SBO - Sandbox output towards FPGA

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The Sandbox Output towards FPGA (SBO) block writes the value of the SBO registers in the FPGA. It is used to transfer data from the CPU to the user-made code within the FPGA. To transfer data from user-made code within the FPGA to the CPU, the SBI block should be used.

An SBO register can be configured as:

- a *configuration register*: the value is written only once, at the code launch
- a *real-time register*: the value can change anytime during the control

In Simulink and PLECS, *configuration register* values are defined from the block mask and *real-time registers* from the block input signal.

Information on FPGA edition is available on:

- Editing the FPGA firmware (sandbox) (PN116)

Usage examples of the SBI block are available on:

- FPGA-based hysteresis current control (TN120)
- FPGA-based SPI communication IP for A/D converter (TN130)
- FPGA-based direct torque control using Vivado HLS (TN133)

Simulink block

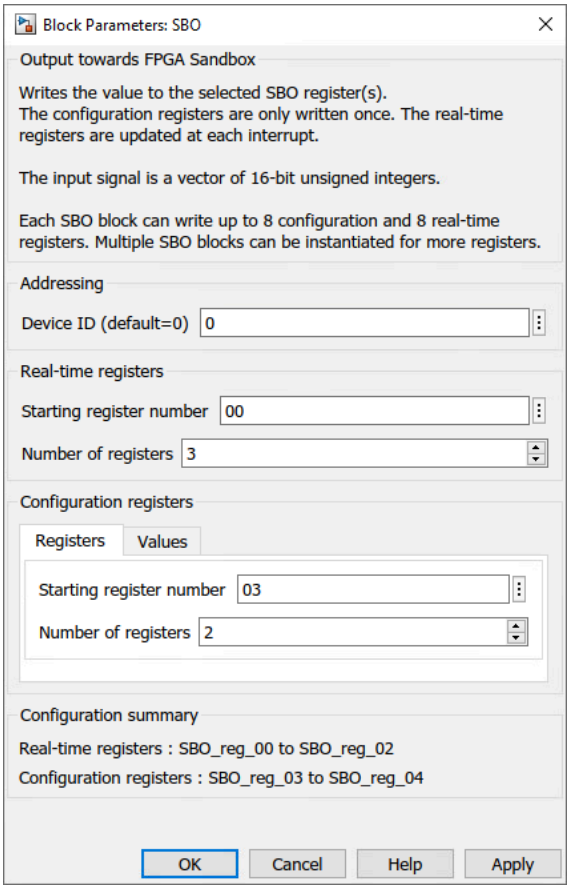
Signal specification

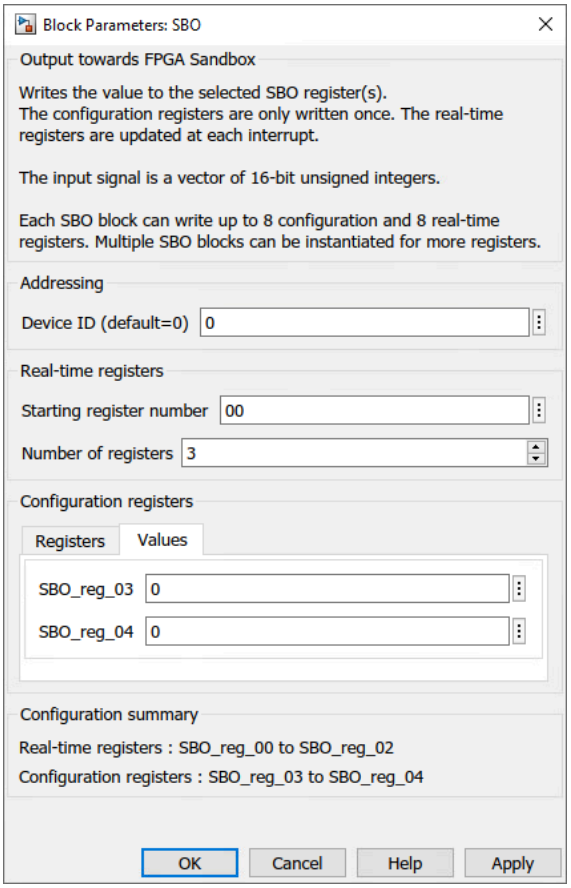
The input expects a vector of 16-bit unsigned integer values to write to the SBO registers.

Up to 8 *real-time registers* and 8 *configuration registers* can be written from a single SBO block. Multiple SBO blocks can be used to write to more registers.

Parameters

- `Device ID` selects which B-Box/B-Board to address when used in a multi-device configuration.
- Real-time registers: `Starting register number` and `Number of registers` define the range of registers to write to.
- Configuration registers: `Starting register number` and `Number of registers` define the range of registers to write to. Their values can be set from the `Values` tab.

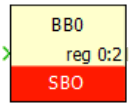




PLECS block

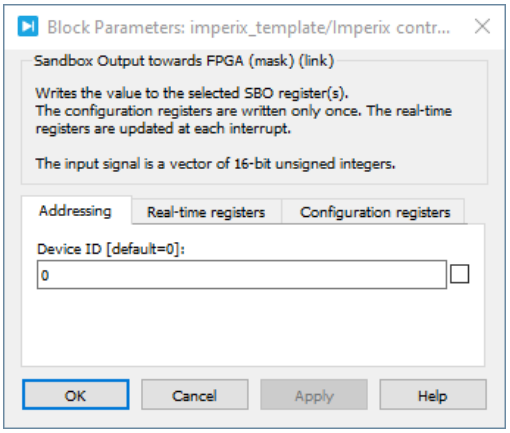
Signal specification

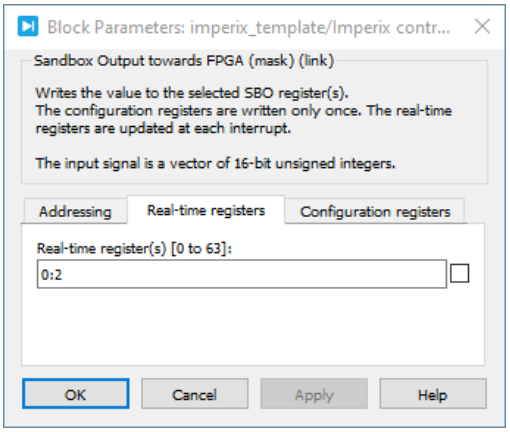
The input expects a vector of 16-bit unsigned integer values to write to the SBO registers

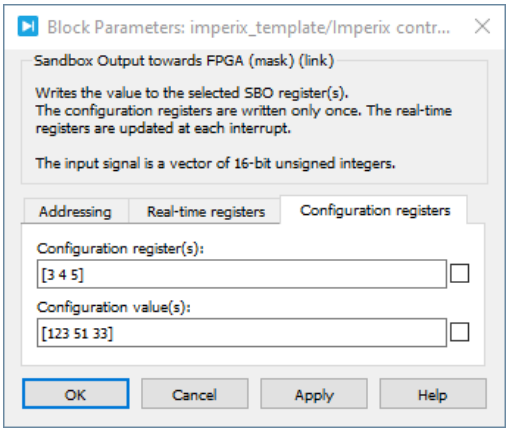


Parameters

- `Device ID` selects which B-Box/B-Board to address when used in a multi-device configuration.
- `Real-time register(s)`(vectorizable) defines the real-time registers to write to using the input signal
- `Configuration register(s)`(vectorizable) defines the configuration registers to write to and `Configuration values(s)` (vectorizable) sets their constant values.







C++ functions

`Sbo_WriteDirectly` **— Write during init phase**

```
void Sbo_WriteDirectly(unsigned int address, uint16_t data, unsigned int device=0);Code language: C++ (cpp)
```

Writes a constant value to an SBO register.

It can only be called in `UserInit()`.

Parameters

- `address`: address of the targeted register (0 to 63)
- `data`: value to write
- `device`: the id of the addressed device (optional, used in multi-device configuration only)

`Sbo_Write` **— Write during run-time**

```
void Sbo_Write(unsigned int address, uint16_t data, unsigned int device=0);Code language: C++ (cpp)
```

Updates the value of an SBO register configured as real-time. It has to be called in the control interrupt.

For this function to work the addressed register must be set as *real-time* using `Sbo_ConfigureAsRealTime()`.

Parameters

- `address`: address of the targeted register (0 to 63)
- `data`: value to write
- `device`: the id of the addressed device (optional, used in multi-device configuration only)

`Sbo_ConfigureAsRealTime` **— Configure as writable during run-time**

```
void Sbo_ConfigureAsRealTime(unsigned int address, unsigned int device=0);Code language: C++ (cpp)
```

Updates the value of an SBO register configured as real-time. It has to be called in the control interrupt.

Tags an SBO register as *real-time*, meaning that its value can be updated from the interrupt routine using `Sbo_Write()` and is transferred to the FPGA at the end of the interrupt routine execution.

It has to be called in `UserInit()`.

Parameters

- `address`: address of the targeted register (0 to 63)
- `device`: the id of the addressed device (optional, used in multi-device configuration only)