

Signal Name	Pin Type	Pin Number	Pin Mode	TOP_LEVEL		
				Entity	External IO Index	Internal IO Index
ClockFPGA	in	128	LVC MOS33	ClockFPGA		
FPGA_nReset	in	126	LVC MOS33	FPGA_nReset		
SPIO_MOSI	in	133	LVC MOS33	SPIO_MOSI		
SPIO_SCLK	in	138	LVC MOS33	SPIO_SCLK		
SPIO_nCE0	in	127	LVC MOS33	SPIO_nCE0		
SPIO_MISO	out	139	LVC MOS33	SPIO_MISO		
GPIO0	inout	125	LVC MOS33	IO_DATA[0]	0	0
GPIO1	inout	122	LVC MOS33	IO_DATA[1]	1	1
InXLeft	inout	83	LVC MOS33	IO_DATA[2]	2	2
InXRight	inout	84	LVC MOS33	IO_DATA[3]	3	3
InXRef	inout	85	LVC MOS33	IO_DATA[4]	4	4
InYBack	inout	87	LVC MOS33	IO_DATA[5]	5	5
InYFront	inout	86	LVC MOS33	IO_DATA[6]	6	6
InYRef	inout	89	LVC MOS33	IO_DATA[7]	7	7
InZBottom	inout	92	LVC MOS33	IO_DATA[8]	8	8
InZTop	inout	91	LVC MOS33	IO_DATA[9]	9	9
InProximity	inout	99	LVC MOS33	IO_DATA[10]	10	10
InIncX_A	inout	93	LVC MOS33	IO_DATA[11]	11	11
InIncX_B	inout	94	LVC MOS33	IO_DATA[12]	12	12
InIncX_I	inout	95	LVC MOS33	IO_DATA[13]	13	13
InIncY_A	inout	96	LVC MOS33	IO_DATA[14]	14	14
InIncY_B	inout	97	LVC MOS33	IO_DATA[15]	15	15
InIncY_I	inout	98	LVC MOS33	IO_DATA[16]	16	16
EnabledDCX	inout	100	LVC MOS33	IO_DATA[17]	17	17
OutDCX_A	inout	103	LVC MOS33	IO_DATA[18]	18	18
OutDCX_B	inout	104	LVC MOS33	IO_DATA[19]	19	19
EnabledDCY	inout	112	LVC MOS33	IO_DATA[20]	20	20
OutDCY_A	inout	111	LVC MOS33	IO_DATA[21]	21	21
OutDCY_B	inout	113	LVC MOS33	IO_DATA[22]	22	22
EnabledDCZ	inout	105	LVC MOS33	IO_DATA[23]	23	23
OutDCZ_A	inout	106	LVC MOS33	IO_DATA[24]	24	24
OutDCZ_B	inout	107	LVC MOS33	IO_DATA[25]	25	25
EnableMagnet	inout	109	LVC MOS33	IO_DATA[26]	26	26
OutMagnet	inout	110	LVC MOS33	IO_DATA[27]	27	27
LEDPowerR	inout	141	LVC MOS33	IO_DATA[28]	28	28
LEDPowerG	inout	140	LVC MOS33	IO_DATA[29]	29	29
LightRed	inout	10	LVC MOS33	IO_DATA[30]	30	30
LightWhite	inout	11	LVC MOS33	IO_DATA[31]	31	31
LightGreen	inout	12	LVC MOS33	IO_DATA[32]	32	32
External 0	inout	73	LVC MOS33	IO_DATA[33]	33	41
External 1	inout	74	LVC MOS33	IO_DATA[34]	34	41
External 2	inout	75	LVC MOS33	IO_DATA[35]	35	41
External 3	inout	76	LVC MOS33	IO_DATA[36]	36	41
External 4	inout	77	LVC MOS33	IO_DATA[37]	37	41
External 5	inout	78	LVC MOS33	IO_DATA[38]	38	41
External 6	inout	81	LVC MOS33	IO_DATA[39]	39	41
External 7	inout	82	LVC MOS33	IO_DATA[40]	40	41

<b>Notes:</b>
1 LVC MOS33 was used given that the majority of pins use this standard. The pins are distributed only across bank 1 and 0 and this forces all pins to the same standard. LVC MOS22 could also be used for all pins
2 Internal IO Pin 41 is grounded and configured as input. The data is not used
3 The external IO and internal IO are related through the default layout of the IO_CROSSBAR. This can be changed by either modifying the original definition in the GOLDI_MODULE_CONFIG package or enabling the dynamic mode. Use first option in case of using External # pins

## Register Map

**Document Version**  
**Hardware Version**  
**Date**

1  
V1.00.00  
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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								BUS_sel
Sensor IO low	2	0x02	0x00	InZTop	InZBottom	InYRef	InYFront	InYBack	InXRef	InXRight	InXLeft
Sensor IO high	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_17	error_16
GPIO0 Driver	7	0x07	0x00						out_enb	data_out	data_in
GPIO1 Driver	8	0x08	0x00						out_enb	data_out	data_in
X Encoder low	9	0x09	0x00	X_VAL[7:0]							
X Encoder high	10	0x0A	0x00	X_VAL[15:8]							
Y Encoder low	11	0x0B	0x00	Y_VAL[7:0]							
Y Encoder high	12	0x0C	0x00	Y_VAL[15:8]							
X Motor Direction	13	0x0D	0x00							X_Right	X_Left
X Motor Speed	14	0x0E	0x00	PWM[7:0]							
Y Motor Direction	15	0x0F	0x00							Y_Front	Y_Back
Y Motor Speed	16	0x10	0x00	PWM[7:0]							
Z Motor Direction	17	0x11	0x00							Z_Top	Z_Bottom
Z Motor Speed	18	0x12	0x00	PWM[7:0]							
Electromagnet Power	19	0x13	0x00								mag_pow
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 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 while graber not in top position
error_11	Y motor actuated while graber not in top position
error_12	Portal at outermost position and X_left
error_13	Portal at outermost position and X_right
error_14	Portal at outermost position and Y_back
error_15	Portal at outermost position and Y_front
error_16	Portal at outermost position and Z_bottom
error_17	Portal at outermost position and Z_top

## Communication Protocol

### System Communication Mode:

BUS\_sel = '0'

Configuration Word - Byte 1								Data Word - Byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
WE	REGISTER ADDRESS							REGISTER DATA							
0	ADDRESS[6:0]							[MOSI: don't care] / [MISO: Register data]							
1	ADDRESS[6:0]							[MOSI: New register data] / [MISO: Old register data]							

### Crossbar Communication Mode:

BUS\_sel = '1'

Configuration Word - Byte 1								Data Word - Byte 1							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
WE	EXTERNAL IO ADDRESS [IO_INDEX + 2]							INTERNAL IO INDEX							
0	EXTERNAL_IO_ADDRESS[6:0]							[MOSI: don't care] / [MISO: Internal IO Index]							
1	EXTERNAL_IO_ADDRESS[6:0]							[MOSI: New Internal IO Index] / [MISO: Old Internal IO Index]							

#### Notes:

- Register 1 [SYSTEM\_CONFIGURATION] is addressable from both buses; this explains the codification of the External IO Address as "Index + 2". Register follows the "System Communication Mode Protocol" independent of content.