

DESCRIPTION

Whether you build props or design small-scale industrial controls, there will likely come a time when you need to control high voltage AC devices from a digital controller (like the Prop-1). The RC-4 is designed just for this purpose, giving the engineer the ability to control up to four AC loads (per board). Outputs may be controlled directly (with a mat switch, for example) or remotely through a simple serial interface that allows the host microcontroller to control up to four RC-4 relay boards.

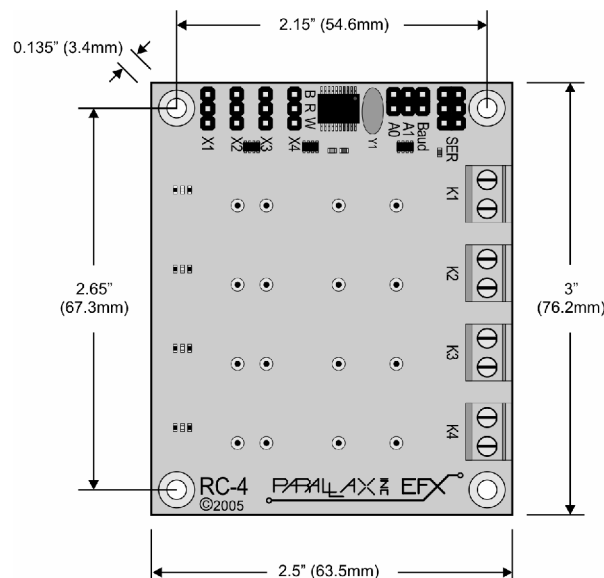
PRODUCT APPLICATIONS

- Props and holiday displays
- Small-scale automation and industrial control
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FEATURES & BENEFITS

- Controls up to four Crydom D2W series solid-state relays
- LED on each channel indicates relay status
- Serial control for connection to host microcontroller
- User-configured baud rate (2400 or 38.4k) for serial control
- User-configured address allows up to four RC-4 boards on one serial connection
- Direct control with simple normally-open (N.O.) switch input on any channel
- Current consumption: 13 mA @ 5 VDC (no relays active)
- Compact size: 2.5" x 3" (63.5 mm x 76.2 mm)

MECHANICAL



Mounting the RC-4

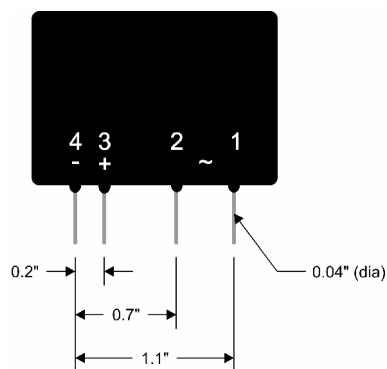


WARNING: The RC-4 is designed to switch high-voltage AC circuits which can be very dangerous, even lethal, if mishandled. The RC-4 should be mounted before installing relays and connecting control and switched AC wiring.

Mount the RC-4 on a non-conductive surface using ½" (12 mm) stand-offs and appropriate hardware. Mounting the RC-4 above a conductive (metal) surface could lead to the possibility of a hazardous condition.

Installing Relays

The RC-4 is designed for Crydom D2W series (and compatible) solid-state relays. If using relays from another manufacturer, it is the user's responsibility to ensure the mechanical *and* electrical specifications match the Crydom D2W series.



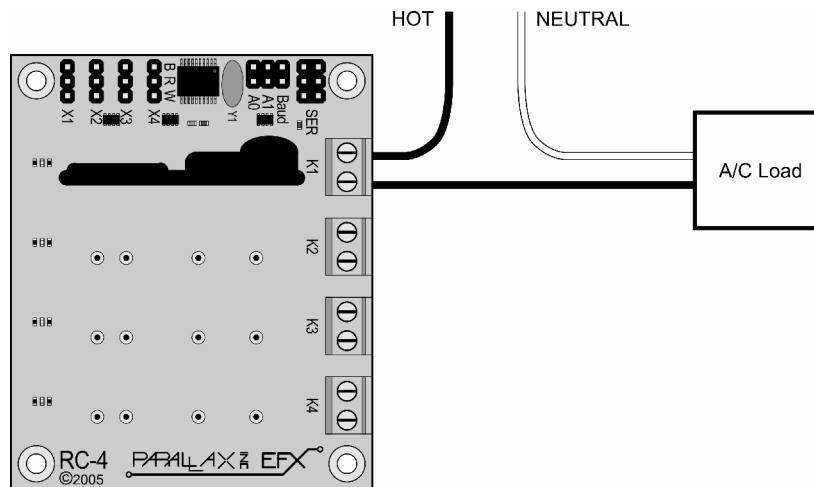
Nominal Input Impedance	1500 ohms
Typical Input Current @ 5vdc	3.0 mA
Must Turn On Voltage	3.0 vdc
Must Turn Off Voltage	1.0 vdc

Connections – Switched AC Power



DANGER: The RC-4 is capable of switching voltages that can be lethal if mishandled. High voltage AC wiring should be installed by a qualified electrician. Before making any high-voltage connections to the RC-4, ensure that all power has been removed.

Each relay output has two connections; this connection acts as a switch to control the hot side of the AC circuit, as shown in the illustration below.



Connections – Serial Control

For most applications the RC-4 will be connected to a host microcontroller like the Prop-1. To make the connection between the host and the RC-4 use a 3-wire servo extender cable (#805-00002). When making the connection it is important to note the color-coded polarity of the extender cable (W = white, R = red, B = black) and match it to the output header on the Prop-1 or other host.



IMPORTANT NOTE: When connecting the RC-4 to a host other than the Prop-1 controller, contact Team EFX (teamefx@efx-tek.com) to ensure the RC-4 is compatible and won't be damaged by the host.

Baud Rate Selection

The RC-4 supports two baud rates: 2400 baud for the Prop-1, and 38.4k baud for other microcontrollers. Baud rate is set with a jumper on the **Baud** header.

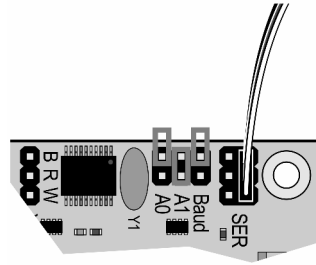
Jumper	Baud Rate
Out	2400 (Prop-1)
In	38.4k (Other controllers)

Address Selection

Using a serial connection allows the host controller to connect to up to four RC-4 boards; to do this, however, each must have a unique address. The RC-4 board address is set with jumpers on the **A0** and **A1** headers.

A1	A0	Address
Out	Out	0 (%00)
Out	In	1 (%01)
In	Out	2 (%10)
In	In	3 (%11)

The illustration below shows the RC-4 configured for serial communication at 2400 baud, on address 2 (%10).



RC-4 Serial Protocol

The RC-4 serial connection conforms to the Parallax AppMod bi-directional communications protocol, which operates at TTL (0 to 5 VDC) using “open-true” baud mode to enable daisy-chaining devices. All exchanges are initiated by the host controller. The format of host communications to the RC-4 is as follows:

`"!RC4", address, command { , data }`

... where “!RC4” is the preamble that allows the RC-4 to exist on the same communications line as other devices (e.g., PSC), *address* is the board address set with jumpers on A0 and A1, *command* is a single character command designator, and *data* is any value that may be required by command. The following section details valid commands (“V”, “S”, “R”, “X”, and “G”) for the RC-4.

“V” – Get RC-4 Version number

Syntax: `"!RC4", address, "V"`

Replay: 3-byte (ASCII) version string

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!RC4", %00, "V")
SERIN  Sio, OT2400, id0, id1, id2
DEBUG "RC-4 Version ", #@id0, #@id1, #@id2, CR
```

“S” – Setup All Relays

Syntax: `"!RC4", address, "S", newStatus`
– *newStatus* is new relay status: %0000..%1111

Reply: none

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!RC4", %00, "S", %0001)
```

In this example, relay K1 will be activated, while K2, K3, and K4 will be deactivated.

"R" – Set/Reset Individual Relay

Syntax: `"!RC4", address, "R", rlyNum, newState`
– *rlyNum* is output: 1..4
– *newState* is new state of relay: 1 = On, 0 = Off

Reply: none

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!RC4", %00, "R", 4, 1)
```

In this example, relay #4 (K4) is activated.

"X" – Reset All Relays

Syntax: `"!RC4", address, "X"`

Reply: none

Prop-1 Example:

```
SEROUT Sio, OT2400, ("!RC4", %00, "X")
```

In this example, all relays (K1..K4) are deactivated.

"G" – Get Relay Status

Syntax: `"!RC4", address, "G"`

Reply: One byte that holds current relay status
– Bit0 = K1, Bit1 = K2, Bit2 = K3, Bit3 = K4
– 1 indicates relay is On; 0 indicates relay is Off.

Prop-1 Example:

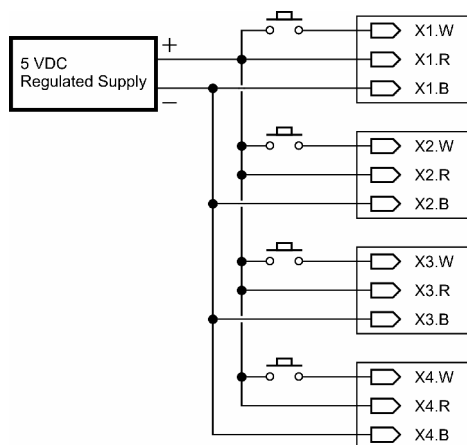
```
Main:  
SEROUT Sio, OT2400, ("!RC4", %00, "G")  
SERIN Sio, OT2400, rlyStatus
```

In this example, bits 0..3 of *rlyStatus* will hold the current state of the RC-4 relays.

Connections – Direct Control

In applications where intelligent control is not required the RC-4 relays may be activated through a direct connection. Direct control is achieved by connecting power and control signal to headers X1..X4 (as required). Note that power is carried to the X1..X4 connections on the R (red: +5 VDC) and B (black: ground) connections. By connection a normally-open button or switch between the W (white: signal) and R connections, the corresponding relay is brought under direct control (on when button pressed).

The diagram the follows shows the connection of the power supply and four normally-open push-buttons to control relays K1..K4.



WARNING: When using direct control the power supplied to the R connections of the X1..X4 connectors must not exceed +5.25 VDC, otherwise damage to the RC-4 will occur. When using an external power supply you must ensure that it is regulated to +5 VDC.

Most plug-in (“wall-wart”) power supplies *are not regulated* – if using this kind of supply, proceed with caution to prevent damage to the RC-4.

Example Program

The following program demonstrates the RC-4 features under serial control using the Prop-1 controller. When using the Prop-1 the serial baud rate is set to 2400 (Baud jumper removed).

```
' =====
'
' File..... RC-4_Test.BS1
' Purpose.... RC-4_Features_Test
' Author..... EFX-TEK
' E-mail..... teamefx@efx-tek.com
' Started....
' Updated.... 01 JUN 2006
'
' {$STAMP BS1}
' {$PBASIC 1.0}
' =====

' -----[ Program Description ]-----
'
' RC-4 demo program.

' -----[ I/O Definitions ]-----

SYMBOL Sio          = 7

' -----[ Constants ]-----

SYMBOL Baud          = OT2400
SYMBOL Addr          = %11          ' %00 - %11
```

```

SYMBOL   IsOn           = 1
SYMBOL   IsOff          = 0

' -----[ Variables ]-----

SYMBOL   id0            = B0                ' version string
SYMBOL   id1            = B1
SYMBOL   id2            = B2

' -----[ Initialization ]-----

Reset:
  DEBUG CLS

' -----[ Program Code ]-----

Main:
  SEROUT Sio, Baud, ("!RC4", Addr, "V")      ' get version
  SERIN  Sio, Baud, id0, id1, id2
  DEBUG "RC-4 Version ", #@id0, #@id1, #@id2, CR

Test_Set:
  FOR id0 = %0000 TO %1111
    SEROUT Sio, Baud, ("!RC4", Addr, "S", id0)  ' set outputs
    GOSUB Show_Status
    PAUSE 500
  NEXT

Test_Reset:
  SEROUT Sio, Baud, ("!RC4", Addr, "X")      ' all off
  GOSUB Show_Status
  PAUSE 500

Test_RelayCtrl:
  FOR id0 = 1 TO 4
    SEROUT Sio, Baud, ("!RC4", Addr, "R", id0, IsOn)
    GOSUB Show_Status
    PAUSE 500
  NEXT
  FOR id0 = 1 TO 4
    SEROUT Sio, Baud, ("!RC4", Addr, "R", id0, IsOff)
    GOSUB Show_Status
    PAUSE 500
  NEXT

Test_Ignore:
  ' send invalid relay number
  SEROUT Sio, Baud, ("!RC4", Addr, "R", 5, IsOn)
  GOSUB Show_Status                          ' no change

  END

' -----[ Subroutines ]-----

Show_Status:
  SEROUT Sio, Baud, ("!RC4", Addr, "G")      ' get status
  SERIN  Sio, Baud, id1
  DEBUG CR, "Status = ", #@id1
  RETURN

```

Accessories

805-00002 14-inch, 3-pin extension cable; *used to connect the RC-4 to the Prop-1 controller*

Additional Applications

For additional ideas and application notes for the RC-4 relay board, be sure to visit our web site at the following link:

www.efx-tek.com



NOTE: NOTE: The RC-4 makes the control of AC circuits very easy, still, caution must be used when installing and using the RC-4 for its intended purpose. EFX-TEK recommends that the RC-4 and related wiring be installed in a suitable enclosure that can be secured to prevent accidental access to live AC circuits.

Consult a qualified electrician regarding the use of AC in your props and displays. For questions on RC-4 application and control, feel free to consult Team EFX at:

teamefx@efx-tek.com