
GOLDI Axis Portal V1

Document version: 2
Release date: 25.05.2023

Overview:

The GOLDI Axis Portal V1 is an FPGA-driven unit used to control the GOLDI Axis Portal V1 model. The FPGA system provides a standard interface for a microcontroller to control the model by writing data to the FPGA registers.

Calibration procedure:

The GOLDI Axis Portal V1 does not have an initialization or calibration process needed to operate correctly. The system can be used directly after initialization. However, it is recommended to drive the crane to the utmost left and back position and reset the encoders using the control register to get a reproducible encoder position value.

Operation:

The GOLDI Axis Portal V1 is operated by writing the corresponding values into the FPGA registers (See Register Table)

SPI Communication Protocol

The GOLDI Axis Portal V1 is configured through an SPI interface. The SPI interface allows the independent reading and writing of values from and into the registers of the model.

SPI Signals

The GOLDI Axis Portal V1 has four signals:

SPI0_SCLK	SPI clock
SPI0_MOSI	SPI serial data input
SPI0_MISO	SPI serial data output
SPI0_nCE0	SPI chip select input (active low)

The module is enabled for an SPI transaction by a logic low on the chip select input nCE0. Bit transfer is synchronous to the bus clock SCLK, with the slave latching the data from MOSI on the rising edge of SCLK and driving data to MISO on the falling edge. The most significant bit is sent first. A minimum of 24 SCLK clock cycles is required for a bus transaction.

(CONFIGURATION_WORD[15:0] + DATA_WORD[7:0])

If more than 24 clocks are driven, the additional bits shifted into MOSI are assigned to increasing lower addresses. If a read transaction with $24+n*8$ clocks is performed then the MISO shifts the data of the selected register and the registers with the addresses (adr-n). If a write transaction with $24+n*8$ clocks is performed the MOSI shifts the data to the selected registers and the registers with the address (adr-n)

nCE0 must be low during the whole SPI transaction. When nCE0 goes high, the unfinished transaction is discarded. The MOSI data is latched once the DATA_WORD is transferred

The configuration word length is based on the value "BUS_ADDRESS_WIDTH" in the GOLDI_COMM_STANDARD package. This corresponds to the address width + 1 bit for the write enable flag. The data word length is based on the value "SYSTEM_DATA_WIDTH" in the GOLDI_COMM_STANDARD package. This value corresponds to the number of data bits

Default configuration for the GOLDI Axis Portal V1 model

<i>BUS_ADDRESS_WIDTH</i>	15
<i>SYSTEM_DATA_WIDTH</i>	8

Configuration Word [15:0]			Data Word[7:0]
Bit 15	Bit [14:8]	Bit [7:0]	Bit [7:0]
WE	REGISTER_ADDRESS		DATA[MSBF]
0	READ_ADDRESS[15:0]		[MOSI: dc] [MISO: Register data]
1	WRITE_ADDRESS[15:0]		[MOSI: New data] [MISO: Register data]

GOLDI Axis Portal V1 hardware pinout

Control Unit Pinout					
Hardware Pinout		FPGA System			
Signal Name	Schematic Name	Pin Type	Pin Number	Pin Mode	Entity name
External FPGA Clock	ClockFPGA	in	128	LVC MOS33	ClockFPGA
Reset	FPGA_nReset	in	126	LVC MOS33	FPGA_nReset
SCLK	SPI0_SCLK	in	138	LVC MOS33	SPI0_SCLK
MOSI	SPI0_MOSI	in	133	LVC MOS33	SPI0_MOSI
MISO	SPI0_MISO	out	139	LVC MOS33	SPI0_MISO
nCE	SPI0_nCE0	in	127	LVC MOS33	SPI0_nCE0
Multi-purpose GPIO0	GPIO0	inout	125	LVC MOS33	IO_DATA[0]
Multi-purpose GPIO1	GPIO1	inout	122	LVC MOS33	IO_DATA[1]
X-axis sensor left	InXLeft	inout	83	LVC MOS33	IO_DATA[2]
X-axis sensor right	InXRight	inout	84	LVC MOS33	IO_DATA[3]
X-axis sensor reference	InXRef	inout	85	LVC MOS33	IO_DATA[4]
Y-axis sensor back	InYBack	inout	87	LVC MOS33	IO_DATA[5]
Y-axis sensor front	InYFront	inout	86	LVC MOS33	IO_DATA[6]
Y-axis sensor reference	InYRef	inout	89	LVC MOS33	IO_DATA[7]
Z-axis sensor bottom	InZBottom	inout	92	LVC MOS33	IO_DATA[8]
Z-axis sensor top	InZTop	inout	91	LVC MOS33	IO_DATA[9]
Z-axis sensor proximity	InProximity	inout	99	LVC MOS33	IO_DATA[10]
Encoder X channel A	InIncX_A	inout	93	LVC MOS33	IO_DATA[11]
Encoder X channel B	InIncX_B	inout	94	LVC MOS33	IO_DATA[12]
Encoder X channel I	InIncX_I	inout	95	LVC MOS33	IO_DATA[13]
Encoder Y channel A	InIncY_A	inout	96	LVC MOS33	IO_DATA[14]
Encoder Y channel B	InIncY_B	inout	97	LVC MOS33	IO_DATA[15]
Encoder Y channel I	InIncY_I	inout	98	LVC MOS33	IO_DATA[16]
X-axis motor enable	EnableDCX	inout	100	LVC MOS33	IO_DATA[17]
X-axis motor out 1	OutDCX_A	inout	103	LVC MOS33	IO_DATA[18]
X-axis motor out 2	OutDCX_B	inout	104	LVC MOS33	IO_DATA[19]
Y-axis motor enable	EnableDCY	inout	112	LVC MOS33	IO_DATA[20]
Y-axis motor out 1	OutDCY_A	inout	111	LVC MOS33	IO_DATA[21]
Y-axis motor out 2	OutDCY_B	inout	113	LVC MOS33	IO_DATA[22]
Z-axis motor enable	EnableDCZ	inout	105	LVC MOS33	IO_DATA[23]
Z-axis motor out 1	OutDCZ_A	inout	106	LVC MOS33	IO_DATA[24]
Z-axis motor out 2	OutDCZ_B	inout	107	LVC MOS33	IO_DATA[25]
E-Magnet power on/off	EnableMagnet	inout	109	LVC MOS33	IO_DATA[26]
E-Magnet out 1	OutMagnet	inout	110	LVC MOS33	IO_DATA[27]
Power LED Red	LEDPowerR	inout	141	LVC MOS33	IO_DATA[28]
Power LED Green	LEDPowerG	inout	140	LVC MOS33	IO_DATA[29]
Environment LED Red	LightRed	inout	10	LVC MOS33	IO_DATA[30]
Environment LED White	LightWhite	inout	11	LVC MOS33	IO_DATA[31]
Environment LED Green	LightGreen	inout	12	LVC MOS33	IO_DATA[32]
Multi-purpose pin 0	External 0	inout	73	LVC MOS33	IO_DATA[33]

Multi-purpose pin 1	External 1	inout	74	LVCMOS33	IO_DATA[34]
Multi-purpose pin 2	External 2	inout	75	LVCMOS33	IO_DATA[35]
Multi-purpose pin 3	External 3	inout	76	LVCMOS33	IO_DATA[36]
Multi-purpose pin 4	External 4	inout	77	LVCMOS33	IO_DATA[37]
Multi-purpose pin 5	External 5	inout	78	LVCMOS33	IO_DATA[38]
Multi-purpose pin 6	External 6	inout	81	LVCMOS33	IO_DATA[39]
Multi-purpose pin 7	External 7	inout	82	LVCMOS33	IO_DATA[40]

Register Map

Document Version 2
Hardware Version V3.00.00
Date 25.05.2023

All registers have a base address located on the package GOLDI_MODULE_CONFIG. This can be changed to move the modules in case the configuration word width is changed.

Register Name	Address (Dec)	Address (Hex)	Default	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
System Configuration	1	0x01	0x00								ENC_rst
Sensor IO high	2	0x02	0x00	InZFront	InZBottom	InYRef	InYFront	InYBack	InXRef	InXRight	InXLeft
Sensor IO low	3	0x03	0x00								InProximity
Error list 1	4	0x04	0x00	error_7	error_6	error_5	error_4	error_3	error_2	error_1	error_0
Error list 2	5	0x05	0x00	error_15	error_14	error_13	error_12	error_11	error_10	error_9	error_8
Error list 3	6	0x06	0x00		error_22	error_21	error_20	error_19	error_18	error_17	error_16
GPIO0 Driver	7	0x07	0x00							Out_enb	Data
GPIO1 Driver	8	0x08	0x00							Out_enb	Data
X Encoder low	9	0x09	0x00	X_VAL[7:0]							
X Encoder high	10	0x0A	0x00	X_VAL[15:8]							
Z Encoder low	11	0x0B	0x00	Y_VAL[7:0]							
Z Encoder high	12	0x0C	0x00	Y_VAL[15:8]							
X Motor Direction	13	0x0D	0x00							right	left
X Motor Speed	14	0x0E	0x00	PWM[7:0]							
Y Motor Direction	15	0x0F	0x00							front	back
Y Motor Speed	16	0x10	0x07	PWM[7:0]							
Z Motor Direction	17	0x11	0x00							top	bottom
Z Motor Speed	18	0x12	0x00	PWM[7:0]							
Electromagnet Power	19	0x13	0x00								mag_pwr
Power LED Red	20	0x14	0x00	on/off	Blink_enb	Delay_on			Delay_off		
Power LED Green	21	0x15	0x00	on/off	Blink_enb	Delay_on			Delay_off		
Light Red	22	0x16	0x00	on/off	Blink_enb	Delay_on			Delay_off		
Light White	23	0x17	0x00	on/off	Blink_enb	Delay_on			Delay_off		
Light Green	24	0x18	0x00	on/off	Blink_enb	Delay_on			Delay_off		

Error List

Error code	Error definition
error_0	Sensors X_left and X_right triggered
error_1	Sensors X_left and X_ref triggered
error_2	Sensors X_right and X_ref triggered
error_3	Sensors Y_back and Y_front triggered
error_4	Sensors Y_back and Y_ref triggered
error_5	Sensors Y_front and Y_ref triggered
error_6	Sensors Z_bottom and Z_top
error_7	X_right and X_left simultaneously on
error_8	Y_back and Y_front simultaneously on
error_9	Z_bottom and Z_top simultaneously on
error_10	X motor actuated left while crane not in top position
error_11	X motor actuated right while crane not in top position
error_12	Y motor actuated back while crane not in top position
error_13	Y motor actuated front while crane not in top position
error_14	Portal at outermost position and X_left
error_15	Portal at outermost position and X_right
error_16	Portal at outermost position and Y_back
error_17	Portal at outermost position and Y_front
error_18	Portal at outermost position and Z_bottom
error_19	Portal at outermost position and Z_top
error_20	X DC motor out channels inverted
error_21	Y DC motor out channels inverted
error_22	Z DC motor out channels inverted

Physical model reference map

