

HANDS-FREE SPEAKERPHONE- INTERCOM KIT

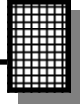


Ramsey Electronics Model No.

SP1

How many times have you played acrobat juggling the phone on your shoulder while looking up something or while working at the bench? And, wouldn't it be nice to be able to answer a call from anywhere in your shop or garage? This handy Speakerphone will do the trick and doubles as a hands-free intercom too!

- **Completely Hands-free; talk and listen at will**
- **Needs no battery - runs off the phone line**
- **Sensitive pick up throughout the room**
- **Excellent speaker volume**
- **Doubles as a hands-free intercom too! Connect as many units as desired across 2 conductor wire**
- **Informative manual answers questions on theory, hook-ups and uses - enhances resale value too!**
- **Includes our case for a finished 'Pro' look.**
- **Clear, concise assembly instructions carefully guide you to a finished kit that works FIRST time!**



PARTIAL LIST OF AVAILABLE KITS

RAMSEY TRANSMITTER KITS

- FM25B FM Stereo Transmitter
- AM1 AM Transmitter
- TV6 Television Transmitter
- FM100B Professional FM Stereo Transmitter
- STC1 Stereo Transmitter Companion

RAMSEY RECEIVER KITS

- FR1 FM Broadcast Receiver
- AR1 Aircraft Band Receiver
- SR2 Shortwave Receiver
- AA7 Active Antenna
- SC1 Shortwave Converter

RAMSEY HOBBY KITS

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- SS70A Speech Scrambler
- MX5, MX-10 Mixers
- MD3 Microwave Motion Detector
- ECG1 Heart Monitor
- LABC1 Lead Acid Battery Charger
- PG13 Plasma Generator
- SHA1 Stereo Headphone Amplifier

RAMSEY AMATEUR RADIO KITS

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SP1 SPEAKERPHONE KIT INSTRUCTION MANUAL

Ramsey Electronics publication No. SP1 Revision E

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KIT ASSEMBLY AND INSTRUCTION MANUAL FOR

SP1 HANDS-FREE SPEAKERPHONE- INTERCOM KIT

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INTRODUCTION TO THE RAMSEY SP1 SPEAKERPHONE:

There are, of course, all kinds of telephone accessories. Also just as various "telephone amplifier" schemes have been around for years, the name "speakerphone" is now a generic part of today's telephone vocabulary, referring to hands-off talk-and-listen communicating. If we look at catalogs or in phone stores, we also see that true hands-free speakerphones command a handsome price or else may be designed only as accessories requiring connection with a separate telephone.

The Ramsey SP1 Speakerphone gives you full, state-of-the-art speakerphone technology...with a difference. First, it is a complete stand-alone telephone for incoming calls. Use some other phone or dialer right along with it only if you have a frequent need to initiate those unique speakerphone-style calls. Otherwise, you can use your SP1 to answer all incoming calls, handling them while you work or play. The SP1 is designed to be practical and understandable, fun to build and to customize for your own needs and decor.

The Ramsey Speakerphone is designed to let you stay in charge of your time...on a budget. Think about the difference between that call you wish or plan to place...and all those other calls that you ANSWER, whether you wanted or expected them or not.

A pair of SP1's also makes a great hands-free INTERCOM system for which you'll imagine dozens of practical applications. You'll figure out how to set them up so they can serve as intercoms AND convenient speakerphones.

The kit style of the Ramsey SP1 lets you choose the type of enclosure and the size of speaker for this very personalized call-answering or intercom system. You will build a quality system around a high-tech Motorola IC, and you'll never have to discard a plastic mystery box that has quit working for you. The Ramsey SP1 Speakerphone PC board and circuit design are solid, rugged applications of today's IC-based telephoning technology.

You may wish to read ahead and learn how to use the SP1 and how it works before beginning actual kit construction. Build and learn about the Ramsey SP1, and no other electronic telephone will ever again seem so intimidating or mysterious!

PARTS SUPPLIED WITH SP1 KIT

CAPACITORS

- 1 100 pF disc [marked 100 or 101] (C1)
- 4 .01 uF disc [marked .01, 103 or 10nf] (C9,10,13,14)
- 2 .05 or .047 uF disc [marked .047 or 473 or .05 or 503] (C3, C18)
- 1 .1 uF disc [marked .1 or 104] (C28)
- 8 .47 uF electrolytic (C2,C4,C6,C7,C8,C17,C22,C23)
- 7 2.2 uF electrolytic (C5,C11,C15,C19,C20,C21,C29)
- 2 47 uF electrolytic (C16,C26)
- 1 220 uF electrolytic (C24)
- 3 470 uF or 330 uF electrolytic (C12,C25,C27)

RESISTORS

- 1 100 ohm [brown-black-brown] (R10)
- 2 270 ohm [red-violet-brown] (R4 alternate R10)
- 1 820 ohm [gray-red-brown] (R8)
- 1 1K ohm [brown-black-red] (R2)
- 4 4.7K ohm [yellow-violet-red] (R3,R9,R13,R19)
- 4 10K ohm [brown-black-orange] (R1,R6,R14,R20)
- 2 47K ohm [yellow-violet-orange] (R7,R12)
- 4 100K ohm [brown-black-yellow] (R11,R15,R16,R17)
- 1 68K ohm [blue-gray-orange] (R5)

SEMICONDUCTORS

- 1 MC65118 28-pin DIP speakerphone IC (U1)
- 1 LM386 8-pin DIP audio amplifier IC (U2)
- 1 6.2 volt zener diode [gray body with black band] (D5)
- 6 1N4002 black epoxy rectifier diode (D1,D2,D3,D4,D6,D7)

OTHER COMPONENTS

- 1 miniature microphone element (MK1)
- 2 1000-to-8 ohm audio transformer (T1,T2)
- 1 2K,5K or 10K potentiometer (R18)
- 2 PC mount DPDT push-switch (S1,S2)

HARDWARE AND MISC.

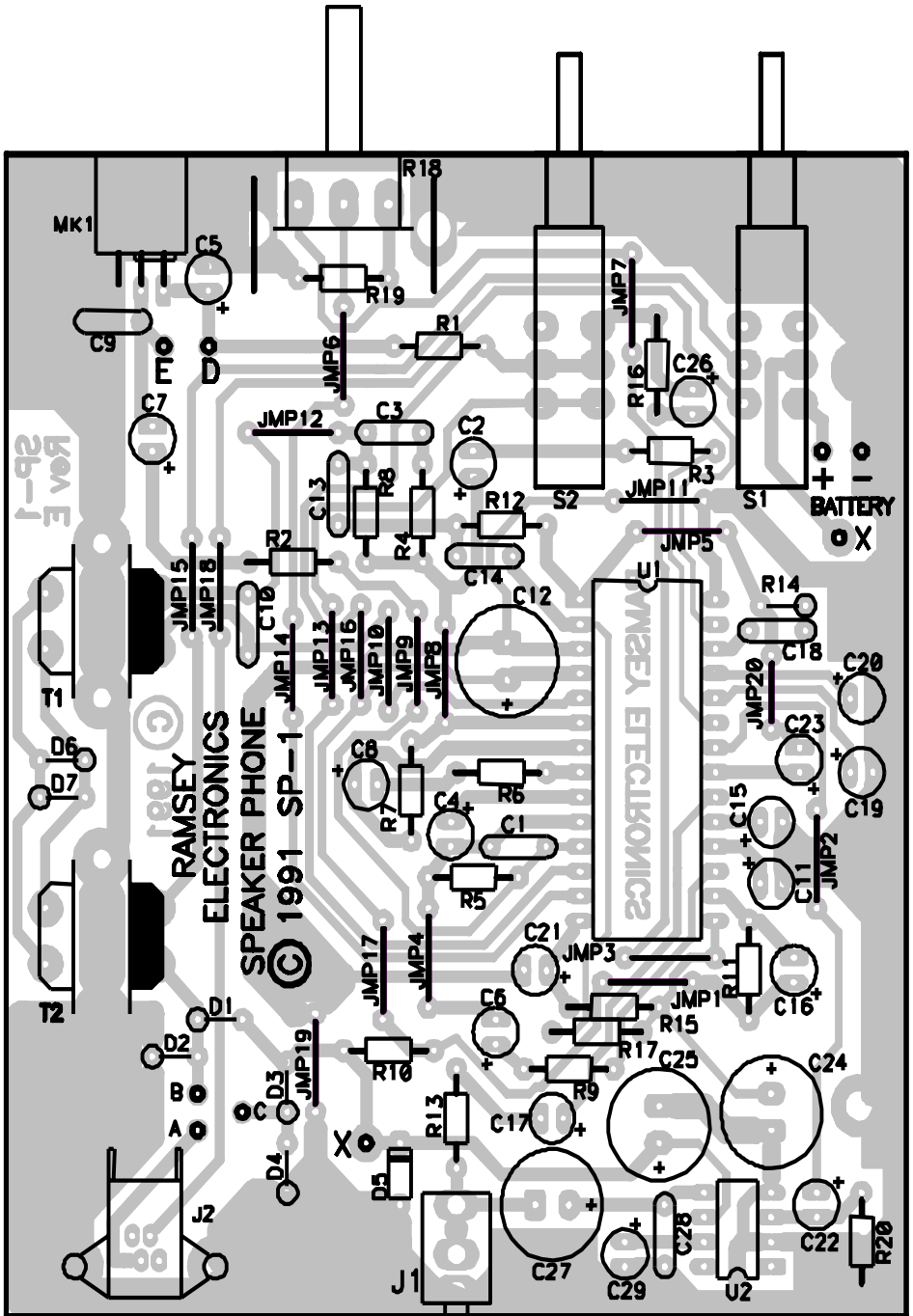
- 1 SP1 printed circuit board
- 1 28-pin DIP socket for U1
- 1 subminiature phone/speaker jack (J1)
- 1 modular telephone line jack (J2)
- 1 9 volt battery snap connector (battery use is optional)
- 1 5" hookup wire (optional connection "X" to "X")

REQUIRED, NOT SUPPLIED

- 1 Modular telephone cord (your choice of length)
- 1 8-ohm speaker

OPTIONAL: Ramsey CSP1 case and knob kit

SP-1 PARTS LAYOUT DIAGRAM



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, unless otherwise specified. This is the side that has no traces or pads on it.

Electrical part installation - 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. The part is then soldered securely to the board, and the remaining lead length is clipped off.

SP1 ASSEMBLY INSTRUCTIONS:

We have a twofold "strategy" for the order of the following kit assembly steps. First, we install parts in physical relationship to each other, so there's minimal chance of inserting wires into wrong holes. Second, whenever possible, we install in an order that fits our "Learn As You Build" Kit-building philosophy.

FOR EACH PART OUR WORD "INSTALL" ALWAYS MEANS THESE STEPS:

1. Pick the correct part value to start with.
2. Insert it into the correct PC board location.
3. Orient it correctly, which means: Please follow the PC board and the written directions for all parts where there's a right way and a wrong way to solder it in. (Diode bands, electrolytic capacitor polarity, transistor shapes, dotted or notched ends of IC's, and so forth).

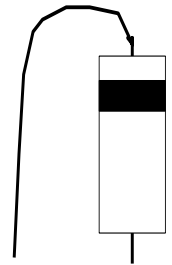
4. Solder all connections unless directed otherwise. Use enough heat and solder flow for clean, shiny, completed connections. Don't be afraid of any pen-style soldering iron having enough heat to damage components.
5. Trim or "nip" excess wire lengths after soldering.

- 1. Install S1, the on-off switch, simply press it into position and solder all six points. This switch is the equivalent of the telephone "hook" or handset button. Incoming calls are answered by pressing S1.
- 2. Similarly, install S2, the Mute switch. This switch can turn off the microphone circuit without breaking the phone connection, providing a privacy or "hold" function.
- 3. Install R18, the volume control. It may have three or five soldering points, with the optional outer two tabs offering additional mechanical rigidity. Solder all points.
- 4. Examine J2, the modular telephone jack. Press its pins into their correct PC board location. Notice that the outer support posts are plastic and are not to be soldered. If you anticipate heavy use of this jack (frequent cord changing, moving, etc.) use a dab of glue to secure J2 before soldering. Solder all 4 connections for modular jack J2. If you look closely, you'll see that only two pins are actually used in the circuit.
- 5. Examine the subminiature jack (J1) supplied for speaker connection. It fits into the PC board position easily. Notice that the tab nearest to the edge of the board is connected to the common ground of the circuit. The other two tabs are connected together to the SP1's speaker audio output. You have a choice of installing J1 supplied or your own speaker wire, depending on your intended application. Install J1 or a suitable length of your own speaker wire.
- 6. Examine the audio transformers, T1 and T2. Notice the red marking on one side of the top insulator on each unit. These marked sides must be pointed toward the center of the board, as shown by the dark sides for T1 and T2 on the PC board drawing. For each transformer (they are identical units), a total of six solder connections should be made. The outer 2 tabs are soldered to common ground for mechanical rigidity. Install transformers T1 and T2.

Completion of your SP1 requires installing over 20 "jumper wires," designed JMP1, JMP2, etc. These simple wire bridges are formed from scrap bare wire snipped from resistors, capacitors or diodes. Unless you have a handy supply of bare, tinned wire, be sure to save all cuttings for these jumper wires. Jumper wires allow a single-sided PC board to have the benefits of a double-sided PC board without the extra cost.

- 7. A choice to make:

- ❑ A) If you plan to use your SP1 as a telephone speakerphone, install zener diode D5 (small gray body with black band). The banded end marks the cathode and must be oriented as illustrated.
- ❑ B) If you plan to use your SP1 only as a duplex intercom, do not install D5. Place it in a safe place for possible future use.
- ❑ 8. The six 1N4002 style black epoxy diodes are installed in upright or vertical position. Correct orientation of the banded cathode ends is important, so always install the diode body in the hole marked by the circle on the PC board illustration. The banded or cathode end should face up. The diodes may come with straight leads or pre-bent, ready-to-insert leads. Install diode D1.
- ❑ 9. Install D2, another black epoxy diode.
- ❑ 10. Install D3, another black epoxy diode.
- ❑ 11. Install D4, another black epoxy diode.
- ❑ 12. Install D6, another black epoxy diode.
- ❑ 13. Install D7, the last black epoxy diode.
- ❑ 14a. The method for installing the microphone to face the front panel and therefore requires soldering the MK1 element's terminals to three short bare wires (nipped from a previously installed component), so that the three wires are at right angles to the MK1 lugs. Notice that one MK1 lug is common to its metal case and must be oriented toward the side of the board so that it is connected to the common ground plane. You may wish to do both ends of this connection first to hold MK1 in place to do the other connections.
- ❑ 14b. If the mike element has only two pins, install a bare wire jumper from "D" to "E" and omit C5 (Step 16). Study the schematic diagram for any clarification needed.
- ❑ 14c. Install mike element MK1.
- ❑ 14d. Solder a wire loop to secure the mike, using the 2 PC board holes on each side of the microphone.
- ❑ 15. Near MK1, install C9, .01 uF (marked .01 or 103 or 10 nf).
- ❑ 16. Install C5, a 2.2 uF electrolytic. This is the first of 21 electrolytic used in your SP1. Be sure to orient the (+) side as shown on the PC board drawing. Note on electrolytic capacitors: Ordinarily, the negative (-) side is clearly marked by a heavy stripe and the "-" sign. However, the positive (+) side may be marked instead, especially on low values such as the eight .47



uF units used in this circuit. Simply make sure that correct polarity is followed for all electrolytic capacitors.

- 17. Install C7, a .47 uF electrolytic.
- 18. Near the volume control, install R19, 4.7K (yellow-violet-red).
- 19. Install R1, 10K (brown-black-orange).
- 20. Near S1, install electrolytic C26, 47 uF.
- 21. Install R16, 100K (brown-black-yellow)
- 22. Install R3, 4.7K (yellow-violet-red).

At this point, we will begin installing jumper wires near parts already installed, if you run short of useful wire lengths during assembly, simply skip that jumper step and go back to it after you've built up your scrap wire supply. Jumpers act as electronic "bridges" carrying signals over PC board traces underneath.

- 23. Near R3, install JMP11.
- 24. Install JMP5.
- 25. Install JMP7 (between R16 and S2).
- 26. Install C2, .47 uF electrolytic. Watch polarity.
- 27. Install C3, .05 or .047 uF (marked .047 or 473 or .05 or 503).
- 28. Install JMP6.
- 29. Install JMP12.
- 30. Install C13, .01 uF (marked .01 or 103).
- 31. Install R8, 820 ohms (gray-red-brown).
- 32. Install R4, 270 ohms (red-violet-brown).
- 33. Install R12, 47K (yellow-violet-orange).
- 34. Install C14, .01 uF (marked .01 or 103 or 10 nf).
- 35. Install JMP15 (near T1).
- 36. Install JMP18.
- 37. Install C10, .01 uF (marked .01 or 10 nf or 103).
- 38. Install R2, 1K (brown-black-red). Install the following jumpers.
- 39. JMP14.

- 40. JMP13.
- 41. JMP16.
- 42. JMP10.
- 43. JMP9.
- 44. JMP8.
- 45. Install C12, 470 uF electrolytic, watch polarity.
- 46. Install R6, 10K (brown-black-orange).
- 47. Install R7, 47K (yellow-violet-orange).
- 48. Install C4, .47 uF, watch polarity.
- 49. Install C8, .47 uF, watch polarity.
- 50. Install C1, 100 pF. (marked 100 or 101).
- 51. Install R5, 68K (blue,gray,orange).
- 52. Install JMP4.
- 53. Install JMP17.
- 54. Install R10, 100 ohms (brown-black-brown). Note: if a battery will be used, for intercom or because of low phone line voltage, R10 should be 270 ohms (red-violet-brown).
- 55. Install JMP19.

PROGRESS SUMMARY: The schematic diagram makes it clear that building the kit consists largely of providing the supporting components for the many functions of the MC65118 IC. Much of that has been done already. This would be a good time to double-check the correctness of parts selection and orientation. Next, we'll build up the LM386 speaker amplifier circuit, install U1 and a few more components, and we'll be ready for testing.

- 56. Install R13, 4.7K (yellow-violet-red).
- 57. Install C27, 470 uF, with correct polarity. C27 couples the output of U2 the speaker.
- 58. Install C17, .47 uF with correct polarity.
- 59. Install C29, 2.2 uF, with correct polarity.
- 60. Install C28, .1 uF (marked .1 or 104).
- 61. Audio amp U2, IC LM386 is soldered directly to the PC board with the

SP1 SCHEMATIC DIAGRAM

notched/ banded end facing the rear of the board as illustrated. There is no need to use a socket, but if you do, use care in soldering the socket and inserting the chip.

- 62. Install U2, 8-pin audio amplifier IC LM386.
- 63. Install C25, 470 uF, with correct polarity.
- 64. Install C24, 220 uF, with correct polarity.
- 65. Install C22, .47 uF, with correct polarity.
- 66. Install R9, 4.7K (yellow-violet-red).
- 67. Install R17, 100K (brown-black-yellow).
- 68. Install R15, 100K (brown-black-yellow).
- 69. Install JMP1.
- 70. Install JMP3.
- 71. Insert the 28-pin DIP IC socket into its PC board position. Check and make sure that all 28 pins are visible on the solder-side of the board. Slightly bend the 4 outermost pins to lock the socket in place. Make sure the socket is flush against the top of the board. Solder all 28 pins with clean connections and no solder bridges.
- 72. Install R11, 100K (brown-black-yellow).
- 73. Install C16, 47 uF, observe polarity.
- 74. Install C11, 2.2 uF, observe correct polarity.
- 75. Install C15, 2.2 uF, observe correct polarity.
- 76. Install C23, .47 uF, observe correct polarity.
- 77. Install C19, 2.2 uF, observe correct polarity.
- 78. Install C20, 2.2 uF, observe correct polarity.
- 79. Install C21, 2.2 uF, observe correct polarity.
- 80. Install C6, .47 uF, observe correct polarity.
- 81. Install jumper wire JMP2.
- 82. Install another jumper wire JMP20.
- 83. Install C18, .05 or .047 uF (marked .05 or 503 or .047 or 473).

- 84. Install R14, 10K (brown-black-orange).
- 85. Install R20, 10K (brown-black-orange).
- 86. If you have not done so already, install U1, MC65118 in its previously installed socket . Do this with care and make sure that all 28 IC pins make it into their socket holes. (It's quite easy to get a pin bent back under the IC body as well as just missing a socket hole.) Also be sure to place the IC so that the dotted or notched end lines up with the dot or notch on the PC board silkscreen. If necessary consult the Parts Layout Diagram for correct placement.

Take a break, clean up the workspace a bit, and then give your work a good double check, looking especially for the following:

- Correct orientation of parts?
- Any missed solder connections?
- Untrimmed wires bent back on another connection?

INITIAL TEST: SPEAKERPHONE MODE

1. Solder a Jumper Wire from point "A" to point "C" (near D3).
2. Set both S1 and S2 to their "out" or off position. Set the volume control to a mid-range point.
3. Next, test the modular phone cord you intend to use with the SP1, even if it is brand new. Do this simply by trying it on another telephone. Then, connect the cord between the SP1's J2 and a working, correctly-wired phone jack. (Defective modular plugs, cords or jacks are a major cause of telephone malfunction.)
4. Connect a speaker in accordance with Assembly Step 5. For decent audio quality, use a speaker at least 3" in diameter. A properly-enclosed speaker will sound better and louder than a speaker lying naked on a workbench.
5. Press S1 to the "in" (on) position. You should hear a normal dial tone. Adjust volume control as desired. If you do not get a dial tone, recheck all your work, starting with the phone line and speaker wires.
6. With S-1 still on, tap the microphone, and you should hear the sound in the speaker.
7. Speak in a normal tone of voice near the microphone, and the dial tone

should drop out when you speak and return when you are quiet.

8. With S2 (Mute/Hold) pressed IN, you should still hear the dial tone, but the microphone should not respond to even a loud yell.

9. Turn S1 OFF; this is the equivalent of putting a phone handset back "on the hook." If everything above checks out, you're ready for your first Speakerphone conversation. Ask someone to call you. When you hear the ring (on any other phone), you can answer the call by pressing S1. You should be able to carry on a normal chat while you are anywhere in an average-sized room. Be aware that since the speakerphone is switching between "receive" and "transmit" there will be a short delay or "pumping" effect as you move from talking to listening. Don't forget to "hang up" when you are finished.

INITIATING SPEAKERPHONE CALLS:

While the MC65118 IC makes provision for adding a DTMF tone dialer, the simplest and least expensive approach rate an ordinary telephone set as part of your Speakerphone installation. The average electronics buff is well aware that suitable phones are abundant at negligible cost, often with memory and other handy features. Simply connect the auxiliary phone and your SP1 to the phone line with a commonly-available dual-modular adapter, or use a dual wall jack, etc. Use the auxiliary phone for dialing, incoming rings and situations where you prefer a handset. Enjoy the Speakerphone for efficient, hands-free communication. Be sure to hang up the auxiliary phone after turning on your SP1 Speakerphone.

RINGER CIRCUITS:

The SP1 does not include a ringer circuit for the simple reason that the average home, shop or office already has plenty of ringer noises whenever there are phone calls. If you are a telephone electronics enthusiast and really want a built-in ringer circuit, it is up to you to understand and comply with telephone company ringer circuit equivalency requirements.

OPTIMIZING YOUR SPEAKERPHONE SET-UP:

There are three variables to be considered in any line-powered Speakerphone installation:

1. Positioning of speaker in relation to the microphone.
2. Your distance from the telephone switching complex which supplies line voltage. (If the voltage is marginal because you are on a distant point of the phone company "loop," supplementary battery power may be needed for this or any other Speakerphone.
3. Basic "talk power" of the party on the other end. Let's consider the three details. First, if your Speakerphone works perfectly from the moment you set it up, then you are in great shape. Otherwise, consider the following:
 - A. In general, some degree of acoustical separation must be provided between microphone and speaker. Put simply, they should not "point" at each other, or there will be some form of oscillation or erratic operation. Some experimenting may be needed. See also the section, Understanding Speakerphone Operation.
 - B. Usually, telephone line voltage is sufficient for good SP1 performance. However, the available voltage is determined by the distance of your location from the central office and local factors. The easiest way to determine if a supplementary battery is needed is just to try it out. Please study the section Installing Optional Battery before making any type of

battery connection. If the battery improves performance, then continue using it for that particular location. It is switched in and out of the circuit by the "B" section of S1.

C. Finally, you may encounter situations where the person on the other end just is not speaking loud enough for positive SP1 switching between receive and transmit. This can be caused either by the other party's use of a poor-quality phone or just because they are speaking too softly. You may need to ask them to try a different phone, or to just speak up or to speak more directly into their handset microphone. Or, redial for a better connection.

UNDERSTANDING SPEAKERPHONE OPERATION:

Because we take telephones so much for granted, it is easy to not care or appreciate the many functions and features of the SP1 and the MC65118 IC. That's OK: if it's working fine, then just enjoy it and don't worry about how it works. However, since its operation characteristics will seem different from a conventional handset telephone, you may get more satisfying use from your speakerphone if you have at least some grasp for what it is accomplishing.

The easiest way to appreciate the functions of the MC65118 is to go through the exercise of designing a two station speakerphone system in your head or on a sketch pad. Both stations must have speakers and sensitive microphones and be interconnected by two wires only, and there can be no manual talk-listen switches. You must be able to turn the speaker up to normal room volume, and the microphone circuit must be sensitive enough for you to speak from anywhere in a small room. How would you do it? Remember: no switches just two wires, and no squealing "feedback"!

The more we ponder how we would "easily rig up " such a system using a \$1 amplifier chip, the more impossible it will seem, and the more we start to appreciate the actual functions of true speakerphone technology. To put it very simply, the speakerphone is "smart": it knows when to be idle, when to transmit, when to receive, when to mute, when to attenuate, what to do about background noise. It even recognizes the difference between steady background noise and the phone line's dial tone.

Motorola explains the MC65118 this way: The fundamental difference between the operation of a speakerphone and a handset is that of half-duplex versus full-duplex. The handset is full duplex since conversation can occur in both directions (transmit and receive) simultaneously. A speakerphone has higher gain levels in both paths and attempting to converse full duplex results in oscillatory problems due to the loop that exists within the system. The loop is formed by the receive and transmit paths, the hybrid, and the acoustic coupling (speaker to microphone.)

"The only practical and economical solution used to date is to design the speakerphone to function in a half-duplex mode: only one person speaks at a time while the other listens. To achieve this requires a circuit which can detect who is talking, switch on the appropriate path (transmit or receive) and switch off (attenuate) the other path. In this way, the loop gain is maintained less than unity. When the talkers exchange function, the circuit must quickly detect this, and switch the circuit appropriately. By providing speech level detectors, the circuit operates in a hands-free mode, eliminating the need for a push-to-talk switch."

"The MC65118 provides the necessary level detectors, attenuators, and switching control for a properly operating speakerphone... (and) provides background noise monitors which make the circuit insensitive to room and line noise, hybrid amplifiers for interfacing to Tip and Ring [i.e. the phone line], the microphone amplifier and other functions....."

OPTIONAL BATTERY OPERATION:

The use of a battery is optional for speakerphone operation but is required for the Intercom operation described in the next section.

The use of a battery in speakerphone operation can compensate for abnormally low telephone line voltage which may occur when a phone connection is at the far end of the local "loop" connecting your location to the phone company's central office. The supplementary battery can reduce the "pumping" effect caused by incoming voice peaks.

IMPORTANT: Use a battery for this purpose, not a DC power supply. *It is important to remember that the telephone line loop voltage is a minus 48 volts DC with respect to earth ground.* Introducing a common AC mains ground at the phone line input may damage SP1 components.

Procedure to hook-up external battery:

- 1. Remove (or don't install) zener diode D5.
- 2. Change R10 from 100 to 270 ohms (red-violet-brown).
- 3. Install the 9V battery snap connector near S1. Red is positive, black is negative or ground.
- 4. Connect "X" near S1 to "X" near D5, using hookup wire.
- 5. Install a fresh 9 volt battery. It will be in use only when S1 is "off the hook."

SP1 CIRCUIT NOTES:

Schematic diagram also provides a sufficiently complete block diagram of the MC65118's functions. How self-evident the circuit functions seem to you depends on your level of electronics experimenting or learning. Here are the highlights of what makes the SP1 tick.

S1: A and a jumper from B to A connect the circuit to the phone line's two wires. There's nothing hi-tech about calling these two wires "tip" and "ring." That's our inheritance from manual switchboard days. Tip and ring referred to parts of the plug and patch cord sets handled by the operator. As mentioned, S1: A performs the same function as a conventional telephone "hook" switch. As soon as S1 is pressed in, the central office equipment is able to sense that the SP1 is connected to the line or "loop."

The phone line carries both audio energy (AC) and DC voltage. T1 and T2 couple the audio signals to U1's hybrid amplifiers (pins 5 and 6). In telephone terminology, "hybrid" is a circuit that divides a single transmission channel into two, one for each direction. Diodes D1-D4 are arranged to make the input insensitive to DC polarity: the circuit gets correct DC polarity no matter which way the phone line is connected!

U2 is a self-contained audio amplifier capable of outputs up to 400 milliwatts, quite sufficient to drive quality speakers to room volume. This same LM386 is also used in our receiver kits with great results.

Switch S2 simply activates the microphone amplifier muting feature built into the speakerphone IC. Pin 12 is ordinarily low (0 voltage) for normal operation. The microphone input circuitry is set up to accommodate both self-powered microphones and those which require a small DC voltage for proper operation. Hands-free intercom operation is the same as half-duplex speakerphone operation except that a source of DC voltage is required. This is made easy by S1B and a jumper from A to C.

Perhaps the easiest overview of the circuit would be the following pin by pin notes on the MC65118. In these notes and on the schematic, BNM+ "background noise monitor." TX = transmit. RX = receive.

PIN	DESCRIPTION
1.	Filter output
2.	Filter input
3.	Chip disable (not used in SP1 design).
4.	Vcc (DC supply voltage)
5.	Hybrid amplifier output #2
6.	Hybrid amplifier output #1
7.	Input to hybrid amplifier #1
8.	TX attenuator output
9.	TX attenuator input
10.	Microphone amplifier output
11.	Microphone amplifier input
12.	Mute input (mike amplifier muted by + DC at pin 12)
13.	Volume control input
14.	Response time to switch between transmit and receive established by R15 and C21.
15.	Supplies bias to volume control, filtered by C24.
16.	Time constant for TX BNM set by R11 and C16.
17.	Input to TX level detector on mike/speaker side.
18.	Output of TX level detector and input to TX BNM
19.	Output of RX level detector on mike/speaker side
20.	Input to RX level detector on mike/speaker side
21.	Input to RX attenuator and dial tone detector.
22.	Output of RX attenuator
23.	Input to transmit level detector on line side
24.	Output of transmit level detector on line side
25.	Output of RX level detector on line side, also input to RX BNM
26.	Input to RX level detector on line side
27.	Time constant for RX BNM set by R16, C26.
28.	Ground for entire IC

NOTE ON SPEAKER PLACEMENT:

In general, the SP1's speaker audio will sound best if the speaker is of reasonably good size and quality and is properly enclosed or "baffled." It should face the same direction as the microphone or away from it, not directly at it. Remember that it is a basic function of the speakerphone to detect incoming audio and quickly attenuate the microphone circuit. Therefore, audio feedback of the familiar "squealing" kind is not a common occurrence. The feedback resulting from poor speaker positioning is more subtle: greatly reduced speaker volume, erratic switching action, possibly with a slight ringing sound.

INTERCOM OPERATION:

Two SP1 units may be used as a hands-free half-duplex wired intercom system. This offers many handy problem-solving applications for home and business alike. If you have the practical application, we see no reason why additional units could not be put "on line."

Phone-line speakerphone operation need not be sacrificed in such local intercom installations. If you successfully built one or more SP1's, you probably already have some handy switching ideas. We'll leave those to your ingenuity.

To set up two SP1's for hands-free intercom service, just do the following:

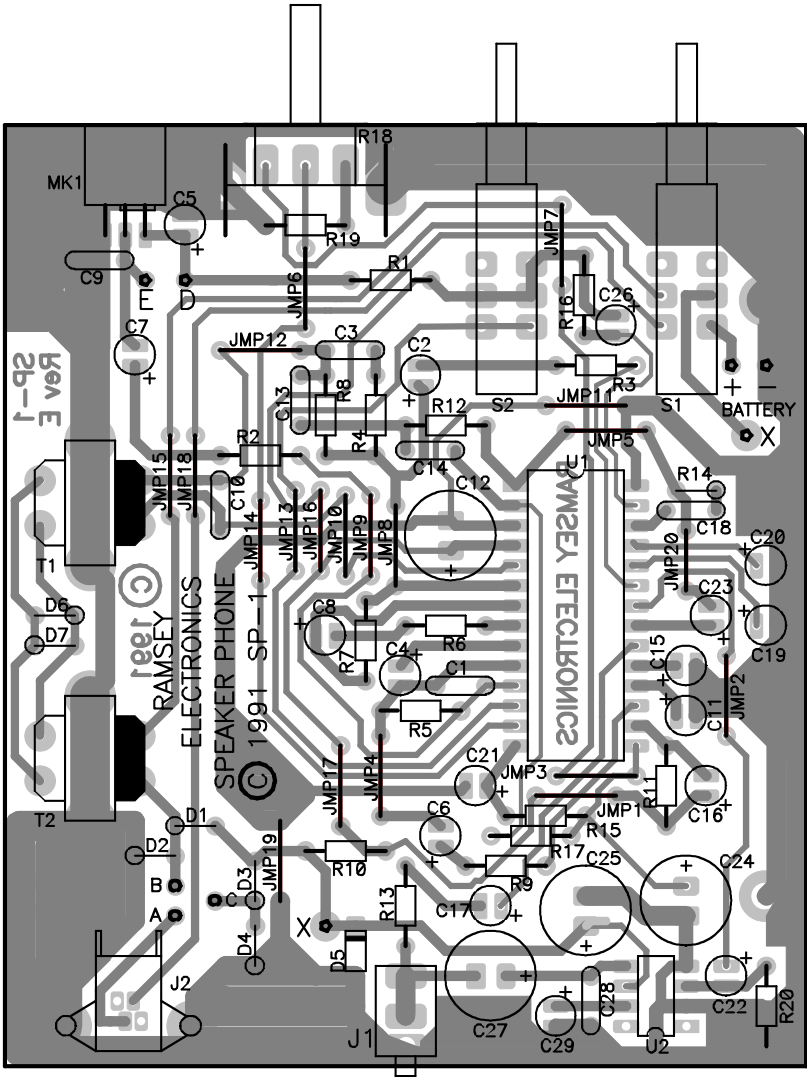
- 1. Solder a jumper from A to B.
- 2. Follow all Battery Operation directions in preceding section. (D5, R10, etc.)
- 3. Interconnect both units with a modular phone extension cord, or any other 2-wire pair practical for your setup.
- 4. Interconnection of further units is up to user testing and experimenting. In general, keep all "tip" and "ring" lines common to each other.

Finally....your Ramsey SP1 Speakerphone is designed by us from up-to-date engineering data to be a hands-on experience in today's electronic telephone technology. We hope you'll enjoy this very practical implementation of a sturdy and proven IC. For a wealth of further know-how, ask your Radio Shack dealer about getting "Understanding Telephone Electronics" (RS No. 62-1388) developed and produced by Texas Instruments Learning Center.

ENCLOSURE & SPEAKER CONSIDERATIONS:

The SP1 may be finished off nicely with its custom Ramsey case and knob kit, running standard speaker wire to an extension speaker in any location convenient for you. Or, the PC board may be mounted within a speaker enclosure of your choice.

PARTS LAYOUT DIAGRAM SP1 SPEAKERPHONE KIT:



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. 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.

SP1 SPEAKERPHONE-INTERCOM KIT

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REQUIRED TOOLS

- Soldering Iron (WLC100)
- Thin Rosin Core Solder (RTS12)
- Needle Nose Pliers (MPP4 or RTS05)
- Small Diagonal Cutters (RTS04)

TOTAL SOLDER POINTS

242

ESTIMATED ASSEMBLY TIME

Beginner 4.0 hrs

Intermediate 2.5 hrs

Advanced 1.5 hrs

ADDITIONAL SUGGESTED ITEMS

- Helping Hands Holder for PC Board/Parts (HH3)
- Technician's Tool Kit (TK405)
- Desoldering Braid (RTS08)

Price: \$5.00

Ramsey Publication No. MSP1

Assembly and Instruction manual for:

RAMSEY MODEL NO. SP1

SPEAKERPHONE-INTERCOM KIT



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