



SMX PCIe Interface Control Document

82-0147-100

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Abstract

This document describes the direct PCIe register control interface for SMX switch cards.

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1 Revision History

Date	Author	Version	Comment
02/25/2020	James Jurack	0.0.1	Initial Revision
03/04/2020	James Jurack	0.0.2	Updated order of Info register bits, clarified some descriptions
07/24/2020	James Jurack	1.0.0	Added Module Type field and document part number; removed SMXR-Model Variant
07/24/2020	James Jurack	1.0.1	Fixed typos and reworded some sections for clarity; added SMX-7xxx and Other Interfaces sections

2 PCIe Base Address Registers

All VTI EMX- and SMX- plugins use PCIe Base Address Registers 0 and 2, in 64-bit addressing mode, for message-based communication with the SentinelEX web server.

When a register-based interface is provided, it is always in Base Address Register 4, in 64-bit addressing mode. The remainder of this document describes that interface for SMX- plugins.

3 SMX Architecture

Each SMX module consists of up to 8 banks of relay drivers. Each bank contains up to 64 bits of relay control, exposed in this interface as two 32-bit words. Depending on the relay layout needs of each particular model, any bits from any of the banks may be used to control the card's relays. This means that some middle banks may control no relays at all, while later banks do, resulting in a sparsely populated register map.

The model's hardware needs determine how the card's relays map to the relay control bits. This mapping is defined in the DCF file, which is an XML file stored in the card's flash memory. It can be downloaded directly from the card via the SentinelEX web server, at URI

`/card/slot<n>_<m>/switch/dcf`, where `<n>` is the PXIe chassis index, and `<m>` is the slot number. The `<relays>` section of this file will include a `bitOffset` property for each throw of each relay. This is an integer value from 0 to 511. A value of 16 would mean that the relay can be closed by setting bit 16 of bank 1 high. A value of 290 would mean that the relay is controlled by bit 34 of bank 4.

3.1 SMX-7xxx Microwave Relay Modules

Because their relay population options can change much more easily, SMX-7xxx Microwave Relay Modules behave differently to other modules. Each relay is assigned a range of relay control bits. The mappings of these for each SMX-7xxx model is given in the table below. The `<relayDefinitions>` section of the DCF file defines how the control lines of the different relay types map within those ranges.

Model	Relay 1	Relay 2	Relay 3
SMX-71xx	16	17	N/A
SMX-72xx	16-23	8-15	0-7

3.2 Other Interfaces

This document only describes the register-based interface for control of SMX modules. See the SMX Series Product Manual (82-0147-000) or VTEXSwitch Driver Manual (82-0117-000) for more information on the other interfaces available, including a web-based Graphical User Interface and IVI-COM, IVI-C, and Linux Instrument Drivers.

3.2.1 Odometers

Relay Odometers are a counter that tracks how many times a relay has been actuated. These are stored in the module's nonvolatile memory, and are tracked coherently for all relay actuations, whether initiated via the GUI, Instrument Driver, or register interfaces. However, the values of these counters cannot be accessed via this register interface. The web-based GUI or Instrument Driver must be used to access their values.

3.2.2 Power-On State

The web-based GUI allows the user to save a relay state that will be automatically applied immediately after power-on. This register interface does not provide access to this feature, but any saved power-on state will still be loaded at power-on, even if the SentinelEX web server is not running.

4 Base Address Register 4 Address Map

Offset	Name	Description
0x00	Version	Version information
0x04	Model	Plugin model number
0x08	Serial	Plugin serial number
0x0C	Info	Relay population and debounce information
0x10	Relay Control 1.1	Relay control for bank 1 bits 0-31
0x14	Relay Control 1.2	Relay control for bank 1 bits 32-63
0x18	Relay Control 2.1	Relay control for bank 2 bits 0-31
0x1C	Relay Control 2.2	Relay control for bank 2 bits 32-63
0x20	Relay Control 3.1	Relay control for bank 3 bits 0-31
0x24	Relay Control 3.2	Relay control for bank 3 bits 32-63
0x28	Relay Control 4.1	Relay control for bank 4 bits 0-31
0x2C	Relay Control 4.2	Relay control for bank 4 bits 32-63
0x30	Relay Control 5.1	Relay control for bank 5 bits 0-31
0x34	Relay Control 5.2	Relay control for bank 5 bits 32-63
0x38	Relay Control 6.1	Relay control for bank 6 bits 0-31
0x3C	Relay Control 6.2	Relay control for bank 6 bits 32-63
0x40	Relay Control 7.1	Relay control for bank 7 bits 0-31
0x44	Relay Control 7.2	Relay control for bank 7 bits 32-63
0x48	Relay Control 8.1	Relay control for bank 8 bits 0-31
0x4C	Relay Control 8.2	Relay control for bank 8 bits 32-63

5 Register Detail

5.1 Version (Offset 0x00)

Bits	Name	Description
31..24	Module Type	0: Switch
23..8	FPGA Version	The version number of the FPGA firmware
7..0	Interface Version	The version number of this interface (currently 0)

5.2 Model (Offset 0x04)

Bits	Name	Description
31..24	Model Variant	Indicates which model variant this module is. Possible values are: 0x00: SMX-xxxx 0x01: SMX-xxxxSMB 0x02: SMX-xxxxDS
23..0	Model Number	The numerical part of the model number, as an unsigned integer, in base 10

5.3 Serial (Offset 0x08)

Bits	Name	Description
31..0	Serial Number	The numerical part of the serial number, as an unsigned integer, in base 10

5.4 Info (Offset 0x0C)

Bits	Name	Description
31	Is Debounced	1 when all relays in the module are fully settled, 0 otherwise
30..16	Reserved	
15	Relay Control 8.2 Populated	1 if the module has relays controlled by bank 8 bits 32-63 populated
14	Relay Control 8.1 Populated	1 if the module has relays controlled by bank 8 bits 0-31 populated
13	Relay Control 7.2 Populated	1 if the module has relays controlled by bank 7 bits 32-63 populated
12	Relay Control 7.1 Populated	1 if the module has relays controlled by bank 7 bits 0-31 populated
11	Relay Control 6.2 Populated	1 if the module has relays controlled by bank 6 bits 32-63 populated
10	Relay Control 6.1 Populated	1 if the module has relays controlled by bank 6 bits 0-31 populated
9	Relay Control 5.2 Populated	1 if the module has relays controlled by bank 5 bits 32-63 populated
8	Relay Control 5.1 Populated	1 if the module has relays controlled by bank 5 bits 0-31 populated
7	Relay Control 4.2 Populated	1 if the module has relays controlled by bank 4 bits 32-63 populated
6	Relay Control 4.1 Populated	1 if the module has relays controlled by bank 4 bits 0-31 populated
5	Relay Control 3.2 Populated	1 if the module has relays controlled by bank 3 bits 32-63 populated
4	Relay Control 3.1 Populated	1 if the module has relays controlled by bank 3 bits 0-31 populated
3	Relay Control 2.2 Populated	1 if the module has relays controlled by bank 2 bits 32-63 populated
2	Relay Control 2.1 Populated	1 if the module has relays controlled by bank 2 bits 0-31 populated
1	Relay Control 1.2 Populated	1 if the module has relays controlled by bank 1 bits 32-63 populated
0	Relay Control 1.1 Populated	1 if the module has relays controlled by bank 1 bits 0-31 populated

5.5 Relay Control X.Y (Offsets 0x10-0x4C)

Bits	Name	Description
31..0	Relay Control	Set bits to 1 to close the corresponding relay, or to 0 to open it. The mapping from relay number to relay control bit offset is different for each model, and is defined by the card's DCF file, which can be downloaded via the SentinelEX web server at <code>/card/slot<n>_<m>/switch/dcf</code>