IR CONTROL INTERFACE

Ramsey Electronics Model No. ICI2

Do you have a ton of old remote controls around, or even a universal remote? Put those to real use by training this unique kit to recognize the remotes, and allow you to control 2 line level audio sources.

- **IR Receiver module with sensitive element can receive your remote control up to 11 meters away.**
- **Control 2 line level audio sources.**
- **Standard RCA jacks for easy hookup.**
- **Easy to train to recognize almost any remote control!**
- **Runs from 7-15V AC or DC. Use our AC125 wall adapter for long operation.**
- **LED indicator and feedback buzzer lets you know when you are receiving an IR signal.**

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- **TXE433 or 916 Transmitter & Encoder Module**
- **TV6C Television Transmitter**
- **RX433 or 916 Data Transmitter**
- **TX916 Data Transmitter**
- **RR1 Wired remote repeater**
- **RRW1 Wireless remote repeater**

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KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

ICI2 IR CONTROL INTERFACE KIT

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ICI2 INTRODUCTION

Welcome to the ICI2 kit (and if you don't have the time, wired and tested). We will give you an overview of IR remote controls and how they typically work and also how this kit works to help you understand what you're building.

Virtually any modern day consumer audio or video device contains an infrared remote control unit. Usually our living room contains several of these to control different appliances. In fact we often have so many of these little gems that it becomes necessary to obtain an "all in one" remote control that controls all the functions of your entertainment system. Of course, this leads to having several remote control units delegated to the junk drawer, and this brought about the idea for the kit. Let's put the old remotes to use with an easy to build kit that will control four separate outputs. By toggling a relay for each, we can live the life of the future by remotely controlling our fans, lamps, and even the coffee pot!

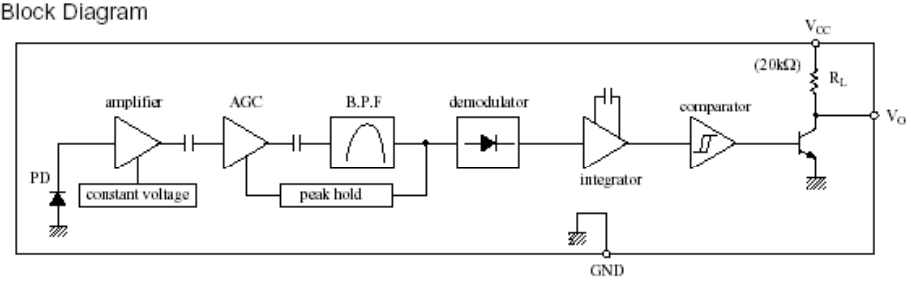
Let's dig into these units a little bit. A typical infrared remote contains a few functional parts in common with each other; we'll examine them. First, there is some type of keypad assembly. Nowadays this is typically a large molded sheet of rubber with the buttons protruding outward. The inside of the button that you cannot see is typically coated with a carbon "button" that will make contact with the printed circuit board underneath, complete in the circuit when the button is depressed (no, it's not sad, it is just making contact!). This switch closure will cause an Integrated Circuit on the circuit board to repeat a pre-determined code at the output. This digital signal typically drives an infrared diode to conduct on the front of the unit "broadcasting" the infrared signal to the equipment to be controlled.

Our eyes are sensitive detectors in the visible light range, but the wavelength of the infrared diode falls outside that detection range. So we can't see the diode performing its function. But rest assured, given a fresh battery, it is dutifully doing it over and over again. These codes are unique so that the infrared detector on the equipment can determine what function each of the buttons should be and perform these functions. These controlling codes are unique to each manufacturer, so our kit needs to "learn" these codes to perform the functions we require.

ICI2 THEORY OF OPERATION

The ICI2 may look quite simple, but there is actually quite a lot to it inside the parts. Many items are inside the IR receiver part (U4) that if built up with discrete components would never fit in this little kit case! Inside this part there is an IR detector diode, amplifier, AGC circuit, bandpass filter, a peak-hold circuit, an integrator, comparators, and an output amp. Heck, the part is a kit in itself! Just be glad it is in one nice module all ready to go.

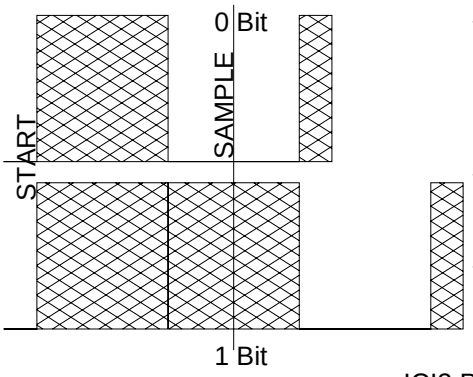
■ Block Diagram



Your IR remote control sends data on a 38kHz carrier, much like an FM or AM radio does. It does this to increase range, and decrease interference from other IR sources such as ambient light. It is done in an OOK (on off keying) fashion, meaning that the IR LED is switched on and off at a rate of 32kHz for a certain duration for a one, and another certain duration for a zero, with pauses of no carrier in-between each one and zero. A common remote control format does some special things to differentiate a one from a zero for digital sending and receiving of data.

When the IR detector "sees" a 38kHz IR signal, the output of the detector goes low (it is inverted), when there is no 38kHz signal, the output idles high. On the output of the IR detector you won't see the 38kHz, just the data that the 38kHz represents from your IR remote control. This allows the remote control to save power since the IR LED is on a minimal amount of time.

Typically a remote control will send data in a format consisting of time slices.



To send a zero, the IR LED will be off for one time slice, and then toggled at a rate of 38kHz for the second time slice. To send a one, the IR remote will use three time slices. Off for two time slices, and on for one. This makes things easy on the receiver side, because we just have to look from the edge of the first on-to-off transition to the middle of the second time slice (1 1/2 time slices from the start) to determine the bit that was sent.

An interesting thing is that most remote controls send a unique first code that can be identified for each and every button, as well as each and every remote control. Some remotes will send a full data stream over and over as long as you hold the button down, up to 48 bits per data stream. Other remotes will only send this full data stream once for the first depression, and then a very short repeat code usually of only one bit, to save on batteries.

The ICI2 recognizes the full codes, and discards the short repeat codes unless you are holding a relay in position. If we didn't do this, we couldn't tell one button from another! You will find that with some remotes, you need to press the button twice to train the ICI2 to remember a certain button. This means the remote you are using is using repeat codes. Other remotes just require you to press and hold the button, so these are the ones that send the same code over and over.

One other variance is the data rate from the remote. Generally most remotes send at a rate of 2400 Hz time slices, but others send at only 1200 Hz time slices. This presents a problem since the sample period will always lie in a high or low portion of the subsequent data, meaning we will receive nothing but ones or zeros. There is a speed jumper you can install to allow the ICI2 to work with these remotes. If an incorrect speed remote control is detected, the microcontroller emits a special beep to let you know the format is wrong. Then you can switch the jumper over to the other speed and try again, then you will get either a recognized beep if you have trained the button, or an unrecognized beep if you have not.

When you train the ICI2, the micro controller looks at the IR data stream and rejects those codes it sees as useless or unverified. The ICI2 looks at the data from the remote sensor, makes sure it is not a repeat code, checks that it is not the wrong speed, and then compares it to a previous send before saving the new value in the Flash memory of the controller. That is why you have to press the button twice on some remotes; so you can get the same code for verification before saving.

When the ICI2 is normally receiving, it looks at the data stream, and compares it to what was saved. If there is a match, the corresponding function is run. If there are repeat codes within the allotted time, the same function is repeated continuously until the IR signal goes away.

The ICI2 stores eight codes, each of which are tied to a specific function (see the on the top of the board layout). For example if you press a button that you programmed on select 0, the volume will go up a single step. Press it again, and it goes up another step. Press and hold, and the volume will go up at the rate of the repeat code sent from the remote. In some cases it may be rather fast, so you may have to find remotes that don't send so fast! We have yet to find one that has been too fast, but we are sure some exist.

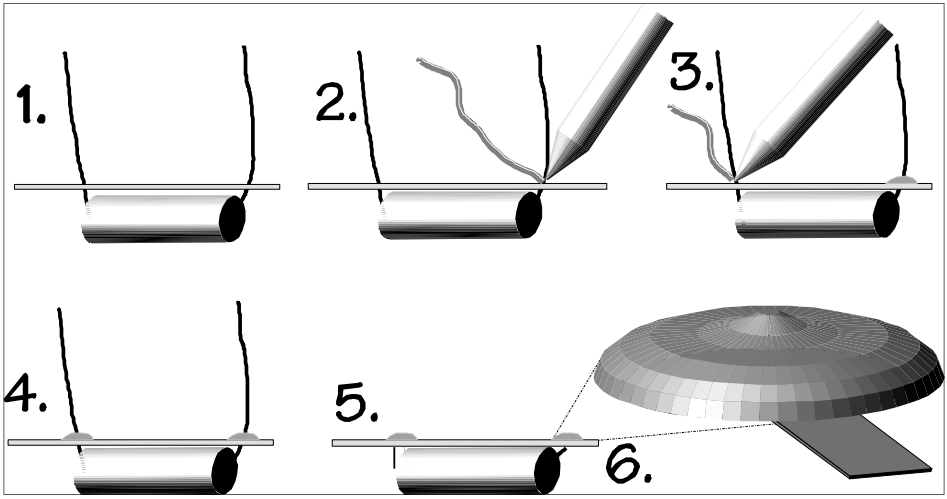
RAMSEY "LEARN-AS-YOU-BUILD" ASSEMBLY STRATEGY

Be sure to read through all of the steps, and check the boxes as you go to be sure you didn't miss any important steps. Although you may be in a hurry to see results, before you switch on the power check all wiring and capacitors for proper orientation. Also check the board for any possible solder shorts, and/or cold solder joints. All of these mistakes could have detrimental effects on your kit - not to mention your ego!

Kit building tips:

Use a good soldering technique - let your soldering iron tip gently heat the traces to which you are soldering, heating both wires and pads simultaneously. Apply the solder on the iron and the pad when the pad is hot enough to melt the solder. The finished joint should look like a drop of water on paper, somewhat soaked in.

Mount all electrical parts on the top side of the board provided. The top side is clearly marked with the word "TOP", you can't miss it. This is the side that has little or no traces on it, but is covered with mostly copper. When parts are installed, the part is placed flat to the board, and the leads are bent on the backside of the board to prevent the part from falling out before soldering (1). The part is then soldered securely to the board (2-4), and the remaining lead length is then clipped off (5). Notice how the solder joint looks on close up, clean and smooth with no holes or sharp points (6).



ICI-2 PARTS LIST

Sort and "check off" the components in the boxes provided. We do our best to pack all our kits correctly but it is *possible* that a mistake has occurred and we missed a part. Please note that physical descriptions of parts are for those currently being shipped. Sometimes the parts in your kit may have a different appearance but still have the same values.

RESISTORS

- ❒ 1 1M ohm resistor [brown-black-green] (R2)
- ❒ 1 4.7K ohm resistor [yellow-violet-red] (R3)
- ❒ 1 1K ohm resistor [brown-black-red] (R12)
- ❒ 1 10 ohm resistor [brown-black-black] (R11)
- ❒ 7 10K ohm resistors [brown-black-orange] (R4,R5,R6,R7,R8,R9,R10,R13,R14)
- ❒ 1 220 ohm resistor [red-red-brown] (R1)

CAPACITORS

- ❒ 1 10pF ceramic capacitor [marked 10 or 10K] (C3)
- ❒ 1 22pF ceramic disc capacitor [marked 22] (C6)
- ❒ 1 0.01uF ceramic capacitor [marked 103] (C4)
- ❒ 4 0.1uF ceramic capacitors [marked 104] (C1,C8,C12,C14,C16)
- ❒ 6 10uF electrolytic capacitors (C2,C5,C7,C10,C11,C13,C15)
- ❒ 1 1000uF electrolytic capacitor (C9)

SEMICONDUCTORS

- ❒ 1 1N4002 Rectifier Diode [Black body with white stripe marked 4002] (D2)
- ❒ 1 2N3904 NPN transistor [marked 2N3904] (Q1)
- ❒ 1 78L05 5V Voltage Regulator [marked 78L05 in transistor-like pack age] (VR1)
- ❒ 1 68HC908JK1 Pre-programmed microcontroller (U2)
- ❒ 1 MCP42010 Dual 10K ohm digital potentiometer (U1)
- ❒ 1 LMC6482AIN op amp (U5)
- ❒ 1 Infrared Photodiode (U3)
- ❒ 1 green LED (D1)

MISCELLANEOUS

- ❒ 1 Power Switch (S1)
- ❒ 1 Small push-button switch (S2)
- ❒ 1 2.1mm Power Jack (J3)
- ❒ 4 RCA Jacks (J1,2,5,9)
- ❒ 1 IR Sensor Module (U3 or U4, see instructions)

- ❒ 1 2-hole screw terminal
- ❒ 4 2-pin headers (J4,J6,J7,J8)
- ❒ 5 2-pin header jumpers
- ❒ 1 Mini speaker (SP1)
- ❒ 1 9.8304MHz Crystal (X1)

ICI2 PC BOARD ASSEMBLY STEPS

Assembly of the ICI2 is pretty simple, but it requires some time and some patience. We will start with the side that has the power jack, and we will move from there using the power jack as a reference.

- ❒ 1. Install J3, the 2.1mm power jack. Be sure to get a good, solid connection to all three pads as this will have to take some mechanical strain during normal use. Use ample solder.
- ❒ 2. Install RCA Jacks J1, J2, J5, and J9 in a little row at the bottom of the board. These are the line in/line out jacks. Use plenty of solder for these too, especially on the ground leads, as these make the jack mechanically strong.
- ❒ 3. Install C13, a 10 uF electrolytic capacitor. Watch the polarity. One lead should be longer than the other and the longer lead is the positive. The negative lead is marked with a stripe or band down one side of the part. Be sure that the "-" band doesn't go into the "+" hole!
- ❒ 4. Install C11, 10 uF electrolytic capacitor. Watch the polarity again.
- ❒ 5. Install C15, 10 uF electrolytic capacitor. Watch the polarity.
- ❒ 6. Install C7, 10 uF electrolytic capacitor. Watch polarity.
- ❒ 7. Install C5, 10 uF electrolytic capacitor. Uh.. watch polarity.
- ❒ 8. Install C16, 0.1 uF ceramic disk capacitor.
- ❒ 9. Install U5, LMC6482AIN op amp, above C7. Make sure it goes in the right way. The notch on the IC should line up with the notch on the board drawing. By changing the gain of this amp, the output levels are adjusted up and down.
- ❒ 10. Install R10, 10K ohm resistor [brown-black-orange], next to U5.
- ❒ 11. Install R14, 10K ohm resistor [brown-black-orange], above C15.
- ❒ 12. Install R13, 10K ohm resistor [brown-black-orange], above R14.
- ❒ 13. Install R4, 10K ohm resistor [brown-black-orange], above R14.
- ❒ 14. Install C10, 10 uF electrolytic capacitor, next to C10.
- ❒ 15. Install U1, MCP42010 dual 10K ohm potentiometer. Make sure it goes in the right way. This chip acts as the gain potentiometers for U5. When it s value changes, the gain of U5 changes, which in turn adjusts the gain.
- ❒ 16. Install C1, 0.1 uF ceramic capacitor, above C10.
- ❒ 17. Install R5, 10K ohm resistor [brown-black-orange], above C1.

- ❒ 18. Install S2, pushbutton switch, next to R5.
- ❒ 19. Install jumper JMP2, using a piece of cutoff component lead, to the left of S2.
- ❒ 20. Install R7, 10K ohm resistor [brown-black-orange], above S2.
- ❒ 21. Install R6, 10K ohm resistor [brown-black-orange], above S2.
- ❒ 22. Install J4, 2 pin header, above R6.
- ❒ 23. Install J6, 2 pin header, above J4.
- ❒ 24. Install J7, 2 pin header, above J6.
- ❒ 25. Install R8, 10K ohm, [brown-black-orange], above J7.
- ❒ 26. Install R9, 10K ohm, [brown-black-orange], above R8.
- ❒ 27. Install J8, 2 pin header, above R9.
- ❒ 28. Install U2, 68HC908JK1 microcontroller, to the left of S2. Line up that notch again. This is the “brain” of the ICI2. This is what learns the different buttons from your remote.
- ❒ 29. Install C8, 0.1 uF ceramic disc capacitor, to the left of U2.
- ❒ 30. Install jumper JMP1.
- ❒ 31. Install R2, 1M ohm resistor, [brown-black-green].
- ❒ 31. Install X1, 9.8304MHz crystal, above C8.
- ❒ 32. Install C6, 10 pF, ceramic disk capacitor, next to X1.
- ❒ 33. Install C3, 10 pF, ceramic disk capacitor.
- ❒ 34. Install R3, 4.7K ohm resistor [yellow-violet-red], next to C3.
- ❒ 35. Install jumper JMP3, above C3. Use a piece of cutoff component lead.
- ❒ 36. Install C14, 0.1 uF ceramic disk capacitor, above JMP3.
- ❒ 37. Install R12, 1K ohm resistor [brown-black-red], to the right of C4.
- ❒ 38. Install R1, 220 ohm resistor [red-red-brown].
- ❒ 39. Install Q1, 2N3904 transistor, to the right of R12. Make sure it goes in the right way. The flat side faces R12 just like the drawing on the board. This drives the speaker SP1.
- ❒ 40. Install speaker SP1, to the right of Q1. It doesn’t matter which way it goes in.
- ❒ 41. Install R11, 10 ohm resistor [brown-black-black], next to SP1.

- ❒ 42. Install C12, 0.1 uF ceramic disc capacitor, next to R11.
- ❒ 43. Install S1, pushbutton switch, next to C1. Be sure to use enough solder to hold it in securely.
- ❒ 44. Install D2, the 1N4002 diode, black with a stripe or band. Be sure to orient the band with the PC board silkscreen marking or the Parts Layout Diagram.
- ❒ 45. Install C9, 1000uF electrolytic capacitor. Again, be sure to line the banded side up with the negative hole and the longer lead with the positive hole, marked with a '+' sign. These caps tend to explode if installed backwards so be careful.
- ❒ 46. Install D1, green LED, above SP1. Place it in so the flat side lines up with the flat side on the circuit board drawing.
- ❒ 47. Install Infrared module U3. Don't worry about U4, It's for another type of module that we used to pack with this kit. It did the same thing, but was a different shape.

SETUP AND TESTING

To begin testing the ICI2 we will need the following items:

- ❒ AC Power supply between 9 and 15VAC or..
- ❒ DC power supply between 9 and 15VDC.
- ❒ A remote control

It's finally time to apply power to your kit. Please be sure before you do that the bench is clear of any scrap component leads and take one final look at your solder connections before you proceed. Again, time spent here can prevent problems encountered during testing, and can avoid damaging any of the components.

Place a two pin header shorting connector in the SEL0 and SEL1 position. This selects the 0,0 configuration for the first button. We pull down the two pins of the microcontroller thru a 10 K ohm resistor to set the voltages at zero, designating a digital "0" state for programming. When we continue the programming, we will use these jumpers to count up in binary for all four states.

Please note that when using these "shorting jumpers" it is common practice to position them on only one pin, offset such that they do not make contact with the other pin in order to set the associated jumper with the logic "1", or 5 VDC state. In this configuration the 10K ohm resistor will pull the associated pin high. This also helps keep you from misplacing the jumpers and will keep them handy for future programming.

Set the power switch to the "off" position, and plug in a suitable power source to the power input connector. The correct range of values for supply voltage is 9 - 15 VAC or VDC, and the current capacity is between 200 - 250 mA. Our AC125 transformer is the recommended source for this kit but any wall wart will do.

Upon energizing the switch a short chirp will be heard from the speaker and the LED should illuminate. The LED should be lit initially but this will change after we program the microcontroller IC.

PROGRAMMING YOUR ICI2

Now that we have made it through the initial 'turn on' steps, it is time to program the microcontroller for your individual codes. Remember to install some fresh batteries in your remote control and aim the infrared LED towards the photo sensor. Depress one of the buttons that you intend to use for operation (I.e. button #1 for the first relay). The LED should begin to blink as the unit receives the infrared code from the transmitter. This testing verifies the operation of the detector and associated circuitry. It will also provide some clues to the operation of the remote control unit (remember we talked about this in the theory of operation) as you may see a long "burst" of code followed by successive shorter pulse trains, or you may see the pulse train being repeated over and over. If you have access to an oscilloscope you can even observe this pulse train on the detector "output "pin, which is tied to pins 1 and 19 of the microcontroller.

Now we will set our controller to the "learn" mode to memorize the pulse trains from our remote, and configure the jumpers to learn four codes as we move along.

❒ Depress and hold the "learn" button.

Now the unit is waiting to memorize the code for your remote. Depress the button on your remote control unit and the LED on the front panel will blink. The speaker will chirp when the code is learned. Just to be safe, push the button on your remote control unit twice to ensure that the micro has memorized your remote control's pulse train.

Uh-oh… a rasberry!

If upon initial programming your speaker emits a two tone "rasberry", don't fret! This simply means that your remote control is transmitting data at a slower rate than expected by the current jumper settings. If this is the case, install the jumper across the "speed" terminals on the circuit board. This will allow the unit to work at the slower pulse train rate just as effectively as the faster rate.

Back to programming. Now that the first, or digital 0,0, location has been programmed it is time to advance to the next three states. We will need to count in binary, or base two. There is no such thing as a number two in binary, only ones and zero's (making it the choice of electronic circuits). The following chart will describe the header jumper sequence for the binary count, and we have left some room to jot down the function key you are using on your remote. Be careful when programming to use the SEL 0 and SEL 1 jumpers in the correct order, as the order of 1's and 0's are important when identifying the buttons.

You have already programmed the 0,0 state so let's get to work on the remaining three states.

- ❒ Move the jumper in the SEL 0 connection so that it is only connected to one pin, offset such that it will not make contact with the other pin in order to set the associated jumper with the logic "1", or 5 VDC state. This sets the IC to learn in the 0, 1 state (or decimal state 1).
- ❒ Depress the learn button and memorize the second code.
- ❒ In the same manner, program the remaining two codes, incrementing the jumpers as you move along.

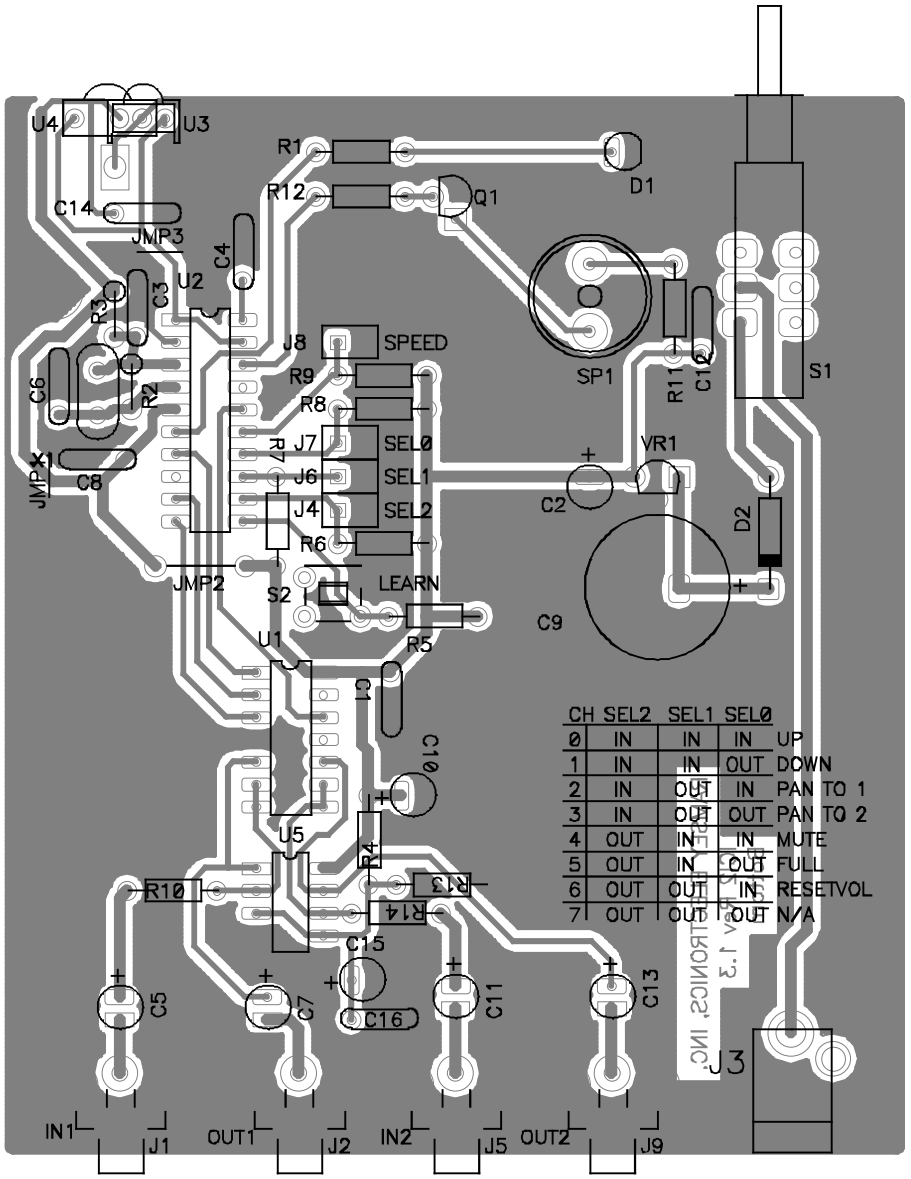
Well, that's it for programming! Now we are ready to put the unit to the test!

Jumper Settings					
SEL2	SEL 1	SEL 0	Binary Num	Function	Remote Button
0	0	0	000	UP	
0	0	1	001	DOWN	
0	1	0	010	PAN1	
0	1	1	011	PAN2	
1	0	0	100	MUTE	
1	0	1	101	FULL	
1	1	0	110	RESETVOL	
1	1	1	111	N/A	

USING THE ICI2

To test out your ICI2 you need a line level audio source like a CD player, VCR, or stereo. Find something with audio out that has standard RCA jacks. Plug the audio out right and left into J1 and J5. You now need to connect J2 and J9 to an "audio in" on another piece of equipment like a stereo. One example setup could be to use a portable CD player with a line level output connected to J1 and J5 and use a stereo with a line level input connected to J2 and J9. Now your ICI2 will act as a volume control between the CD player and stereo. Once you get your setup straight, try pushing the buttons you programmed for each function and be amazed at how well your spiffy kit performs.

ICI2 BOARD LAYOUT



CH	SEL2	SEL1	SEL0	
0	IN	IN	IN	UP
1	IN	IN	OUT	DOWN
2	IN	OUT	IN	PAN TO 1
3	IN	OUT	OUT	PAN TO 2
4	OUT	IN	IN	MUTE
5	OUT	IN	OUT	FULL
6	OUT	OUT	IN	RESETVOL
7	OUT	OUT	OUT	N/A

TROUBLESHOOTING

PROBLEM: The green LED doesn't light up when I aim my remote at it.
SOLUTION: There is a lot that can go wrong here, so we will go from the most likely to the least.

1. You forgot to turn on the power or your DC adapter isn't compatible (the polarity is reversed).
2. You installed the green LED backwards. Please check the orientation.
3. Your remote control's battery is shot. Replace the battery.
4. Junior poured a coke and some ice cream into it. Take it apart and clean it with warm water and a touch of dish detergent.
5. It is an ancient remote that has a hammer and chimes inside. Those just won't work; this is for IR remotes only.
6. You are trying to relay an IR remote that is modulated at some frequency other than 38kHz. There are a variety of ranges available but 38kHz is by far the most common. Most consumer components operate at 38kHz. This product ONLY works at 38kHz.

PROBLEM: I just can't make the &#^$^@! Thing work!
SOLUTION: Call Ramsey Tech Support at 1-585-924-4560 or look at the warranty in this manual. We are here to help and reduce your frustration as much as possible. It is usually something simple. Oh, please count to ten before calling, taking some deep breaths first...

The Ramsey Kit Warranty

Please read carefully BEFORE calling or writing in about your kit. Most problems can be solved without contacting the factory.

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours too! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that a team of knowledgeable people have field-tested several "copies" of this kit straight from the Ramsey Inventory. If you need help, please read through your manual carefully. All information required to properly build and test your kit is contained within the pages!

1. DEFECTIVE PARTS: It's always easy to blame a part for a problem in your kit, Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and it's sad to say that our human construction skills have not! But on rare occasions a sour component can slip through. All our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defective, please mail it to our factory for testing and replacement. Please send only the defective part(s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you 'blew-it', we're all human and in most cases, replacement parts are very reasonably priced.

2. MISSING PARTS: Before assuming a part value is incorrect, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable (such as "100 to 500 uF"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the '1K ohm' resistors are actually the 'missing' 10 K parts ("Hum-m-m, I guess the 'red' band really does look orange!") Ramsey Electronics project kits are packed with pride in the USA. If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual as supplied with the basic kit by Ramsey, please write or call us with information on the part you need and proof of kit purchase.

3. FACTORY REPAIR OF ASSEMBLED KITS:

To qualify for Ramsey Electronics factory repair, kits MUST:

1. NOT be assembled with acid core solder or flux.

2. NOT be modified in any manner.

3. BE returned in fully-assembled form, not partially assembled.

4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of $25.00, or authorization to charge it to your credit card account.

5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.

The repair is $49.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

4. REFUNDS: You are given ten (10) days to examine our products. If you are not satisfied, you may return your unassembled kit with all the parts and instructions and proof of purchase to the factory for a full refund. The return package should be packed securely. Insurance is recommended. Please do not cause needless delays, read all information carefully.

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REQUIRED TOOLS

- Soldering Iron Ramsey #RTS06, (Radio Shack #RS64-2072)
- Thin Rosin Core Solder Ramsey #RTS12, (RS64-025)
- Needle Nose Pliers Ramsey #RTS05, (RS64-1844)
- Small Diagonal Cutters Ramsey #RTS04, (RS64-1845)

<OR> Complete Soldering Tool Set (RS64-2801)

ADDITIONAL SUGGESTED ITEMS

- Soldering Iron Holder/Cleaner (RS64-2078)

TOTAL SOLDER POINTS
171

ESTIMATED ASSEMBLY TIME
Beginner .....2 hrs
Intermediate .....0.5 hrs
Advanced .....0.5 hrs

Price: $5.00
Ramsey Publication No. ICI2

Assembly and Instruction manual for:
RAMSEY MODEL NO. ICI2

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