DIY KIT 142. 12 CHANNEL IR RELAY BOARD

Infrared (IR) remote controls are everywhere. Just about every piece of electronic equipment you can think of has one – TVs, VCRs, DVDs, hi-fi systems. Even the lastest cameras have them!

Why are they so popular? The answer is simple – convenience. You can change TV channels without leaving your chair. Or adjust the volume on your stereo system. Or, in the case of cameras, be in the photo yourself without having to find someone else to take it.

This kit comprises a commercial 14-button remote control unit (Photo 1) and a 12 channel relay board (Photo 2). All 12 relays are provided on the receiver board – nothing more to add. This makes it very simple to add infrared remote control to any project or existing equipment.

Indicator LEDs are used to show which relays are operated.

Buttons 1 to 12 on the remote control operate the corresponding relay on the receiver board, ie. button 1 operates relay 1, button 2 operates relay 2, etc. The 12 relays are organized into 2 groups of 8 and 4. Buttons 13 and 14 are used to turn off each group of relays (more on this later).

Photo 1

The kit requires a 12V DC 500mA power supply for the receiver board. A plugpack style AC-DC adaptor will be fine. The remote control unit requires 2 x AAA batteries (not supplied).

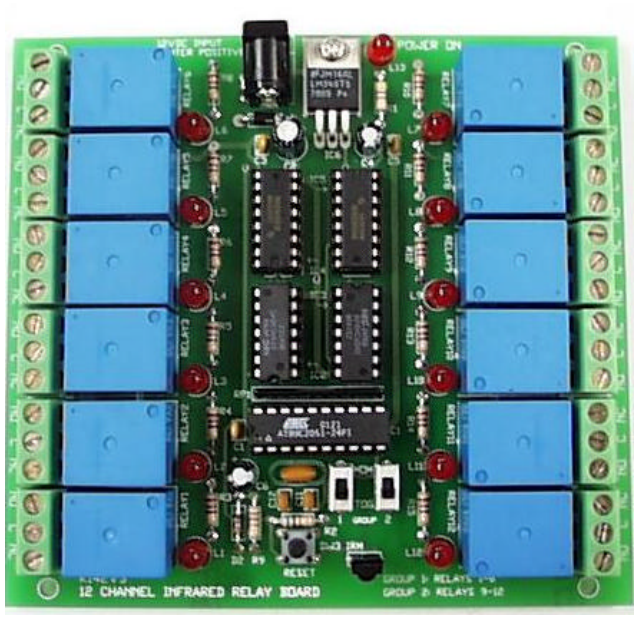

Photo 2

SPECIFICATIONS

Operating Voltage - Remote control Receiver	 3V (2 x AAA batteries) 12VDC
Operating Current	35mA (all relays off) 395mA (all relays on) (approx. 30mA/relay)
Operating range	Up to 18 metres (60 feet) (length of our factory!)
Relay Contact Rating	10A/240V AC/DC max. **(Warning. See text)**

CIRCUIT DESCRIPTION

The remote control unit uses a modulated 38kHz carrier to transmit data about which button is pressed. This method is used in all IR remote controls as it offers a high degree of noise immunity against interfering light sources.

At the receiver end the Waitrony IR receiver module extracts the data signal from the carrier. A pre-programmed Atmel 89C2051 microcontroller decodes this signal and sets the corresponding output low. This active LOW output is used to operate a relay via an inverter chip, IC2 or 3, and a relay driver chip, IC4 or 5.

At first glance you may wonder why the signal is inverted TWICE. Why not eliminate the first inverter (IC2 or 3) and simply use an active HIGH output from the microcontroller to the relay driver chips? It's all to do with what happens on reset.

On reset the microcontroller's I/O ports are configured as inputs (via internal hardware) and "float" high. If the outputs were connected directly to the relay drivers then the relays would operate during reset. Of course the relays would be released after reset once the onboard software took over. However the relays would "flick" on momentarily – not what we want. Using the extra inverter means we can use an active LOW output to operate the

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relay and a HIGH to release it - just right during reset! External pullup resistors, RP1 and 2, are used to ensure a 'solid' high level signal to turn a relay off.

(Of course, you may ask the questions: why invert the signals twice in any case. Why not just directly connect the outputs of the Atmel to the relays. The answer is that the Atmel pins would burn out with the 12V being applied to them. A relay driver IC is required. The most commonly available driver chip which we are using is also an inverter.)

LEDs L1 to L12 indicate which relay is operated. Each LED has a current limiting resistor in series. The LED/resistor combination is simply in parallel with the corresponding relay.

As mentioned the relays are divided into two groups of eight and four relays respectively. The operating mode of each group of relays can be set to "momentary" or "toggling" via slide switches SW1 and SW2.

Momentary mode means the relay is operated (on) while the corresponding button on the remote is being pressed. Releasing the button releases the relay (turns it off).

Toggling mode means that separate key presses are needed to turn the relay on and off. The first press of the button turns the relay on (if it was off). The relay stays on when the button is released. Pressing the button again turns the relay off. Each button press 'toggles' the state of the relay.

Buttons 13 and 14 are used to turn off ALL relays in a group. Button 13 applies to Group 1 and button 14 to Group 2.

Note: Pressing the reset switch will turn off all relays.

The rest of the circuitry is standard for microcontrollers. Capacitor C6 and resistor R9 provide power on reset while pushbutton SW3 is used for manual reset. A 12MHz ceramic resonator provides a stable clock frequency. Voltage regulator IC6 provides a 5 volt supply. Diode D1 provides reverse polarity protection on the power input.

The relay contacts are rated at 10 amps. However the PCB tracks can only take around 5 amps. You may need to add wire links on the bottom of the PCB to increase the current carrying capacity if you want to draw over 5A.

The relay outputs are rated to switch up to 240VAC mains voltages. **Extreme care should be taken when switching mains voltage. Don't do this unless you are experienced and know exactly what you are doing. Mains voltages can be lethal!**

ASSEMBLY

The remote control unit is **not** supplied with batteries. You will need to install 2 x AAA batteries.

Use the component overlay on the PCB to place the components in the following order. Do not insert any ICs until after the "TESTING" section.

1. Resistors and diodes.
2. IC sockets
3. Resistor networks. Note that RP2 is inserted inside the IC1 IC socket. The small dot at one end of the network denotes pin 1 which is the square pad.
4. Ceramic resonator, capacitors and IR module. The lens bump of the IR module faces outwards.
5. Three switches – 2 SPDT and a zippy tact switch
6. DC power jack and 7805 regulator. Use needle nosed pliers to bend the leads of the regulator. It does not require a heatsink. Screw down onto to PCB.
7. LED's
8. Electrolytic capacitors. Make sure you insert them the correct way around.
9. Terminal blocks. Note the terminal blocks do NOT slide together. Also make sure the wire entry side faces out from the PCB.
10. Relays

TESTING

Finally after you have inspected your work connect 12V DC center positive from a plugpack. The power LED should light. Use a multimeter to measure the 5V output from the regulator. Easiest way to do this is across pins 10 and 20 of the IC1 socket (pin 20 = positive).

If all is well you can remove the power and insert the ICs. Take care that none of the IC leads are bent under when inserting them into their sockets.

Connect a 12V supply again. Put the slide switches in the momentary (MOM) position and press button 1 on the remote control unit. Relay 1 should operate and LED L1 should light. Release the button and the relay should release. Check each of the other relays in turn by pressing the other buttons. Buttons 13 and 14 have no affect in momentary mode.

Now put the slide switches in the toggle (TOG) position. Now press and release button 1 on the remote control unit. Relay 1 should operate and stay operated. LED L1 should also be on. Press each of the other buttons 2 to 12 in turn and note that each relay and its LED is on.

At this point all the relays and LEDs should be on. Now press button 13. All Group 1 relays (1-8) should release and LEDs L1-8 should be off. Pressing button 14 should release all Group 2 (9-12) relays and turn off their associated LEDs L9-12.

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PART LIST – KIT 142

Resistors 1/4W, 5%, carbon film

470R yellow violet brown	R1	1
2K2 red red red	R3-8, R10-15	12
10K brown black orange	R2, R9	2
10K resnet	RP1	1
10 pin 9 resistor 'A' type		
10K resnet	RP2	1
6 pin 5 resistor 'A' type		

Capacitors

27pF ceramic	C11,12	2
100nF monobloc	C1,3,5	3
10uF 16V electrolytic	C4,6	2
100uF 25V electrolytic	C2	1

Semiconductors

1N4004 diode	D1	1
1N4148 diode	D2	1
AT89C2051	IC1	1
Pre-programmed microcontroller		
74HC04 or 74HC14	IC2,3`	2
Hex Inverter		
ULN2003A`	IC4,5`	2
Relay driver		
7805 voltage regulator	IC6	1
IR receiver module	IRM	1
'Waitrony' PIC1018SCL		
LED, Red, 5mm	L1-13	13

Miscellaneous

Ceramic resonator,12MHz	Y1	1
Relay, 12V	RELAY1-12	12
'Goodsky' RWH-SH-112D		
Terminal block, 3-way	X1-12	12
DC power jack, 2.5mm	X13	1
Slide switch, SPDT	SW1,2	2
Pushbutton TACT switch	SW3	1
IC socket, 14 pin	for IC2,3	2
IC socket, 16 pin	for IC4,5	2
IC socket, 20 pin	for IC1	1
Screw, 3mm x 6mm long	for IC6	1
Nut, 3mm	for IC6	1
PCB, K142		1
Remote Control unit (2xAAA batteries not supplied)		1

Note the source code for the decoder IC is not available.

TROUBLESHOOTING

Poor soldering ("dry joints") is the most common reason for the circuit not working. Check all soldered joints carefully under a good light. Re-solder any that look suspicious.

Are all the components in their correct position on the PCB?
Are the electrolytic capacitors and diodes the right way round?Are the ICs the right way around?
Are any IC leads bent up under the IC body?
Is the regulator output = 5V?

DATASHEETS

The data sheet for the Waitrony IR Receiver module can be downloaded at **http://kitsrus.com/pdf/pic1018scl.pdf**

Data on the AT89C2051 microcontroller can be found on the Atmel website at **www.atmel.com**

This kit was reviewed in the Australian magazine Silicon Chip in September, 2002. There is more explanation in the article about how it works. You can download the article from

http://www.kitsrus.com/pdf/k142_article.pdf

WEB ADDRESS & EMAIL

You can email us at **peter@kitsrus.com** if you have any problems or requests.

Information on other kits in the range is available from our Web page at "**http://www.kitsrus.com**"

For any technical problems or questions, contact the kit developer at **frank@ozitronics.com**

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