

Extended I/O Board User Manual

Revision 0.1

November 11, 2019

Contents

Contents	1
List of Figures	2
Overview	3
Package Contents	3
Board Overview	4
Design Specification	5
Block Diagram	5
Power Supply	6
USB Blaster	7
Analog Output	8
Analog Input	9
Photo coupler output	10
Photo coupler input	11
User I/O	13
Onboard Sensor devices	15
Accelerometer	15
Tempurature sensor	15
Magnetic sensor	15
Board pin function	16
Expansion Connection Table (CN4)	16
Terminal (TB1)	18
User I/O (CN5~CN9)	19
Optional Analong Input (CN10)	20
JTAG socket (CN3)	20
Associated Product	21
OSCAR Board	21
Additional Information	22
Getting Help	22
Revision History	22

List of Figures

Figure 1 : The Extended I/O Board	3
Figure 2 : Top View of Extended I/O Board	4
Figure 3 : Bottom View of Extended I/O Board	4
Figure 4 : Block Diagram.....	5
Figure 5 : Power Block Diagram.....	6
Figure 6 : USB blaster conection	7
Figure 7 : Analog output.....	8
Figure 8 : Analog input.....	9
Figure 9 : Photo coupler output.....	10
Figure 10 : Photo coupler output.....	11
Figure 11 : Photo coupler output pin description	11
Figure 12 : User I/O.....	13
Figure 13 : Onboard sensor.....	15
Figure 14 : OSCAR Board	21
Figure 15 : OSCAR board installation.....	21

Overview

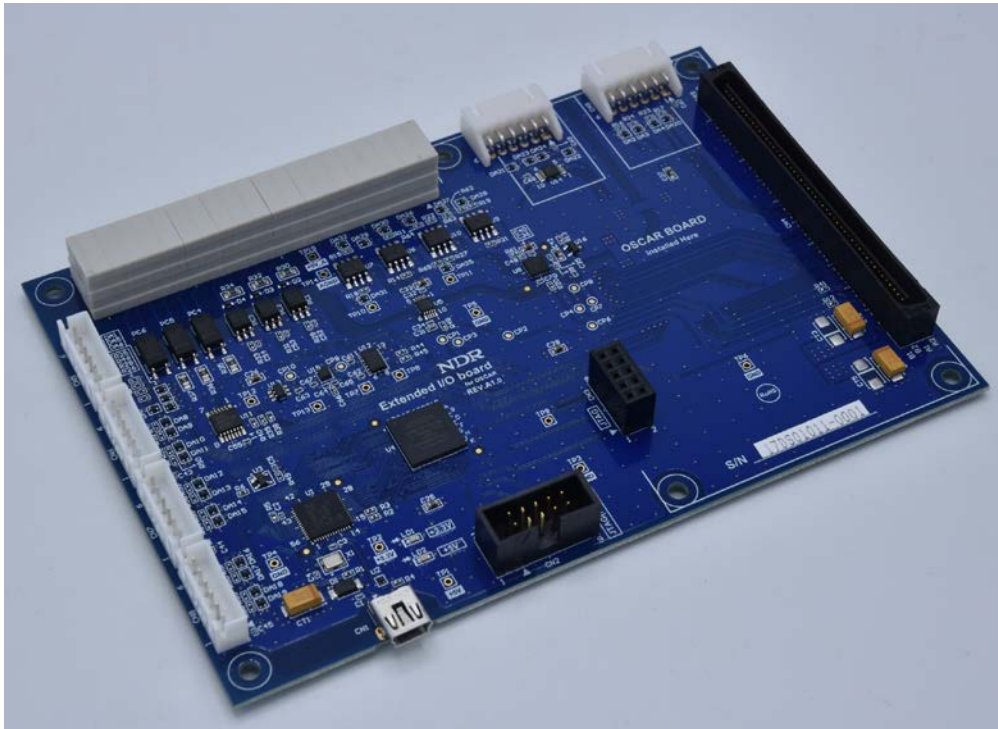


Figure 1 : The Extended I/O Board

Extended I/O board is designed to use with OSCAR board. There are 3 channel of photo coupler output, 3 channel of photo coupler input, 3 channel of DAC output, 3 channel of ADC input (+ 4 channel optional ADC input) and 5 channel of user I/O port. Extended I/O board also include USB blaster circuit. Thus, if attach OSCAR board to Extended I/O board, there can use onboard USB blaster to config/debug MAX10 FPGA.

Package Contents

- Extended I/O Board RevA1.0
- Extended I/O Board User Manual
- 5V DC Power Supply

Board Overview

The components on the Extended I/O board are shown in the Figure below.

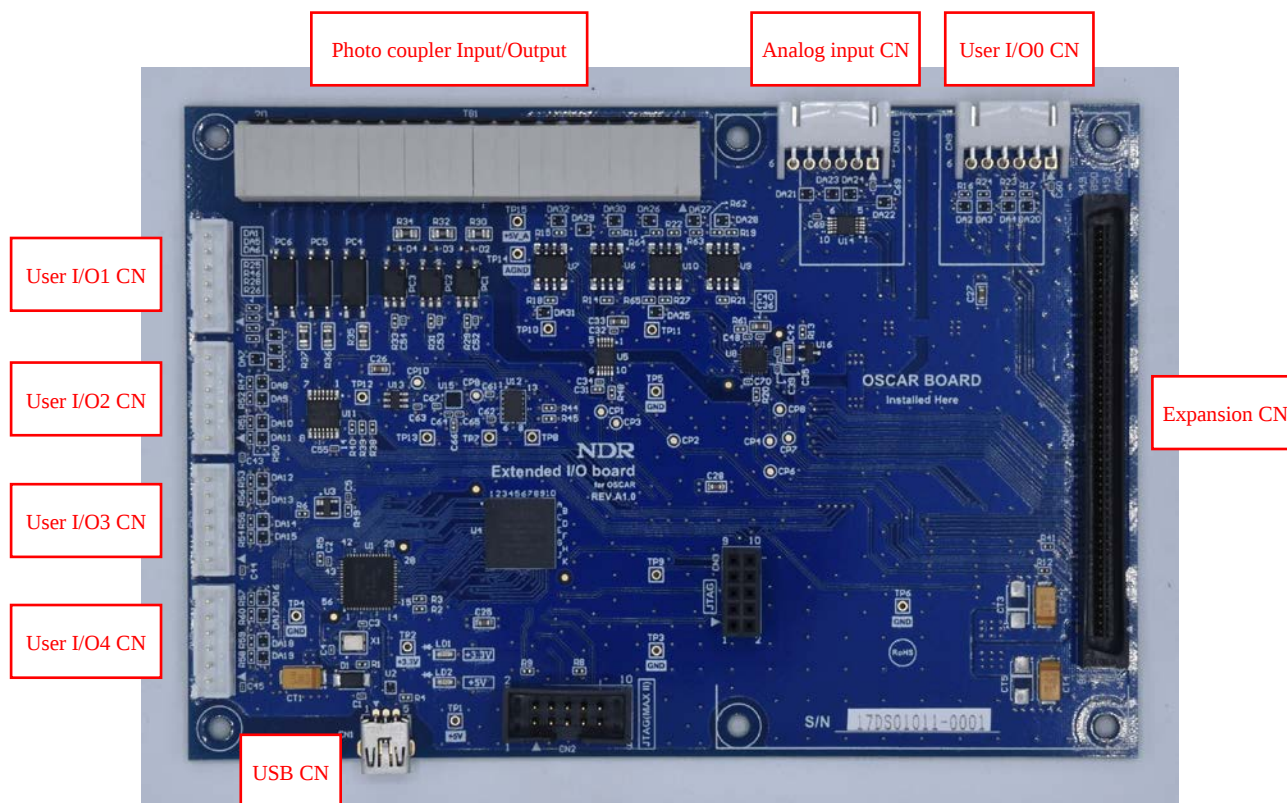


Figure 2 : Top View of Extended I/O Board

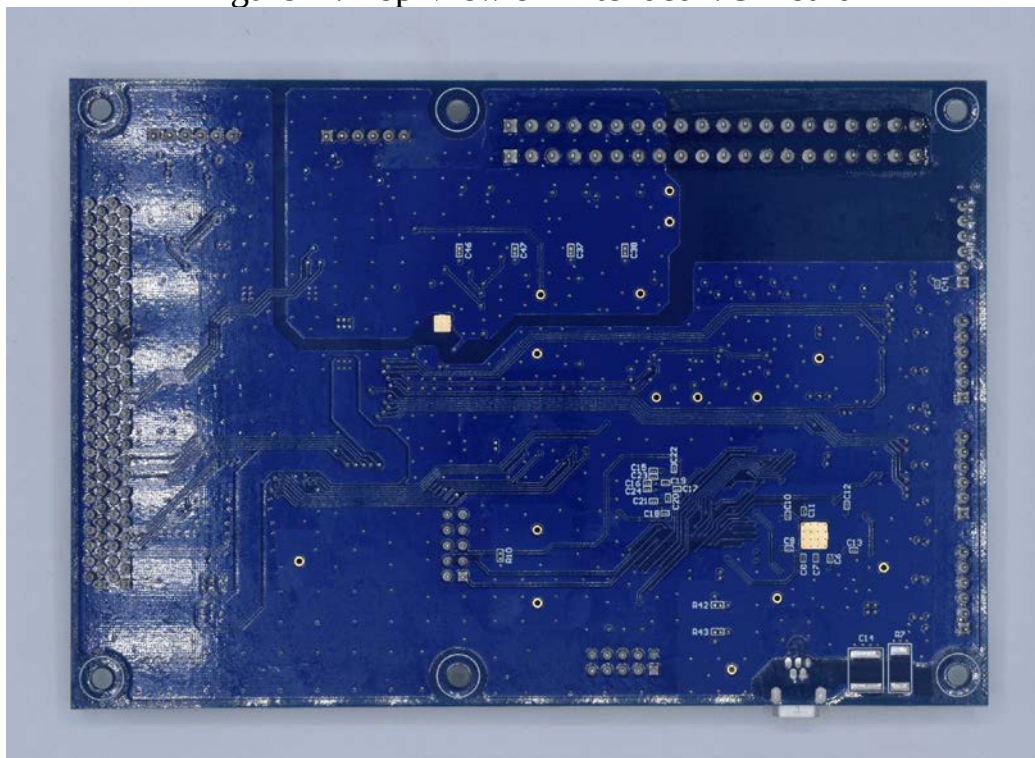


Figure 3 : Bottom View of Extended I/O Board

Design Specification

- OSCAR board expansion connector : FX2C-100P-1.27DSA(71)
- Photo coupler output : TLP387
- Photo coupler input : TLP2362
- Analog output : 3 channels
- Analog input : 3 channels (+ 4 mux channel)
- User I/O : 5 channels
- Onboard sensor device : Accelerometer (ADXL343BCCZ)
Temperature sensor (TMP101NA/3K)
Magnetic sensor (LIS3MDLTR)
- FPGA configuration : Onboard USB blaster

Block Diagram

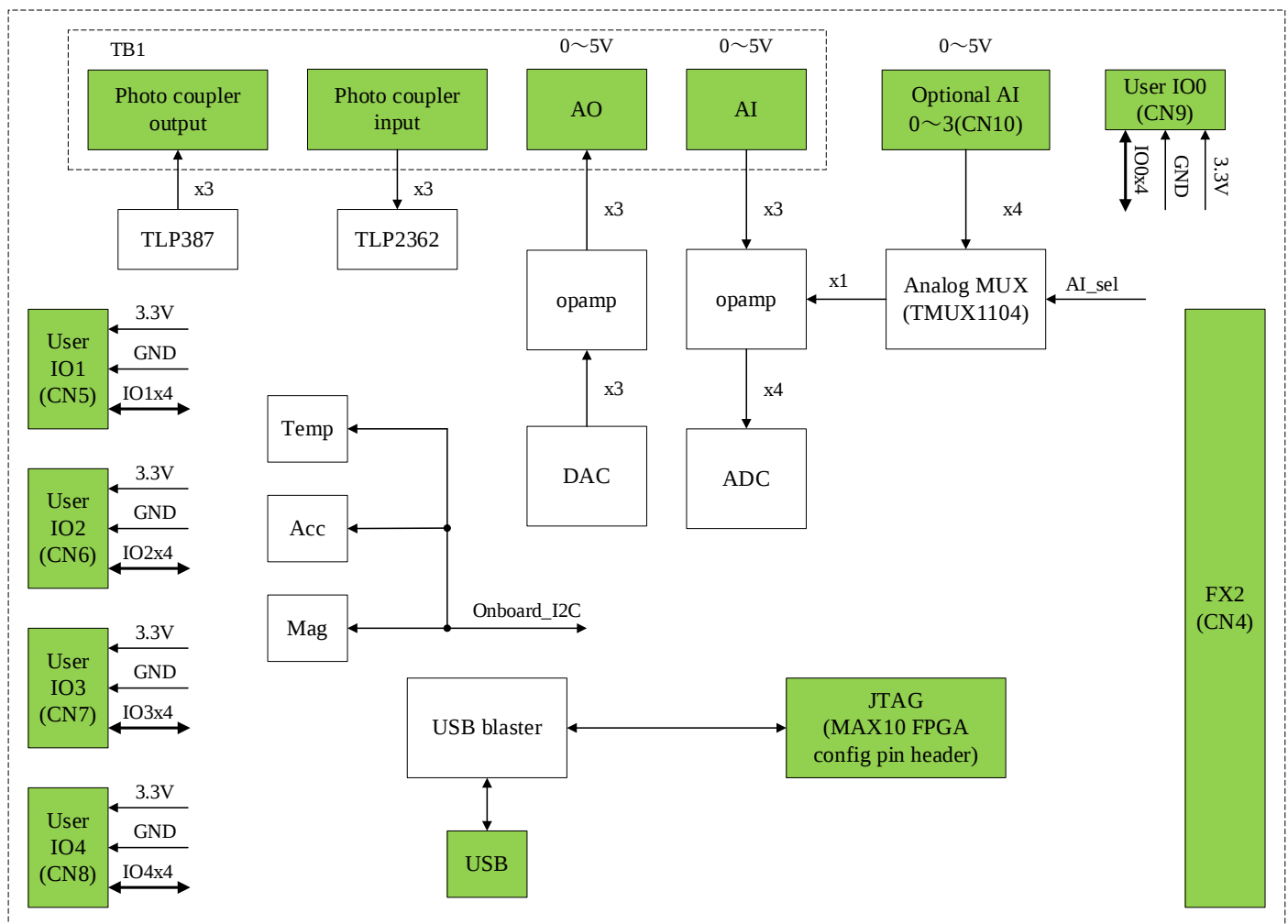


Figure 4 : Block Diagram

Power Supply

The Extended I/O board power can receive from OSCAR board (via FX2 connector) or receive power from USB connector. After applying 5V to Extend I/O board, LD1 and LD2 will bright to show 3.3V and 5V power status.

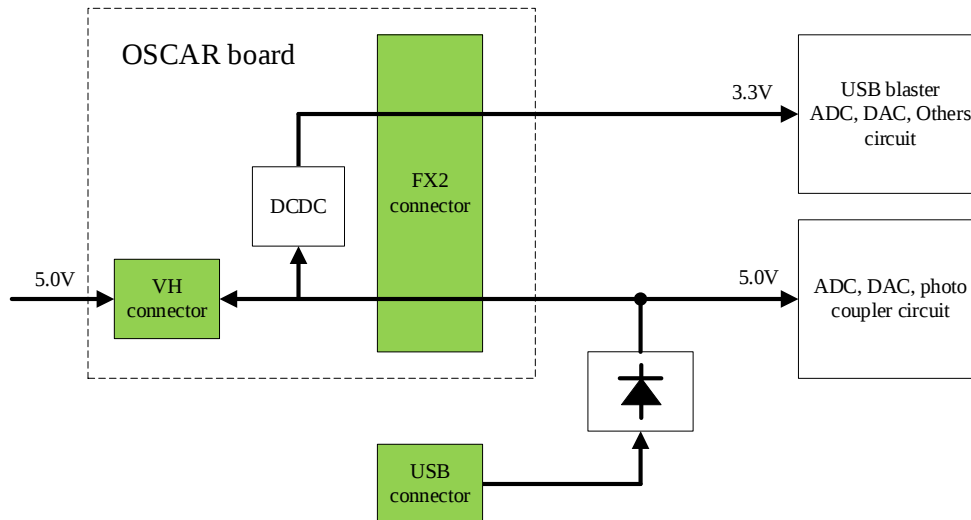


Figure 5 : Power Block Diagram

USB Blaster

The Extended I/O board includes onboard USB blaster circuit. When attached OSCAR board to Extended I/O board. There can use onboard USB blaster to config MAX10 FPGA.

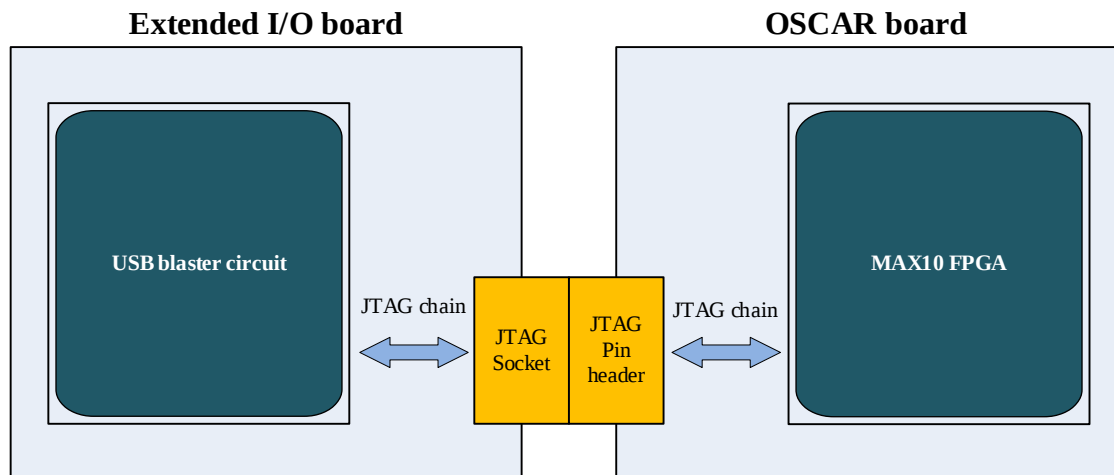


Figure 6 : USB blaster conection

Analog Output

The Extended I/O board use DAC124S085C1MM/NOPB as analog output convertor. MAX10 FPGA will control DAC via SPI interface.

DAC specification:

Resolution : 12bits
 Analog output range : 0-5V
 Number output channel : 3ch output to TB1, 1 ch left as test pin

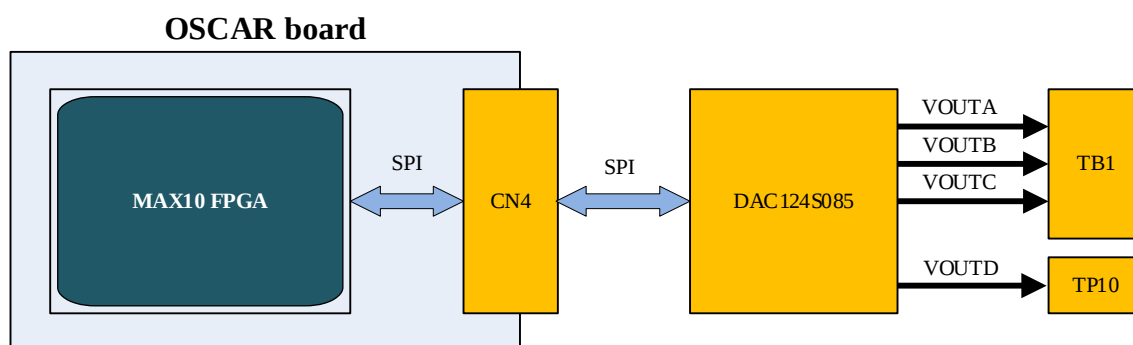


Figure 7 : Analog output

The list of OSCAR board FPGA pin connection is shown below.

Signal Name	DAC pin fuction	CN4 pin No	FPGA pin No
DAC_DIN	DIN	B5	A15
DAC_SYNC_L	SYNC#	B7	A13
DAC_SCLK	SCLK	B6	E10

Table 1 : DAC pin description

Analog Input

The Extended I/O board use ADS7950SBRGER as analog input convertor. MAX10 FPGA will control DAC via SPI interface. There are 3 channels connect directly to ADC convertor. Another one channel is use analog multiplexer (TMUX1104) to expand number of ADC input. Thus, the maximum ADC input is 7 channels

ADC specification:

Resolution	: 12bits
Analog input range	: 0-5V
Number output channel	: 3ch + 4 ch (Analog MUX)

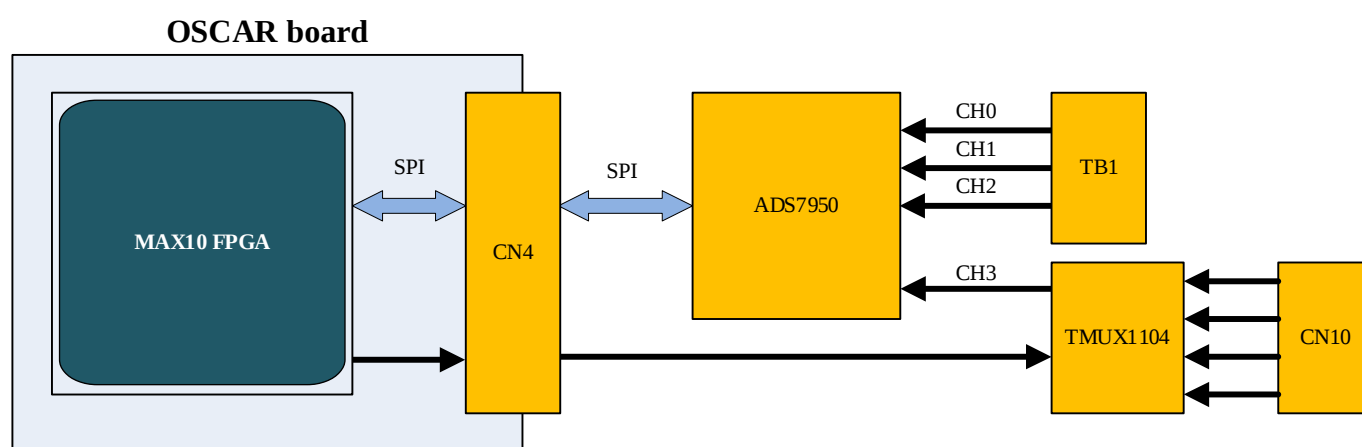


Figure 8 : Analog input

The list of OSCAR board FPGA pin connection is shown below.

Signal Name	ADC pin fuction	CN4 pin No	FPGA pin No
ADC_CS_L	CS#	A6	F10
ADC_SCLK	SCLK	A9	F9
ADC_SDI	SDI	A7	B13
ADC_SDO	SDO	A8	D9
AIMUX_A0	A0	A22	A5
AIMUX_A1	A1	B24	F5
AIMUX_EN	EN	B25	F4

Table 2 : ADC pin description

Photo coupler output

The Extended I/O board prepare 3 isolated outputs by using photo coupler TLP387.

Output specification:

Breakdown voltage : 300V
 Current : 100mA
 Turn on time : 50us

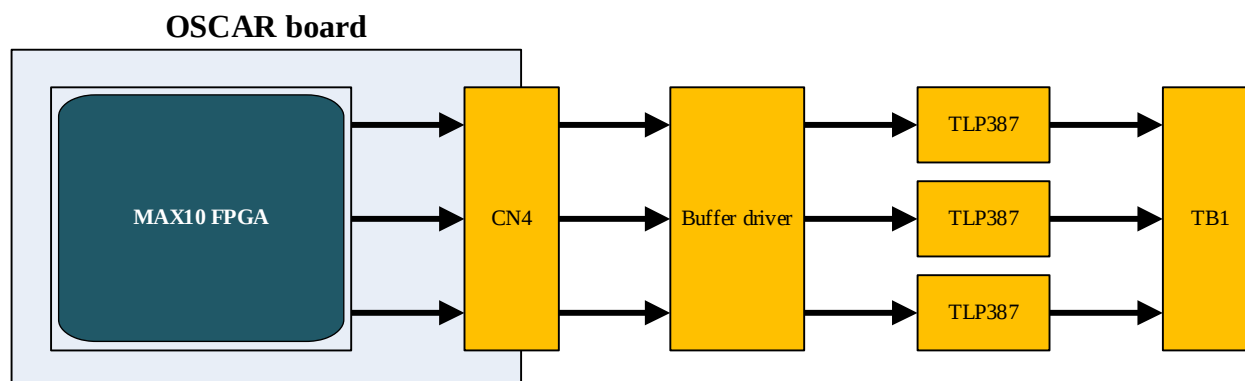


Figure 9 : Photo coupler output

The list of OSCAR board FPGA pin connection is shown below.

Signal Name	CN4 pin No	FPGA pin No
PC_OUT1_L	B8	C9
PC_OUT2_L	B9	B12
PC_OUT3_L	B11	B11

Table 3 : Photo coupler output pin description

Photo coupler input

The Extended I/O board prepare 3 isolated inputs by using photo coupler TLP2362.

Input specification:

Input voltage : 5V
Turn on time : 100ns

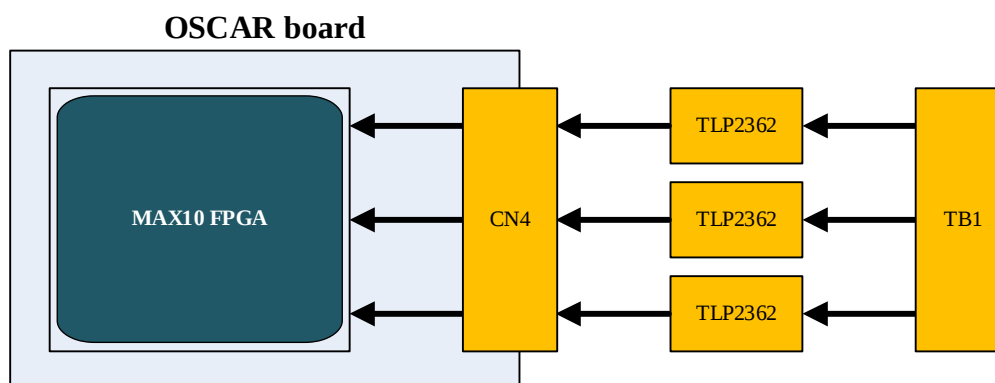


Figure 10 : Photo coupler output

The list of OSCAR board FPGA pin connection is shown below.

Signal Name	CN4 pin No	FPGA pin No
PC_IN1	B12	A11
PC_IN2	B13	A12
PC_IN3	B14	A10

Table 4 : Photo coupler output pin description

Note: Photo coupler input is designed for input 5V. If user wants to apply input over than 5V, there needs to add additional resistor at terminal (TB1) as shown below.

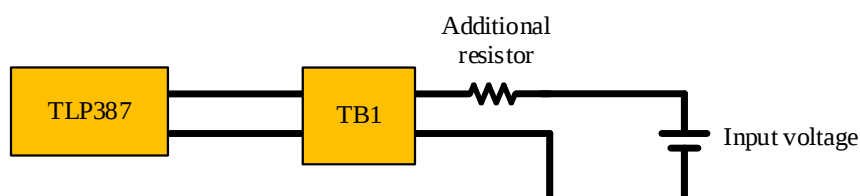


Figure 11 : Photo coupler output pin description

Input voltage	Additional resistor
12V	715Ω
24V	1.96kΩ
48V	4.32kΩ

Table 5 : Example of additional resistor value

User I/O

The Extended I/O board prepare 5 channel of user I/O. each channel has 4 GPIO port. All GPIO ports are directly connected between expansion connector (CN4) and I/O input/output connector (CN5~CN9). User can implement each I/O to be any interface (Ex: I2C, SPI) by modifying MAX10 FPGA at OSCAR board.

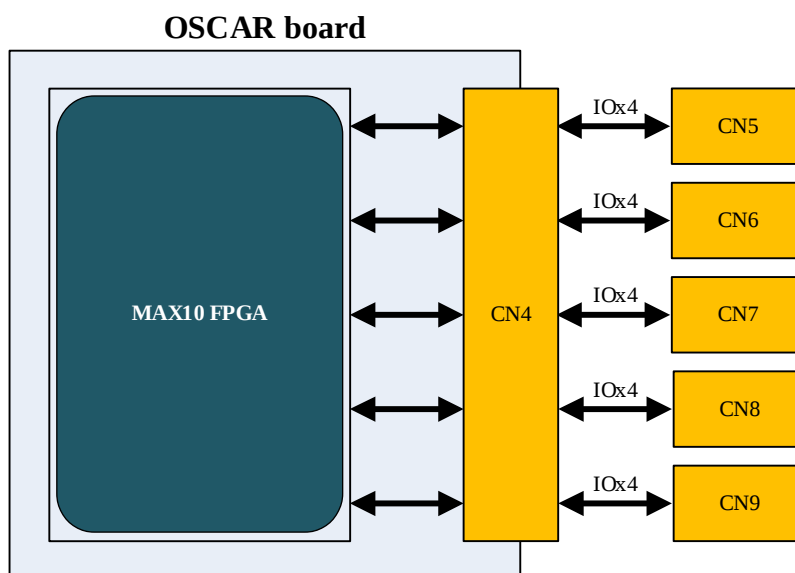


Figure 12 : User I/O

The list of OSCAR board FPGA pin connection is shown below.

Signal Name	CN4 pin No	CN5 pin No	FPGA pin No
IO1_1	B19	3	N4
IO1_2	B21	4	C5
IO1_3	B22	5	A3
IO1_4	B23	6	B3

Signal Name	CN4 pin No	CN6 pin No	FPGA pin No
IO2_1	A15	3	B7
IO2_2	A16	4	B9
IO2_3	A17	5	B6
IO2_4	A18	6	C6

Signal Name	CN4 pin No	CN7 pin No	FPGA pin No
IO3_1	B15	3	A9
IO3_2	B16	4	A8
IO3_3	B17	5	A7
IO3_4	B18	6	A6

Signal Name	CN4 pin No	CN8 pin No	FPGA pin No
IO4_1	A11	3	E9
IO4_2	A12	4	C10
IO4_3	A13	5	B10
IO4_4	A14	6	B8

Signal Name	CN4 pin No	CN9 pin No	FPGA pin No
IO0_1	B26	3	H5
IO0_2	B27	4	G5
IO0_3	B28	5	G2
IO0_4	B29	6	F1

Table 6 : User I/O pin description

Onboard Sensor devices

There are 3 types of sensor are installed on Extended I/O board. All sensors are connecte by I2C interface.

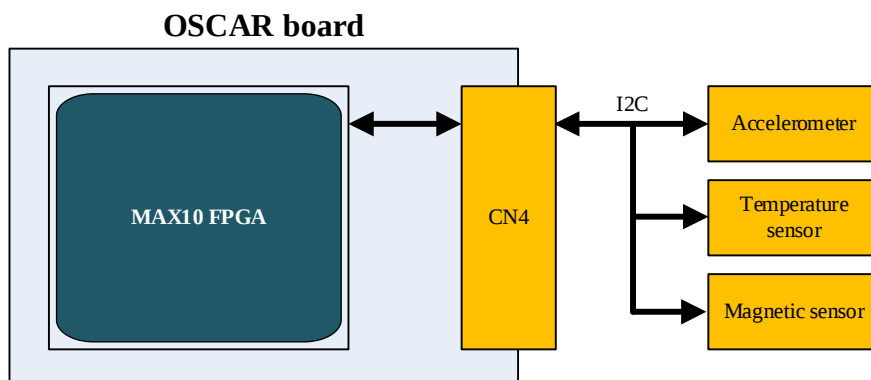


Figure 13 : Onboard sensor

Accelerometer

ADXL343BCCZ

Slave address : 0x53 (write: 0xA6, read: 0xA7)

Interface : I2C

Measurement range : ± 2 , ± 4 , ± 8 , ± 16 g

Measurement axis : X, Y, Z

Resolution : 13bits

Tempurature sensor

TMP101NA/3K

Slave address : 0x48 (write: 0x90, read: 0x91)

Interface : I2C

Measurement range : $-128 \sim 128^{\circ}\text{C}$

Resolution : 12bits

Magnetic sensor

LIS3MDLTR : 0x1C (write: 0x38, read: 0x39)

Interface : I2C

Measurmenet range : ± 2 , ± 4 , ± 8 , ± 16 gauss

Measurement axis : X, Y, Z

Resolution : 16bits

Board pin function

The Extended I/O board has expansion connector for connect to OSCAR board. Voltage level of all pin's connection is 3.3V.

Expansion Connection Table (CN4)

FPGA pin No	Signal Name	CN4 pin No	CN4 pin No	Signal Name	FPGA pin No
-	Plus5V	A1	B1	Plus5V	-
-	Plus5V	A2	B2	Plus5V	-
-	Plus3V3	A3	B3	Plus3V3	-
-	Plus3V3	A4	B4	Plus3V3	-
F12	ADC_GPIO	A5	B5	DAC_DIN	A15
F10	ADC_CS_L	A6	B6	-	-
B13	ADC_SDI	A7	B7	DAC_SYNC_L	A13
D9	ADC_SDO	A8	B8	PC_OUT1_L	C9
-	-	A9	B9	PC_OUT2_L	B12
-	Ground	A10	B10	Ground	-
E9	IO4_1	A11	B11	PC_OUT3_L	B11
C10	IO4_2	A12	B12	PC_IN1	A11
B10	IO4_3	A13	B13	PC_IN2	A12
B8	IO4_4	A14	B14	PC_IN3	A10
B7	IO2_1	A15	B15	IO3_1	A9
B9	IO2_2	A16	B16	IO3_2	A8
B6	IO2_3	A17	B17	IO3_3	A7
C6	IO2_4	A18	B18	IO3_4	A6
B5	I2C_SDA	A19	B19	IO1_1	N4
-	Ground	A20	B20	Ground	-
B4	I2C_SCL	A21	B21	IO1_2	C5
A5	AIMUX_A0	A22	B22	IO1_3	A3
-	-	A23	B23	IO1_4	B3
-	-	A24	B24	AIMUX_A1	F5
-	-	A25	B25	AIMUX_EN	F4
-	-	A26	B26	IO0_1	H5
-	-	A27	B27	IO0_2	G5
-	-	A28	B28	IO0_3	G2
-	-	A29	B29	IO0_4	F1
-	Ground	A30	B30	Ground	-
-	-	A31	B31	-	-

FPGA pin No	Signal Name	CN4 pin No	CN4 pin No	Signal Name	FPGA pin No
-	-	A32	B32	-	-
-	-	A33	B33	-	-
-	-	A34	B34	-	-
-	-	A35	B35	-	-
-	-	A36	B36	-	-
-	-	A37	B37	-	-
-	-	A38	B38	-	-
-	-	A39	B39	-	-
-	Ground	A40	B40	Ground	-
-	-	A41	B41	-	-
-	-	A42	B42	-	-
-	-	A43	B43	-	-
-	-	A44	B44	-	-
-	-	A45	B45	-	-
-	-	A46	B46	-	-
-	-	A47	B47	-	-
-	-	A48	B48	-	-
-	-	A49	B49	-	-
-	-	A50	B50	-	-

Table 7 : CN4 pin description

Terminal (TB1)

Signal Name	TB1 pin No
AIN1	1
AIN2	2
AIN3	3
AGND	4
AOUT1	5
AOUT2	6
AOUT3	7
AGND	8
PC_IN1_P	9
PC_IN1_N	10
PC_IN2_P	11
PC_IN2_N	12
PC_IN3_P	13
PC_IN3_N	14
PC_OUT1_P	15
PC_OUT1_N	16
PC_OUT2_P	17
PC_OUT2_N	18
PC_OUT2_P	19
PC_OUT2_N	20

User I/O (CN5~CN9)

Signal Name	CN5 pin No
Plus3V3	1
Ground	2
IO1_1	3
IO1_2	4
IO1_3	5
IO1_4	6

Signal Name	CN6 pin No
Plus3V3	1
Ground	2
IO2_1	3
IO2_2	4
IO2_3	5
IO2_4	6

Signal Name	CN7 pin No
Plus3V3	1
Ground	2
IO3_1	3
IO3_2	4
IO3_3	5
IO3_4	6

Signal Name	CN8 pin No
Plus3V3	1
Ground	2
IO4_1	3
IO4_2	4
IO4_3	5
IO4_4	6

Signal Name	CN9 pin No
Plus3V3	1
Ground	2
IO5_1	3
IO5_2	4
IO5_3	5
IO5_4	6

Optional Analog Input (CN10)

Signal Name	CN9 pin No
Plus5V_A	1
SENSOR_AIN1	2
SENSOR_AIN2	3
SENSOR_AIN3	4
SENSOR_AIN4	5
AGND	6

JTAG socket (CN3)

Signal Name	CN4 pin No	CN4 pin No	Signal Name
TCK	1	2	-
TDO	3	4	-
TMS	5	6	-
-	7	8	-
TDI	9	10	Ground

Associated Product

OSCAR Board

The OSCAR board is an evaluation board which contains MAX 10, two of 10/100 Ethernet (PHY), SDRAM, EEPROM, NOR flash memory LED, rotary switch, and expansion connector. For more information please see on OSCAR Board User Manual. The look of the OSCAR board is shown in the Figure 14.

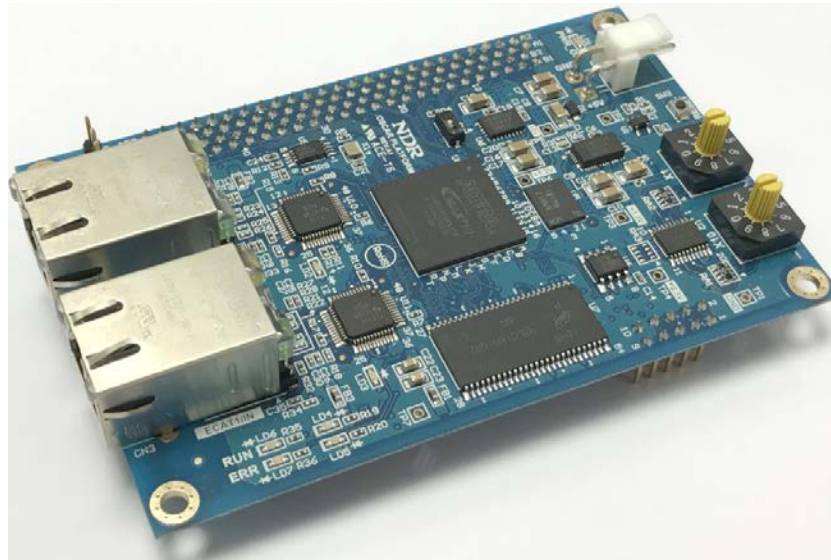


Figure 14 : OSCAR Board

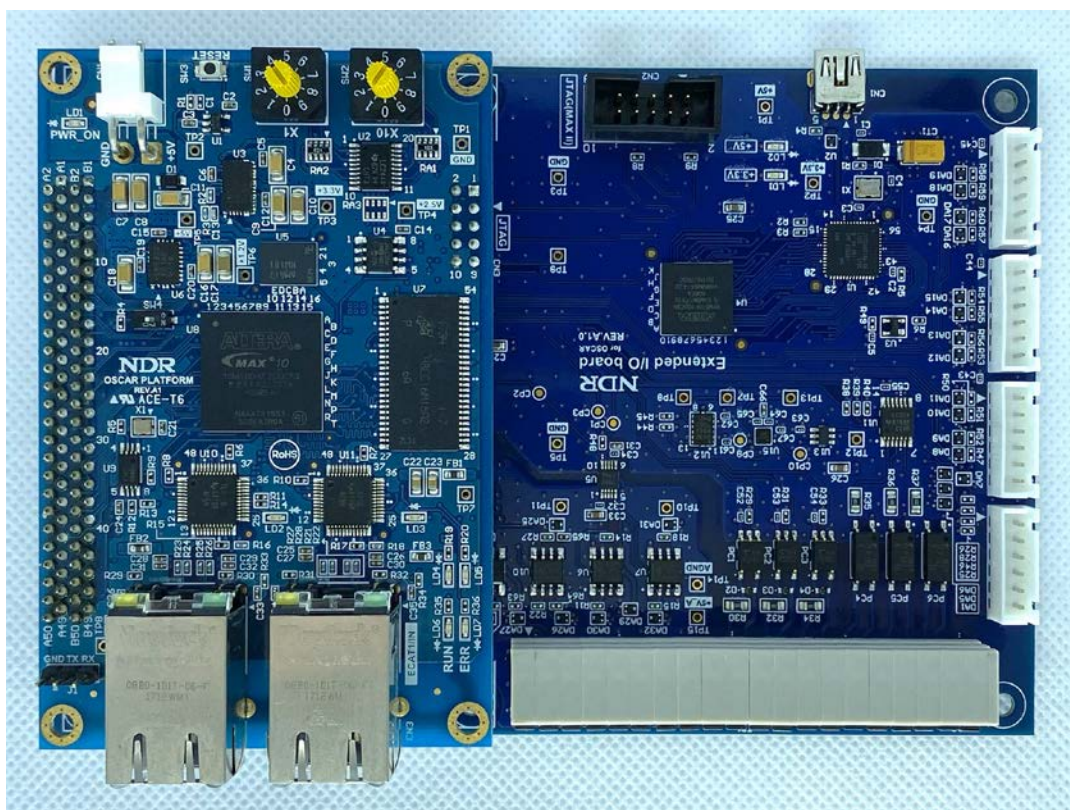


Figure 15 : OSCAR board installation

Additional Information

Getting Help

NDR Company Limited

2F, Osaka Hommachi-Nishi Daiichi Building,
2-1-1, Awaza, Nishi-ku, Osaka-shi, Osaka, JAPAN 550-0011

Email: info-ndr@ndr.co.jp

Tel.: +816-6539-2111

Web: <http://ndr.co.jp/en/>

Revision History

Date	Revision	Changes list
2019-11-1	0.1	First draft