CCINT} Lower)
C_BASEADDR + 0x358	Alarm Threshold Register 6	R/W	0x0	The 10-bit MSB justified alarm threshold register 6 (V _{CCAUX} Lower)
C_BASEADDR + 0x35C	Alarm Threshold Register 7	R/W	0x0	The 10-bit MSB justified alarm threshold register 7 (OT Lower)
C_BASEADDR + 0x360 to C_BASEADDR + 0x3FC	Undefined	N/A	Undefined	Do not Read/Write these register
Notes: <ol style="list-style-type: none"> 1. Reading of this register returns undefined value. 2. Writing into this register has no effect. 3. Used in event-driven sampling mode only. 4. TOW = Toggle On Write. Writing a '1' to a bit position within the register causes the corresponding bit position in the register to toggle. 5. These are 16-bit registers internal to SYMON hard macro. These are mapped to lower half word boundary on 32-bit XPS SYMON ADC IP Core registers. For more detail please refer System Monitor Register File Interface section in Virtex-5 and Virtex-6 System Monitor User Guide, UG192 (latest version). 6. Writing to this SYSMON hard macro register is not allowed. The SYSMON ADC hard macro data registers are 16-bits in width. The SYSMON hard macro specification guarantees the first 10-MSB bits accuracy, so only these bits are used for reference. 7. Writing to this register will reset the SYSMON hard macro. No specific data pattern is required to reset the SYSMON hard macro. Reading of this register will give the details of Vp/Vn port. 8. Please read the System Monitor User Guide, UG192 (latest version) for setting the different bits available in configuration registers for Virtex-5 and Virtex-6. 9. The OT Upper register is available only in Virtex-6 FPGA devices. This register location is N/A when Virtex-5 devices are targeted. 10. The OT Upper register is user configurable register for upper threshold level of temperature. If this register is left un-configured, then the SYSMON will consider 125⁰C as upper threshold value for OT. Please note that, while configuring this register, the last 4-bits must be set to 0011 i.e. Alarm Threshold Register 3[3:0] = 0011. Please note that upper 12 bits of this register are user configurable. 				

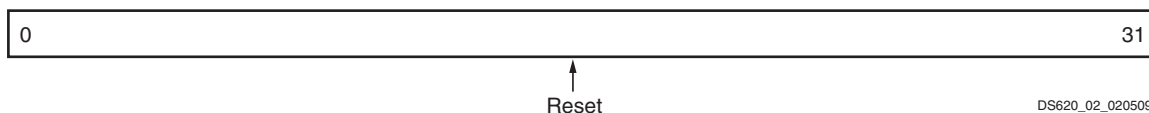
XPS SYSMON ADC Local Register Grouping

It is expected that the XPS SYSMON ADC IP Core registers will be accessed in their preferred-access mode only. If the write attempt is made to read-only registers, then there will not be any effect on register contents. If the write-only registers are read, then it will result in undefined data. All the internal registers of the core have to be accessed in 32-bit format. If any other kind of access (like half word or byte access etc.) is done for XPS

SYSMON ADC IP Core's internal 32 bit registers, then the transaction will be completed with generation of error for corresponding transaction.

Software Reset Register (SRR)

The Software Reset Register permits the programmer to reset the XPS SYSMON ADC IP Core including SYSMON hard macro output ports (except JTAG related outputs), independently of other IP cores in the systems. To activate software reset, the value 0x0000_000A must be written to the register. Any other access, read or write, has undefined results. The bit assignment in the software reset register is shown in Figure 3 and described in Table 5.



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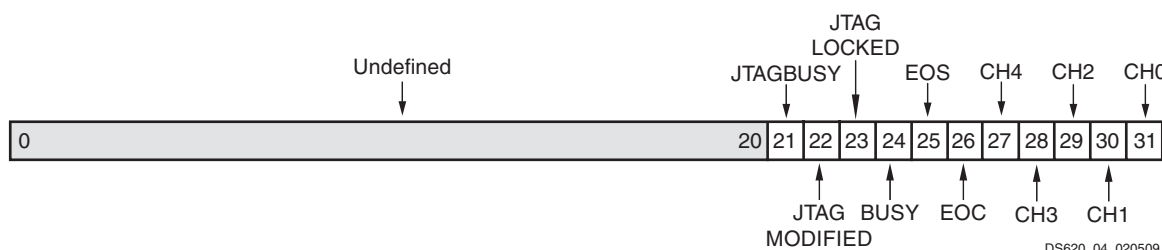
Figure 3: Software Reset Register

Table 5: Software Reset Register Description (C_BASEADDR + 0x00)

Bit(s)	Name	Core Access	Reset Value	Description
0 - 31	Reset	Write only	N/A	The only allowed operation on this register is a write of 0x0000_000A, which resets the XPS SYSMON ADC IP Core. The reset is active only for 2 clock cycles.

Status Register (SR)

Status Register contains the XPS SYSMON ADC IP Core channel status, EOC, EOS, and JTAG access signals. This register is read only. Any attempt to write the bits of the register will not be able to change the bits. The Status Register bit definitions are shown in Figure 4 and explained in Table 6.



DS620_04_020509

Figure 4: Status Register

Table 6: Status Register (C_BASEADDR + 0x04)

Bit(s)	Name	Core Access	Reset Value	Description
0 - 20	Undefined	N/A	N/A	Undefined.
21	JTAGBUSY	Read	'0'	Used to indicate that a JTAG DRP transaction is in progress.
22	JTAG MODIFIED	Read	'0'	Used to indicate that a write to DRP through JTAG interface has occurred. This bit is cleared when a successful DRP read/write operation through fabric is performed. The DRP read/write through fabric fails, if JTAGLOCKED = '1'
23	JTAG LOCKED	Read	'0'	Used to indicate that a DRP port lock request has been made by the Joint Test Action Group (JTAG) interface.

Table 6: Status Register (C_BASEADDR + 0x04) (Contd)

Bit(s)	Name	Core Access	Reset Value	Description
24	BUSY	Read	N/A	ADC busy signal. This signal transitions high during an ADC conversion.
25	EOS	Read	N/A	End of Sequence. This signal transitions to an active High when the measurement data from the last channel in the auto sequence is written to the status registers. This bit is cleared when a read operation is performed on status register.
26	EOC	Read	N/A	End of Conversion signal. This signal transitions to an active High at the end of an ADC conversion when the measurement is written to the SYSMON hard macro's status register. This bit is cleared when a read operation is performed on status register.
27 - 31	CHANNEL [4 : 0]	Read	N/A	Channel selection outputs. The ADC input MUX channel selection for the current ADC conversion is placed on these outputs at the end of an ADC conversion.

Alarm Output Status Register (AOSR)

Alarm Output Status Register contains all the alarm outputs for the XPS SYSMON ADC IP Core. This register is read only. Any attempt to write the bits of the register will not be able to change the bits. The Alarm Output Status Register bit definitions are shown in Figure 5 and explained in Table 7.

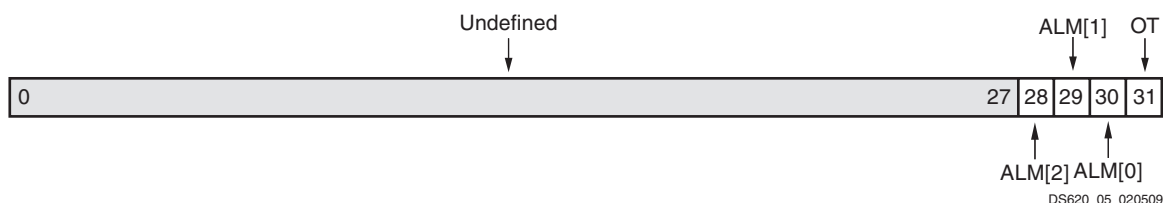


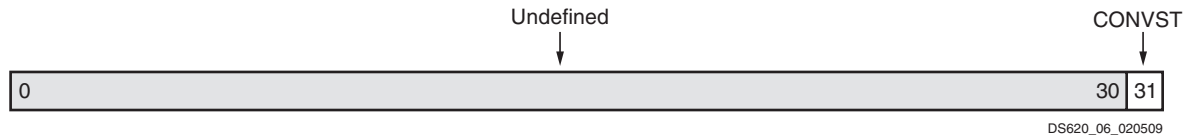
Figure 5: Alarm Output Status Register

Table 7: Alarm Output Status Register (C_BASEADDR + 0x08)

Bit(s)	Name	Core Access	Reset Value	Description
0 - 27	Undefined	N/A	N/A	Undefined.
28	ALM[2]	Read	'0'	System Monitor V_{CCAUX}-sensor Interrupt. System Monitor V _{CCAUX} -sensor alarm output interrupt occurs when V _{CCAUX} exceeds user defined threshold.
29	ALM[1]	Read	'0'	System Monitor V_{CCINT}-sensor Interrupt. System Monitor V _{CCINT} -sensor alarm output interrupt occurs when V _{CCINT} exceeds user defined threshold.
30	ALM[0]	Read	'0'	System Monitor temperature-sensor Interrupt. System Monitor temperature-sensor alarm output interrupt occurs when device temperature exceeds user defined threshold.
31	OT	Read	'0'	Over-Temperature alarm Interrupt. Over-Temperature alarm output interrupt occurs when the die temperature exceeds a factory set limit of 125 degree celsius.

CONVST Register (CONVSTR)

The CONVST Register is used for initiating a new conversion in the event-driven sampling mode. The output of this register is logically OR'ed with external CONVST input signal. The attempt to read this register will result un-defined data. The CONVST Register bit definitions are shown in Figure 6 and explained in Table 8.



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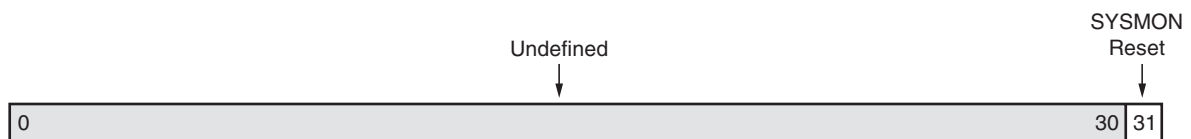
Figure 6: CONVST Register

Table 8: CONVST Register (C_BASEADDR + 0x0C)

Bit(s)	Name	Core Access	Reset Value	Description
0 - 30	Undefined	N/A	N/A	Undefined.
31	CONVST	Write	'0'	A rising edge on the CONVST input initiates start of ADC conversion in event-driven sampling mode. For selected channel the CONVST bit in the register needs to be set to '1' and again reset to '0' to start a new conversion cycle. The conversion cycle ends with EOC bit going high.

SYSMON Reset Register (SYSMONRR)

SYSMON Reset Register is used to reset only the SYSMON hard macro. As soon as the reset is released the ADC begins with a new conversion. If sequencing is enabled this conversion is the first in the sequence. This register resets the OT and ALM[n] output from SYSMON hard macro. This register does not reset the interrupt registers if they are included in the design. Also note that any reset from the fabric does not affect the RFI (Register File Interface) contents of SYSMON hard macro. The attempt to read this register will result un-defined data. The SYSMON Reset Register bit definitions are shown in Figure 7 and explained in Table 9.



DS620_07_020509

Figure 7: SYSMON Reset Register

Table 9: SYSMON Reset Register (C_BASEADDR + 0x10)

Bit(s)	Name	Core Access	Reset Value	Description
0 - 30	Undefined	N/A	N/A	Undefined.
31	SYSMON Reset	Write	'0'	Writing '1' to this bit position resets the SYSMON hard macro. The reset is released only after '0' is written to this register.

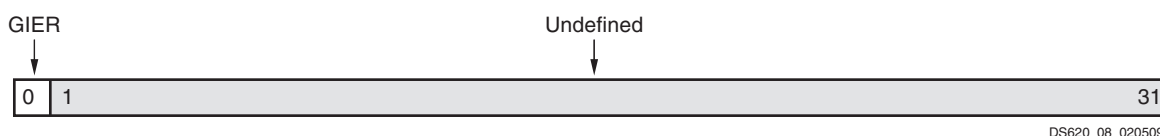
XPS SYSMON ADC Interrupt Controller Register Grouping

The Interrupt Controller Module is included in XPS SYSMON ADC IP Core design when `C_INCLUDE_INTR = '1'`. The XPS SYSMON ADC has number of distinct interrupts that are sent to the Interrupt Controller Module which is one of the sub-modules of XPS SYSMON ADC IP Core. The Interrupt Controller Module allows each interrupt to be enabled independently (via the IP interrupt enable register (PIER)). All the interrupt signals are rising edge sensitive.

The interrupt registers are in the Interrupt Controller Module. The XPS SYSMON ADC IP Core permits multiple conditions for an interrupt, or an interrupt strobe which occurs only after the completion of a transfer.

Global Interrupt Enable Register (GIER)

The Global Interrupt Enable Register (GIER) is used to globally enable the final interrupt output from the Interrupt Controller as shown in Figure 8 and described in Table 10. This bit is a read/write bit and is cleared upon reset.



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Figure 8: Global Interrupt Enable Register (GIER)

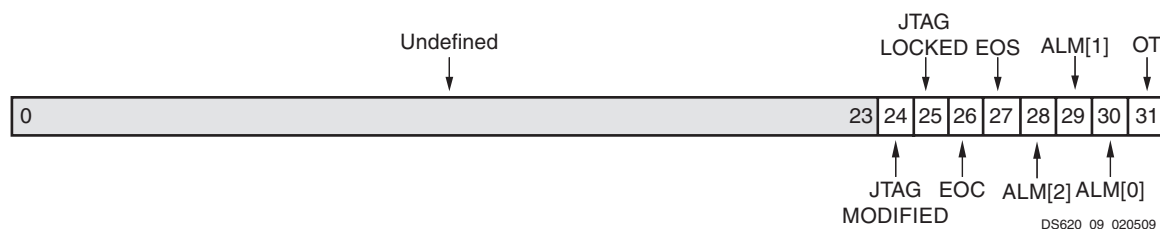
Table 10: Global Interrupt Enable Register (GIER) Description (C_BASEADDR + 0x5C)

Bit(s)	Name	Access	Reset Value	Description
0	GIER	R/W	'0'	Global Interrupt Enable Register. It enables all individually enabled interrupts to be passed to the interrupt controller. '0' = Disabled '1' = Enabled
1 - 31	Undefined	N/A	N/A	Undefined.

IP Interrupt Status Register (IPISR)

Six unique interrupt conditions are possible in XPS SYSMON ADC IP Core.

The Interrupt Controller has a register that can enable each interrupt independently. Bit assignment in the Interrupt register for a 32-bit data bus is shown in Figure 9 and described in Table 11. The interrupt register is a read/toggle on write register and by writing a '1' to a bit position within the register causes the corresponding bit position in the register to 'toggle'. All register bits are cleared upon reset.



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Figure 9: IP Interrupt Status Register (IPISR)

Table 11: IP Interrupt Status Register (IPISR) Description (C_BASEADDR + 0x60)

Bit(s)	Name	Access	Reset Value	Description
0 - 21	Undefined	N/A	N/A	Undefined.
22	ALM[0] Deactive	R/TOW ⁽¹⁾	'0'	<p>ALM[0] Deactive Interrupt. This signal indicates that falling edge of the ALM[0] (ALM[0] indicates the user temperature range violation) signal is detected. It is cleared by writing '1' to this bit position.</p> <p>Note: Please note that "ALM[0] Deactive" signal is generated locally from the core. This signal indicates that the SYSMON macro has deactivated the user temperature violation signal output.</p>
23	OT Deactive	R/TOW ⁽¹⁾	'0'	<p>OT Deactive Interrupt. This signal indicates that falling edge of the Over Temperature signal is detected. It is cleared by writing '1' to this bit position.</p> <p>Note: Please note that "OT Deactive" signal is generated locally from the core. This signal indicates that the SYSMON macro has deactivated the Over Temperature signal output.</p>
24	JTAG MODIFIED	R/TOW ⁽¹⁾⁽²⁾	'0'	JTAGMODIFIED Interrupt. This signal indicates that a write to DRP through JTAG interface has occurred. It is cleared by writing '1' to this bit position.
25	JTAG LOCKED	R/TOW ⁽¹⁾⁽²⁾	'0'	JTAGLOCKED Interrupt. This signal is used to indicate that a DRP port lock request has been made by the Joint Test Action Group (JTAG) interface.
26	EOC	R/TOW ⁽¹⁾⁽²⁾	N/A	End of Conversion signal Interrupt. This signal transitions to an active High at the end of an ADC conversion when the measurement is written to the SYSMON hard macro's status register.
27	EOS	R/TOW ⁽¹⁾⁽²⁾	N/A	End of Sequence Interrupt. This signal transitions to an active High when the measurement data from the last channel in the auto sequence is written to the status registers.
28	ALM[2]	R/TOW ⁽¹⁾⁽²⁾	'0'	System Monitor V_{CCAUX}-sensor Interrupt. System Monitor V _{CCAUX} -sensor alarm output interrupt occurs when V _{CCAUX} exceeds user defined threshold.
29	ALM[1]	R/TOW ⁽¹⁾⁽²⁾	'0'	System Monitor V_{CCINT}-sensor Interrupt. System Monitor V _{CCINT} -sensor alarm output interrupt occurs when V _{CCINT} exceeds user defined threshold.
30	ALM[0]	R/TOW ⁽¹⁾⁽²⁾	'0'	System Monitor temperature-sensor Interrupt. System Monitor temperature-sensor alarm output interrupt occurs when device temperature exceeds user defined threshold.
31	OT	R/TOW ⁽¹⁾⁽²⁾	'0'	Over-Temperature alarm Interrupt. Over-Temperature alarm output interrupt occurs when the die temperature exceeds a factory set limit of 125 degree celsius.

Notes:

1. TOW = Toggle On Write. Writing a '1' to a bit position within the register causes the corresponding bit position in the register to toggle.
2. This interrupt signal is directly generated from SYSMON hard macro.

IP Interrupt Enable Register (IPIER)

The IPIER has an enable bit for each defined bit of the IPISR as shown in Figure 10 and described in Table 12. All bits are cleared upon reset.

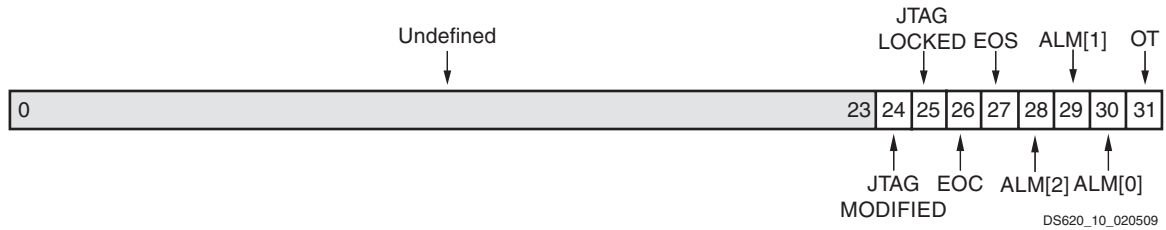


Figure 10: IP Interrupt Enable Register (IPIER)

Table 12: IP Interrupt Enable Register (IPIER) Description (C_BASEADDR + 0x68)

Bit(s)	Name	Access	Reset Value	Description
0 - 21	Undefined	N/A	N/A	Undefined.
22	ALM[0] Deactive	R/W	'0'	ALM[0] Deactive Interrupt '0' = Disabled '1' = Enabled
23	OT Deactive	R/W	'0'	OT Deactive Interrupt '0' = Disabled '1' = Enabled
24	JTAG MODIFIED	R/W	'0'	JTAGMODIFIED Interrupt '0' = Disabled '1' = Enabled
25	JTAG LOCKED	R/W	'0'	JTAGLOCKED Interrupt '0' = Disabled '1' = Enabled
26	EOC	R/W	'0'	End of Conversion signal Interrupt '0' = Disabled '1' = Enabled
27	EOS	R/W	'0'	End of Sequence Interrupt '0' = Disabled '1' = Enabled
28	ALM[2]	R/W	'0'	System Monitor V_{CCAUX}-sensor Interrupt '0' = Disabled '1' = Enabled
29	ALM[1]	R/W	'0'	System Monitor V_{CCINT}-sensor Interrupt '0' = Disabled '1' = Enabled
30	ALM[0]	R/W	'0'	System Monitor temperature-sensor Interrupt '0' = Disabled '1' = Enabled
31	OT	R/W	'0'	Over-Temperature alarm Interrupt '0' = Disabled '1' = Enabled

More about Locally Generated Interrupt Bits in IPIER and IPISR

The interrupt bits ranging from the bit-24 to bit-31 in IPISR as well as IPIER are direct output signals of SYSMON hard macro. The signals like OT Deactive (bit-23) and ALM[0] Deactive (bit-22) are locally generated in the core. These two interrupts will be generated on the falling edge of the Over Temperature and AML[0] signals. The falling edge of these two signals may be used in controlling external things like controlling fan or air-conditioning of the system etc. Please refer the Virtex 5 FPGA System Monitor user guide ([UG192](#)) for detailed reference about the significance of these interrupts.

SYSMON Hard Macro Register Grouping

The SYSMON hard macro register set consists of all the registers present in SYSMON hard macro on Virtex-5 and Virtex-6 FPGAs. The addresses of these registers are mentioned in [Table 4](#). Since these registers are 16-bit wide but the processor data bus is 32-bit wide, the hard macro register data resides on lower 16 bits of 32-bit data bus as shown in [Figure 11](#). The 10-bit MSB aligned A/D converted value of different channels from SYSMON hard macro are left shifted and resides from bit position 16 to 25 of processor data bus. The remaining bit positions from 26 to 31 should be ignored while considering the ADC data for different channels. Along with 16-bit data, JTAGMODIFIED and JTAGLOCKED bits are passed which can be used by the software driver application for determining the validity of the DRP read data. The JTAGMODIFIED bit is cleared when a DRP read/write operation through fabric is successful. A DRP read/write through fabric fails, if JTAGLOCKED = '1'. The JTAGLOCKED signal is independently controlled through JTAG TAP. It is expected that these SYSMON hard macro registers should be accessed in their preferred access-mode only. The XPS SYSMON ADC IP Core will not be able to differentiate any non-preferred access to the SYSMON hard macro registers. For more information on these registers please refer the [Reference Documents](#) section.

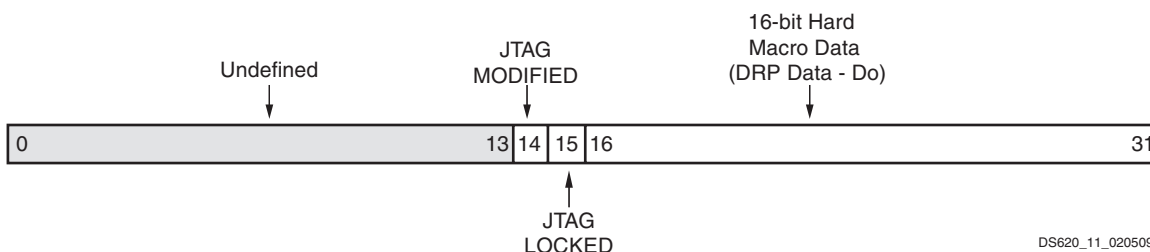


Figure 11: SYSMON Hard Macro Register

XPS SYSMON ADC Timing Diagrams

Figure 12 shows the write operation and Figure 13 shows the read operation waveform for XPS SYSMON ADC IP Core Local Registers. Figure 14 shows the write operation and Figure 15 shows the read operation waveform for SYSMON hard macro registers through XPS SYSMON ADC IP Core.

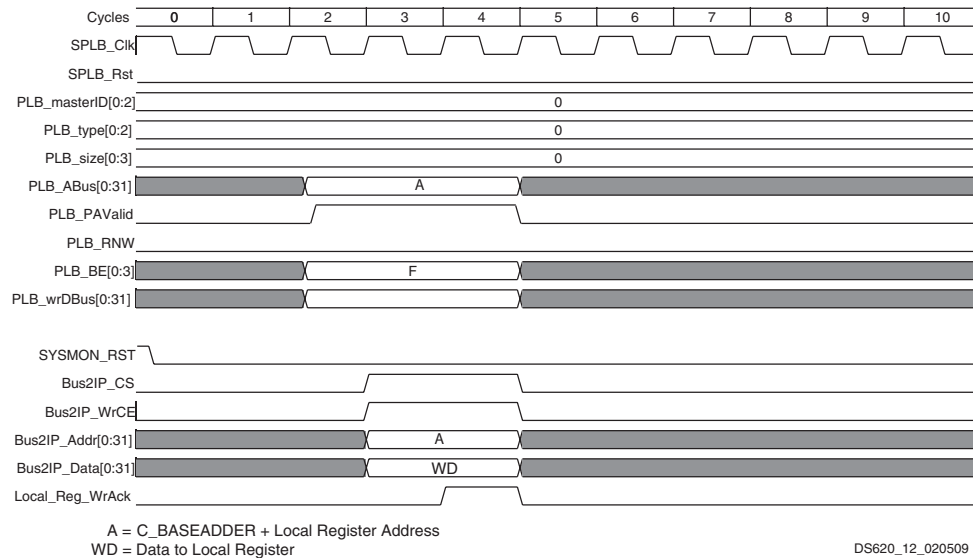


Figure 12: XPS SYSMON ADC IP Core Local Register Write Operation

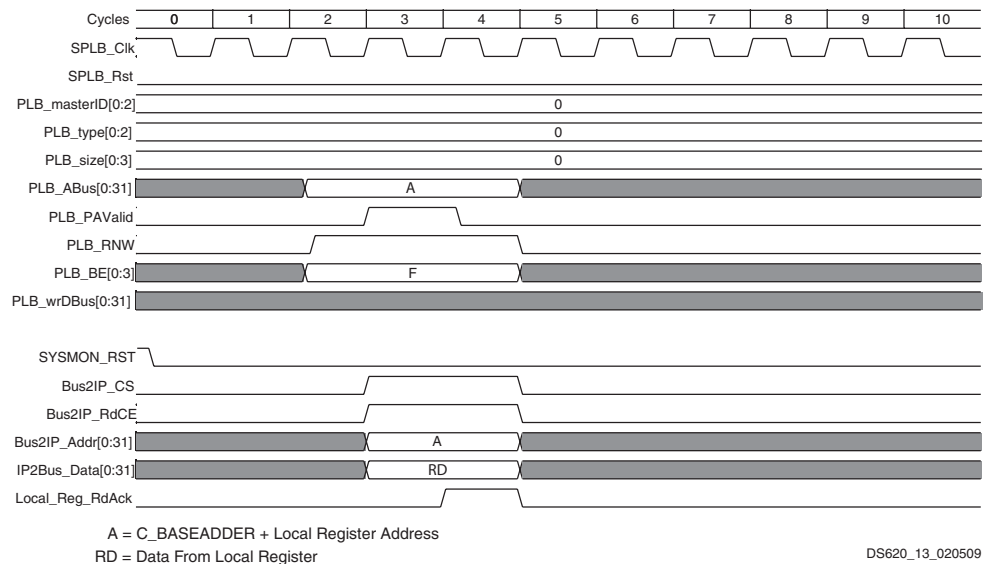


Figure 13: XPS SYSMON ADC IP Core Local Register Read Operation

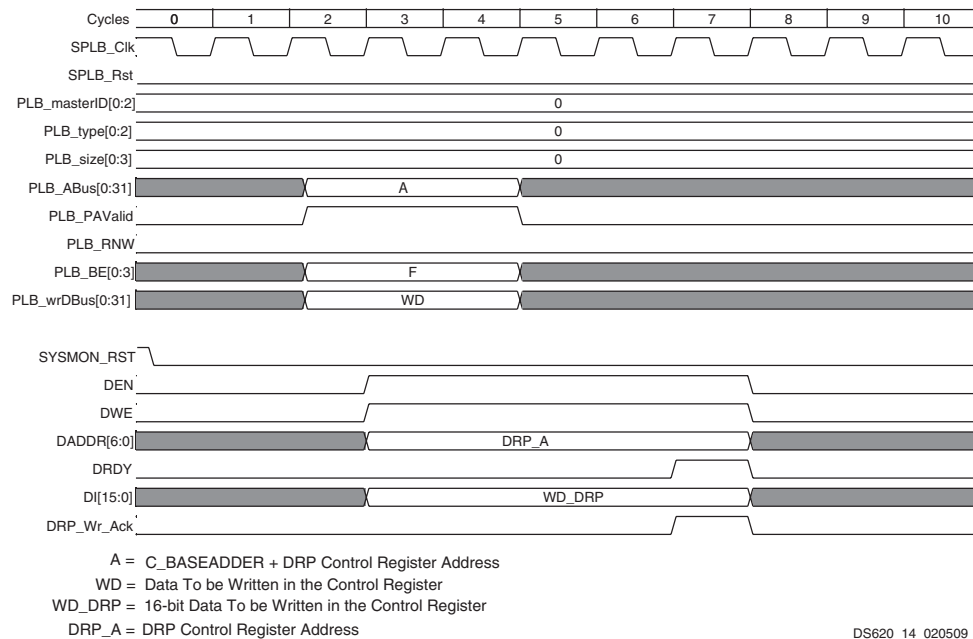


Figure 14: SYSMON Hard Macro Register Write Operation

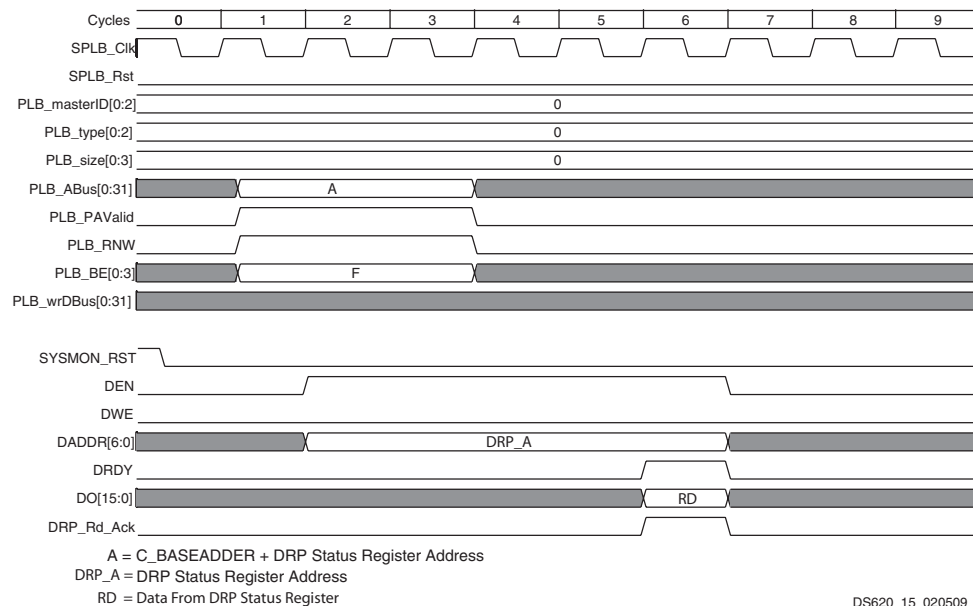


Figure 15: SYSMON Hard Macro Register Read Operation

Design Constraints

Note: An example User Constraints File for this core is available and must be modified for use in the system. Please refer to the *EDK Getting Started Guide* for the location of this file.

Timing Constraints

For complete timing coverage, it is recommended that following timing constraints on SYSMON hard macro ports is specified along with SPLB_Clk input constraint. An example is shown in [Figure 16](#).

```
NET "SPLB_Clk" TNM NET = "SPLB_Clk";
TIMESPEC "TS_SPLB_Clk" = PERIOD "SPLB_Clk" 6.6 ns HIGH 50%;
```

Figure 16: XPS SYSMON ADC Timing Constraints

Design Implementation

Target Technology

The intended target technology is Virtex-5 and Virtex-6 family FPGAs.

Device Utilization and Performance Benchmarks

Core Performance

Since the XPS SYSMON ADC IP Core will be used with other design modules in the FPGA, the utilization and timing numbers reported in this section are estimates only. When the XPS SYSMON ADC IP Core is combined with other designs in the system, the utilization of FPGA resources and timing of the XPS SYSMON ADC IP Core design will vary from the results reported here.

The XPS SYSMON ADC IP Core resource utilization for various parameter combinations measured with the Virtex-5 FPGA as the target device are detailed in [Table 13](#).

Table 13: Performance and Resource Utilization Benchmarks on the Virtex-5 FPGA (xc5vlx50-ff676-1)

Parameter Values (Other parameters at default values)	Device Resources		Performance
C_INCLUDE_INTR	Slice Flip-Flops	LUTs	F _{Max} (MHz)
0	169	112	179
1	231	136	217

The XPS SYSMON ADC IP Core resource utilization for various parameter combinations measured with the Virtex-6 FPGA as the target device are detailed in [Table 14](#).

Table 14: Performance and Resource Utilization Benchmarks on the Virtex-6 FPGA (xc6vlx130t-ff1156-1)

Parameter Values (Other parameters at default values)	Device Resources		Performance
C_INCLUDE_INTR	Slice Flip-Flops	LUTs	F _{Max} (MHz)
0	170	172	226
1	232	269	191

System Performance

To measure the system performance (F_{MAX}) of the XPS SYSMON ADC core, it was added to a Virtex-5 and Virtex-6 FPGA system as the Device Under Test (DUT) as shown in [Figure 17](#).

Because the XPS SYSMON ADC core will be used with other design modules in the FPGA, the utilization and timing numbers reported in this section are estimates only. When this core is combined with other designs in the system, the utilization of FPGA resources and timing of the core design will vary from the results reported here.

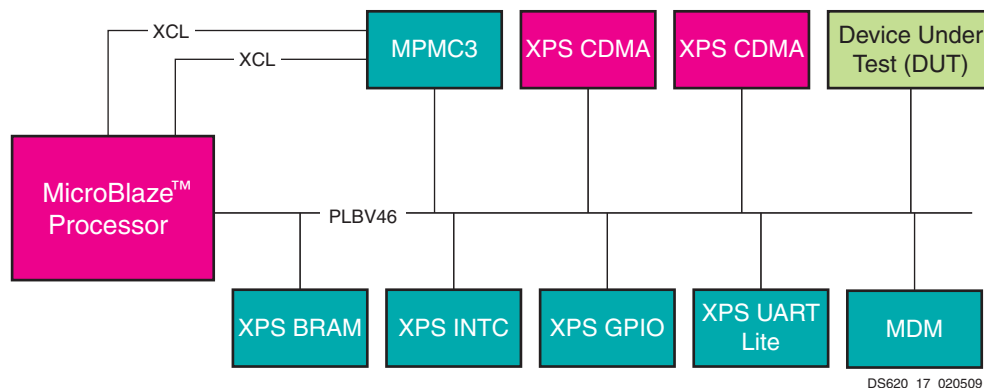


Figure 17: Virtex-5 LX FPGA System with the XPS SYSMON ADC Core as the DUT

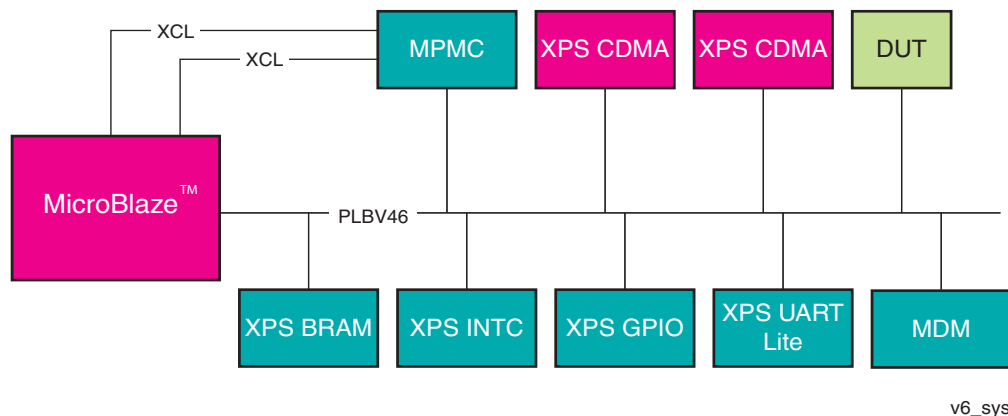


Figure 18: Virtex-6 System with the XPS SYSMON ADC Core as the DUT

The target FPGA was then filled with logic to drive the LUT and BRAM utilization to approximately 70% and the I/O utilization to approximately 80%. Using the default tool options and the slowest speed grade for the target FPGA, the resulting target F_{MAX} numbers are shown in [Table 15](#).

Table 15: XPS SYSMON ADC Core System Performance

Target FPGA	Target F_{MAX} (MHz)
V5LXT50 -1	120
V6LXT130-1	150

The target F_{MAX} is influenced by the exact system and is provided for guidance. It is not a guaranteed value across all systems.

User Application Examples

This section provides examples on configuring XPS SYSMON ADC IP Core in either continuous cycling of sequence or single channel (continuous or event driven) mode. It is assumed that the user is aware with the XPS SYSMON ADC IP Core Register Description given in [Table 4 on page 9](#).

Continuous Cycling Of Sequence Mode Example

To configure XPS SYSMON ADC IP Core in Continuous Cycling of Sequence Mode, SEQ1 and SEQ0 bits in Configuration Register 1 should be set to '1' and '0' respectively. The specific value written to registers may vary depending upon the need of application. Below is the configuration example for monitoring On-Chip Temperature, V_{CCINT} and V_{CCAUX} channel in continuous cycling of sequence mode with clock ratio set to 32.

1. Issue a software reset by writing the data word 0x0000_000A to the SRR. This asserts the reset of XPS SYSMON ADC IP Core for 2 clock cycles.
2. Write 0x0000_0000 to Configuration Register 0. This configures the SYSMON hard macro in continuous sampling mode.
3. Write 0x0000_2000 to Configuration Register 1. This configures the SYSMON hard macro in continuous cycling of sequence mode, all calibration disabled and all alarm outputs enabled.
4. Write 0x0000_2000 to Configuration Register 2. This configures the SYSMON hard macro to have $ADCCLK = DCLK/32$.
5. Read Status Register (SR) to reset EOC/EOS signal set by any previous conversions.
6. If interrupt controller is present, then read IPISR to know the value set by any previous conversions. Assume for this application the value read is 0x0000_003E.
7. Write 0x0000_003E to IPISR to toggle the bits which are '1' so that the new value of IPISR becomes 0x0000_0000.
8. If interrupt controller is present, i.e. $C_INCLUDE_INTR = 1$, do global enabling of interrupts by writing 0x8000_0000 to GIER.
9. Enable the operational interrupts by writing 0x0000_00FF to the IPIER.
10. Write 0x0000_0700 to Sequence Register 0 and 0x0000_0000 to Sequence Register 1. This configures SYSMON hard macro for monitoring On-Chip Temperature, V_{CCINT} and V_{CCAUX} channel.
11. Write 0x0000_0000 to Sequence Register 2 and 3. This disables ADC channel averaging.
12. Write 0x0000_0000 to Sequence Register 4 and 5. This configures ADC channel in unipolar input mode.
13. Write 0x0000_0000 to Sequence Register 6 and 7. This configures ADC channel acquisition time to four $ADCCLK$ cycles.
14. Write 0x0000_A900 to Alarm Register 0. This configures the upper limit for temperature alarm, which for this application is set to 60° C.
15. Write 0x0000_9980 to Alarm Register 1. This configures the upper limit for V_{CCINT} alarm, which for this application is set to 1.8 V.
16. Write 0x0000_EE80 to Alarm Register 2. This configures the upper limit for V_{CCAUX} alarm, which for this application is set to 2.8 V.
17. Write 0x0000_A000 to Alarm Register 4. This configures the lower limit for temperature alarm, which for this application is set to 42° C.
18. Write 0x0000_4400 to Alarm Register 5. This configures the lower limit for V_{CCINT} alarm, which for this application is set to 0.8 V.
19. Write 0x0000_9980 to Alarm Register 6. This configures the lower limit for V_{CCAUX} alarm, which for this application is set to 1.8 V.
20. Write 0x0000_A180 to Alarm Register 7. This configures the lower limit for OT alarm, which for this application is set to 45° C.

21. The Alarm Register 3 will be active only in case of Virtex-6 device. When Virtex-6 FPGA is targeted then this register is used to set the upper limit of OT. Please note that, the OT upper is 12 bit register, with lower 4 bits needs to be set to "0011". If this register is left un-initialized, then 125° C will be considered as default upper temperature for OT.
22. Write 0x0000_2000 to Configuration Register 1. This configures the SYSMON hard macro in continuous cycling of sequence mode, all calibration disabled and all alarm outputs enabled. We need to perform a write operation on this register to enable the sequence written to sequence registers. [Refer System Monitor User Guide for bits of Configuration Register 0, when targeted for Virtex-5 and Virtex-6 devices]
23. Read SR, if the present conversion cycle is completed then EOS bit in SR is set to '1'. If the interrupt controller is present then EOS bit in IPISR is also set to '1'.
24. Read converted value of On-Chip Temperature, V_{CCINT} and V_{CCAUX} channel from address C_BASEADDR + 0x200, C_BASEADDR + 0x204 and C_BASEADDR + 0x208 respectively.

Single Channel Mode Examples

To configure XPS SYSMON ADC IP Core in Single Channel Mode, both SEQ1 and SEQ0 bits in Configuration Register 1 should be set to '1'. The Single Channel Operation can be programmed to operate either in Event-Driven Sampling Mode or Continuous Sampling Mode by setting \overline{EC} bit in Configuration Register 0 to '1' or '0'.

Single Channel Event-Driven Sampling Mode Example

To configure XPS SYSMON ADC IP Core in Single Channel Event-Driven Sampling Mode, \overline{EC} bit in Configuration Register 0 should be set to '1'. The specific value written to registers may vary depending upon the need of application. Also if On-Chip temperature or voltages are monitored then Alarm registers should be configured with appropriate values before writing to Configuration Registers. Below is the configuration example for monitoring V_P/V_N channel with clock ratio set to 32.

1. Issue a software reset by writing the data word 0x0000_000A to the SRR. This asserts the reset of XPS SYSMON ADC IP Core for 2 clock cycles.
2. If interrupt controller is present, i.e. C_INCLUDE_INTR = 1, do global enabling of interrupts by writing 0x8000_0000 to GIER.
3. Enable the operational interrupts by writing 0x0000_00FF to the IPIER.
4. Write 0x0000_0203 to Configuration Register 0. This configures the SYSMON hard macro with no averaging, unipolar mode, event driven sampling, and selects channel 3 (V_P/V_N) for conversion.
5. Write 0x0000_3000 to Configuration Register 1. This configures the SYSMON hard macro in single channel mode, all calibration disabled and all alarm outputs enabled.
6. Write 0x0000_2000 to Configuration Register 2. This configures the SYSMON hard macro to have ADCCLK = DCLK/32.
7. Read Status Register (SR) to reset EOC/EOS signal set by any previous conversions.
8. If interrupt controller is present read IPISR to know the value set by any previous conversions. Assume for this application the value read is 0x0000_003E.
9. Write 0x0000_003E to IPISR to toggle the bits which are '1' so that the new value of IPISR becomes 0x0000_0000.
10. Conversion Start can be signalled by writing 0x0000_0001 to CONVSTR or by making external CONVST port = '1'.
11. Reset the CONVSTR by writing 0x0000_0000 to it or by making CONVST port = '0' depending upon which kind of trigger (either CONVSTR register or CONVST port) is used for conversion start.
12. Read SR, if conversion is completed then EOC bit in SR will be set to '1'. If the interrupt controller is present then EOC bit in the IPISR is also set to '1'.
13. Read converted value of channel 3 (V_P/V_N) from address C_BASEADDR + 0x20C.

Single Channel Continuous Sampling Mode Example

To configure XPS SYSMON ADC IP Core in Single Channel Continuous Sampling Mode, \overline{EC} bit in Configuration Register 0 should be set to '0'. The specific value written to registers may vary depending upon the need of application. Also if On-Chip temperature or voltages are monitored then Alarm registers should be configured with appropriate values before writing to Configuration Registers. Below is the configuration example for monitoring V_P/V_N channel with clock ratio set to 32.

1. Issue a software reset by writing the data word 0x0000_000A to the SRR. This asserts the reset of XPS SYSMON ADC IP Core for 2 clock cycles.
2. If interrupt controller is present, i.e. C_INCLUDE_INTR = 1, do global enabling of interrupts by writing 0x8000_0000 to GIER.
3. Enable the operational interrupts by writing 0x0000_00FF to the IPIER.
4. Write 0x0000_0003 to Configuration Register 0. This configures the SYSMON hard macro with no averaging, unipolar mode, event driven sampling, and selects channel 3 (V_P/V_N) for conversion.
5. Write 0x0000_3000 to Configuration Register 1. This configures the SYSMON hard macro in single channel mode, all calibration disabled and all alarm outputs enabled.
6. Write 0x0000_2000 to Configuration Register 2. This configures the SYSMON hard macro to have ADCCLK = DCLK/32.
7. Write 0x0000_0001 to the SYSMON Reset Register to reset the SYSMON hard macro. This step is required to put the SYSMON hard macro in the reset state.
8. Read Status Register (SR) to reset EOC/EOS signal set by any previous conversions. After reading the Status Register the EOC, EOS from IP core will be in reset state.
9. If Interrupt Controller is present read IPISR to know the value set by any previous conversions. Assume for this application the value read is 0x0000_003E.
10. Write 0x0000_003E to IPISR to toggle the bits which are '1' so that the new value of IPISR becomes 0x0000_0000.
11. Write 0x0000_0000 to the SYSMON Reset Register to bring the SYSMON hard macro out of reset. Once the SYSMON hard macro comes out of reset, it will start its normal operation of data acquisition of the configured channels.
12. Read SR, if conversion is completed then EOC bit in SR will be set to '1'. If the interrupt controller is present then EOC bit in IPISR is also set to '1'.
13. Read converted value of channel 3 (V_P/V_N) from address C_BASEADDR + 0x20C.

Reference Documents

1. [UG192](#) Virtex-5 FPGA System Monitor User Guide (latest version)
2. DS561 PLBV46_Slave_Single (latest version)
3. *IBM CoreConnect™ 128-Bit Processor Local Bus, Architectural Specification (v4.6)*

Revision History

Date	Version	Revision
08/06/07	1.0	Initial Xilinx release.
10/1/07	1.2	Added FMax Margin System Performance section.
6/27/08	1.3	Updated the version. Added locally generated interrupt bits information.
6/24/09	1.4	Updated for EDK_L 11.2; created v2.00a; added Virtex-6 support; updated the SYSMON register data base to support newly added registers; updated the utilization table for Virtex-5 and added utilization table for Virtex-6.

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