



OPAL-RT



OP4500 RT-LAB-RCP/HIL SYSTEM USER GUIDE

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SYMBOL DEFINITIONS

The following table lists the symbols used in this document to denote certain conditions:

Symbol	Definition
	ATTENTION: Identifies information that requires special consideration
	TIP: Identifies advice or hints for the user, often in terms of performing a task
	REFERENCE _ INTERNAL: Identifies an additional source of information within the bookset.
CAUTION	Indicates a situation which, if not avoided, may result in equipment or work (data) on the system being damaged or lost, or may result in the inability to properly operate the process.
	Indicates a situation where users must observe precautions for handling electrostatic sensitive devices.
	CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
	WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in serious injury or death.

CONTENTS

INTRODUCTION	7
FEATURES.....	8
FRONT INTERFACE.....	9
REAR INTERFACE.....	10
DB37 PIN ASSIGNMENTS (GENERAL).....	11
DB37 ANALOG OUTPUT.....	11
DB37 ANALOG INPUT.....	11
DB37 DIGITAL OUTPUT.....	12
DB37 DIGITAL INPUT.....	13
DB9 PIN ASSIGNMENTS (GENERAL).....	14
OP4500 SIMULATOR SPECIFICATIONS.....	15
ON BOARD I/O SPECIFICATIONS.....	16
32 DIGITAL IN.....	16
32 DIGITAL OUT.....	16
RS422 DIGITAL IN.....	16
RS422 DIGITAL OUT.....	16
OP4500 SERIES PIN ASSIGNMENTS	17
OP4500 SERIES 100 FOR MECHATRONICS.....	17
OP4500 SERIES 200 FOR RCP.....	24
OP4500 SERIES 300 AND 400 FOR POWER ELECTRONICS.....	31
LIMITED WARRANTY	39
LIMITED WARRANTY.....	39
RETURN POLICY.....	39
EXCLUSIONS.....	39
WARRANTY LIMITATION AND EXCLUSION.....	40
DISCLAIMER OF UNSTATED WARRANTIES.....	40
LIMITATION OF LIABILITY.....	40

INTRODUCTION

The OP4500 is a compact device with 96 fast I/O channels with signal conditioning, fast 5-Gbits fiber optics and is fully integrated with Simulink, SimPowerSystem. The integration of high-end INTEL multi-core processors with powerful XILINX Kintex 7 FPGA allows greater simulation power and sub-microsecond simulation time steps to maximize accuracy of fast power electronic systems. The OP4500 can simulate power grids with up to about 200 nodes.

A series of standardized I/O configurations are available with the OP4500, each targeting specific fields:

- Series 100 - RCP/HIL. Simulink models run on CPU and I/O managed by the FPGA
- Series 200 - RCP/HIL for Power Electronic systems simulated on the CPU
- Series 300 - RCP/HIL for fast Power Electronic system simulation on FPGA using eHS
- Series 400 - RCP/HIL for Power Grids simulation

The OP4500 is an entry-level simulator that contains an FPGA carrier, which can accept two standard OPAL-RT mezzanine boards, in addition to the onboard digital and differential signals (see image below).

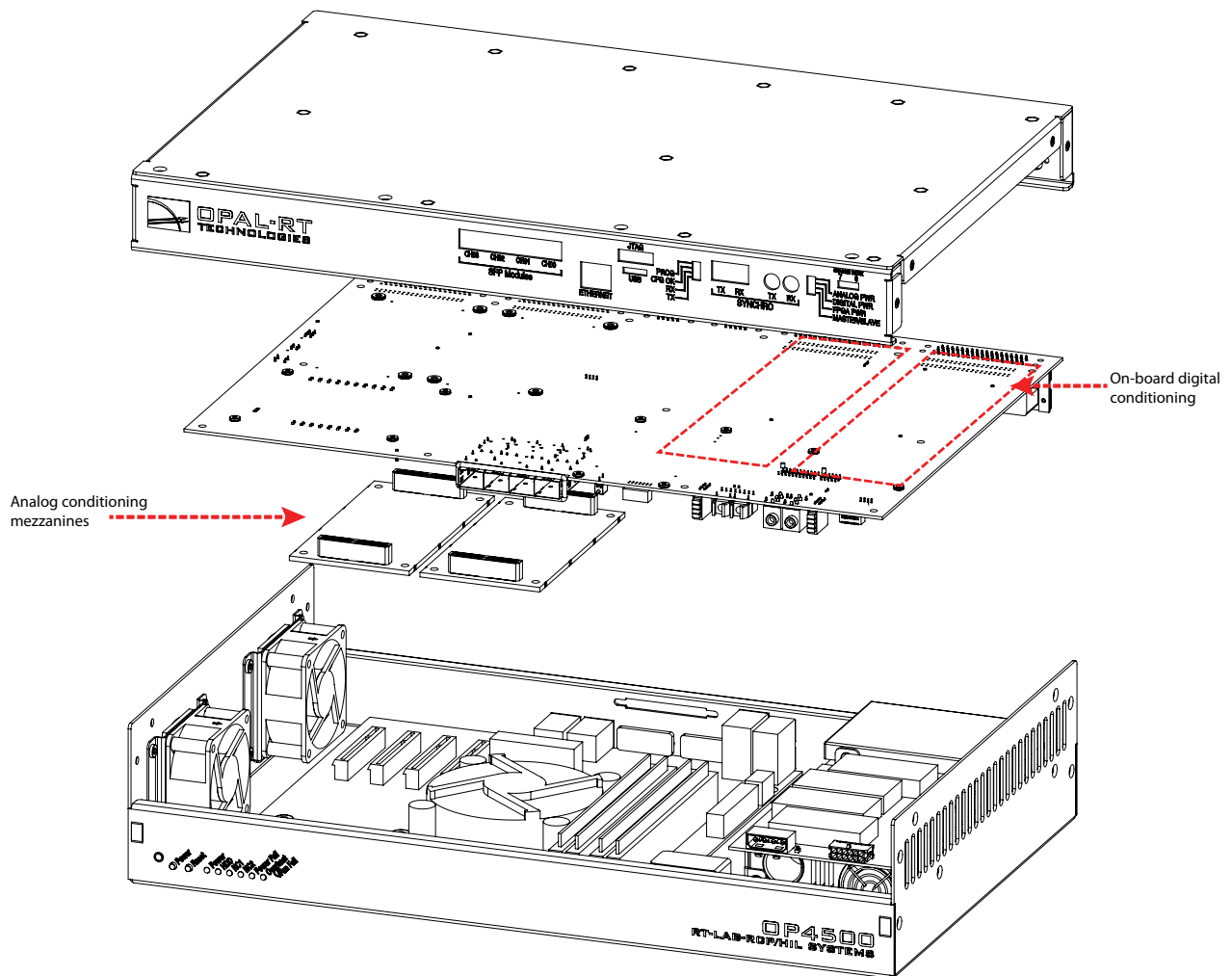


Figure 1: OP4500 architecture

The mezzanine slots can accept either 16 analog inputs or outputs, depending on the type of mezzanine boards selected. These mezzanine boards use a DB37 connector.

Analog and digital signals use a DB37 connector and RS422 differential signals use a DB9 connector.

The OP4500 offers two types of synchronisation, either LVDS or fiber optic, making it easier to synchronize with any OPAL-RT device.

FEATURES

- Status LEDs
- Target status LEDs
- DB37 connectors
- DB9 connectors

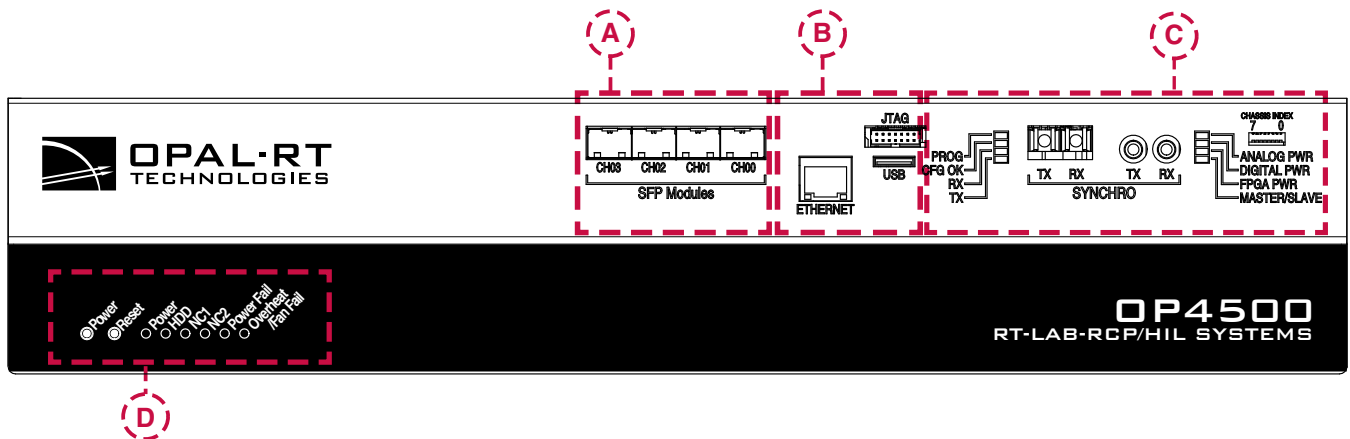
Digital Output Channels:

- 32 Dout on two DB37F connector (Channel 00 to 15 and 16 to 31)
- 5 V to 15 V, 50 mA max, individual channel protection with Resettable Fuse
- Galvanic isolation, Vuser from 5 V min to 15 V max

Digital Input Channels:

- 32 Din on two DB37F connector (Channel 0 to 31)
- 4 V to 30 V, 3.6 mA min,
- 40 nanosecond typical propagation delay
- Opto-coupler isolation, Vinput from 4 V min to 30 V max

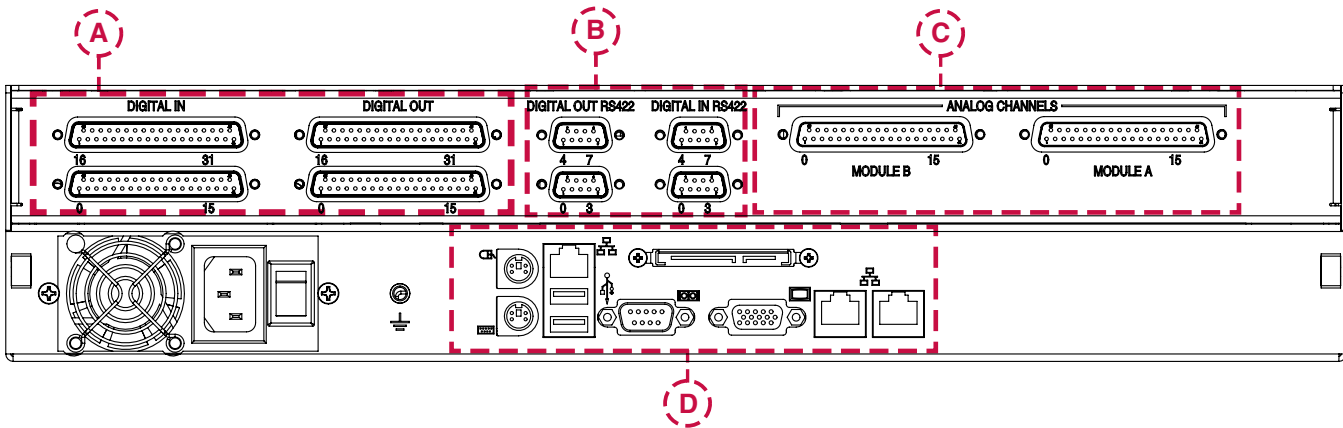
FRONT INTERFACE



- A. Small Form-factor pluggable (SFP) module connectors (*not available - reserved for future use*).
- B. JTAG, USB and ETHERNET connectors (USB and ETHERNET are *not available - reserved for future use*)
- C. Synchronization connectors and status LEDs:
- PROG:** Lights on setup (for technicians's use only)
 - CFG OK:** Lights on setup (for technicians's use only)
 - RX:** Green when receiving synchronization
 - TX :** Green when transmitting synchronization
 - ANALOG PWR:** Green to indicate analog power is functioning
 - DIGITAL PWR:** Green to indicate digital power is functioning
 - FPGA PWR:** Green to indicate FPGA power is functioning
 - MASTER/SLAVE:** . Green indicates MASTER mode, Yellow indicates SLAVE mode
 - CHASSIS INDEX:** 8-pin DIP switch that allows users to set the device's network chassis index. It can be set from 00 to FF (in HEX) for a maximum of 256 addresses.
- D. Target computer monitoring interface. Two push buttons include POWER in top position to power on or shut down the Target computer and RESET, in the bottom position, to reset the target computer. There are 6 LED indicators:

LED	NAME	Description
Green	Power	On indicates that the unit is powered up.
Green	HDD	On indicates that the hard disk drive is operating.
Green	NIC1	On indicates that network port 1 is in use.
Green	NIC2	On indicates that network port 2 is in use.
Red	Power Fail	On indicates a power fault.
Red	Overheat/Fan Fail	On indicates either that unit has overheated or a fan fault.

REAR INTERFACE



- A. DB37 connectors for digital inputs and outputs.
- B. DB9 connectors for RS422 differential signal inputs and outputs.
- C. DB37 connectors for analog inputs and outputs.
- D. Standard computer connectors (left to right): mouse and keyboard, USB ports, monitor, network ports* and (above monitor connectors) a SATA connector to provide access to the OP4500 hard drive.

*Note that only one network port is required for network connection; use of other connectors is optional.

DB37 PIN ASSIGNMENTS (GENERAL)

The following table provides the generic pin assignments for the OP4500's DB37 connectors. More detailed information, tailored to specific firmware, can be found in "OP4500 Series Pin Assignments".

DB37 Analog Output

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+AOUT00	20	CHASSIS_GND
2	+AOUT01	21	CHASSIS_GND
3	+AOUT02	22	CHASSIS_GND
4	+AOUT03	23	CHASSIS_GND
5	+AOUT04	24	CHASSIS_GND
6	+AOUT05	25	CHASSIS_GND
7	+AOUT06	26	CHASSIS_GND
7	+AOUT07	27	CHASSIS_GND
9	+AOUT08	28	CHASSIS_GND
10	+AOUT09	29	CHASSIS_GND
11	+AOUT10	30	CHASSIS_GND
12	+AOUT11	31	CHASSIS_GND
13	+AOUT12	32	CHASSIS_GND
14	+AOUT13	33	CHASSIS_GND
15	+AOUT14	34	CHASSIS_GND
16	+AOUT15	35	CHASSIS_GND
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		

DB37 Analog Input

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+AIN00	20	-AIN00
2	+AIN01	21	-AIN01
3	+AIN02	22	-AIN02
4	+AIN03	23	-AIN03
5	+AIN04	24	-AIN04
6	+AIN05	25	-AIN05
7	+AIN06	26	-AIN06
7	+AIN07	27	-AIN07
9	+AIN08	28	-AIN08
10	+AIN09	29	-AIN09
11	+AIN10	30	-AIN10
12	+AIN11	31	-AIN11
13	+AIN12	32	-AIN12
14	+AIN13	33	-AIN13
15	+AIN14	34	-AIN14
16	+AIN15	35	-AIN15
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		

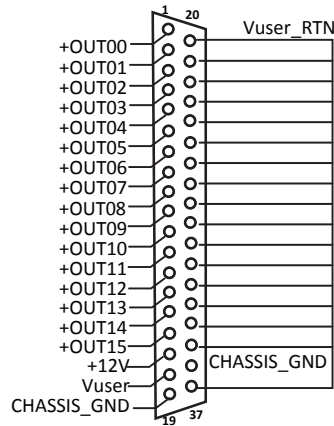
Introduction

DB37 Pin Assignments (general)

DB37 Digital Output

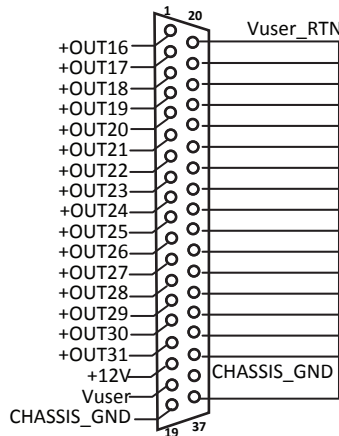
Connector 0-15

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+OUT00	20	Vuser_RTN
2	+OUT01	21	Vuser_RTN
3	+OUT02	22	Vuser_RTN
4	+OUT03	23	Vuser_RTN
5	+OUT04	24	Vuser_RTN
6	+OUT05	25	Vuser_RTN
7	+OUT06	26	Vuser_RTN
7	+OUT07	27	Vuser_RTN
9	+OUT08	28	Vuser_RTN
10	+OUT09	29	Vuser_RTN
11	+OUT10	30	Vuser_RTN
12	+OUT11	31	Vuser_RTN
13	+OUT12	32	Vuser_RTN
14	+OUT13	33	Vuser_RTN
15	+OUT14	34	Vuser_RTN
16	+OUT15	35	Vuser_RTN
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Connector 16-31

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+OUT16	20	Vuser_RTN
2	+OUT17	21	Vuser_RTN
3	+OUT18	22	Vuser_RTN
4	+OUT19	23	Vuser_RTN
5	+OUT20	24	Vuser_RTN
6	+OUT21	25	Vuser_RTN
7	+OUT22	26	Vuser_RTN
7	+OUT23	27	Vuser_RTN
9	+OUT24	28	Vuser_RTN
10	+OUT25	29	Vuser_RTN
11	+OUT26	30	Vuser_RTN
12	+OUT27	31	Vuser_RTN
13	+OUT28	32	Vuser_RTN
14	+OUT29	33	Vuser_RTN
15	+OUT30	34	Vuser_RTN
16	+OUT31	35	Vuser_RTN
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		

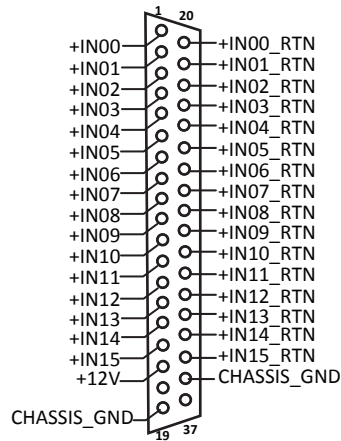


Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

DB37 Digital Input

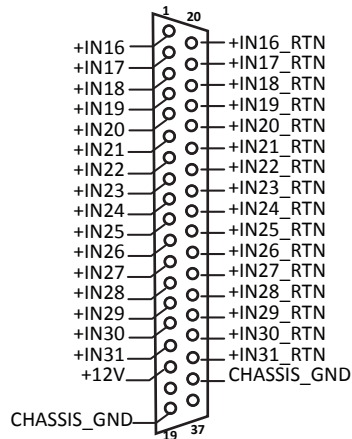
Connector 0-15

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+IN00	20	+IN00_RTN
2	+IN01	21	+IN01_RTN
3	+IN02	22	+IN02_RTN
4	+IN03	23	+IN03_RTN
5	+IN04	24	+IN04_RTN
6	+IN05	25	+IN05_RTN
7	+IN06	26	+IN06_RTN
7	+IN07	27	+IN07_RTN
9	+IN08	28	+IN08_RTN
10	+IN09	29	+IN09_RTN
11	+IN10	30	+IN10_RTN
12	+IN11	31	+IN11_RTN
13	+IN12	32	+IN12_RTN
14	+IN13	33	+IN13_RTN
15	+IN14	34	+IN14_RTN
16	+IN15	35	+IN15_RTN
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



Connector 16-31

DB37	OP4500 pin assignment	DB37	OP4500 pin assignment
1	+IN16	20	+IN16_RTN
2	+IN17	21	+IN17_RTN
3	+IN18	22	+IN18_RTN
4	+IN19	23	+IN19_RTN
5	+IN20	24	+IN20_RTN
6	+IN21	25	+IN21_RTN
7	+IN22	26	+IN22_RTN
7	+IN23	27	+IN23_RTN
9	+IN24	28	+IN24_RTN
10	+IN25	29	+IN25_RTN
11	+IN26	30	+IN26_RTN
12	+IN27	31	+IN27_RTN
13	+IN28	32	+IN28_RTN
14	+IN29	33	+IN29_RTN
15	+IN30	34	+IN30_RTN
16	+IN31	35	+IN31_RTN
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



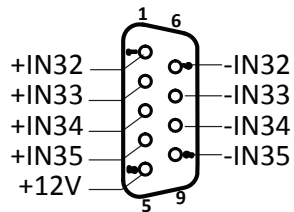
Introduction

DB9 Pin Assignments (general)

DB9 PIN ASSIGNMENTS (GENERAL)

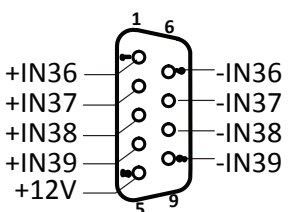
RS422 Digital IN 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+CH32 IN	6	-CH32 IN
2	+CH33 IN	7	-CH33 IN
3	+CH34 IN	8	-CH34 IN
4	+CH35 IN	9	-CH35 IN
5	+12V OUT		



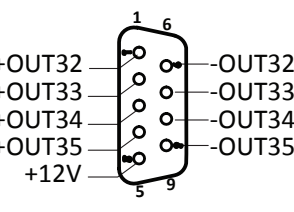
RS422 Digital IN 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+CH36 IN	6	-CH36 IN
2	+CH37 IN	7	-CH37 IN
3	+CH38 IN	8	-CH38 IN
4	+CH39 IN	9	-CH39 IN
5	+12V OUT		



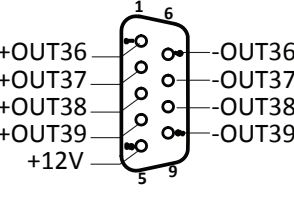
RS422 Digital OUT 0-3

DB9 Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+CH32 OUT	6	-CH32 OUT
2	+CH33 OUT	7	-CH33 OUT
3	+CH34 OUT	8	-CH34 OUT
4	+CH35 OUT	9	-CH35 OUT
5	+12V OUT		



RS422 Digital OUT 4-7

DB9 Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+CH36 OUT	6	-CH36 OUT
2	+CH37 OUT	7	-CH37 OUT
3	+CH38 OUT	8	-CH38 OUT
4	+CH39 OUT	9	-CH39 OUT
5	+12V OUT		



SPECIFICATIONS

OP4500 SIMULATOR SPECIFICATIONS

Product name	OP4500 RT-LAB-RCP/HIL SYSTEM
Power supply	Universal input and active power factor correction 650W continuous power DC to DC converters for analog voltage
I/O connectors	DB37F DB9
Number of SFP	4
SFP speed	2 Gbps
Number of channels	32 Dout or 24 Dout and 8 digital out RS422 (DB9) 32 Din or 24 Din and 8 digital in RS422 (DB9)
PC interface	Standard PC connectors (monitor, keyboard, mouse and network)
Dimensions (WxDxH)	43.2 x 27.4 x 8.9cm (17" x 10.8" x 3.5")
Weight	Approx. 1 Kg (2.2 lbs)
Operating temperature	10 to 40 °C (50 to 104°F)
Storage temperature	-55 to 85°C (-67 to 185°F)
Relative humidity	10 to 90% non-condensing
Maximum altitude	2000 m (6562 ft.)

Introduction

On Board I/O specifications

ON BOARD I/O SPECIFICATIONS

32 Digital In

Number of channels	32 digital inputs
Isolation	Optical isolator
Connection mode	Anode and cathode available on connector
Input current	4.7 mA, current limiting diode
Reverse voltage protection	Schottky diode
Maximum reverse voltage protection	30 Volts
Detection threshold	Separate Schmitt Trigger
Voltage range	< 0.8 V for low logic 4.2 to 30 V for high logic

32 Digital Out

Number of channels	32 digital outputs
Isolation	Galvanic isolator
Output Protection	50 mA resettable fuse
Protection thresholds	Under voltage: 4.85 V Over voltage: 18.1 V Reverse voltage: maximum 35 V.
Output Voltage range	5 to 15 Vdc
Output configuration	Push-pull
Delay Low-to-High	≤ 50 ns
Delay High-to-Low	≤ 50 ns
Rise/Fall times	≤ 15 ns
Power Isolation	On-board DC to DC isolated converter

RS422 Digital In

Number of channels	8 differential inputs
Isolation	Optical isolator
Detection threshold	± 0.2 V (for ± 7 V range) ± 0.5 V (for ± 15 V range)
Input current	± 3 mA
Voltage range	5 to 15 Vdc
Delay Low-to-High	65 ns

RS422 Digital Out

Number of channels	8 differential outputs
Isolation	Galvanic isolator
High level (With load) Low level (With load)	2.5 V min @ -20 mA 0.5 V max @ 20 mA
Voltage range	5 to 15 Vdc
Delay Low-to-High	55 ns

OP4500 SERIES PIN ASSIGNMENTS

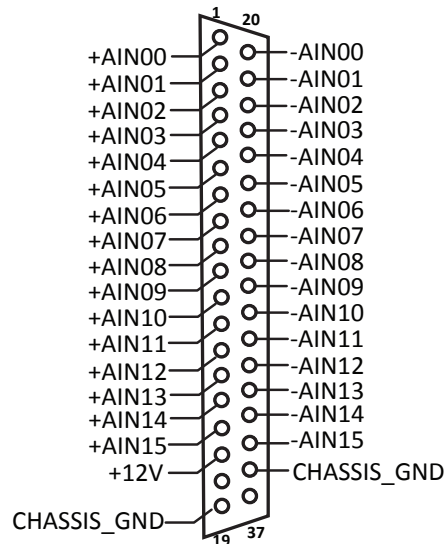
Because the OP4500 is available in different configurations (Series), the pin assignments vary according to the series option selected. The following tables provide details, including bitstream details, for each of the available series.

OP4500 SERIES 100 FOR MECHATRONICS

I/O Bitstream	I/O Configuration
MMPK7_1-EX-0001-X_X_X_X-SERIES100-100-XX.bin	<ul style="list-style-type: none"> • 16 Static Digital Inputs and Outputs • 8 Pulse-Width Modulated Digital inputs and outputs • 2 Differential Encoder inputs and outputs • 2 Differential Pulse-Width Modulated digital inputs and outputs • 16 Analog Inputs and Outputs

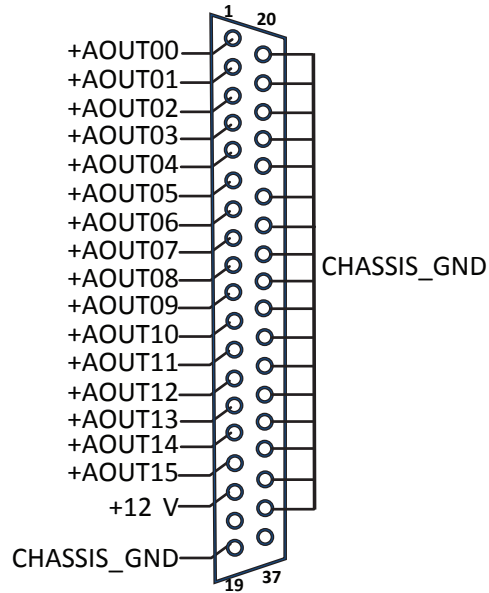
SERIES 100 - MODULE A - ANALOG IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin assignment
1	+AIN00	20	-AIN00
2	+AIN01	21	-AIN01
3	+AIN02	22	-AIN02
4	+AIN03	23	-AIN03
5	+AIN04	24	-AIN04
6	+AIN05	25	-AIN05
7	+AIN06	26	-AIN06
8	+AIN07	27	-AIN07
9	+AIN08	28	-AIN08
10	+AIN09	29	-AIN09
11	+AIN10	30	-AIN10
12	+AIN11	31	-AIN11
13	+AIN12	32	-AIN12
14	+AIN13	33	-AIN13
15	+AIN14	34	-AIN14
16	+AIN15	35	-AIN15
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



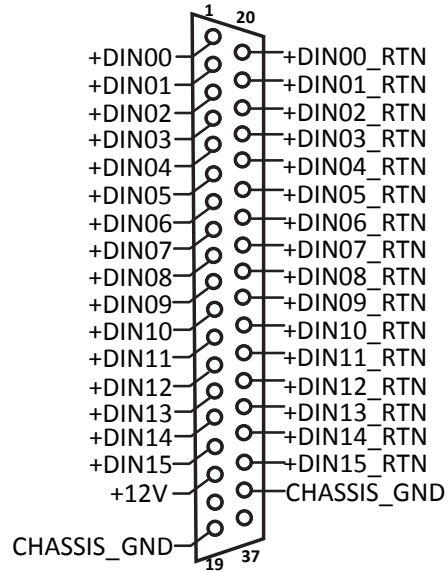
SERIES 100 - MODULE B - ANALOG OUT 0-15 DB37

DB37	Module pin assignment	DB37	Module pin assignment
1	+AOUT00	20	CHASSIS_GND
2	+AOUT01	21	CHASSIS_GND
3	+AOUT02	22	CHASSIS_GND
4	+AOUT03	23	CHASSIS_GND
5	+AOUT04	24	CHASSIS_GND
6	+AOUT05	25	CHASSIS_GND
7	+AOUT06	26	CHASSIS_GND
8	+AOUT07	27	CHASSIS_GND
9	+AOUT08	28	CHASSIS_GND
10	+AOUT09	29	CHASSIS_GND
11	+AOUT10	30	CHASSIS_GND
12	+AOUT11	31	CHASSIS_GND
13	+AOUT12	32	CHASSIS_GND
14	+AOUT13	33	CHASSIS_GND
15	+AOUT14	34	CHASSIS_GND
16	+AOUT15	35	CHASSIS_GND
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



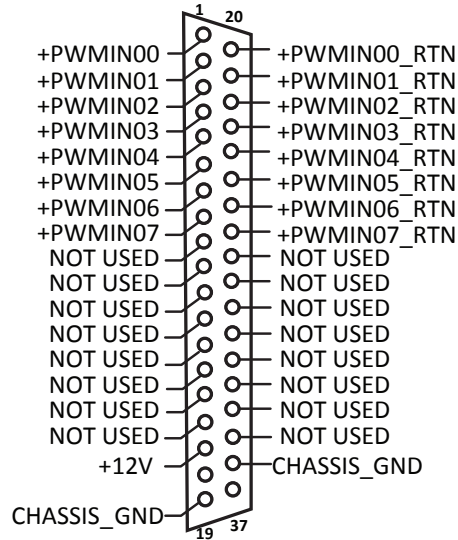
SERIES 100 - DIGITAL IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin assignment
1	+DIN00	20	+DIN00_RTN
2	+DIN01	21	+DIN01_RTN
3	+DIN02	22	+DIN02_RTN
4	+DIN03	23	+DIN03_RTN
5	+DIN04	24	+DIN04_RTN
6	+DIN05	25	+DIN05_RTN
7	+DIN06	26	+DIN06_RTN
8	+DIN07	27	+DIN07_RTN
9	+DIN08	28	+DIN08_RTN
10	+DIN09	29	+DIN09_RTN
11	+DIN10	30	+DIN10_RTN
12	+DIN11	31	+DIN11_RTN
13	+DIN12	32	+DIN12_RTN
14	+DIN13	33	+DIN13_RTN
15	+DIN14	34	+DIN14_RTN
16	+DIN15	35	+DIN15_RTN
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



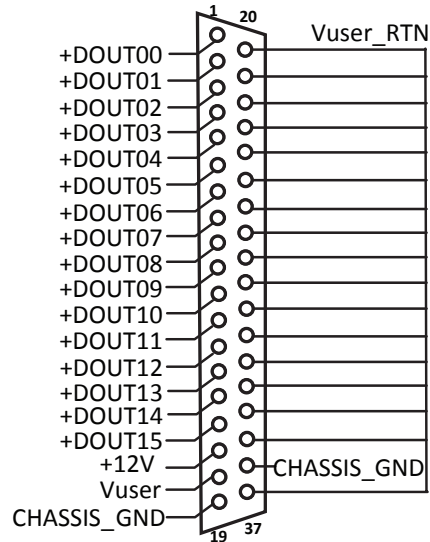
SERIES 100 - DIGITAL IN 16-31 DB37

DB37	Module pin assignment	DB37	Module pin assignment
1	+PWMIN00	20	+PWMIN00_RTN
2	+PWMIN01	21	+PWMIN01_RTN
3	+PWMIN02	22	+PWMIN02_RTN
4	+PWMIN03	23	+PWMIN03_RTN
5	+PWMIN04	24	+PWMIN04_RTN
6	+PWMIN05	25	+PWMIN05_RTN
7	+PWMIN06	26	+PWMIN06_RTN
8	+PWMIN07	27	+PWMIN07_RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



SERIES 100 - DIGITAL OUT 0-15 DB37

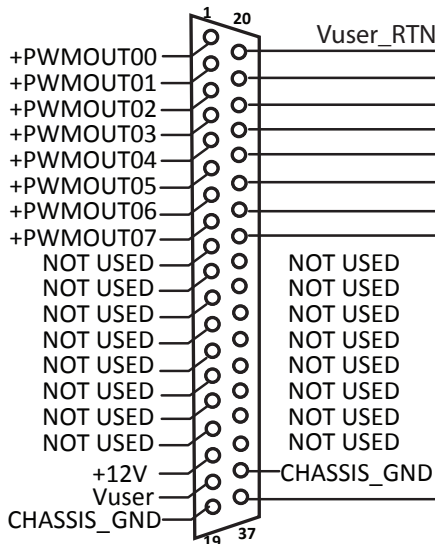
DB37	Module pin assignment	DB37	Module pin assignment
1	+DOUT00	20	Vuser_RTN
2	+DOUT01	21	Vuser_RTN
3	+DOUT02	22	Vuser_RTN
4	+DOUT03	23	Vuser_RTN
5	+DOUT04	24	Vuser_RTN
6	+DOUT05	25	Vuser_RTN
7	+DOUT06	26	Vuser_RTN
8	+DOUT07	27	Vuser_RTN
9	+DOUT08	28	Vuser_RTN
10	+DOUT09	29	Vuser_RTN
11	+DOUT10	30	Vuser_RTN
12	+DOUT11	31	Vuser_RTN
13	+DOUT12	32	Vuser_RTN
14	+DOUT13	33	Vuser_RTN
15	+DOUT14	34	Vuser_RTN
16	+DOUT15	35	Vuser_RTN
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

SERIES 100 - DIGITAL OUT 16-31 DB37

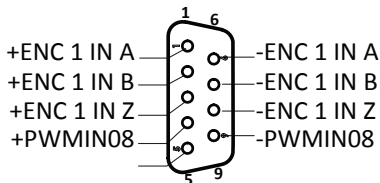
DB37	Module pin assignment	DB37	Module pin assignment
1	+PWMOUT00	20	Vuser_RTN
2	+PWMOUT01	21	Vuser_RTN
3	+PWMOUT02	22	Vuser_RTN
4	+PWMOUT03	23	Vuser_RTN
5	+PWMOUT04	24	Vuser_RTN
6	+PWMOUT05	25	Vuser_RTN
7	+PWMOUT06	26	Vuser_RTN
8	+PWMOUT07	27	Vuser_RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

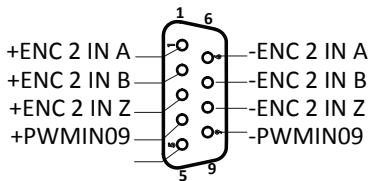
RS422 Digital IN 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC1 IN A	6	-ENC1 IN A
2	+ENC1 IN B	7	-ENC1 IN B
3	+ENC1 IN Z	8	-ENC1 IN Z
4	+PWMIN08	9	-PWMIN08
5			



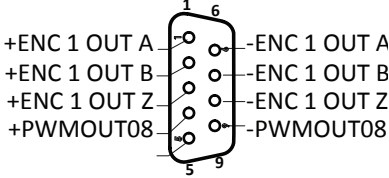
RS422 Digital IN 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC2 IN A	6	-ENC2 IN A
2	+ENC2 IN B	7	-ENC2 IN B
3	+ENC2 IN Z	8	-ENC2 IN Z
4	+PWMIN09	9	-PWMIN09
5			



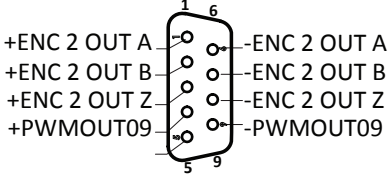
RS422 Digital OUT 0-3

DB9 Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC1 OUT A	6	-ENC1 OUT A
2	+ENC1 OUT B	7	-ENC1 OUT B
3	+ENC1 OUT Z	8	-ENC1 OUT Z
4	+PWMOUT08	9	-PWMOUT08
5			



RS422 Digital OUT 4-7

DB9 Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC2 OUT A	6	-ENC2 OUT A
2	+ENC2 OUT B	7	-ENC2 OUT B
3	+ENC2 OUT Z	8	-ENC2 OUT Z
4	+PWMOUT09	9	-PWMOUT09
5			




The OP4500 firmware can drive a maximum of 32 digital input and 32 digital output channels at one time. Two configurations are available:

- 1) CH00 to 31 active; CH 32 to 39 inactive
- 2) CH 00 to 23 and CH 32 to 39 active: CH24 to 31 inactive

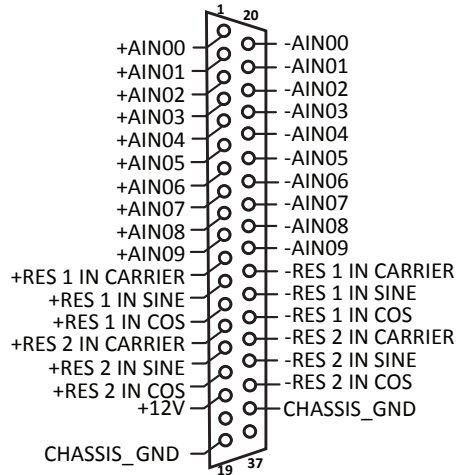
Input and output lines do not need to function in the same configuration: input lines can function in one configuration while output lines function in another configuration. (ex.: users can use channels 00 to 23 and 32 to 39 for digital output lines or vice versa)

OP4500 SERIES 200 FOR RCP

I/O Bitstream	I/O Configuration
MMPK7_1-EX-0001-X_X_X_X-SERIES200-200-XX.bin	<ul style="list-style-type: none"> • 16 Time stamped digital inputs and outputs • 8 Pulse-width modulated digital inputs and outputs • 2 Differential encoder inputs and outputs • 2 Differential pulse-width modulated digital inputs and outputs • 10 Analog inputs and outputs • 2 Resolver inputs and outputs

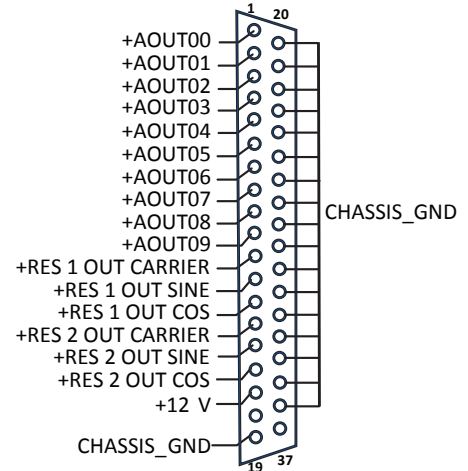
SERIES 200 - MODULE A - ANALOG IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+AIN00	20	-AIN00
2	+AIN01	21	-AIN01
3	+AIN02	22	-AIN02
4	+AIN03	23	-AIN03
5	+AIN04	24	-AIN04
6	+AIN05	25	-AIN05
7	+AIN06	26	-AIN06
8	+AIN07	27	-AIN07
9	+AIN08	28	-AIN08
10	+AIN09	29	-AIN09
11	+RES 1 IN CARRIER	30	-RES 1 IN CARRIER
12	+RES 1 IN SINE	31	-RES 1 IN SINE
13	+RES 1 IN COS	32	-RES 1 IN COS
14	+RES 2 IN CARRIER	33	-RES 2 IN CARRIER
15	+RES 2 IN SINE	34	-RES 2 IN SINE
16	+RES 2 IN COS	35	-RES 2 IN COS
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



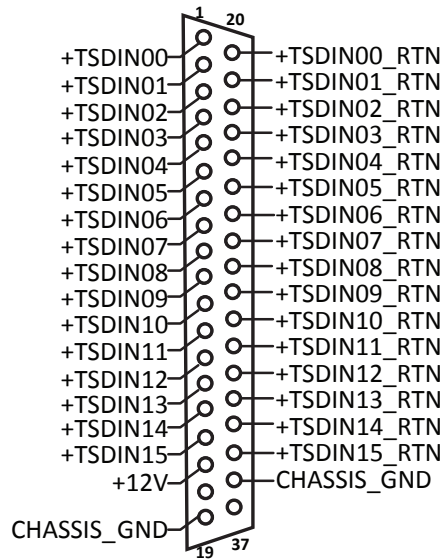
SERIES 200 - MODULE B - ANALOG OUT 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+AOUT00	20	CHASSIS_GND
2	+AOUT01	21	CHASSIS_GND
3	+AOUT02	22	CHASSIS_GND
4	+AOUT03	23	CHASSIS_GND
5	+AOUT04	24	CHASSIS_GND
6	+AOUT05	25	CHASSIS_GND
7	+AOUT06	26	CHASSIS_GND
8	+AOUT07	27	CHASSIS_GND
9	+AOUT08	28	CHASSIS_GND
10	+AOUT09	29	CHASSIS_GND
11	+RES 1 OUT CARRIER	30	CHASSIS_GND
12	+RES 1 OUT SINE	31	CHASSIS_GND
13	+RES 1 OUT COS	32	CHASSIS_GND
14	+RES 2 OUT CARRIER	33	CHASSIS_GND
15	+RES 2 OUT SINE	34	CHASSIS_GND
16	+RES 2 OUT COS	35	CHASSIS_GND
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



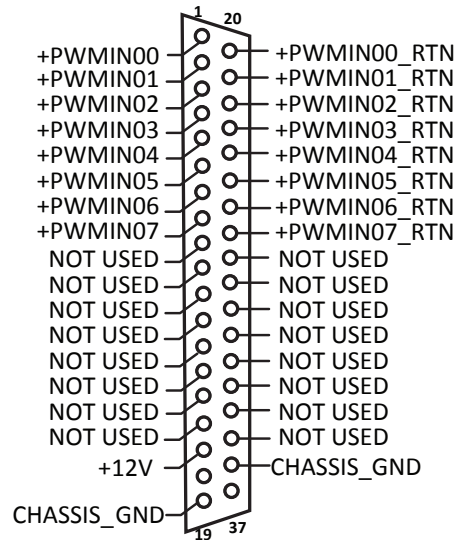
SERIES 200 - DIGITAL IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+TSDIN00	20	+TSDIN00 _RTN
2	+TSDIN01	21	+TSDIN01 _RTN
3	+TSDIN02	22	+TSDIN02 _RTN
4	+TSDIN03	23	+TSDIN03 _RTN
5	+TSDIN04	24	+TSDIN04 _RTN
6	+TSDIN05	25	+TSDIN05 _RTN
7	+TSDIN06	26	+TSDIN06 _RTN
8	+TSDIN07	27	+TSDIN07 _RTN
9	+TSDIN08	28	+TSDIN08 _RTN
10	+TSDIN09	29	+TSDIN09 _RTN
11	+TSDIN10	30	+TSDIN10 _RTN
12	+TSDIN11	31	+TSDIN11 _RTN
13	+TSDIN12	32	+TSDIN12 _RTN
14	+TSDIN13	33	+TSDIN13 _RTN
15	+TSDIN14	34	+TSDIN14 _RTN
16	+TSDIN15	35	+TSDIN15 _RTN
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



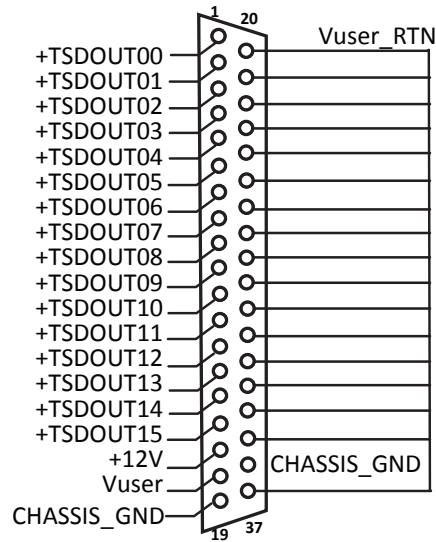
SERIES 200 - DIGITAL IN 16-31 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+PWMIN00	20	+PWMIN00 _RTN
2	+PWMIN01	21	+PWMIN01 _RTN
3	+PWMIN02	22	+PWMIN02 _RTN
4	+PWMIN03	23	+PWMIN03 _RTN
5	+PWMIN04	24	+PWMIN04 _RTN
6	+PWMIN05	25	+PWMIN05 _RTN
7	+PWMIN06	26	+PWMIN06 _RTN
8	+PWMIN07	27	+PWMIN07 _RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



SERIES 200 - DIGITAL OUT 0-15 DB37

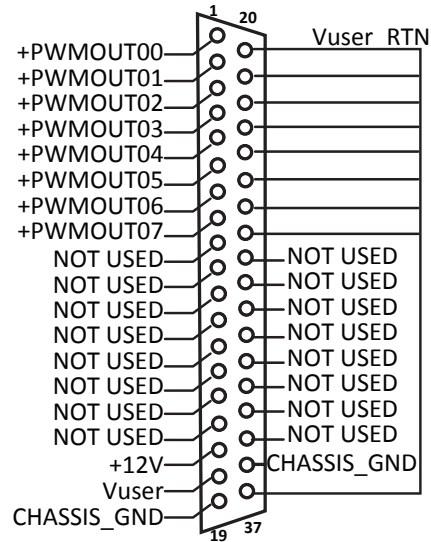
DB37	Module pin assignment	DB37	Module pin Assignment
1	+TSDOUT00	20	Vuser_RTN
2	+TSDOUT01	21	Vuser_RTN
3	+TSDOUT02	22	Vuser_RTN
4	+TSDOUT03	23	Vuser_RTN
5	+TSDOUT04	24	Vuser_RTN
6	+TSDOUT05	25	Vuser_RTN
7	+TSDOUT06	26	Vuser_RTN
8	+TSDOUT07	27	Vuser_RTN
9	+TSDOUT08	28	Vuser_RTN
10	+TSDOUT09	29	Vuser_RTN
11	+TSDOUT10	30	Vuser_RTN
12	+TSDOUT11	31	Vuser_RTN
13	+TSDOUT12	32	Vuser_RTN
14	+TSDOUT13	33	Vuser_RTN
15	+TSDOUT14	34	Vuser_RTN
16	+TSDOUT15	35	Vuser_RTN
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

SERIES 200 - DIGITAL OUT 16-31 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+PWMOUT00	20	Vuser_RTN
2	+PWMOUT01	21	Vuser_RTN
3	+PWMOUT02	22	Vuser_RTN
4	+PWMOUT03	23	Vuser_RTN
5	+PWMOUT04	24	Vuser_RTN
6	+PWMOUT05	25	Vuser_RTN
7	+PWMOUT06	26	Vuser_RTN
8	+PWMOUT07	27	Vuser_RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

RS422 Digital IN 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC 1 IN A	6	-ENC 1 IN A
2	+ENC 1 IN B	7	-ENC 1 IN B
3	+ENC 1 IN Z	8	-ENC 1 IN Z
4	+PWMIN11	9	-PWMIN11
5			

Diagram labels:
 +ENC 1 IN A (Pin 1), +ENC 1 IN B (Pin 2), +ENC 1 IN Z (Pin 3), +PWMIN11 (Pin 4), -ENC 1 IN A (Pin 6), -ENC 1 IN B (Pin 7), -ENC 1 IN Z (Pin 8), -PWMIN11 (Pin 9).

RS422 Digital IN 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC 2 IN A	6	-ENC 2 IN A
2	+ENC 2 IN B	7	-ENC 2 IN B
3	+ENC 2 IN Z	8	-ENC 2 IN Z
4	+PWMIN15	9	-PWMIN15
5			

Diagram labels:
 +ENC 2 IN A (Pin 1), +ENC 2 IN B (Pin 2), +ENC 2 IN Z (Pin 3), +PWMIN15 (Pin 4), -ENC 2 IN A (Pin 6), -ENC 2 IN B (Pin 7), -ENC 2 IN Z (Pin 8), -PWMIN15 (Pin 9).

RS422 Digital OUT 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC 1 OUT A	6	-ENC 1 OUT A
2	+ENC 1 OUT B	7	-ENC 1 OUT B
3	+ENC 1 OUT Z	8	-ENC 1 OUT Z
4	+PWMOUT11	9	-PWMOUT11
5			

Diagram labels:
 +ENC 1 OUT A (Pin 1), +ENC 1 OUT B (Pin 2), +ENC 1 OUT Z (Pin 3), +PWMOUT11 (Pin 4), -ENC 1 OUT A (Pin 6), -ENC 1 OUT B (Pin 7), -ENC 1 OUT Z (Pin 8), -PWMOUT11 (Pin 9).

RS422 Digital OUT 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+ENC 2 OUT A	6	-ENC 2 OUT A
2	+ENC 2 OUT B	7	-ENC 2 OUT B
3	+ENC 2 OUT Z	8	-ENC 2 OUT Z
4	+PWMOUT15	9	-PWMOUT15
5			

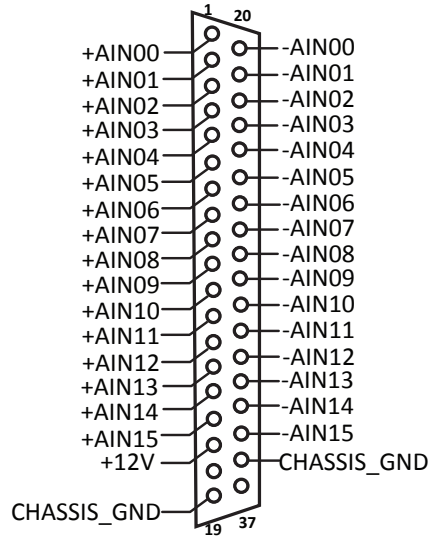
Diagram labels:
 +ENC 2 OUT A (Pin 1), +ENC 2 OUT B (Pin 2), +ENC 2 OUT Z (Pin 3), +PWMOUT15 (Pin 4), -ENC 2 OUT A (Pin 6), -ENC 2 OUT B (Pin 7), -ENC 2 OUT Z (Pin 8), -PWMOUT15 (Pin 9).

OP4500 SERIES 300 AND 400 FOR POWER ELECTRONICS

I/O Bitstream	I/O Configuration
MMPK7_1-EX-0001-X_X_X_X-SERIES400-400-XX.bin	<ul style="list-style-type: none"> 16 Time-stamped digital inputs and outputs 8 Pulse-width modulated digital inputs and outputs 8 Differential pulse-width modulated digital inputs and outputs 16 Analog inputs and outputs

SERIES 300/400 - MODULE A - ANALOG IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+AIN00	20	-AIN00
2	+AIN01	21	-AIN01
3	+AIN02	22	-AIN02
4	+AIN03	23	-AIN03
5	+AIN04	24	-AIN04
6	+AIN05	25	-AIN05
7	+AIN06	26	-AIN06
8	+AIN07	27	-AIN07
9	+AIN08	28	-AIN08
10	+AIN09	29	-AIN09
11	+AIN10	30	-AIN10
12	+AIN11	31	-AIN11
13	+AIN12	32	-AIN12
14	+AIN13	33	-AIN13
15	+AIN14	34	-AIN14
16	+AIN15	35	-AIN15
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		

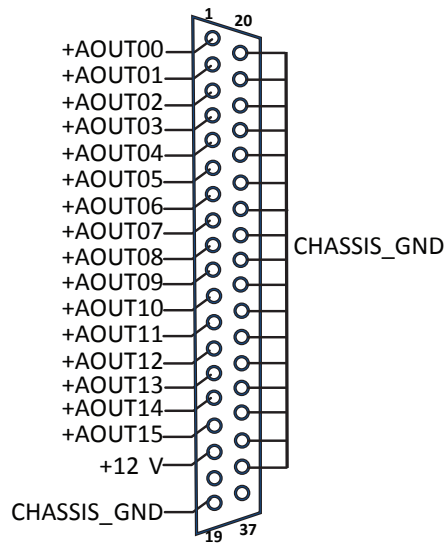


OP4500 Series Pin Assignments

OP4500 Series 300 and 400 for Power Electronics

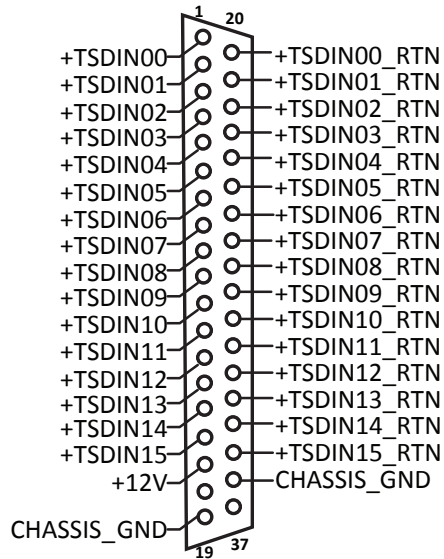
SERIES 300/400 - MODULE B - ANALOG OUT 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+AOUT00	20	CHASSIS_GND
2	+AOUT01	21	CHASSIS_GND
3	+AOUT02	22	CHASSIS_GND
4	+AOUT03	23	CHASSIS_GND
5	+AOUT04	24	CHASSIS_GND
6	+AOUT05	25	CHASSIS_GND
7	+AOUT06	26	CHASSIS_GND
8	+AOUT07	27	CHASSIS_GND
9	+AOUT08	28	CHASSIS_GND
10	+AOUT09	29	CHASSIS_GND
11	+AOUT10	30	CHASSIS_GND
12	+AOUT11	31	CHASSIS_GND
13	+AOUT12	32	CHASSIS_GND
14	+AOUT13	33	CHASSIS_GND
15	+AOUT14	34	CHASSIS_GND
16	+AOUT15	35	CHASSIS_GND
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



SERIES 300/400 - DIGITAL IN 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+TSDIN00	20	+TSDIN00_RTN
2	+TSDIN01	21	+TSDIN01_RTN
3	+TSDIN02	22	+TSDIN02_RTN
4	+TSDIN03	23	+TSDIN03_RTN
5	+TSDIN04	24	+TSDIN04_RTN
6	+TSDIN05	25	+TSDIN05_RTN
7	+TSDIN06	26	+TSDIN06_RTN
8	+TSDIN07	27	+TSDIN07_RTN
9	+TSDIN08	28	+TSDIN08_RTN
10	+TSDIN09	29	+TSDIN09_RTN
11	+TSDIN10	30	+TSDIN10_RTN
12	+TSDIN11	31	+TSDIN11_RTN
13	+TSDIN12	32	+TSDIN12_RTN
14	+TSDIN13	33	+TSDIN13_RTN
15	+TSDIN14	34	+TSDIN14_RTN
16	+TSDIN15	35	+TSDIN15_RTN
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		

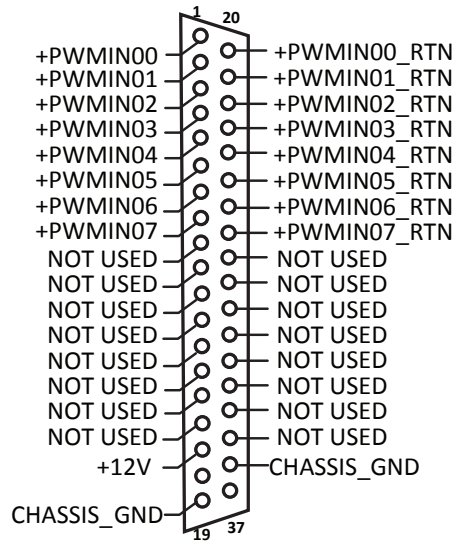


OP4500 Series Pin Assignments

OP4500 Series 300 and 400 for Power Electronics

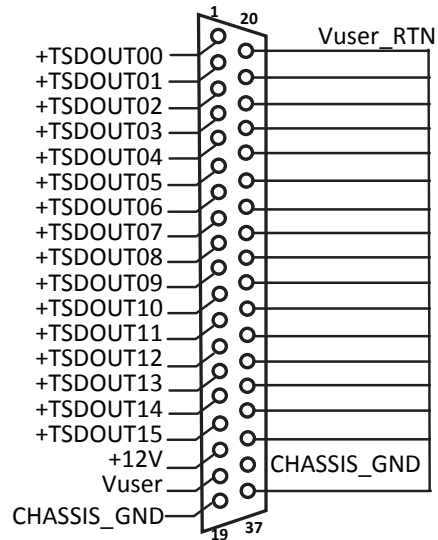
SERIES 300/400 - DIGITAL IN 16-31 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+PWMIN00	20	+PWMIN00_RTN
2	+PWMIN01	21	+PWMIN01_RTN
3	+PWMIN02	22	+PWMIN02_RTN
4	+PWMIN03	23	+PWMIN03_RTN
5	+PWMIN04	24	+PWMIN04_RTN
6	+PWMIN05	25	+PWMIN05_RTN
7	+PWMIN06	26	+PWMIN06_RTN
8	+PWMIN07	27	+PWMIN07_RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18		37	
19	CHASSIS_GND		



SERIES 300/400 - DIGITAL OUT 0-15 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+TSDOUT00	20	Vuser_RTN
2	+TSDOUT01	21	Vuser_RTN
3	+TSDOUT02	22	Vuser_RTN
4	+TSDOUT03	23	Vuser_RTN
5	+TSDOUT04	24	Vuser_RTN
6	+TSDOUT05	25	Vuser_RTN
7	+TSDOUT06	26	Vuser_RTN
8	+TSDOUT07	27	Vuser_RTN
9	+TSDOUT08	28	Vuser_RTN
10	+TSDOUT09	29	Vuser_RTN
11	+TSDOUT10	30	Vuser_RTN
12	+TSDOUT11	31	Vuser_RTN
13	+TSDOUT12	32	Vuser_RTN
14	+TSDOUT13	33	Vuser_RTN
15	+TSDOUT14	34	Vuser_RTN
16	+TSDOUT15	35	Vuser_RTN
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



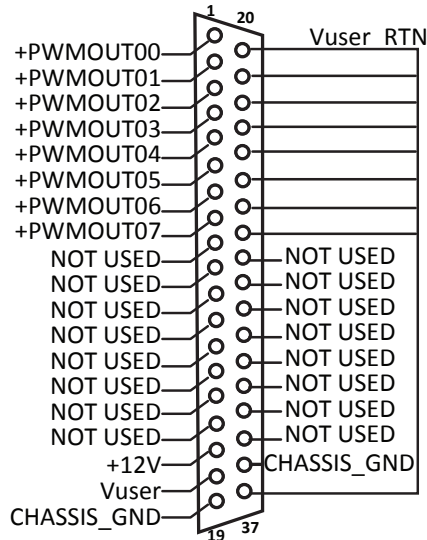
Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

OP4500 Series Pin Assignments

OP4500 Series 300 and 400 for Power Electronics

SERIES 300/400 - DIGITAL OUT 16-31 DB37

DB37	Module pin assignment	DB37	Module pin Assignment
1	+PWMOUT00	20	Vuser_RTN
2	+PWMOUT01	21	Vuser_RTN
3	+PWMOUT02	22	Vuser_RTN
4	+PWMOUT03	23	Vuser_RTN
5	+PWMOUT04	24	Vuser_RTN
6	+PWMOUT05	25	Vuser_RTN
7	+PWMOUT06	26	Vuser_RTN
8	+PWMOUT07	27	Vuser_RTN
9	NOT USED	28	NOT USED
10	NOT USED	29	NOT USED
11	NOT USED	30	NOT USED
12	NOT USED	31	NOT USED
13	NOT USED	32	NOT USED
14	NOT USED	33	NOT USED
15	NOT USED	34	NOT USED
16	NOT USED	35	NOT USED
17	+12V	36	CHASSIS_GND
18	Vuser	37	Vuser_RTN
19	CHASSIS_GND		



Vuser for channels 0-15 is the same Vuser for channels 16-31. Both banks use a common Vuser and Vrtn. We recommend providing power to only one DB37 bank via pins 18 and 37.

RS422 Digital IN 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+PWMIN08	6	-PWMIN08
2	+PWMIN09	7	-PWMIN09
3	+PWMIN10	8	-PWMIN10
4	+PWMIN11	9	-PWMIN11
5			

RS422 Digital IN 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+PWMIN12	6	-PWMIN12
2	+PWMIN13	7	-PWMIN13
3	+PWMIN14	8	-PWMIN14
4	+PWMIN15	9	-PWMIN15
5			

RS422 Digital OUT 0-3

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+PWMOUT08	6	-PWMOUT08
2	+PWMOUT09	7	-PWMOUT09
3	+PWMOUT10	8	-PWMOUT10
4	+PWMOUT11	9	-PWMOUT11
5			

RS422 Digital OUT 4-7

DB9F Pin	OP4500 pin assignment	DB9F Pin	OP4500 pin assignment
1	+PWMOUT12	6	-PWMOUT12
2	+PWMOUT13	7	-PWMOUT13
3	+PWMOUT14	8	-PWMOUT14
4	+PWMOUT15	9	-PWMOUT15
5			



LIMITED WARRANTY

Limited Warranty

OPAL-RT Technologies Inc. warrants to the original purchaser and/or ultimate customer (“Purchaser”) of OPAL-RT products (“Product”) that if any part thereof proves to be defective in material or workmanship within one (1) year, such defective part will be repaired or replaced, free of charge, at OPAL-RT Technologies’ discretion, if shipped prepaid to OPAL-RT Technologies Inc. at 1751 Richardson, suite 2525, Montreal, Quebec, Canada, H3K 3G6, in a package equal to or in the original container. The Product will be returned freight prepaid and repaired or replaced if it is determined by OPAL-RT Technologies Inc. that the part failed due to defective materials or workmanship. Otherwise, the fees will be charged to the client (see article “Warranty Limitation and Exclusion”). The repair or replacement of any such defective part shall be OPAL-RT Technologies’ sole and exclusive responsibility and liability under this limited warranty.

Purchaser must request an RMA number before shipping any Product for repair:

1. Access the OPAL-RT website (www.opal-rt.com/support/ return-merchandise-authorization-rma-request), click on support and select Return Merchandise (RMA).
2. Fill out the online form and submit.
3. OPAL-RT’s Support department will evaluate the return and either issue an RMA number via email
 - If the Product is returned for repair more than 12 months after purchase, the Purchaser is responsible for the cost of repair. OPAL-RT will assess the repair and prepare a quote. The RMA number will be sent with the quote.
4. Only when the Purchaser receives the RMA number, may they ship the Product, prepaid, to OPAL-RT.

Return Policy

the following fees will apply when customers return products for credit:

A full credit, less a 15% fee and less return fee will only be issued if the product is in perfect working condition and if the product is returned within 1 month following the shipping date. If repairs are required on the returned product, the cost of these repairs will be deducted from the credit to be issued.

No credits will be issued beyond the one month period.

Exclusions

If third party products are part of the Product, OPAL-RT will honor the original manufacturer’s warranty.

This limited warranty does not cover consumable items, such as batteries, or items subject to wear or periodic replacement, including lamps, fuses or filter elements.

Warranty Limitation and Exclusion

OPAL-RT Technologies will have no further obligation under this limited warranty. All warranty obligations of OPAL-RT Technologies are void if the Product has been subject to abuse, misuse, negligence, or accident or if the Purchaser fails to perform any of the duties set forth in this limited warranty or if the Product has not been operated in accordance with instructions, or if the Product serial number has been removed or altered.

Disclaimer of Unstated Warranties

The warranty printed above is the only warranty applicable to this purchase. All other warranties, express or implied, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose are hereby disclaimed.

Limitation of Liability

It is understood and agreed that OPAL-RT Technologies' liability, whether in contract, in tort, under any warranty, in negligence or otherwise shall not exceed the amount of the purchase price paid by the purchaser for the product and under no circumstances shall OPAL-RT Technologies be liable for special, indirect, or consequential damages. The price stated for the product is a consideration limiting OPAL-RT Technologies' liability. No action, regardless of form, arising out of the transactions under this warranty may be brought by the purchaser more than one year after the cause of actions has occurred.

CONTACT

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Technical Services

www.opal-rt.com/support

Note:

While every effort has been made to ensure accuracy in this publication, no responsibility can be accepted for errors or omissions. Data may change, as well as legislation, and you are strongly advised to obtain copies of the most recently issued regulations, standards, and guidelines.

This publication is not intended to form the basis of a contract.



OPAL-RT

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