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RC-4 Relay Board (#31204)

Solid-State Relay Controller

General Description

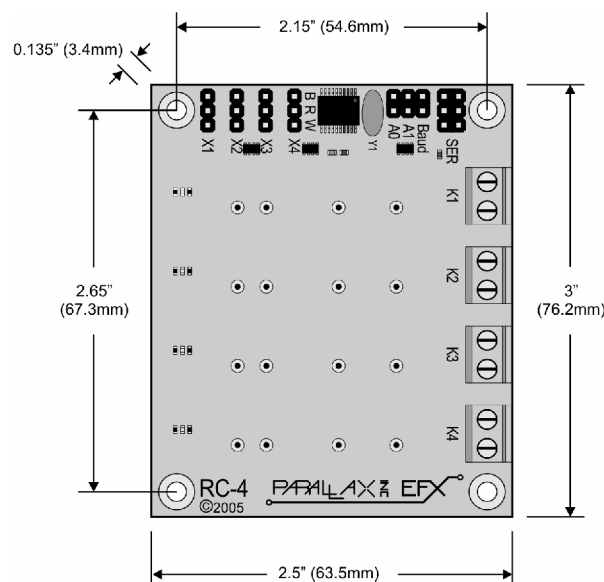
Whether you build props or design small-scale industrial controls, there will likely come a time when you need to control high voltage AC devices from a digital controller (like the Prop-1). The RC-4 is designed just for this purpose, giving the engineer the ability to control up to four AC loads (per 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.

Applications

- Props and holiday displays
- Small-scale industrial control

Features

- 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 N.O. switch input on any channel
- Current consumption: 13 mA @ 5 vdc (no relays active)
- Compact size: 2.5" x 3"



Mounting the RC-4

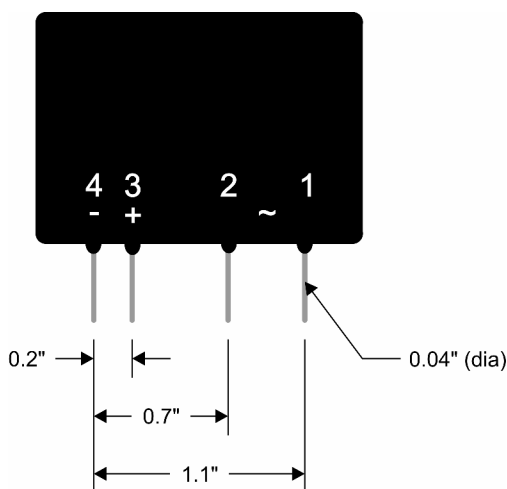


NOTE: The RC-4 is designed to switch high-voltage AC circuits which can be very dangerous, even lethal, if mishandled. The RC-4 should be mounted before installing relays and connecting control and switched AC wiring.

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 product from another relay 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

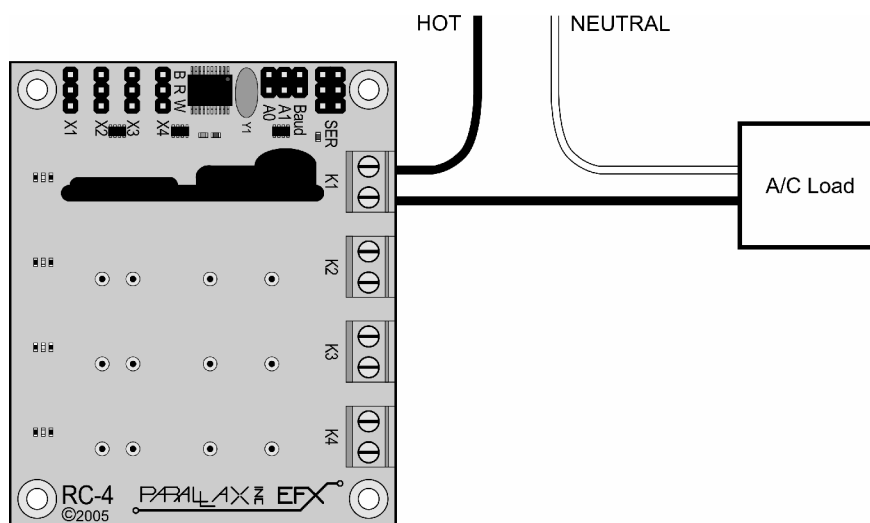
Trim the relay legs to ¼" (6 mm) with diagonal cutters before installing – this ensures the best mechanical performance of the RC-4 relay sockets. The relays may be installed in any order and in any position, though when installing fewer than four relays starting at position K1 is recommended.

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 or a BASIC Stamp® 2 model in a Board of Education® (BoE). To make the connection between the host controller and the RC-4 use a 3-wire servo extender cable (e.g., Parallax #805-00001 or #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.



NOTE: When using the BoE as the host controller platform the servo voltage jumper *must* be set to Vdd (+5 vdc) – if this jumper is set to Vin the RC-4 will be damaged.

Baud Rate Selection

The RC-4 supports two baud rates: 2400 baud for the Prop-1 (BS1 family) and 38.4k baud for the BS2-family and other microcontrollers. Baud rate is set with a jumper on the **Baud** header.

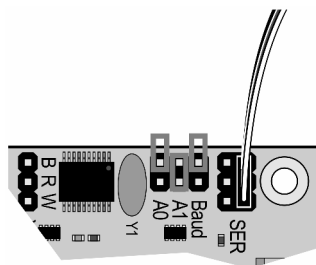
Jumper	Baud Rate
Out	2400 (Prop-1, BS1, and compatible controllers)
In	38.4k (BS2 and compatible controllers)

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 2400 baud, set to 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 – 5v) 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:

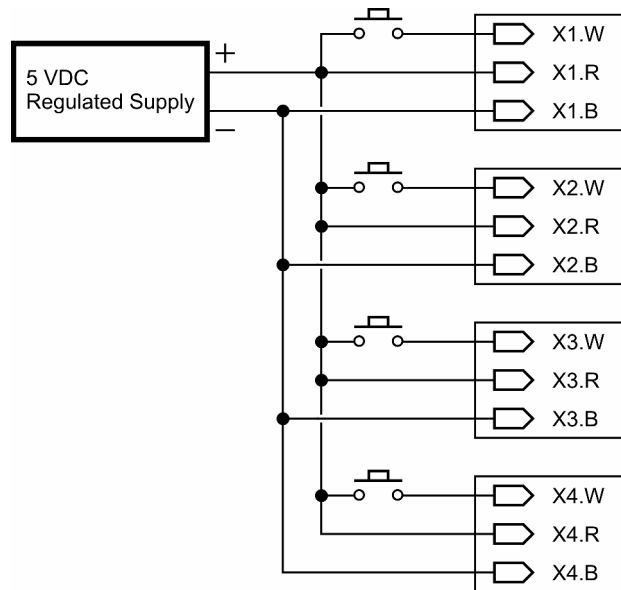
```
Main:  
SEROUT Sio, OT2400, (“!RC4”, %00, “G”)  
SERIN Sio, OT2400, rlyStatus
```

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.



NOTE: 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 (BS1) controller. When using the Prop-1 the serial baud rate is set to 2400 (Baud jumper removed).

```
' =====
'
' File..... RC4_Test.BS1
' Purpose.... RC-4 Features Test
' Author..... Team EFX -- Copyright (C) 2005 Parallax, Inc.
' E-mail..... teamefx@parallax.com
' Started....
' Updated.... 01 SEP 2005
'
' {$STAMP BS1}
' {$PBASIC 1.0}
'
' =====
'
' -----[ Program Description ]-----
```

```

'
' RC-4 demonstration program

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

SYMBOL  Sio                = 0

' -----[ 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

```

For additional programming examples be sure to visit us on the web:

www.parallax.com
www.parallaxefx.com
forums.parallax.com



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. Parallax 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 Parallax Team EFX at:

teamefx@parallax.com.

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