# *THE BULLSHOOTER*
ENDLESS LOOP
VOICE RECORDER

Ramsey Electronics Model No.   BS2C

Announcing an event is now easier than ever! Just say it once and hear it over and over. Easy transmitter hookup for broadcasting.

- **Operates on 5 to 12 Volts DC, 250mA at maximum volume.**

- **Records both line levels and microphone levels, front panel switchable.**

- **Internal microphone included, has external microphone jack for higher fidelity.**

- **Adjustable line level output.**

- **8 separate message locations totaling up to 8 minutes, or combine into one 8-minute message.**

- **Up to a 8kHz sample rate for good audio reproduction to 3.4kHz.**

- **Digital speaker volume control and 8 ohm speaker output.**

- **Single-Play and continuous repeat mode with programmable delays : 0sec, 0.5sec, 5sec, 30sec, 1min, 10min, 30min, 60min.**

- **Easy to record a message and allows monitoring of recording session for easy level adjustment.**

- **Lock mode which prevents user tampering once set up. (multiple key combination to lock/unlock)**

- **Non-volatile message storage capable of retaining recording for over 100 years without power.**
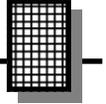
RAMSEY TRANSMITTER KITS
- **FM100B Professional FM Stereo Transmitter**
- **FM25B Synthesized Stereo Transmitter**
- **AM1, AM25 AM Transmitters**
- **TV6 Television Transmitter**

RAMSEY RECEIVER KITS
- **FR1 FM Broadcast Receiver**
- **AR1 Aircraft Band Receiver**
- **SR2 Shortwave Receiver**
- **AA7 Active Antenna**
- **SC1 Shortwave Converter**

RAMSEY HOBBY KITS
- **SG7 Personal Speed Radar**
- **SS70A Speech Scrambler**
- **SP1 Speakerphone**
- **WCT20 Wizard Cable Tracer**
- **PH10 Peak hold Meter**
- **LC1 Inductance-Capacitance Meter**

RAMSEY AMATEUR RADIO KITS
- **DDF1 Doppler Direction Finder Kit**
- **HR Series HF All Mode Receivers**
- **QRP Series HF CW Transmitters**
- **CW700 Micro Memory CW Keyer**
- **CPO3 Code Practice Oscillator**
- **QRP Power Amplifiers**

RAMSEY MINI-KITS
Many other kits are available for hobby, school, Scouts and just plain FUN. New kits are always under development. Write or call for our free Ramsey catalog.

KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

THE BULLSHOOTER
ENDLESS LOOP
VOICE RECORDER

TABLE OF CONTENTS

RAMSEY ELECTRONICS, INC.
590 Fishers Station Drive
Victor, New York 14564
Phone (585) 924-4560
Fax (585) 924-4555
www.ramseykits.com

INTRODUCTION

Each of us at one time or another has probably heard an endless loop player repeating a list of movies playing at the local theatre, or advertising a house for sale through your car radio. Sure could be handy around the house occasionally, or maybe down at the local flea market. Could you modify a cassette or CD player to duplicate this function? Good luck! Where could you even find that sort of machine anyway, and how much would it cost? Enter the BS2C Bullshooter.

As a stand alone unit, the BS2C is perfect for the task of, say, announcing repetitive instructions at an event: "*All vendors please report to the registration desk located at the …".* Connected to one of our personal broadcasters like the FM25B, the BS2C is ideal for advertising neighborhood garage sales or school or church functions. How about a look at the BS2C?

You will notice right away that the Bullshooter isn't your average tape player. In fact, utilizing one of the latest voice recording chips on the market, the BS2C performs its job without need of a tape. There are no motors, drive belts, or gears to wear out. With the exception of the front panel controls, there are no moving parts at all! In addition, the endless loop playback feature makes the Bullshooter a truly unique device.

A quick push of the RECORD and PLAY buttons sets up the BS2C to record up to a full eight minutes of audio, depending on how you have set up the sample rate, and what message location you start at (See "Using the BS2C"). Use the on-board microphone to record a quick message or press both UP DOWN keys to enable use of the line level input for recording from other sources; cassette, CD, radio, etc. A "Record" LED serves as the record mode indicator and extinguishes when the maximum memory capacity has been reached or you press STOP.

The PLAY button selects playback mode which is set up for single play operation by default. The message recorded will continue playback indefinitely, looping over and over for as long as the unit remains in play mode. Through programming of the internal microcontroller the message will always start from the beginning, thus negating the need for rewinding. The "Play" LED simply serves as an indicator for playback mode.

 The Bullshooter features two sets of audio outputs to best suit the application at hand. The speaker output (volume controlled by the front panel UP/DOWN buttons) has sufficient power to drive most speakers well into normal listening volumes. Although being a monaural device, twin line level outputs are provided for connection to equipment such as mixers, amplifiers, or transmitters which would normally require left and right inputs.

BS2C CIRCUIT DESCRIPTION

We will go through the BS2C section by section, but most circuitry that used to be in separate circuits in the BS1 has been fully integrated into the BS2C main chip. For example, you can switch between the microphone and line inputs digitally so you can select them using the front panel switches. The part also contains a speaker power amplifier so we no longer need a separate IC for this.

The BS2C power supply: The power supply is fairly basic in that we only need a single voltage to run the entire kit. The trend these days is to run things from lower voltages for faster operation and less power requirements, so all of the parts in the BS2C run from 3.3V. VR1 is a low-dropout 1.5 Amp regulator, though we will hopefully never pull that much current with the BS2C during operation. This part "smoothes" out the incoming, usually noisy wall wart power supply voltage into a nice, clean, predictable voltage to supply all of the other components.

The BS2C "brains": The brain of this kit is a nice Motorola microcontroller, the MC68HRC908JK1. This part contains 1.5K of ROM for all the memory required for the program and space saving settings. Compare that to your PC memory space! This part is used to interpret the key presses, and then act on them by controlling the voice recorder IC, U3. It also controls the LED display and monitors for "End of Message" indications from U2, the voice recorder, to know when to replay messages.

The BS2C sound recorder IC: This part is a fully integrated component, loaded with options for switching audio, mixing audio, adjusting gains, changing

Figure: ISD5008 Block Diagram
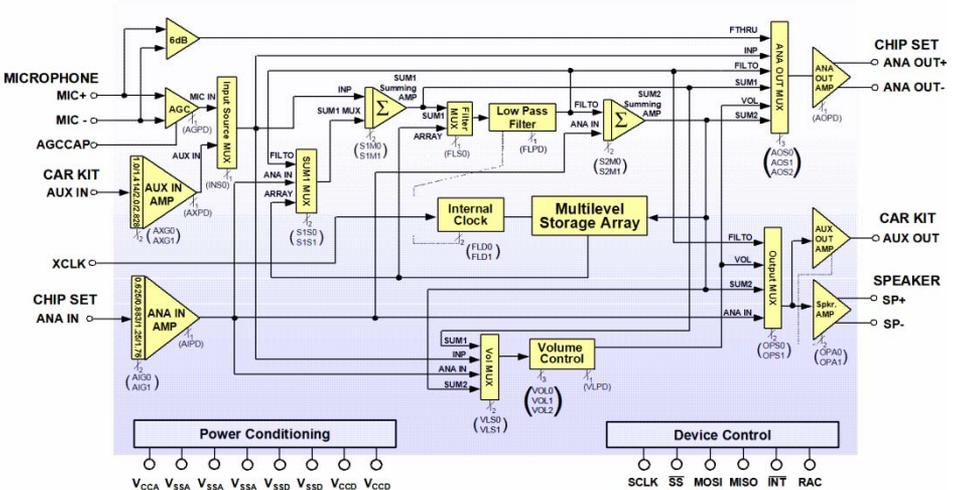
sample rates. . . all controlled through a serial access method (called SPI for Serial Peripheral Interface) by the microcontroller. This truly is an amazing part! There are so many features that we couldn't take advantage of them all, but are using some of the best ones for this product.

The Display: The display is driven by a serial shift register rather than a display decoder so we can have more versatility in the number of digits shown. The same serial lines used for the voice recorder can be used to drive U4, making efficient use of the I/O lines on the microcontroller. It has the added benefit of being very low noise during operation so as not to interfere with the recording.

U1:A, U1:B, The line level circuit: This circuit takes the differential output from the sound recorder and converts it to single-ended so that you can use it properly on RCA type connections. It also provides for a bit of filtering and some gain control to better match your system levels.

These are the primary blocks of circuitry in the BS2C. Now it is time to collect your soldering iron, tools, and wits, and start putting this neat project together!

PARTS SUPPLIED WITH BS2C VOICE RECORDER KIT

Capacitors
- ❑ 9 0.1uF ceramic capacitors (Marked 104) [C5,7,9,11,13,15,17,19,20]
- ❑ 2 0.01uF ceramic capacitors (Marked 103) [C8,10]
- ❑ 1 10pF ceramic capacitor (Marked 10p or 10) [C18]
- ❑ 1 4.7uF Electrolytic capacitor [C12]
- ❑ 7 10uF Electrolytic capacitors [C1,2,4,6,16,21,23]
- ❑ 2 470uF Electrolytic capacitors [C3,14]

Resistors
- ❑ 1 330 ohm resistor (orange-orange-brown) [R15]
- ❑ 9 470 ohm resistors (yellow-violet-brown) [R17,25,26,28,29,30,31,32,33]
- ❑ 1 1k ohm resistor (brown-black-red) [R7]
- ❑ 5 2.2 k ohm resistors (red-red-red) [R9,11,14,16,18]
- ❑ 14 10k ohm resistors (brown-black-orange)
     [R1,2,3,5,8,10,12,19,20,21,22,23,24,27]
- ❑ 1 10k ohm vertical trimmer pot [R13]
- ❑ 1 1k ohm horizontal trimmer pot (Marked 103, orange adjustment)[R6]

Semiconductors
- ❑ 1 1N4000 series diode (epoxy case marked 1N4000 to 1N4004) [D2]
- ❑ 1 Red LED [D6]
- ❑ 1 Green LED [D5]
- ❑ 1 LM1086CS-3.3 3.3Volt 1.5A voltage regulator [VR1]
- ❑ 1 LMC6482AIN Dual Rail to Rail Opamp IC [U1]
- ❑ 1 ISD5008P Voice Recorder IC [U2]
- ❑ 1 74HC595AN Serial to Parallel shift register IC [U3]
- ❑ 1 MC68HRC908JK1 Microcontroller IC (marked with white sticker) [U3]
- ❑ 1 7-segment display (LTS367P)

Inductors
- ❑ 1 22uH inductor (fatter than a resistor, red-red-black-gold) [L1]

Hardware, Misc.
- ❑ 6 Horizontal push-button switches [S2,3,4,5,6,7]
- ❑ 1 DPDT Power switch [S1]
- ❑ 2 3.5mm monaural style switch jacks [J5,12]
- ❑ 1 2.1mm Center-pin positive power jack [J1]
- ❑ 1 Single RCA jack [J9]
- ❑ 1 Dual RCA jack [J2]
- ❑ 1 20-pin socket for U3
- ❑ 1 28-pin socket for U2
- ❑ 1 MC-1 microphone cartridge [MC1]
- ❑ 3 8-pin dual-row headers [J6,8,11] (These are also [J4,7,10])
- ❑ 1 BS2C printed circuit board

Required, not supplied
❑ 6 Volt DC power transformer

Optional
❑ Line level audio source (such as a tape deck or CD player)
❑ Shielded stereo audio cables
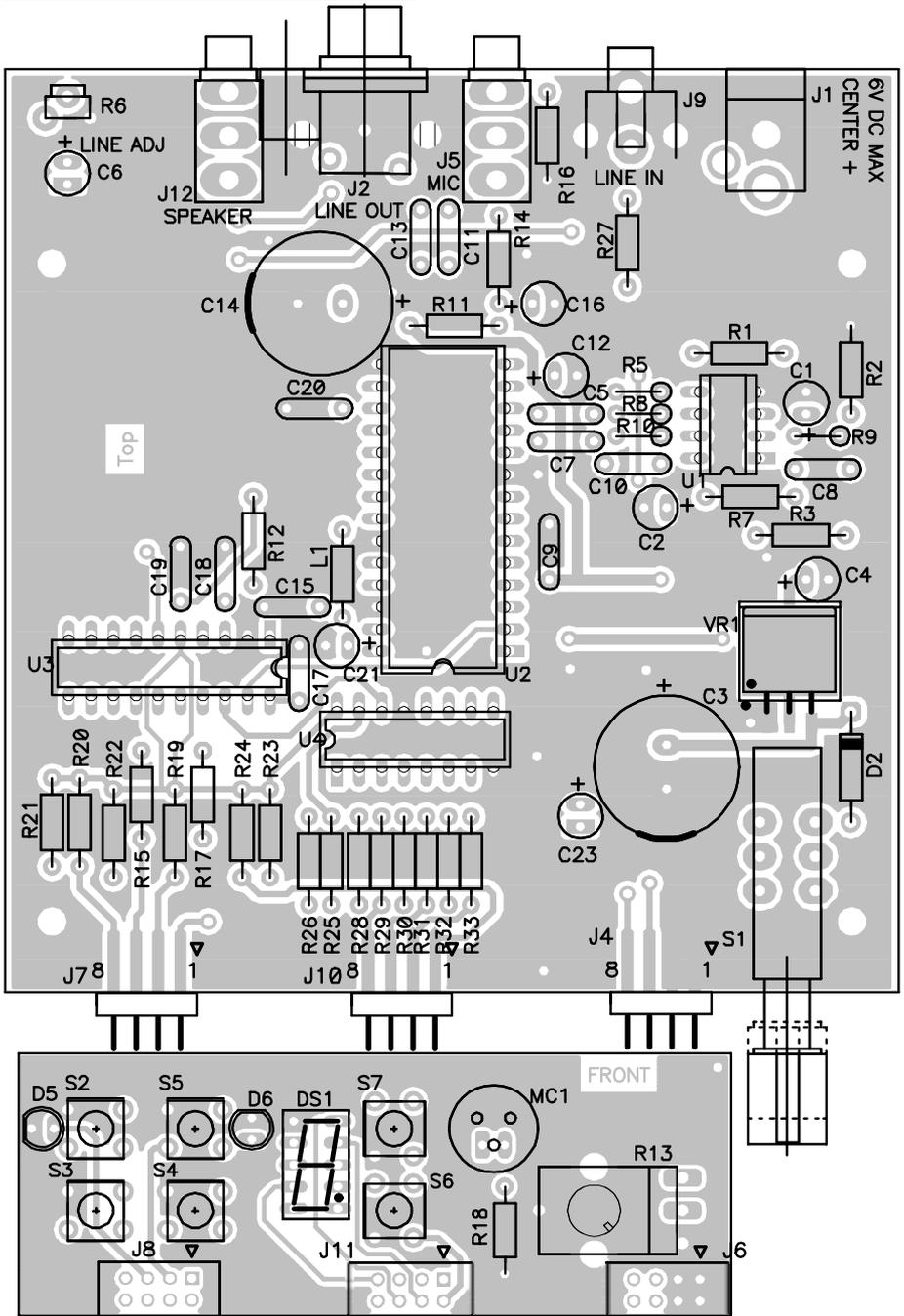❑ Speaker

Case and Knob Parts
❑ Top Cover
❑ Bottom Base Tray
❑ 4 - Short Phillips Head Screws
❑ 2 - Long Phillips Screws
❑ Front and Rear Plastic Panels with Labels
❑ 4 - Rubber Feet
❑ Appropriate Knobs for Kit

Required Tools
❑ Pen or Pencil
❑ Small Phillips Head Screwdriver
❑ Soldering Iron
❑ 60/40 Rosin Core Solder
❑ Wire Clippers
❑ Safety Glasses

BS2C PARTS LAYOUT DIAGRAM

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

As you can see in examining the circuit board and components, there is a bit more to this voice recorder kit than just soldering a few parts. So that you don't spend extra time "troubleshooting" instead of enjoying your new kit, we strongly recommend that you follow the assembly strategy and step-by-step procedures we provide.

Our strategy in installing parts on our PC board is to install the larger and more obvious parts such as the connectors and controls. These parts will then act as "landmarks" so that each additional device installed is seen in relationship to them, or to others previously installed.

BS2C ASSEMBLY

Use the boxes to check off your progress.

Check all received parts against the Parts list on page 7 and 8. The parts list describes the various markings that may be found on the kit parts.

In ALL the following instruction steps, our word "INSTALL" means this:

- Insert the part, oriented correctly, into its correct holes in the PC board.

- If helpful, gently BEND the part's wire leads or tabs to hold it in place, with the body of the part snugly against the top "component side" of the PC board.

- SOLDER ALL wires or pins of the part, whether the two wires of a resistor or every pin of an IC socket.

- Nip or "trim" all excess wires extending beyond each solder connection, taking care that wire trimmings do not become lodged in PC board solder connections.

Enough said. . . Let's get building!

Since you may appreciate some "warm-up" soldering practice as well as a chance to put some "landmarks" on the PC board, we'll first install some of the larger components. Have a look at the Parts Layout Diagram to help with your assembly.

We'll start with the larger PC board and work our way through that before tackling the smaller front panel board. The first parts we'll install will be the IC sockets, and there's a reason for that. If we install them first while there are no other parts on the board you'll be able to lay the board flat on the ICs while soldering and that will ensure that the parts are lying flat on the PC board. Let's begin with the chips that don't use a socket, then the socketed parts.

- ❐ 1. Install U4, the 74HC595AN Serial to Parallel shift register. The part has a notch or dot on one end and so does the PC board silkscreen for that part. You can also see the notch on your Parts Layout Diagram. Align the notch on the part as shown on the drawings. Be sure that all the pins are through the board, that none are bent under or out, and make sure the part is sitting flat before soldering all the leads. It's helpful to solder two of the corner pins to hold the IC in place, check the placement, and then solder the rest of the pins.

- ❐ 2. In the same way, install U1, the LMC6482AIN dual rail to rail opamp chip. Line up the notch on the part with the notch shown on the PC board silkscreen and Parts Layout Diagram. Be sure all 8 leads are through the board and the part is flat before soldering them in.

- ❐ 3. Next we'll install the socket for U3. The socket has a notch similar to the one on the PC board simply to make it easier to orient the part once you're ready to install it in the socket. As with the ICs before, make sure all pins are through and the part is flat before soldering. We'll install the next part before placing the ICs into their sockets, again so that you can rest the board on the part being soldered and get it set in the board correctly.

- ❐ 4. Install the socket for U2. Orient the notch, place the part flush with the surface and solder all the leads.

- ❐ 5. Take U3, the microcontroller IC marked with a sticker and place it in the socket installed in step 3. You might want to gently roll the pins on one side, then the other, to make the part slip into the holes more easily. Remember to orient the notch as shown on the silkscreen and Layout Diagram.

- ❐ 6. In the same way, place U2 in its socket. Check that all pins are in the socket, not bent underneath or outside the holes.

- ❐ 7   Install S1, the DPDT power switch. Be sure it's flush to the PC board before soldering all 6 pins.

- ❐ 8. Install D2, the 1N4000 series diode. This component has a polarity

which means that it must be installed in the proper orientation to work correctly. You'll note that there's a stripe or band at one end of the part and a band marked on the PC board silkscreen and Parts Layout Diagram. Align the two bands and solder the diode in place.

🞏 9. Install C3, 470uF electrolytic capacitor (marked 470uF). Because this is an *electrolytic* cap it has a polarity and must be installed correctly in order to function. The other little quirky thing about electrolytic caps is that they tend to explode when installed backwards. We're not trying to scare you, just make you aware of the fact that care is needed when installing this part and all the other electrolytic caps. You'll see a band or stripe down one side of the part. This band typically has zeros or minus signs in it and denotes the negative lead. If they have not been clipped off, one of the leads should also be shorter than the other. The short lead is also the negative.   The PC board silkscreen has a '+' sign on it to show you where the positive lead should be placed. With this in mind, place C3 with the longer positive lead in the hole marked with the '+' sign and solder it in place. Since it's a large part you'll want to have it flush to the PC board before soldering. In fact, unless we tell you to do something different, make sure that all of your parts are down as close to the PC board as possible. It's good practice, especially in RF circuits, and your board will look neatly and professionally done if you keep the parts low.

🞏 10. Next install C23, 10uF electrolytic cap, right next to C3 (marked 10uF). As in the last step, follow the '+' sign for correct placement.

🞏 11. Install VR1, an LM1086CS-3.3 voltage regulator (3.3 volts). The body of the part is meant to lay down on the silver square on the board and you'll want to solder it to the board at that point. Simply melt some solder onto the square, then bend the three leads of the part so that it can lay flat. Place the leads through the board and solder them, then heat up the metal tab on the regulator while pressing it down onto the silver square. This will heat the solder underneath and secure the part to the board. It's not critical so if you can't get it to solder, don't worry about it. It's just a bit of extra mechanical strength and provides more of a heatsink, but we've yet to see that part get warm so it's not going to affect your kit if you don't do it.

🞏 12. Install C4, another electrolytic capacitor (marked 10uF). Remember to orient the part so that the positive lead is in the hole marked with a '+' sign.

OK, that was a good warm-up. Let's take a look at those solder joints to make sure we're in good shape to move on. A good solder connection should be shiny, smooth, and solid. No room for loose connections here! An old trick is to wipe the hot tip of the iron across a damp sponge before soldering each connection. This keeps the tip clean and spreads the heat faster for a solid connection. If you haven't tried it, give it a shot and see how much easier it goes.

Those last few parts are the power supply section of our kit, taking the raw DC input to the kit and smoothing it out for all the circuits. Ready to move on?

☐ 13. Install R3, 10k ohms (brown-black-orange). Resistors can be installed in either direction but your kit will look better if you have all the gold bands lined up the same way.

☐ 14. Install R7, the only 1k ohm resistor in this kit (brown-black-red). Check the color code to be sure that the red stripe is really red and not orange like the 10k's.

☐ 15. Install C8, 0.01uF ceramic disc cap (marked 103, .01, or 10nF). .

☐ 16. Install C1, 10uF electrolytic capacitor. Remember to watch the polarity when installing.

The next part is mounted in standup fashion, meaning that one lead is placed through the circuit board and the other lead is bent around and then placed through the board. The part is placed upright rather than flat like the other resistors we've installed so far.

☐ 17. Install R9, 2.2k ohms (red-red-red). The body of the part is placed in the hole marked with a circle and the other lead is bent over to fit in the other hole. Again, keep the lead lengths short and the part flush to the board.

☐ 18. Install R2, 10k ohms (brown-black-orange).

☐ 19. Install R1, also 10k ohms (brown-black-orange).

☐ 20. Install C9, 0.1uF ceramic disc capacitor (marked 104).

☐ 21. Install C2, 10uF electrolytic capacitor (marked 10uF). Remember to watch the polarity.

☐ 22. Install C10, 0.01uF ceramic disc capacitor (marked 103, .01, or 10nF).

☐ 23. Install R10, 10k ohms standup (brown-black-orange).

☐ 24. Install R8, 10k ohms (brown-black-orange). Again, mount this part standing up.

☐ 25. Install R5, another 10k ohm resistor (brown-black-orange).

☐ 26. Install C7, 0.1uF ceramic disc capacitor (marked 104).

☐ 27. Install C5, 0.1uF ceramic disc capacitor (marked 104).

☐ 28. Install C12, the lone 4.7uF electrolytic capacitor. Again, watch the way it's installed and make sure the positive lead goes in the positive hole.

❒ 29. Install C16, 10uF electrolytic cap. Yes, watch the polarity again.

❒ 30. Install R27, 10k ohms (brown-black-orange).

❒ 31. Install R14, 2.2k ohms (red-red-red).

❒ 32. Install R11, another 2.2k ohm resistor (red-red-red).

❒ 33. Install R16, 2.2k ohms (red-red-red). It's hiding between the MIC and LINE IN jacks.

❒ 34. Install C11, 0.1uF ceramic disc capacitor (marked 104).

❒ 35. Install C13, 0.1uF ceramic disc capacitor (marked 104).

❒ 36. Install C14, the other big 470uF electrolytic capacitor. This is another part where it pays to be careful about the polarity, since the larger the cap, the bigger the bang if it blows up! Just follow the '+' marking like you have been and everything will be fine.

Now is a good time to double check your work. Loose pins, solder bridges, or an improperly installed IC can really throw a wrench into the works. It's also a good time to take a break and maybe rub your eyes before you get back into it.

❒ 37. Install C20, 0.1uF ceramic disc capacitor (marked 104). It's nice not to have to worry about the polarity of these ceramic disc caps, isn't it?

❒ 38. Install L1, 22uH inductor (red-red-silver bands). This part is very similar to a resistor but fatter around the middle. It's the only part with those color bands so you shouldn't have any trouble identifying it. It has no polarity so just insert and solder it.

❒ 39. Install C15, 0.1uF ceramic disc capacitor (marked 104).

❒ 40. Install R12, 10k ohms (brown-black-orange).

❒ 41. Install C18, 10pF ceramic disc capacitor (marked 10).

❒ 42. Install C19, 0.1uF ceramic disc capacitor (marked 104).

❒ 43. Install C17, another 0.1uF ceramic disc capacitor (marked 104). This part is kind of squeezed in at the end of U3 but I'm sure you can fit it in there.

❒ 44. Install C21, 10uF electrolytic (marked 10uF). This part is a tight fit too, but it's taller so that should be easier for you.

❒ Next we'll move to the center of the board and install a row of the same value resistors. They're all 470 ohms (yellow-violet-brown). Start with R33 and work your way through R32, R31, R30, R29, R28, R25, to R26. There, killed 8 parts with 1 step!

❒ 45. Install R23 and R24, both 10k (brown-black-orange).

❒ 46. Install R17, the last 470 ohm (yellow-violet-brown).

☐ 47. Install R19, 10k ohms (brown-black-orange).

☐ 48. Install R15, 330 ohms (orange-orange-brown).

☐ 49. Install R20, 21, and 22, all 10k ohms (brown-black-orange).

☐ 50. Now we'll move to the other end of the PC board. Install C6, 10uF electrolytic capacitor. Watch orientation!

☐ 51. Install R6, the 1k ohm vertical trimmer pot (marked 102). It only fits into the board one way. Solidly solder all three pins.

☐ 52. Install J12, the 3.5mm monaural style switch jack. Be sure the part is flat to the board before soldering, otherwise you'll have a hard time fitting the kit into the case and having things line up where they should. This part is your external speaker jack.

☐ 53. Install the dual RCA jack, J2. This is your line output jack.

☐ 54. Install J5, the other 3.5mm monaural style switch jack. This is your microphone jack.

☐ 55. Install J9, the single RCA jack that will be used for line level audio input. It's important to solder the heavier ground connections on this type of jack so use enough heat and time to make a solid connection here. It'll pay off when you're using the kit!

☐ 56. Install J1, the 2.1mm center positive power jack.

Time to move on to the smaller front panel board. Just a few parts there and we'll solder the boards together, then you'll be just about ready to fire up your Bullshooter. Pretty exciting, huh? Well, let's get moving then!

☐ 57. We'll start at the middle of the board with the smallest part. Install R18, 2.2k ohms (red-red-red). We started with this one because it's small and sits flat on the board and would be difficult to put in later when you'd have to squish it in between the larger parts.

☐ 58. Install DS1, the seven segment display (LTS367P). You'll see that there is a decimal point in one of the corners of the part. Orient the display so that the decimal point will be at the lower right when you're looking at the front of the unit. You should be able to rest the board on this part to keep it flat when soldering but you'll also want to check it to be sure it's square. Solder all 6 leads.

☐ 59. Now we'll install the LEDs. D6 is the red LED and D5 is the green LED. Being diodes, these components are polarized and must be oriented correctly. Examine one of the LED's and notice how one lead is longer than the other. The longer of the two leads is the anode, or (+) connection. Most diodes also have a flat molded in the component body. This corresponds to the cathode or (-) side of the part. You'll see that the PC board silkscreen for these parts shows a flat side that corresponds to the

flat side on the part. Line these flat sides up and the diodes will be installed correctly. If installed backwards they will never light. Install D6, the red LED, by correctly orienting the flat side on the part with the flat side shown on the PC board silkscreen and Parts Layout Diagram. Leave the leads between the bottom of the part and the PC board at least 1/2 inch long. Solder both leads. When you clip the leads off the back of the board leave a little extra on this part and on D5. This will allow you to line the LEDs up with the hole in the front panel and make sure they push through enough to be seen. We'll get to how to do that when we attach the two boards together and put them in the case. In the same way that you installed D6 above, install D5, placing the flat side correctly and leaving excess lead length on the back. You can clip the leads off later if you wish.

☐ 60. Install S2, one of the horizontal pushbutton switches. Be sure it's flush before soldering.

☐ 61. In the same way, install S3, S4, S5, S6, and S7, making sure the parts are sitting correctly on the board and soldering all 4 leads of each switch. These are the function buttons and you'll be pressing them a lot as you use your kit.

☐ 62. Install MC1, the small microphone cartridge. Because the case is connected to the ground lead on the part and that lead is not attached to ground in this kit you'll want to leave a bit of space between the body of the microphone and the PC board. This is one of the times we won't tell you to make sure that the part is flat to the board before soldering! Line the part up in the circle on the silkscreen, leave a little space underneath the part (1/16 of an inch is fine) and solder it in place.

☐ 63. Install R13, the 10k ohm vertical mount pot. You might need some extra time on the ground connections on this part but it's worth it to make it solid now. You'll be adjusting this part and you'll want a good mechanical connection from the start.

☐ 64. Now we'll install the three 8 pin dual row headers to the front panel. These will be used to connect the two boards together. Let's start with J6. Place the header through the PC board so that the long pins come out the back of the board on the solder side. Line it up so that it's straight and solder one of the end pins, then check straightness again before soldering the rest.

☐ 65. In the same way, solder the 8 pin headers in the J11 and J8 positions.

Ok! All the parts are in but we're not quite through. We still have to attach the boards together, test your new BS2 and case it up. Before applying power it would be a good idea for one last glance over the entire PC board. Check for:

• Missed solder joints.

- Solder shorts between components. Check your schematic and parts layout diagrams if you suspect a fault.

- Proper orientation of diodes, capacitors, and ICs.

- Ensure proper power supply polarity and voltage (5 to 12 volts DC, center positive)

All finished checking your kit over? I went and got a glass of water to give you time to thoroughly examine your solder joints and parts placement, knowing that you wouldn't want to leave me sitting here idly waiting for you. Now that we're both back, let's attach the boards together and test this baby out!

☐ 66. Locate the bottom half of your clamshell case; it's the one with the mounting posts for your board screws in it. While you're at it, find a couple of the short Phillips head screws and the prepunched front panel. Since we're talking about the front panel, take a look at yours now. You'll see a place labeled "Input Level". That label should be under the large potentiometer labeled "Volume". Yes, we goofed. The volume is actually controlled by the UP/DOWN buttons, and the pot is for adjusting the line level input if you need to. Sorry for any confusion. Now, back to what we were doing. Place the front panel into either end of the clamshell case, sliding it into the slots provided; it doesn't matter which end it goes into. Put that aside for a second; we'll get back to it.

☐ 67. Take the main PC board and line the smaller front panel board up to the main board so that the dual header pins can be soldered to the corresponding pads on the main board. All lined up? Good! Don't grab your soldering iron yet, though. We're going to be sure that the front panel PC board fits up against the kit's front panel before permanently attaching the boards together. When they've been soldered together they'll want to stay that way, meaning that it's a bear to get them apart again. We'll try to do this right the first time!

☐ 68. Once the boards are lined up and together, place the combined but not yet soldered boards into the bottom of the case. To do this you'll slide the front panel components through the front panel and then line the main board up with the screw holes in the bottom of the case. Don't worry if the front panel isn't lined up perfectly yet; that's what we're tweaking right now. Use the two screws you located earlier to attach the main board to the case so that you know how it's going to line up. It's best to use a couple of screws kitty-corner from each other. You simply have to have the board in place, you don't have to tighten the screws down tightly.

☐ 69. Now that the board is temporarily screwed into place, take the front panel board that hasn't been soldered to the main board yet and pull it forward to where you want it to line up with the front panel. You'll want the buttons and LEDs to poke out and look good, and you'll want things to

be flush and square. Once you have things where you want them, take your soldering iron and tack solder the two outside pins of the two outside 8 pin headers to hold the whole thing in place.

☐ 70. Now is the time to check your LED placement, while the header solder joints cool and before you pull the main board back out. If the LEDs poke through the case as far as you want them to, then you're finished with this step. If they stick out too far and are pushing the front panel out you'll want to heat both pads of each LED and when the solder is flowing, push the LED to the position you desire. The same is true if you want to push the LEDs out so that they poke through the case farther than they are currently. You run the risk of losing the pads for the LEDs so you'll only want to do this once. In other words, if they look fine where they are, leave them alone. If they don't fit in correctly, here's the procedure for moving them. Choose which LED you want to move and place your soldering iron tip *between* the pads of the LED, heating both pads at once. Once the solder is heated you can either push the LED back with a fingertip or move it forward with needlenose pliers to the correct position in the front panel. Once you take the iron away things will cool and you'll have the LED where you want it. If necessary, do the same with the other LED. Again, if they look good, don't bother changing things.

☐ 71. You can take the main board out of the case now and carefully solder all the pins of the three 8 pin headers. These are the control lines and connections to the main board from the front panel board so be careful and do a good job.

We're just about finished now; all we have to do is test the kit and then case it up.

INITIAL TESTING AND OPERATION

Power Supply Considerations

The BS2C is designed to run off an external source of 5 to 12 VDC. Batteries, power supplies, or AC adapters may be connected to the unit through the power jack, J1. Care should be taken to ensure that the center tip is positive. Before applying power make sure the volume control is turned down.

You'll need to read the following section on using the BS2C to familiarize yourself with the operation of the kit before testing can begin.

Time ————————————————————————————————➤

Time ————————————————————————————————➤

EOM
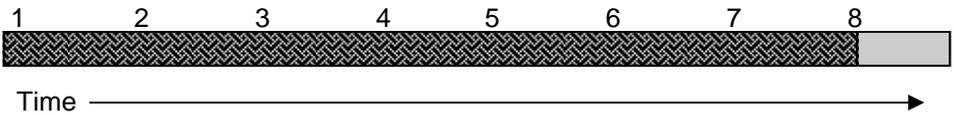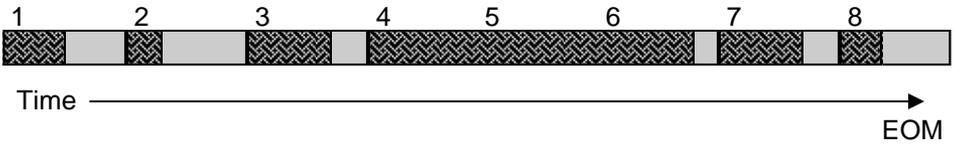
Time ————————————————————————————————➤

Using the BS2C   = Used Space   [   ] = Unused Space

Recorder Layout

The BS2C's memory is laid out like a timeline, and the BS2C software can jump to any absolute position within that line. You can think of it like a piece of tape laid out in a long strip. It is then divided into eight equal pieces that mark the start point for any one of eight messages. The BS2C can instantly go to any one of these eight points. (See the above diagrams). This makes the BS2C very flexible since you are not limited to 8 one minute messages, but any combination of lengths to use the full 8 minutes. (Depending on sample rate of course).

Any message can start at any one of these points, but it doesn't have to end at one. A single message can cross into the next message's area, and keep going right up to the end of memory. Example two above shows how Messages 1, 2, 3, 7, and 8 are all within their respective segments of memory, but message 4 crosses into 5 and 6. If you were to play message 5, you would start the player at partway into message 4. Keep in mind you are limited in message length by its location in respect to the end of memory. Message 1, you can record the full 8 minutes, message 4, only 1/2 of the memory, and message 8, only one minute. So when you are planning on where to store your messages, pick addresses accordingly!

Adjusting Sample Rate

OK, what is this sampling rate anyway? Sampling rate has a direct relationship between length of recording and audio quality. The higher the sampling rate, the better the audio, but we go through memory faster and this results in less time for recording. The fastest rate is 8kHz resulting in 4 minutes of audio. At this rate the audio bandwidth is 3.4kHz so the fidelity for voice is good. The slowest rate is 4kHz, which means we can record lower fidelity audio for a full 8 minutes. The audio is now only good to 1.7kHz, but typically still good quality.

To change the sample rate of the BS2C, power it down, then press and hold the PAUSE button while powering the unit on. The display will show three dashes to indicate sample rate selection. Now press the UP DOWN keys to select from one of four sample rates.

When finished, press the STOP button to save changes and get back into normal operation at the new rate.

Sample Mode	Sample Rate	Recording Time	Passband
1	4kHz	8 minutes	1.7kHz
2	5kHz	6.4 minutes	2.3kHz
3	6kHz	5.3 minutes	2.7kHz
4	8kHz	4 minutes	3.4kHz

Here is a cool thing you can do! Record your messages at a slow sample rate, then change to a new, faster sample rate, and your messages can play back funny-fast! You can also go the other way to make your messages sound really slow.

Recording

You can record up to three different ways with the BS2C, the first being the internal microphone located on the front panel. The second way to record is by using an external microphone (which assumes you are using an external electret microphone) though J5, and the third way is to record RCA levels through J9. By default the BS2C is set up to select the microphone. This is indicated by the LACK of a decimal point on the display. If you plug in an external microphone the BS2C automatically switches off the front microphone in favor of the external microphone.

To switch to the RCA line level input, press both of the UP and DOWN keys at the same time. The decimal point on the display will come on indicating that the line input is selected. To switch back to the microphone, click both switches again.

To begin recording, select the message location by pressing the UP DOWN buttons, then press both PLAY and RECORD switches. The record LED will blink several times to indicate a pause to eliminate switch noise. Then the numeric display will rotate to indicate that a recording is in progress. Once you are finished recording, press the STOP button. The internal microphone will pick up the slight click of the button, but that should not detract from the kit and is unavoidable.

Playback

Playback is pretty straightforward. You select the message you want to play using the UP DOWN keys, and then hit the PLAY button. If you hit the PLAY

button first and then try to select the location you'll see letters on the display. The letters indicate the volume level, as explained in the next section. Be sure to select the location first before hitting PLAY. Now it does get a little more complex if you want to replay the same message over and over again rather than the default mode of play once only.

To change to the new repeat mode, power down the BS2C, and then power it back up while holding the PLAY button down. The display will now show an "r" to indicate repeat mode. Now you can select from a list of 16 different delays you can use. See the following table:

Delay time on same message	Delay time with increment message	Time delay
0	8	0 seconds
1	9	0.5 seconds
2	A	5 seconds
3	b	30 seconds
4	C	1 minute
5	d	10 minutes
6	E	30 minutes
7	F	60 minutes

The numbers 0 through 7 will set the delay time on the same memory location, to repeat the same location over and over at a set time delay. The number 8 through the letter F will set the time delay between different memory locations. For example, if you want to play through from message 1 to message 2 with a certain time delay, set the time using that section of the chart. When you've chosen your delay time, press the STOP button to save the setting. Also, don't forget that the delay time is the time you set *plus* the time it takes for the message to play. The delay time starts at the end of your message and repeats it at your desired interval. The next interval will be the time you set in addition to the time the message takes to run. For example, setting the time delay for 1 minute with a 30 second message will cause the message to be played after 1 minute and 30 seconds. Pretty simple, but something to keep in mind.
To turn the repeat mode back off again, turn off the BS2C, and then power it back up while pressing just the RECORD key. The BS2C will go back to normal mode and save the settings.

Playback Volume
You can adjust the playback volume using the UP/DOWN buttons while the BS2C is playing. You have 8 levels to choose from: L,A,B,C,D,E,F,H. H being

the highest, L being the lowest. When you change the volume setting, always hit PLAY to lock the setting in. If not, it will default to a preset volume level.

Lock Mode
To enable the lock down mode requires a bit of finesse. You have to press all three buttons, UP, DOWN, and STOP, at the same time to toggle the lock mode on and off. The hope is that most people casually messing with your kit will not bother to figure that out. When lock mode is on, an "L" is displayed, and no keys will be honored unless you toggle the lock back off.

In auto repeat mode, the BS2C will automatically start playing upon power up. This includes LOCK mode. This allows the BS2C to start playing after a power failure, not relying on you to press PLAY to start it back up again.

Adjusting Line Record Level
While recording the line input you may adjust the recording level by using the UP DOWN keys while active; this gives some additional gain over the front panel control R13. This change resets the address pointer to the start, but you can hear the progress of the change through the speaker. You only have 4 steps, but this should be adequate for recording levels.

R13 is provided for feed-through operation when in playback mode to get levels adjusted for various uses.

Connecting it all together
Connecting this product couldn't be easier. Simply plug an 8-ohm speaker into J12 using a 3.5mm jack. Plug in the power, and turn the unit on. If you wish to connect a line level audio source to record from, simply connect it at the LINE IN jack using the correct cable for your device. If you wish to connect the output of the BS2C to a device requiring a line level input you can connect it at the LINE OUT jack, J2, again using whatever cable you need to connect to your device.

Using the BS2C practically
When the BS2C is not playing a message or recording one it can pass audio through without filtering it for you to keep the good sound of the original source material. True, it is single-channel audio, but such is life with a monaural recorder. This means that the BS2C will allow you to play music on hold through it and periodically insert commercials or announcements. It can also be used as a station identifier in automatic systems and other similar uses.

If you use the repeat mode, and choose an appropriate delay, you can use the BS2C to insert commercials, insert IDs, play station IDs on your radio, play an advertisement, play sound effects in a carnival or haunted hay ride, or whatever else your wild imagination can come up with.

CASE UP INSTRUCTIONS:

The enclosure is a key element to the overall pride you will have upon completing your Ramsey kit. The enclosure will show how you were able to "build from scratch" a commercial piece of high-tech electronics. For some of us, the enclosure will also hide a number of "not-so-pretty" assembly mistakes. Once the kit is enclosed your friends will never know that you were new to soldering. Finally, the enclosure case will protect your electronics from many possible causes of damage so that you can receive years worth of enjoyment using, talking about, and remembering the fun you had building your kit.

☐ 1. Since you should already have the front panel installed in the bottom case tray from step 65, move on to the next step.

☐ 2. You'll probably want to put the button cover on S1, the power switch, before putting the board assembly into the case. It might be difficult to get it on after.

☐ 3. Insert the board into the case with the knob, buttons, and LEDs extending through the holes in the front panel.

☐ 4. Raise the rear portion of the PC board and extend the jacks through the rear plastic plate. Insert the plate into the grooves on the base tray.

☐ 5. Secure the PC board to the bottom base tray with 4 short Phillips head screws.

☐ 6. Push the knob cover onto R13, the front panel Line Level Input Adjustment pot.

☐ 7. Note that the top cover has a groove and a lip on it that correspond to the groove and lip on the bottom case half. Fit the top cover on and use the two long screws to hold it in place.

☐ 8. While the kit is flipped over, stick the rubber feet on the 4 corners of the case bottom.

Now you're really finished! Start using and amazing your friends with your new Bullshooter 2!

<u>TROUBLESHOOTING</u>

Won't record from Microphone and/or Line In.

1. Check to make sure you have the proper recording mode selected. The decimal point on the numeric display indicates the mode. If in microphone mode, the LED is off. If in line-record mode, the LED is on. Check your source and be sure you don't have both an external microphone and a line level audio source plugged in at the same time.

2. You have to press BOTH PLAY and RECORD at the same time. This is to prevent accidental erasures by bumping the wrong key.

The LEDs work, but nothing else happens.

1. Make sure U3 and U2 are properly seated and there are no bent-over or bent under pins.

2. Make sure you have your speaker properly wired.

No LEDs light

1. Check for 3.3VDC on the output pin of the regulator.

2. Make sure your power adapter is between 5 and 12VDC, center pin positive. Alternately you can run the kit from 4 AA cells in series to get 6V.

The #@$%! Thing won't work! Ramsey engineers know nothing!

Shall we direct you to the warranty at the end of this manual? (ummm, on the next page) We also have a BBS to help you at

http://www.ramseyelectronics.com

Thanks for putting this great product together!

-The Ramsey Team.

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 $50.00 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.

BS2C Endless Loop Voice Recorder Kit
Quick Reference Page Guide

REQUIRED TOOLS

- Soldering Iron (WLC100)
- Thin Rosin Core Solder (RTS12)
- Needle Nose Pliers (PTS401)
- Small Diagonal Cutters (PTS400)

ADDITIONAL SUGGESTED ITEMS

- Helping Hands Holder for PC Board/Parts (HH3)
- Desoldering Braid (RTS08)

Price: $5.00
Ramsey Publication No. MBS2C
Assembly and Instruction manual for:
RAMSEY MODEL NO. BS2C

ramsey

RAMSEY ELECTRONICS, INC.
590 Fishers Station Drive
Victor, New York 14564
Phone (585) 924-4560
Fax (585) 924-4555
www.ramseykits.com

TOTAL SOLDER POINTS
200
ESTIMATED ASSEMBLY TIME

Beginner	**6 hrs**
Intermediate	**3 hrs**
Advanced	**1 hrs**