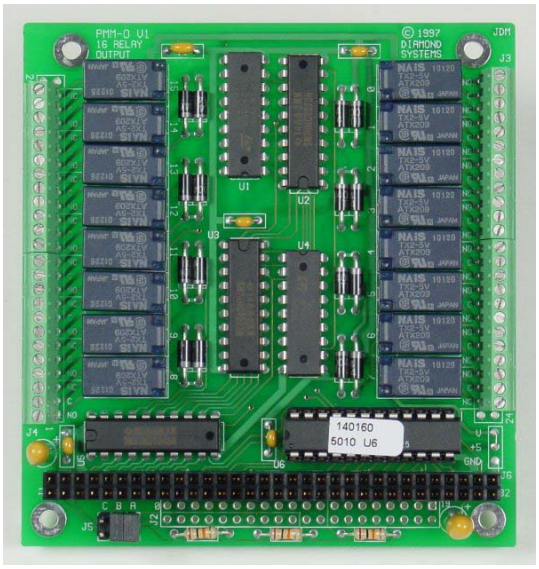
DIAMOND SYSTEMS CORPORATION

PEARL-MM

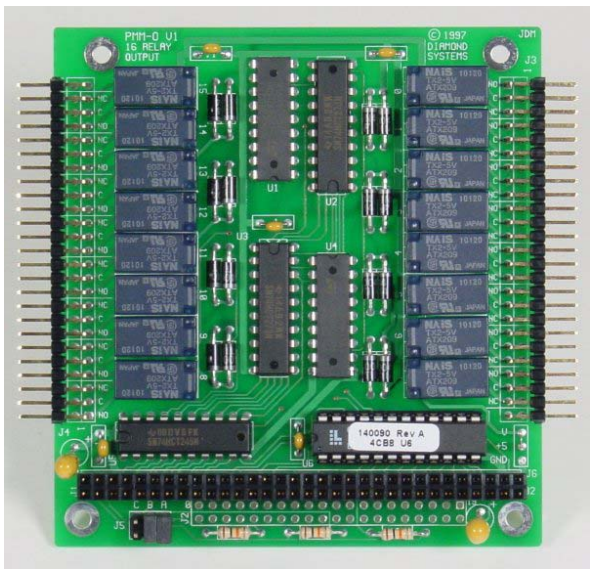
16 Relay PC/104 Module

User Manual V1.2



Model PMM-S

Screw terminal I/O



Model PMM-P

Ribbon cable I/O

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PEARL-MM-O

16 Relay Digital Output PC/104 Module

1. DESCRIPTION

Pearl-MM is a PC/104 format digital I/O module designed for control of high current AC or DC loads. This module features 16 relay outputs. The 16 relay outputs are SPDT format (form C). Each relay has 3 contacts: Common, Normally Open, and Normally Closed. For safety and reliability, all relays are at their power-off state at power-up or system reset. Each relay can switch both AC and DC voltages.

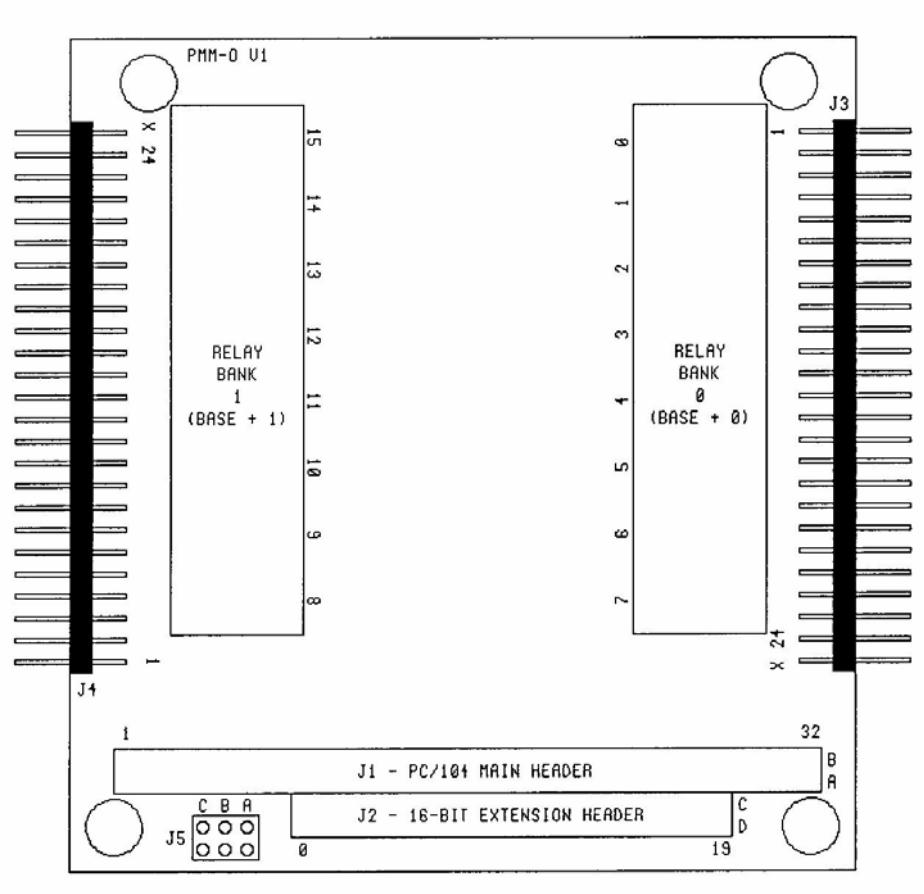
All outputs are isolated from the PC up to 500V AC or DC. The relays have long a rated lifetime of 100,000,000 operations and quick actuation time (4ms max operate and release).

Two versions are available: Model **PMM-P** has pin headers for quick IDC ribbon cable connections, and model **PMM-S** has screw terminals on .1" centers for heavier duty wiring.

2. FEATURES

- 16 relay digital outputs
- Relays have SPDT (form C) contacts
- Max switching capacity 60W (DC) or 60VA (AC)
- Max load: 30VDC / 2A or 125VAC / 0.5A (resistive)
- Long lifetime relays (100,000,000 operations)
- 500VAC or DC isolation between board and signals
- High-density .1" pitch screw terminals or ribbon cable header for I/O

3. PEARL-MM BOARD DRAWING



J1: Main PC/104 header

J2: 16-bit PC/104 header

J3: Connections for relays 0 - 7

J4: Connections for relays 8 - 15

J5: Base address selection

NOTE: J3 and J4 are shown as pin headers (model PMM-P). The boards is also available with screw terminals in these locations (model PMM-S).

4. I/O HEADER PINOUT AND PIN DESCRIPTION

Pearl-MM is available with two different types of output connectors, pin headers (**-P** option) and screw terminals (**-S** option). There are two identical headers on each board. **J3** on the right side of the board (relative to the PC/104 connector) is for channels 0 - 7, and **J4** on the left side is for channels 8 - 15. Refer to the appropriate connector pinout diagram for the board you have.

4.1 Pin Header (-P Option)

Note that each pair of pins is connected together on the pin headers.

J3 (Right side, pin 1 at top)

0 NO	1	2	0 NO
0 C	3	4	0 C
0 NC	5	6	0 NC
1 NO	7	8	1 NO
1 C	9	10	1 C
1 NC	11	12	1 NC
2 NO	13	14	2 NO
2 C	15	16	2 C
2 NC	17	18	2 NC
3 NO	19	20	3 NO
3 C	21	22	3 C
3 NC	23	24	3 NC
4 NO	25	26	4 NO
4 C	27	28	4 C
4 NC	29	30	4 NC
5 NO	31	32	5 NO
5 C	33	34	5 C
5 NC	35	36	5 NC
6 NO	37	38	6 NO
6 C	39	40	6 C
6 NC	41	42	6 NC
7 NO	43	44	7 NO
7 C	45	46	7 C
7 NC	47	48	7 NC
Not Used	49	50	Not Used

J4 (Left side, pin 1 at bottom)

8 NO	1	2	8 NO
8 C	3	4	8 C
8 NC	5	6	8 NC
9 NO	7	8	9 NO
9 C	9	10	9 C
9 NC	11	12	9 NC
10 NO	13	14	10 NO
10 C	15	16	10 C
10 NC	17	18	10 NC
11 NO	19	20	11 NO
11 C	21	22	11 C
11 NC	23	24	11 NC
12 NO	25	26	12 NO
12 C	27	28	12 C
12 NC	29	30	12 NC
13 NO	31	32	13 NO
13 C	33	34	13 C
13 NC	35	36	13 NC
14 NO	37	38	14 NO
14 C	39	40	14 C
14 NC	41	42	14 NC
15 NO	43	44	15 NO
15 C	45	46	15 C
15 NC	47	48	15 NC
Not Used	49	50	Not Used

Signal Name	Definition
N NO	Relay output **normally open** contact; this contact is disconnected when power is off or when a 0 is written to the relay's control bit in the relay control register, and it is connected to the Out *N* C contact when power is on and a 1 is written to the relay's control bit.
N C	(*N* = 0 to 15) Relay output **common** contact; this contact is always used with relay output connections.
N NC	Relay output **normally connected** contact; this contact is connected to the Out *N* C contact when power is off or when a 0 is written to the relay's control bit in the relay control register, and it is disconnected when power is on and a 1 is written to the relay's control bit.

4.2 Screw Terminals (-S Option)

J3 (Right side, pin 1 at top)

1	0 NO
2	0 C
3	0 NC
4	1 NO
5	1 C
6	1 NC
7	2 NO
8	2 C
9	2 NC
10	3 NO
11	3 C
12	3 NC
13	4 NO
14	4 C
15	4 NC
16	5 NO
17	5 C
18	5 NC
19	6 NO
20	6 C
21	6 NC
22	7 NO
23	7 C
24	7 NC

J4 (Left side, pin 1 at bottom)

1	8 NO
2	8 C
3	8 NC
4	9 NO
5	9 C
6	9 NC
7	10 NO
8	10 C
9	10 NC
10	11 NO
11	11 C
12	11 NC
13	12 NO
14	12 C
15	12 NC
16	13 NO
17	13 C
18	13 NC
19	14 NO
20	14 C
21	14 NC
22	15 NO
23	15 C
24	15 NC

Signal Name	Definition
N NO	Relay output **normally open** contact; this contact is disconnected when power is off or when a 0 is written to the relay's control bit in the relay control register, and it is connected to the Out *N* C contact when power is on and a 1 is written to the relay's control bit.
N C	(*N* = 0 to 15) Relay output **common** contact; this contact is always used with relay output connections.
N NC	Relay output **normally connected** contact; this contact is connected to the Out *N* C contact when power is off or when a 0 is written to the relay's control bit in the relay control register, and it is disconnected when power is on and a 1 is written to the relay's control bit.

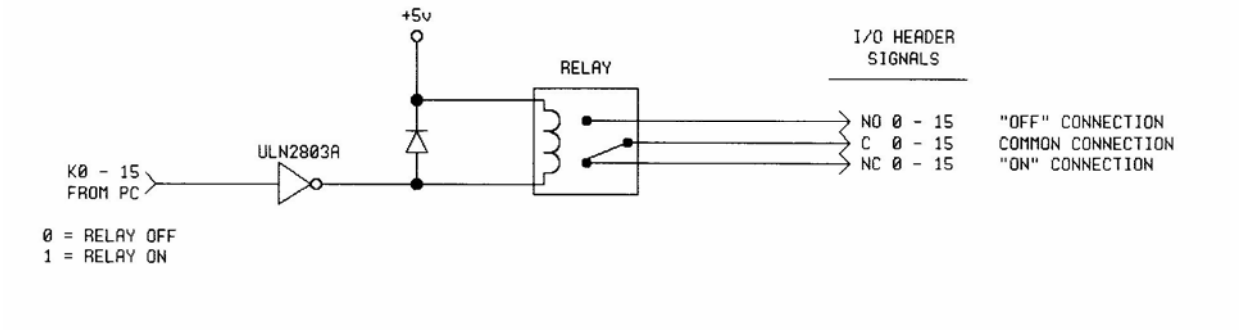
5. BASE ADDRESS SELECTION

Refer to the Drawing of Pearl-MM on page 4 for locations of the jumper block mentioned here.

Each peripheral board in the computer system must have a unique I/O address or group of addresses. Pearl-MM's I/O address is set with jumper block J5, located at the lower left corner of the board below the PC/104 header. Seven different I/O addresses are selectable, depending on the jumper settings. The table below lists all the possible I/O addresses for Pearl-MM and their corresponding jumper settings. The default setting is 300 Hex (768 Decimal). Jumpers are installed vertically below the corresponding letters.

J5: I/O Address		Jumper Settings		
Hex	**Decimal**	**C**	**B**	**A**
240	576	Out	Out	Out
280	640	Out	Out	In
2C0	704	Out	In	Out
300	768	Out	In	In
340	832	In	Out	Out
380	896	In	Out	In
3C0	960	In	In	Out

6. RELAY SCHEMATIC



7. I/O REGISTERS

Pearl-MM occupies two addresses in the computer's I/O space. The lowermost address is called the Base Address of the board. This address is selected with jumper block J4 described above. Each address is used to control one group of 8 relays.

Base + 0 Write Relays 0 - 7

Bit No.	7	6	5	4	3	2	1	0
Name	K7	K6	K5	K4	K3	K2	K1	K0

Base + 1 Write Relays 8 - 15

Bit No.	7	6	5	4	3	2	1	0
Name	K15	K14	K13	K12	K11	K10	K9	K8

Definitions:

K15 - 0 Relay output control bits:

0 = Turn relay off.

C contact is connected to NC contact

NO contact is disconnected

1 = Turn relay on.

C contact is connected to NO contact

NC contact is disconnected

Notes:

Relays are in the Off state when power is off to the computer.

Upon power up, all relays remain in the off state.

Upon system reset, all relays will return to the off state.

8. PROGRAMMING

The following code example shows how to program the board directly. The Diamond Systems Universal Driver software also supports this board.

8.1 Turning Relays On and Off

To turn a relay on, write a 1 to its corresponding bit in the output register. To turn the relay off, write a 0 to the corresponding bit. Note the following characteristics:

Relays are in the Off state when power is off to the computer.

Upon power up, all relays remain in the off state.

Upon system reset, all relays will return to the off state.

Note that you cannot individually address each bit in the output register. You must write all 8 bits at once. This means that your program must remember the contents of the output register at all times and only modify the bit(s) of the relay(s) you want to change.

Here is how to control the relays.

In C:

```
int mask[8], ioaddr, i, outdata, x;
ioaddr = 768;   // assume default address
outdata = 0;    // initial value of output reg; all relays off
x = 1;          // used to create masks

// create masks for each bit position;
// mask = all 1s except for a 0 in the selected bit position
for(i = 0; i <= 7; i++) {
  mask[i] = 255 - x;
  x *= 2;
}
// now mask[0] = 254, mask[1] = 253, ... mask[7] = 127

// turn a relay on; let's use relay 4 (2^4 = 16)
outdata = outdata | 16; // must use bitwise or, not +
outp(ioaddr, outdata);

// now turn relay 5 off; here we use the masks created above
outdata = outdata & mask[5];  // use bitwise and to clear bit 5
outp(ioaddr, outdata);
```

In Basic:

```
10  'create masks for each bit position
20  for i = 0 to 7: mask(i) = 255 - 2^i: next i
30  ioaddr = 768            'assume default address
40  outdata = 0  'initial value of register at power up
50  'turn relay 4 on
60  outdata = outdata or 16 'must use or, not +
70  out ioaddr, outdata
80  'turn relay 5 off
90  outdata = outdata and mask(5) 'clear bit 5, protect other bits
100 out ioaddr, outdata
```

9. SPECIFICATIONS

Relay Outputs

Outputs:	16 relays
Relay type:	SPDT (Form C)
Maximum voltage/current:	
DC outputs:	30VDC / 2A
AC outputs:	250VAC / 0.5A resistive
Max switching capacity:	60W (DC), 60VA (AC)
Max operating voltage:	220VDC, 250VAC
Contact resistance:	100mΩ max
Relay lifetime:	100,000,000 operations
Actuation time:	Operate 4ms max, release 4ms max

General

Connection headers:	
-P version:	50-position (2x20) .025” square pin header on .1” centers; Mates with standard ribbon cable (IDC) connectors
-S version:	24-position screw terminals on .1” centers; terminals accept 14-30 gauge wiring
Isolation:	500VDC or AC, channel to channel and board to output
Power supply:	+5VDC ±10%
Current consumption:	100mA typical, all relays off; Additional 20mA per activated relay
Operating temperature:	-40 to +85°C
Operating humidity:	5% to 95% noncondensing
PC/104 bus:	8 bit main bus header is installed and used. 16-bit extension header footprint is present for optional passthrough use; however no signals on this header are used on Pearl-MM.