

HX-DIO

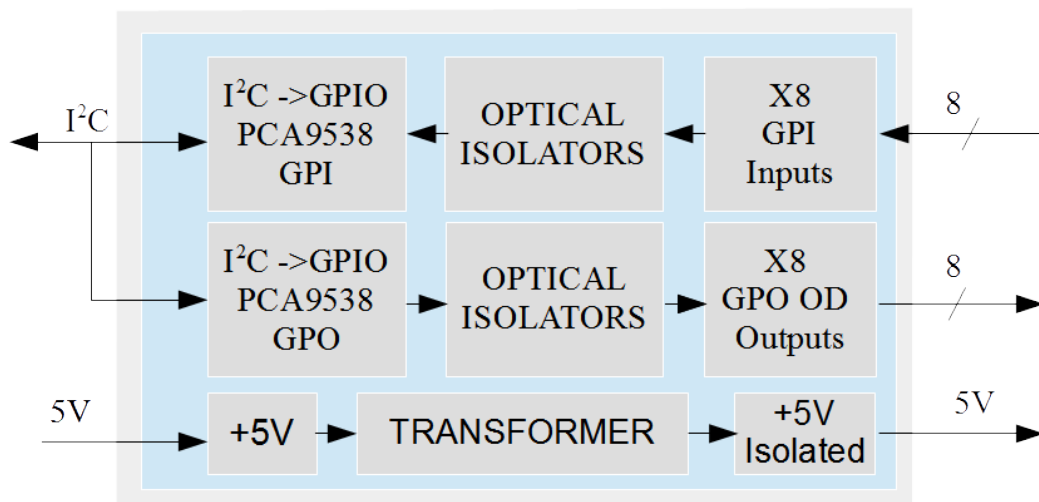
Digital I/O Extension EDS

External Design Specification

Revision 0.6

1. Features

- 8 isolated input pins up to 24V input
- 8 isolated open drain output pins up to 24V operation
- Flywheel diode for VDD on all DO channels
- 2kV isolation
- 5V 50mA protected isolated voltage available to user
- Interrupt support
- System Wake-On-GPIO (WOG) support
- Separate SMBus controllers for input and output pins
- Used as extension with all models of HQ-BOX Embedded server



HX-DIO DIGITAL I/O EXPANSION

2. Absolute maximum ratings ($T_a=25^{\circ}\text{C}$)

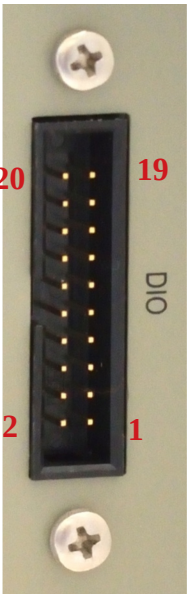
Symbol	Parameter	Value	Units
GPIx [0..7]	Voltage on any input pin	-0.3 to 26	V
GPOx [0..7]	Voltage on any output OD pin	-0.3 to 26	V
+VDD_ISO	Power input for flywheel diode for isolated DO	-0.3 to 26	V
+V5_ISO	Isolated power supply voltage	5.3	V

3. Recommended working conditions ($T_a=25^{\circ}\text{C}$)

Symbol	Parameter	Type	Value		Units
			Min	Max	
GPIx [0..7]	Voltage on any input pin	I	0	24	V
GPOx [0..7]	Voltage on any output OD pin	OD	0	24	V
+VDD_FLY	Power input for flywheel diode for isolated DO	I	0	24	V
+V5_ISO	Isolated power supply voltage output	O	5.1	5.3	V
+V5_ISO	Isolated power supply current	O	-	50	mA

Isolated DI					
V_{IH}	Input high voltage	-	3.14	24	V
V_{IL}	Input low voltage	-	0	1.5	V
R_I	Input resistance	-	-	1000	Ohm
$V_{ISOLATION}$	Isolation voltage	-	-	2000	V
Isolated DO					
V_{OG}	Digital output to isolated ground	-	0	24	V
I_x	Sink current on any output	-	-	2	A
$V_{ISOLATION}$	Isolation voltage	-	-	2000	V
Isolated 5V DC Power Source for DO					
V_{supply}	Supply voltage	0	5.1	5.3	V
I_{supply}	Supply current	0	-	50	mA
$V_{ISOLATION}$	Isolation voltage	-	-	2000	V

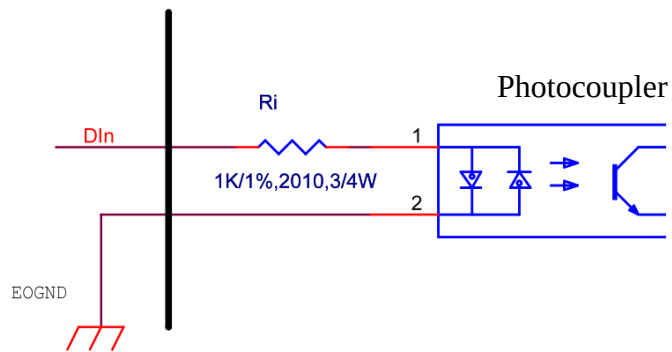
4. Connector pinout

	Pin	Signal	Pin	Signal
	1	EOGND	2	+VDD_FLY
	3	DI0	4	DO0
	5	DI1	6	DO1
	7	DI2	8	DO2
	9	DI3	10	DO3
	11	DI4	12	DO4
	13	DI5	14	DO5
	15	DI6	16	DO6
	17	DI7	18	DO7
	19	+V5_ISO	20	EOGND

DI	DI _n	Input of isolated DI channel (n=0 to 7)
	EOGND	Common isolated ground
DO	DO _n	Output of isolated DO channel (n=0 to 7)
	EOGND	Common isolated ground
	+V5_ISO	Isolated 5V DC power , max. output 50mA
	+VDD_FLY	Power input signal for flywheel diode of isolated DO channel 0 to 7

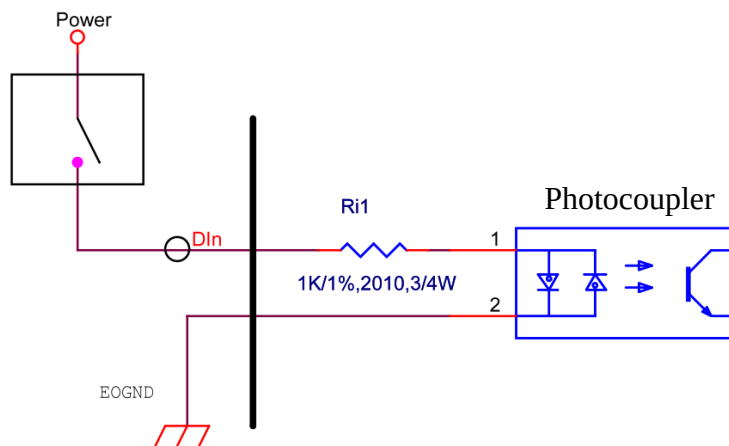
5. Isolated DI circuits connection

Each one of the inputs Din (n=0..7) may accepts voltages up to 24V, using input resistor 1K@0.75W as shown below:

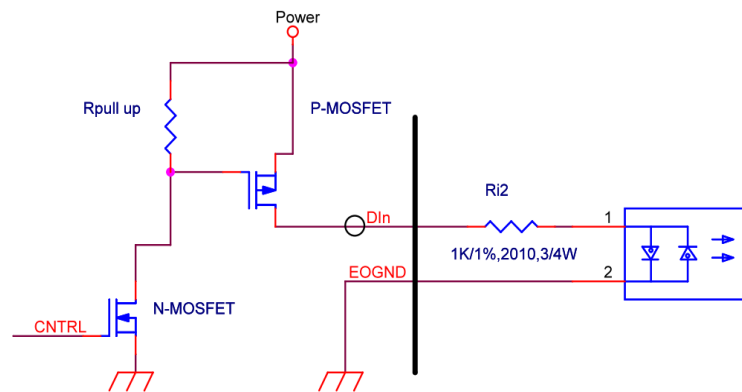


DI connection examples

Example using direct power connection using the switch/button



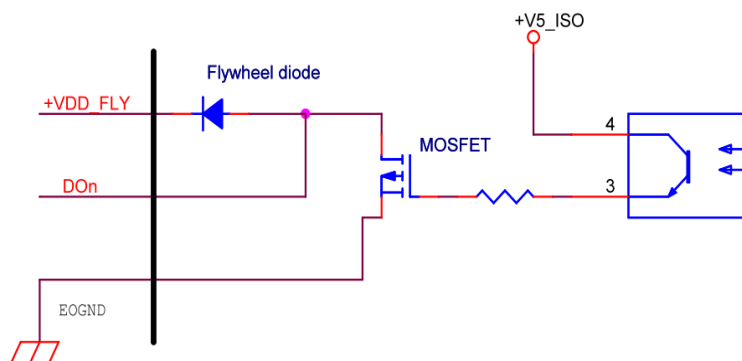
Example using transistor with conversion from CMOS acceptable logic



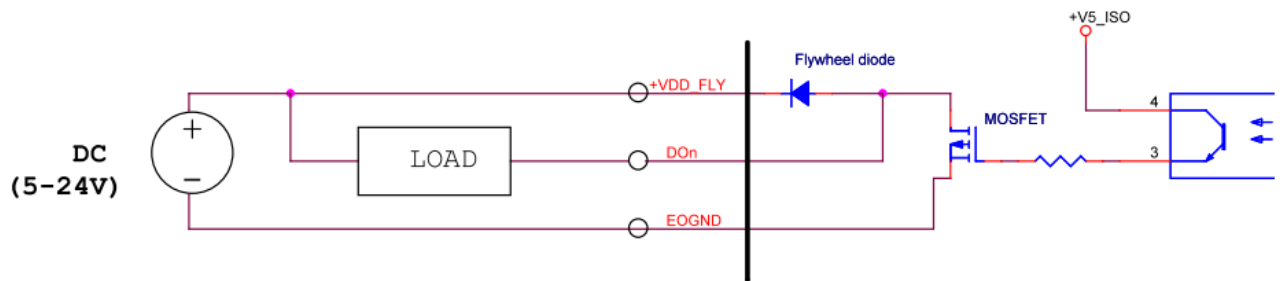
6. Isolated DO circuits connection

Each isolation digital output channel adopts a MOSFET transistor, capable of driving peak current up to 2.5A (sustained current up to 2 A) with voltage ranges from 5V to 24V.

The VDD_FLY pin is connected in series with a flywheel diode protecting the driver during inductance loading, such as relay, motor, or solenoid, wherein the VDD_FLY must connect to external power to form a flywheel current loop.



DO connection example



7. Software access and control

Device access

HX-DIO extension module uses two separate identical 8-bit PCA9538 I2C SMBus controllers– one for digital input (DI) pins and second for digital output (DO) pins with standard I2C bus access with the address map as below:

Controller	7-bit access address	8-bit access address
DI PCA9538	0x71	0xE2-0xE3
DO PCA9538	0x73	0xE6-0xE7

DI SMBus Registers

Command byte

The command byte is the first byte to follow the address byte during a write transmission. It is used as a pointer to determine which of the registers will be written or read.

Command	Protocol	Function
0	read byte	Input Port register
2	read/write byte	Polarity Inversion register
3	read/write byte	Configuration register

Register 0 – Input port register

This register is a read-only port. It reflects the incoming logic levels of the pins, regardless of whether the pin is defined as an input or an output by Register 3. Writes to this register have no effect. The default value ‘X’ is determined by the externally applied logic level.

Bit	Pin	Access	Value	Description
7	DI7	read only	X*	value ‘X’ is determined by externally applied logic level
6	DI6	read only	X*	
5	DI5	read only	X*	
4	DI4	read only	X*	
3	DI3	read only	X*	
2	DI2	read only	X*	
1	DI1	read only	X*	
0	DI0	read only	X*	

Register 2 – Polarity Inversion register

This register allows the user to invert the polarity of the Input Port register data. If a bit in this register is set (written with 1), the corresponding Input Port data is inverted. If a bit in this register is cleared (written with a 0), the Input Port data polarity is retained.

Bit	Pin	Access	Value	Description
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7	DI7	R/W	0*	inverts polarity of Input Port register data 0 = Input Port register data retained (default value) 1 = Input Port register data inverted
6	DI6	R/W	0*	
5	DI5	R/W	0*	
4	DI4	R/W	0*	
3	DI3	R/W	0*	
2	DI2	R/W	0*	
1	DI1	R/W	0*	
0	DI0	R/W	0*	

Register 3 – Configuration register

This register configures the directions of the I/O pins. If a bit in this register is set, the corresponding port pin is enabled as an input with high-impedance output driver. If a bit in this register is cleared, the corresponding port pin is enabled as an output. At reset, the I/Os are configured as inputs.

For HX-DIO DI SMBus the only valid value for this register is **0xFF**

Bit	Pin	Access	Value	Description
7	DI7	R/W	1*	configures the directions of the I/O pins 0 = corresponding port pin enabled as an output 1 = corresponding port pin configured as an input (default value)
6	DI6	R/W	1*	
5	DI5	R/W	1*	
4	DI4	R/W	1*	
3	DI3	R/W	1*	
2	DI2	R/W	1*	
1	DI1	R/W	1*	
0	DI0	R/W	1*	

DO SMBus Registers

Command byte

The command byte is the first byte to follow the address byte during a write transmission. It is used as a pointer to determine which of the registers will be written or read.

Command	Protocol	Function
1	read/write byte	Input Port register
3	read/write byte	Configuration register

Register 1 – Output Port register

This register reflects **inverted** outgoing logic levels of the pins defined as outputs by Register 3. Bit values in this register have no effect on pins defined as inputs. Reads from this register return the value that is in the flip-flop controlling the output selection, not the actual pin value.

Bit	Pin	Access	OD output	Description
7	DO7	R/W	sink	reflects outgoing logic levels of pins defined as outputs by Register 3
6	DO6	R/W	sink	
5	DO5	R/W	sink	
4	DO4	R/W	sink	
3	DO3	R/W	sink	
2	DO2	R/W	sink	
1	DO1	R/W	sink	
0	DO0	R/W	sink	

Register 3 – Configuration register

This register configures the directions of the I/O pins. If a bit in this register is set, the corresponding port pin is enabled as an input with high-impedance output driver. If a bit in this register is cleared, the corresponding port pin is enabled as an output. At reset, the I/Os are configured as inputs.

For HX-DIO DO SMBus the only valid value for this register is **0x00**

Bit	Pin	Access	Value	Description
7	DO7	R/W	1*	configures the directions of the I/O pins 0 = corresponding port pin enabled as an output 1 = corresponding port pin configured as an input (default value)
6	DO6	R/W	1*	
5	DO5	R/W	1*	
4	DO4	R/W	1*	
3	DO3	R/W	1*	
2	DO2	R/W	1*	
1	DO1	R/W	1*	
0	DO0	R/W	1*	

Example of SMBus DI access

i2cset (0x71,0x03,0xff) – set SMBus DI pins to input state
 i2cget (0x71,0x00) - read SMBus DI input register

Example of SMBus DO access

i2cset (0x73,0x03,0x00) – set SMBus DO pins to output state
 i2cset (0x73,0x01,0x18) - set SMBus DO pins DO3 and DO4 to 1

8. Interrupt output

The open-drain interrupt output (INT) is activated when one of the port pins changes state and the pin is configured as an input. The interrupt is de-activated when the input returns to its previous state or the Input Port register is read. Note that changing an I/O from an output to an input may cause a false interrupt to occur if the state of the pin does not match the contents of the Input Port register.

HX-DIO SMBus DI interrupt pin connected to SMB_ALERT of the system.

9. Revision notes

Revision	Date	Revision notes
0.5	18-03-2018	Preliminary release
0.6	22-03-2018	1. Corrected DI example circuit 2. Added PCA9538 reference 3. Added Copyright notice 4. Updated definitions for V_{IL} and V_{IH} 5. Added block diagram

10. Copyright Notice

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