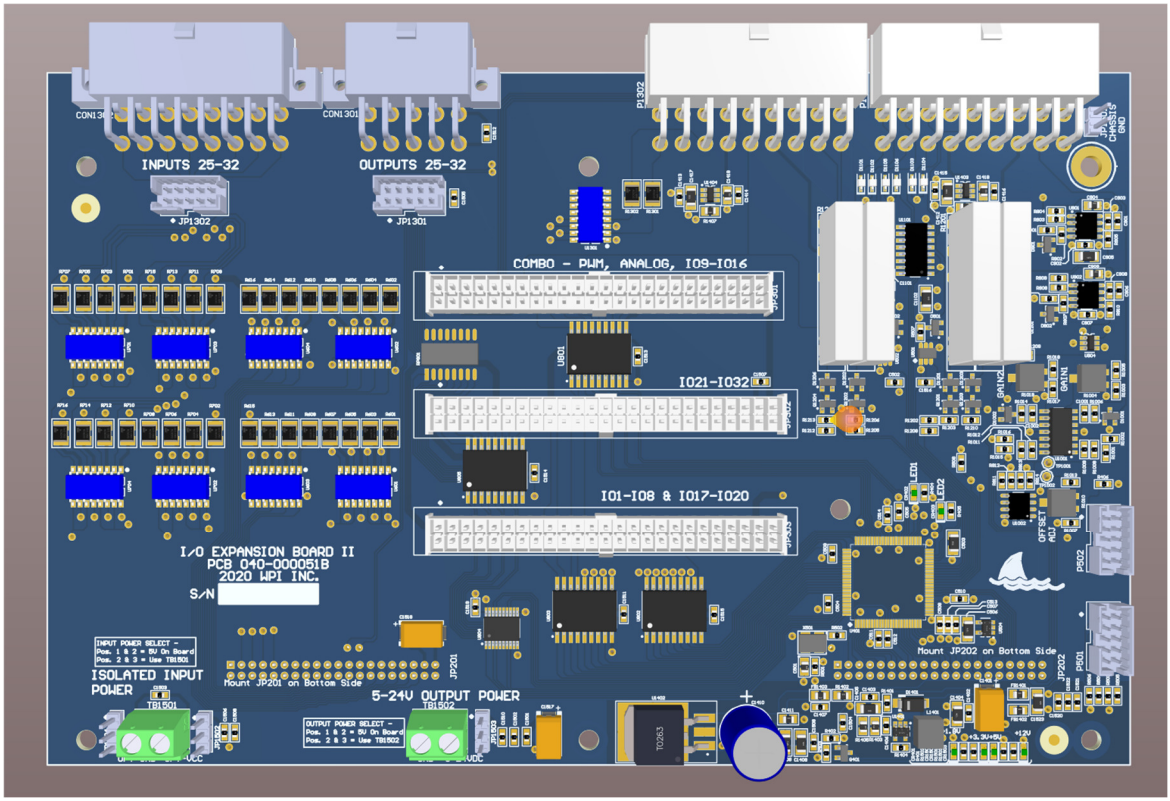
Ultra IO Expansion Board Manual



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1 Products and System Requirements

This document is intended as a guide to installing and operating the Ultra IO Expansion Board. Contained within are instructions on system integration, connections, setup, and standard operating methods.

1.1 Overview

The Ultra IO Expansion Board provides the following:

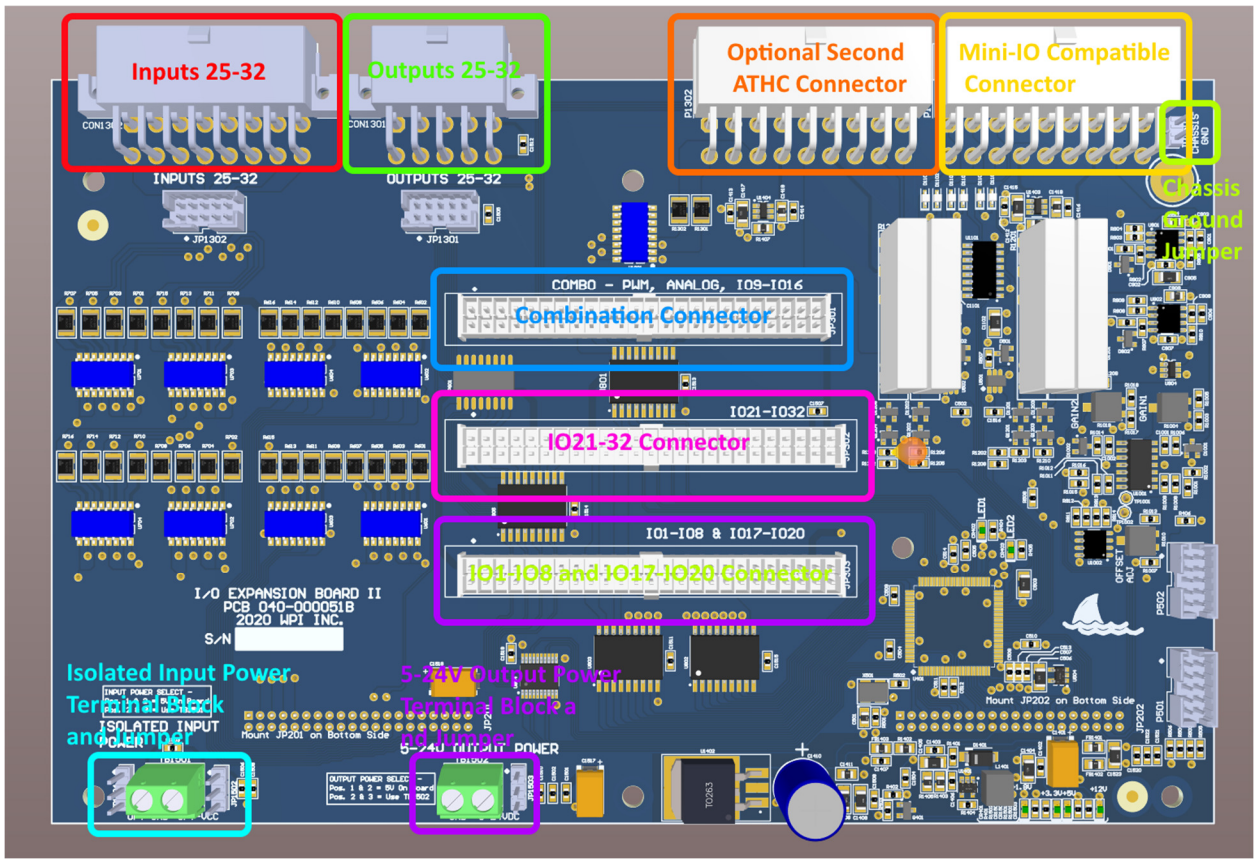
- 24 additional opto-isolated inputs with selectable voltage operation
- 24 additional outputs (8 available as TTL-level outputs and 32 open-collector active-low outputs)
- 2 relay outputs (4 with optional second IO back panel connector)
- 1 quadrature encoder input supporting A and B channels along with an Index pulse
- 2 analog outputs
- 2 analog inputs (only one active at a time)
- 1 PWM output
- **Optional** support for a second 18-position connector for seamless connection of a second ATHC system. When equipped with this connector, an additional 2 relay outputs are made available.

1.2 Datasheet

1.2.1 Connectors and Capabilities

The addition of the Ultra IO Expansion Board expands the capabilities of the Signal Generator to include 32 opto-isolated inputs, 32 open-collector outputs (16 of which are also available as TTL-level outputs), 2 x 0-10V analog outputs, 2 x 0-10V analog inputs (only one is active at a time), quadrature encoder support (for spindle speed monitoring), and one PWM/PFM TTL-level output.

1.2.2 Connector Identification



1.2.3 Connector Functions

Connector	Function
TB1501	OPT-VCC and OPT-GND input
JP1502, JP1504	OPT-GND and OPT-VCC selection
JP1501	Chassis GND connection
TB1502	5-24VDC input
JP1503	5-24VDC selection
CON1301	Back Panel Connector for Inputs 25-32
JP1301	Internal Connector for Inputs 25-32
CON1302	Back Panel Connector for Outputs 25-32
JP1502	Internal Connector for Outputs 25-32
P1301	Back Panel Connector for IO Connector 2 (optional)
P1302	Back Panel Connector for IO Connector 1
JP1301	Internal Combination IO Connector
JP1302	Internal IO 21-32 Connector
JP1303	Internal IO 1-8 and IO 17-20 Connector

1.2.4 Connector Pinouts

1.2.4.1 Isolated Input Power Terminal Block and Jumpers

Pin	TB1501 – Signal	Isolated Input Power Description	I/O
1	TB-GND	OPT-GND	PWR
2	TB-VCC	OPT-VCC	PWR

Pin	JP1502 – Signal	OPT-POWER Jumper Description	I/O
1	5VDC	On-board 5VDC	PWR
2	OPT-VCC	Power to Optoisolated inputs	PWR
3	TB-VCC	OPT-VCC from TB1501	PWR

Pin	JP1504 – Signal	OPT-GND Jumper Description	I/O
1	GND	On-board GND	PWR
2	OPT-GND	GND to Optoisolated inputs	PWR
3	TB-GND	OPT-GND from TB1501	PWR

Installing a jumper from positions 1-2 of the JP1502 and JP1504 connectors will operate the opto-isolated inputs on the Ultra IO Expansion board from the on-board 5VDC power supply.

Installing a jumper from positions 2-3 of the JP1502 and JP1504 connectors will operate the opto-isolated inputs from the voltage applied to the TB1501 connector.

Only the opto-isolated inputs on CON1302, JP1302, JP301, JP302, and JP303 are affected by this jumper setting.

1.2.4.2 Chassis Ground Jumper

Pin	JP1501 – Signal	Chassis GND Jumper Description	I/O
1	GND	GND	PWR
2	Chassis	Chassis GND Connection (MTG Hole)	PWR

Installing a jumper on JP1501 will connect digital ground of the controller to the chassis ground connection at the plated mounting hole of the PCB.

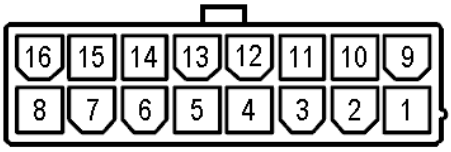
1.2.4.3 5-24VDC Oputput Power Terminal Block and Jumpers

Pin	TB1502 – Signal	5-24V Output Power Description	I/O
1	GND	GND	PWR
2	TB-24VDC	5-24VDC to open collector outputs	PWR

Pin	JP1503 – Signal	5-24VDC Output Power Jumper Description	I/O
1	5VDC	On-board 5VDC	PWR
2	5-24VDC	5-24VDC to open collector outputs	PWR
3	TB-24VDC	TB-24VDC from TB1502	PWR

Installing a jumper from positions 1-2 of the JP1503 connector will operate the 5-24VDC power supply from the on-board 5VDC power supply. If a voltage higher than 5VDC is to be switched by the open-collector outputs provided on JP301, JP302, and JP303, that voltage must be connected to TB1502 for proper clamp operation.

1.2.4.4 Input Connectors



External Input connector pinout
as viewed from rear of the Signal Generator.

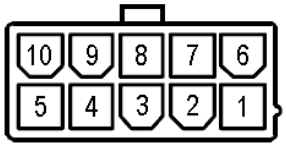
Pin	CON1301 – Signal	Input Connector Description	I/O
1	OPT-GND	OPT-GND	PWR
2	OPT-GND	OPT-GND	PWR
3	OPT-GND	OPT-GND	PWR
4	OPT-GND	OPT-GND	PWR
5	OPT-GND	OPT-GND	PWR
6	OPT-GND	OPT-GND	PWR
7	OPT-GND	OPT-GND	PWR
8	OPT-GND	OPT-GND	PWR
9	IN25	Input 25	I
10	IN26	Input 26	I
11	IN27	Input 27	I
12	IN28	Input 28	I
13	IN29	Input 29	I
14	IN30	Input 30	I
15	IN31	Input 31	I
16	IN32	Input 32	I

This connector provides external access to Inputs 25 through 32.

Pin	JP1301 – Signal	INput Connector Description	I/O
1	IN26	Input 26	I
2	IN25	Input 25	I
3	IN28	Input 28	I
4	IN27	Input 27	I
5	IN30	Input 30	I
6	IN29	Input 29	I
7	IN32	Input 32	I
8	IN31	Input 31	I
9	OPT-GND	OPT-GND	PWR
10	OPT-GND	OPT-GND	PWR

This connector provides the same signals as CON1301.

1.2.4.5 Output Connectors



External Output connector pinout
as viewed from rear of the Signal Generator.

Pin	CON1302 – Signal	Output Connector Description	I/O
1	OUT25	Output 25	O
2	OUT26	Output 26	O
3	OUT27	Output 27	O
4	OUT28	Output 28	O
5	OUT29	Output 29	O
6	OUT30	Output 30	O
7	OUT31	Output 31	O
8	OUT32	Output 32	O
9	5VDC	5VDC	PWR
10	GND	GND	PWR

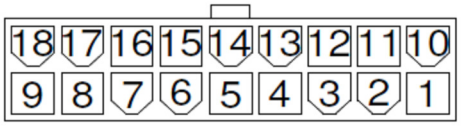
This connector provides external access to Outputs 25-32.

These are TTL-level outputs capable of drive 0-5VDC. They will not interface properly with 24VDC systems without additional circuitry. Output logic high is normally 5VDC but can droop as low as 4.3VDC under load. Output logic low is normally 0VDC, but can rise as high as 0.4VDC under full load. Each output can provide up to 24mA of current. These outputs are initialized at system power-on to a logic low (inactive) state.

Pin	JP1302 – Signal	Output Connector Description	I/O
1	OUT26	Output 26	O
2	OUT25	Output 25	O
3	OUT28	Output 28	O
4	OUT27	Output 27	O
5	OUT30	Output 30	O
6	OUT29	Output 29	O
7	OUT32	Output 32	O
8	OUT31	Output 31	O
9	GND	OPT-GND	PWR
10	5VDC	5VDC	PWR

This connector provides the same signals as CON1302.

1.2.4.6 IO Connector 1



External IO connector pinout
as viewed from rear of the Signal Generator.

Pin	P1301 – Signal	Mini-IO Connector 1 Description	I/O
1	CH A-	Encoder A-	I
2	CH B-	Encoder B-	I
3	IDX-	Encoder Index -	I
4	GND	GND	PWR
5	GND	GND	PWR
6	RLY A-	Relay A-	O
7	RLY B-	Relay B-	O
8	AGND	Analog GND	PWR
9	AGND	Analog GND	PWR
10	CH A+	Encoder A+ / Input 19	I
11	CH B+	Encoder B+	I
12	IDX+	Encoder Index + / Input 20	I
13	LIM_5VA1	Current limited 5VDC	PWR
14	PWM1	PWM Output 1	O
15	RLY A+	Relay A+	O
16	RLY B+	Relay B+	O
17	AOUT1	Analog Output 1	AO
18	AIN1	Analog Input 1	AI

1.2.4.6.1 Spindle Speed Feedback

Channel A+/-, Channel B +/-, and Index +/- are inputs used for spindle encoder input, most commonly used as spindle speed feedback to monitor the spindle speed in real time and to control threading operations on CNC lathes. These inputs may be single-ended or differential and they may be connected to single channel or quadrature encoders. Using these inputs to index the start of a threading operation allows the operator to re-start a specific thread or turn multiple threads on the same workpiece.

The encoder signal requirements are as follows:

- RS-422 inputs (A,B, Index), single ended (A) or differential (A+ and A-) signals.
- Single channel (A) or 2 channel (A + B) used for spindle direction.
- Indexing optional.

- 16 to 2048 counts per revolution (CPR).

When not used for interfacing to an encoder, the A+ channel can be used as Input 19 and the I+ channel can be used as Input 20.

When accessed through this connector inputs 19 and 20 are **NOT** opto-isolated.

1.2.4.6.2 5VDC Power Supply Output

A 5VDC +/-5% current limited (0.8A) power supply is provided.

1.2.4.6.3 PWM 1 Output

A TTL-level, software configurable PWM output is provided. It can be configured to vary either frequency or pulse width. The signal can sink or source up to 500mA. It is typically used for controlling the output power of a device or pulsing the output of a device such as a spindle or laser.

The PWM output specification is as follows:

- 0-100% duty cycle.
- 1Hz to 1MHz operation.
- Based on two 16-bit counters, one for the high pulse width and the other for the low pulse width.
- Driven from a 2MHz clock source.

1.2.4.6.4 Relay 1

A dry contact closure is provided for switching external devices.

This relay output is controlled by Output 1 of the signal generator.

1.2.4.6.5 Relay 2

A dry contact closure is provided for switching external devices.

This relay output is controlled by Output 2 of the signal generator.

1.2.4.6.6 Analog Output 1

A 0-10VDC variable analog output is available. It is intended to control spindle speed or any device that requires a variable voltage input for control.

1.2.4.6.7 Analog Input 1

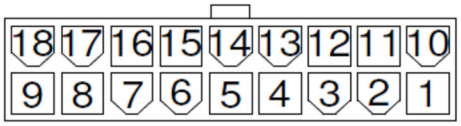
A 0-10VDC analog input is provided for reading power, temperature, or sensor inputs.

Analog Input 1 and Analog Input 2 cannot be used simultaneously.

Output 5 must be **OFF** for this input to be active.

1.2.4.7 IO Connector 2 (optional)

Depending on revision, this connector and supporting circuitry are optional.



External IO connector 2 pinout
as viewed from rear of the Signal Generator.

Pin	P1302 – Signal	Mini-IO Connector 2 Description	I/O
1	GND	GND	I
2	-	-	-
3	GND	GND	I
4	GND	GND	PWR
5	GND	GND	PWR
6	RLY C-	Relay C-	O
7	RLY D-	Relay D-	O
8	AGND	Analog GND	PWR
9	AGND	Analog GND	PWR
10	IN21	Input 21	I
11	-	-	-
12	IN22	Input 22	I
13	LIM_5VA2	Current limited 5VDC	PWR
14	PWM2	PWM Output 2	O
15	RLY C+	Relay C+	O
16	RLY D+	Relay D+	O
17	AOUT2	Analog Output 2	AO
18	AIN2	Analog Input 2	AI

1.2.4.7.1 Digital Inputs

Inputs 21 and 22 are available on this connector.

They are opto-isolated, but they are **NOT** biased by the OPT-VCC and OPT-GND connections made by JP1502 and JP1504. These inputs use the on-board 5VDC power supply at all times.

1.2.4.7.2 5VDC Power Supply Output

A 5VDC +/-5% current limited (0.8A) power supply is provided.

1.2.4.7.3 PWM 2 Output

Reserved for Future Use

1.2.4.7.4 Relay 3

A dry contact closure is provided for switching external devices.

This relay output is controlled by Output 3 of the signal generator.

1.2.4.7.5 Relay 4

A dry contact closure is provided for switching external devices.

This relay output is controlled by Output 4 of the signal generator.

1.2.4.7.6 Analog Output 2

A 0-10VDC variable analog output is available. It is intended to control spindle speed or any device that requires a variable voltage input for control.

1.2.4.7.7 Analog Input 2

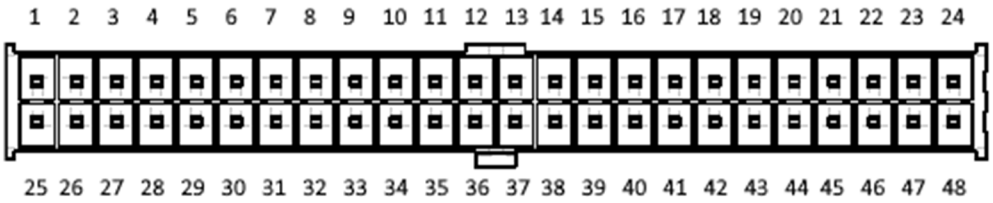
A 0-10VDC analog input is provided for reading power, temperature, or sensor inputs.

Analog Input 1 and Analog Input 2 cannot be used simultaneously.

Output 5 must be **ON** for this input to be active.

1.2.4.8 Expansion Connectors

1.2.4.8.1 Internal Combination IO Connector



Internal Combination IO Connector

Pin	JP301 – Signal	External Power Description	I/O
1	PWM1	PWM Output 1	O
2	GND	GND	PWR
3	GND	GND	PWR
4	GND	GND	PWR
5	GND	GND	PWR
6	GND	GND	PWR
7	PWM2	PWM Output 2	O
8	5-24VDC	5-24VDC	PWR
9	5-24VDC	5-24VDC	PWR
10	5-24VDC	5-24VDC	PWR
11	5-24VDC	5-24VDC	PWR
12	5-24VDC	5-24VDC	PWR
13	5-24VDC	5-24VDC	PWR
14	5-24VDC	5-24VDC	PWR
15	5-24VDC	5-24VDC	PWR
16	OPT-GND	OPT-GND	PWR
17	OPT-GND	OPT-GND	PWR
18	OPT-GND	OPT-GND	PWR
19	OPT-GND	OPT-GND	PWR
20	OPT-GND	OPT-GND	PWR
21	OPT-GND	OPT-GND	PWR
22	OPT-GND	OPT-GND	PWR
23	OPT-GND	OPT-GND	PWR
24	OPT-VCC	OPT-VCC	PWR
25	AGND	Analog GND	PWR
26	AOUT2	Analog Output 2	AO
27	AOUT1	Analog Output 1	AO
28	AGND	Analog GND	PWR
29	AIN2	Analog Input 2	AI
30	AIN1	Analog Input 1	AI
31	AGND	Analog GND	PWR
32	OUT16	Output 16	O
33	OUT15	Output 15	O
34	OUT14	Output 14	O
35	OUT13	Output 13	O
36	OUT12	Output 12	O

37	OUT11	Output 11	O
38	OUT10	Output 10	O
39	OUT9	Output 9	O
40	IN16	Input 16	I
41	IN15	Input 15	I
42	IN14	Input 14	I
43	IN13	Input 13	I
44	IN12	Input 12	I
45	IN11	Input 11	I
46	IN10	Input 10	I
47	IN9	Input 9	I
48	OPT-VCC	OPT-VCC	PWR

The Internal Combination IO Connector provides:

- 8 opto-isolated inputs
- 8 open-collector outputs (active low)
- analog inputs
- analog outputs
- 1 PWM output

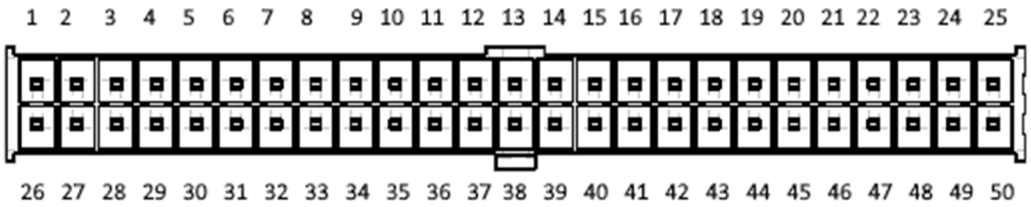
To ease wiring connections, additional connection locations are provided for:

- GND
- 5-24VDC
- OPT-GND
- OPT-VCC
- Analog GND

IO Signals on this connector are referenced to power supplies as follows:

Signal	Power Supply References
Outputs 9-16	GND and 5-24VDC
PWM Output 1	GND
Analog Inputs 1 and 2	Analog GND
Analog Outputs 1 and 2	Analog GND
Inputs 9-16	OPT-GND and OPT-VCC

1.2.4.8.2 Internal IO Connector 1 (IO21-IO32)



Internal IO connector 1 (IO21-IO32)

Pin	JP302 – Signal	External Power Description	I/O
1	5-24VDC	5-24VDC	PWR
2	5-24VDC	5-24VDC	PWR
3	5-24VDC	5-24VDC	PWR
4	5-24VDC	5-24VDC	PWR
5	5-24VDC	5-24VDC	PWR
6	5-24VDC	5-24VDC	PWR
7	5-24VDC	5-24VDC	PWR
8	5-24VDC	5-24VDC	PWR
9	5-24VDC	5-24VDC	PWR
10	5-24VDC	5-24VDC	PWR
11	5-24VDC	5-24VDC	PWR
12	5-24VDC	5-24VDC	PWR
13	OPT-GND	OPT-GND	PWR
14	OPT-GND	OPT-GND	PWR
15	OPT-GND	OPT-GND	PWR
16	OPT-GND	OPT-GND	PWR
17	OPT-GND	OPT-GND	PWR
18	OPT-GND	OPT-GND	PWR
19	OPT-GND	OPT-GND	PWR
20	OPT-GND	OPT-GND	PWR
21	OPT-GND	OPT-GND	PWR
22	OPT-GND	OPT-GND	PWR
23	OPT-GND	OPT-GND	PWR
24	OPT-GND	OPT-GND	PWR
25	OPT-VCC	OPT-VCC	PWR
26	OUT32	Output	O
27	OUT31	Output	O
28	OUT30	Output	O
29	OUT29	Output	O
30	OUT28	Output	O
31	OUT27	Output	O
32	OUT26	Output	O
33	OUT25	Output	O
34	OUT24	Output	O
35	OUT23	Output	O
36	OUT22	Output	O
37	OUT21	Output	O
38	IN32	Input	I

39	IN31	Input	I
40	IN30	Input	I
41	IN29	Input	I
42	IN28	Input	I
43	IN27	Input	I
44	IN26	Input	I
45	IN25	Input	I
46	IN24	Input	I
47	IN23	Input	I
48	IN22	Input	I
49	IN21	Input	I
50	OPT-VCC	OPT-VCC	PWR

The Internal IO Connector 1 provides:

- 12 opto-isolated inputs
- 12 open-collector outputs (active low)

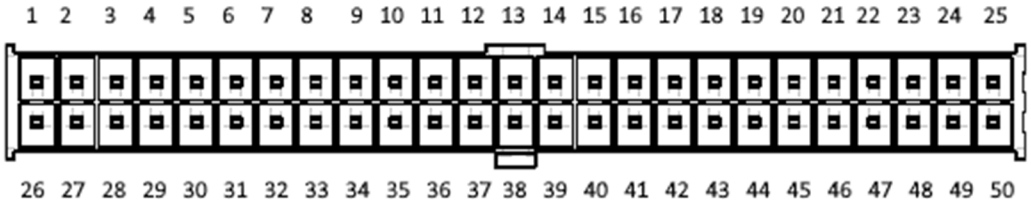
To ease wiring connections, additional connection locations are provided for:

- 5-24VDC
- OPT-GND
- Analog GND

IO Signals on this connector are referenced to power supplies as follows:

Signal	Power Supply References
Outputs 21-32	GND and 5-24VDC
Inputs 21-32	OPT-GND and OPT-VCC

1.2.4.8.3 Internal IO Connector 2 (IO1-IO8 and IO17-IO20)



Internal Combination IO Connector 2

(IO1-IO8 and IO17-IO20)

Pin	JP303 – Signal	External Power Description	I/O
1	5-24VDC	5-24VDC	PWR
2	5-24VDC	5-24VDC	PWR
3	5-24VDC	5-24VDC	PWR
4	5-24VDC	5-24VDC	PWR
5	5-24VDC	5-24VDC	PWR
6	5-24VDC	5-24VDC	PWR
7	5-24VDC	5-24VDC	PWR
8	5-24VDC	5-24VDC	PWR
9	5-24VDC	5-24VDC	PWR
10	5-24VDC	5-24VDC	PWR
11	5-24VDC	5-24VDC	PWR
12	5-24VDC	5-24VDC	PWR
13	OPT-GND	OPT-GND	PWR
14	OPT-GND	OPT-GND	PWR
15	OPT-GND	OPT-GND	PWR
16	OPT-GND	OPT-GND	PWR
17	OPT-GND	OPT-GND	PWR
18	OPT-GND	OPT-GND	PWR
19	OPT-GND	OPT-GND	PWR
20	OPT-GND	OPT-GND	PWR
21	OPT-GND	OPT-GND	PWR
22	OPT-GND	OPT-GND	PWR
23	OPT-GND	OPT-GND	PWR
24	OPT-GND	OPT-GND	PWR
25	OPT-VCC	OPT-VCC	PWR
26	OUT20	Output	O
27	OUT19	Output	O
28	OUT18	Output	O
29	OUT17	Output	O
30	OUT8	Output	O
31	OUT7	Output	O
32	OUT6	Output	O
33	OUT5	Output	O
34	OUT4	Output	O
35	OUT3	Output	O
36	OUT2	Output	O
37	OUT1	Output	O
38	IN20	Input	I

39	IN19	Input	I
40	IN18	Input	I
41	IN17	Input	I
42	IN8	Input	I
43	IN7	Input	I
44	IN6	Input	I
45	IN5	Input	I
46	IN4	Input	I
47	IN3	Input	I
48	IN2	Input	I
49	IN1	Input	I
50	OPT-VCC	OPT-VCC	PWR

The Internal IO Connector 2 provides:

- 12 opto-isolated inputs
- 12 open-collector outputs (active low)

To ease wiring connections, additional connection locations are provided for:

- 5-24VDC
- OPT-GND
- Analog GND

IO Signals on this connector are referenced to power supplies as follows:

Signal	Power Supply References
Outputs 1-8 and Outputs 17-20	GND and 5-24VDC
Inputs 1-8 and Outputs 17-20	OPT-GND and OPT-VCC

1.2.4.8.4 USB IO Expansion Board Interface (JP201 and JP202)

These two extended-length connectors are mounted on the bottom side of the Ultra I/O Expansion Board and they are used to make the necessary electrical connections between the Ultra I/O Expansion Board and the signal generator host board.

No signals of any relevance to the end user are present on these headers so pinouts are not provided here. It is recommended that these connectors not be touched or probed since damage to either board could result.

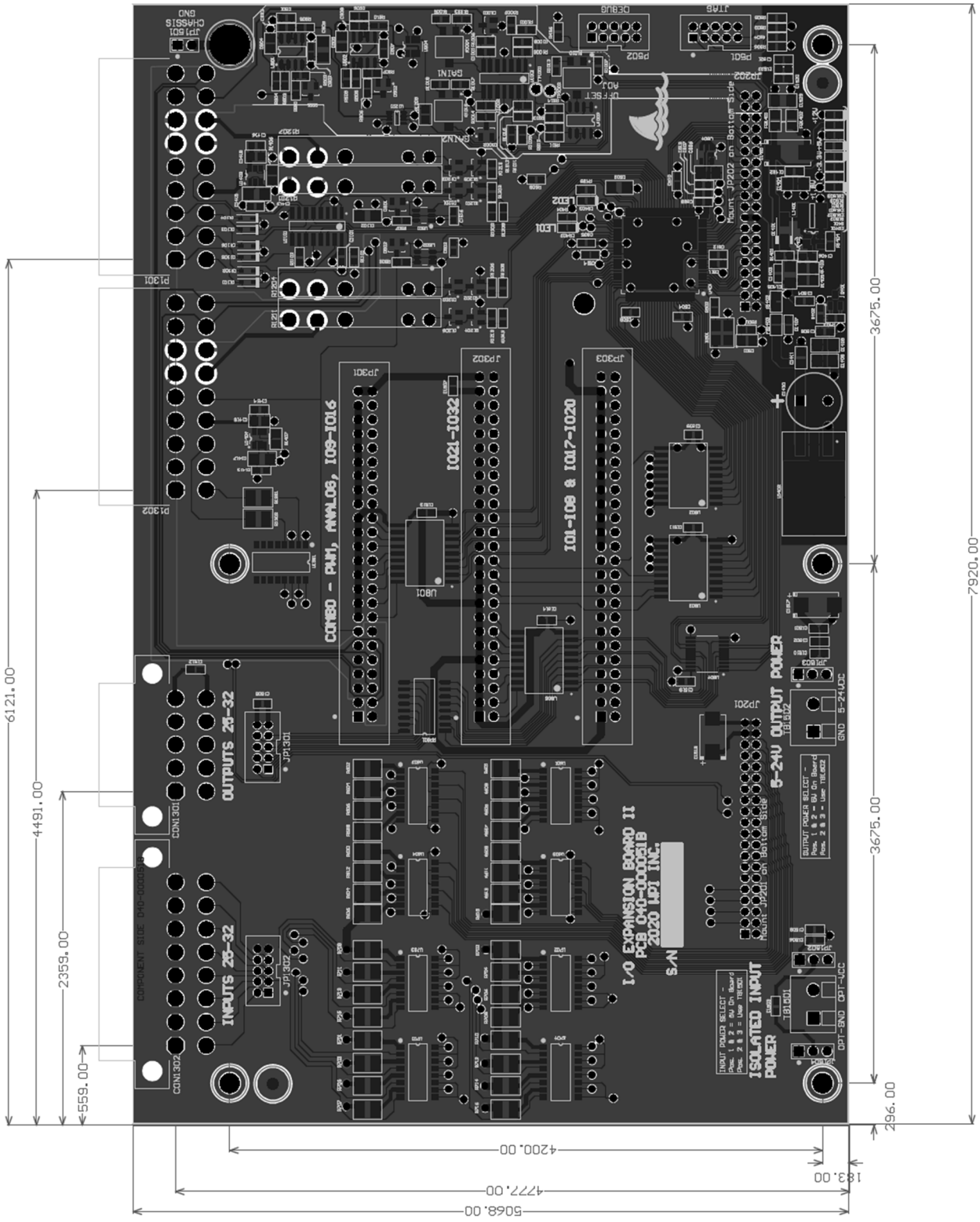
1.3 Specifications

Board Dimensions	7.92” x 5.069”
Digital Inputs	32 optoisolated, 1 quadrature encoder including A, B, and Index
Digital Outputs	32 open-collector outputs 8 TTL outputs 2-4 relay dry contact
Analog Inputs	2 each, 10 bit ADC, 0-10V
Analog Outputs	2 each, 12 bit DAC, 0-10V
Power Requirements	Less than 5W depending upon configuration and load, board received power from host signal generator

1.4 Mating Connectors

Connector Reference Designator	Manufacturer	Manufacturer Part Number (housing)	Manufacturer Part Number (terminal)
CON1301	Molex	0039012160	0039000039
CON1302	Molex	0039012100	0039000039
P1301, P1302	Molex	0039012180	0039000039
JP301	Samtec	IPL1-124-01-L-D	CC79L-2024-01-F
JP302, JP303	Samtec	IPL1-125-01-L-D	CC79L-2024-01-F
JP1301, JP1302	Molex	0511101060	0503948051

1.5 Dimensional Drawing



Dimensions