

# FM STEREO TRANSMITTER



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**Ramsey Electronics Model No.**

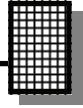
**FM10C**

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*Own and operate your own FM Stereo broadcast station. Definitely not a toy, the FM-10C has an exceptional transmission range... and the audio quality puts your favorite radio station to shame. See why this is one of our most popular kits!*

- **Great for transmitting your tape deck or CD player throughout the house, yard or even your car.**
- **Powerful enough for college or neighborhood radio stations - in use all over the world.**
- **Fantastic audio quality sounds better than most stations on the dial. And we'll tell you why!**
- **Easily connects to the line-level outputs on any tape deck, stereo system or CD player.**
- **Some users hook up one channel to the scanner and the other to their two way radio. Now you can hear what's going on around town up to several blocks away from your house with a simple stereo receiver... and adjust the volume of each individually with your balance control!**
- **Add a mike-mixer and tape/CD deck for a "PRO" sounding station.**
- **Operates on 5 to 20 volts, using a crystal controlled subcarrier.**
- **Tunable anywhere in the 88-108 MHz FM band.**





## PARTIAL LIST OF AVAILABLE KITS

### RAMSEY TRANSMITTER KITS

- FM25B FM Stereo Transmitter
- AM1, AM25 AM Transmitters
- TV6 Television Transmitter
- FM100B Professional FM Stereo 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
- MX5, MX-10 Mixers
- MD3 Microwave Motion Detector
- PH14, 15, 16 Peak hold Meter Kits
- TFM3 Tri-Field Meter Kit
- STC1 Stereo Transmitter Companion

### RAMSEY AMATEUR RADIO KITS

- DDF1 Doppler Direction Finder
- HR Series HF All Mode Receivers
- QRP Series HF CW Transmitters
- 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.

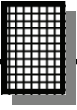
### FM STEREO TRANSMITTER KIT INSTRUCTION MANUAL

Ramsey Electronics publication No. MFM10C Revision 2.1b

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## KIT ASSEMBLY AND INSTRUCTION MANUAL FOR

# FM10C FM STEREO TRANSMITTER

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FM10C Kit Warranty 35



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## **INTRODUCTION**

The Ramsey FM10C is a true STEREO FM broadcast transmitter, which any person may build and use in accordance with the rules of your nation's telecommunications authority. For U.S. residents, that authority is the Federal Communications Commission (FCC). The FM10C's low-power broadcasting capability and other practical uses can be fun and interesting for people of all ages, but the FM10C is definitely not a toy. We will refer to the FCC regulations frequently in this manual and provide you with some information necessary to enjoy the FM10C's capabilities in accordance with the law.

Typical uses for the FM10C include the following:

- Extension of home stereo system - without wires.
- Listening aid for auditoriums, churches.
- Student-operated school radio station.
- College dorm favorite music broadcast service.
- Short-range, two-channel experiments and demonstrations.

We think you will be very pleased with the transmitting range, audio quality, frequency stability and stereo channel separation of this build-it-yourself FM stereo transmitter. If you follow our assembly directions carefully and use your FM10C in accordance with applicable FCC rules, a whole new world of sharing music, news and views with friends and neighbors awaits you.

Since the sharing of music and information is vital to the culture of our late-20th-century global community, we realized that our FM10C low-power FM Stereo Transmitter kit was certain to attract worldwide interest among hobbyists, students and "pioneers." While the use of the FM10C may need to be limited to "wireless stereo extensions" in some USA households (to comply with FCC Rules, Part 15), we have seen it serve very well as a serious, though simple, broadcast station for remote villages throughout the world where low cost AM-FM receivers are available to people of all economic levels. After you're done building your kit, sitting back and listening to your handiwork, consider this: many other FM10C's just like yours are faithfully relaying news and information to listeners in remote parts around the world. The FM10C is most definitely not a toy!

## **CIRCUIT DESCRIPTION**

### **Power Supply**

The FM10C can be powered with a standard 9 Volt battery or an external DC supply. When a standard external female 2.1MM power plug is inserted into J3 its SW contact is removed from its RING contact. This disconnects the battery from the FM10C's circuit. S1 applies power to the circuit. L3 and C3 are a low pass filter designed to prevent RF (Radio Frequencies) from entering the unit through the power cord. C4 is a filter capacitor that reduces 60 or 120Hz ripple from an external supply. VR1 is a voltage regulator designed to provide 2.6 Volts DC output with a 5 to 20 Volt DC input. Regulators will also provide low frequency filtering. C9 is a low frequency output filter. C15, C16, C17, C21, and C25 are high frequency filter caps that are placed physically as close to the supplied devices as possible.

### **U1 FM Stereo Transmitter IC**

FM stereo transmitter IC (U1) is at the heart of the FM10C. It contains a stereo modulator that develops a main L+R signal, a sub (L-R) signal, a 19kHz pilot signal, and RF Carrier (88-108 MHz). The control of U1 is determined by its surrounding circuitry as described in the following paragraphs.

### **Audio**

We will look only at the left channel circuitry since the right channel is identical to the left. J1 is an RCA connector that brings the left channel audio into the FM10C. L2 and C2 form a low-pass filter that reduce any RF brought in by the audio cables. R2 is a dropping resistor used to decrease the audio level into R4. R4 allows the user to set the level of audio that reaches U1. C6 and R6 set the pre-emphasis characteristics for the region you intend to operate (75  $\mu$ s for USA, 50  $\mu$ s for Europe). C8 is a coupling capacitor that allows the audio to pass but prevents DC bias from the IC from being affected by the setting of R4.

### **Multiplexer Balance**

R7 sets the multiplexer balance of U1. This control should be set to mid-range.

### **Stereo Generator**

C11, C12, X1, and U1 form a 38 kHz oscillator that is used by U1 to create the 19 kHz pilot frequency for stereo generation.

### **Multiplexed Audio/Pilot**

U1 pin 13 is the pilot output. U1 pin14 is the multiplexed audio output. R8 sets the pilot signal level and R9 sets the multiplexed audio level going back into U1 at pin12.

**RF Oscillator**

This oscillator consists of U1, C19, C20, L4, and C18. The setting of L4 and the value of C18 sets the RF Carrier frequency that is received by a standard FM radio.

**RF Amp**

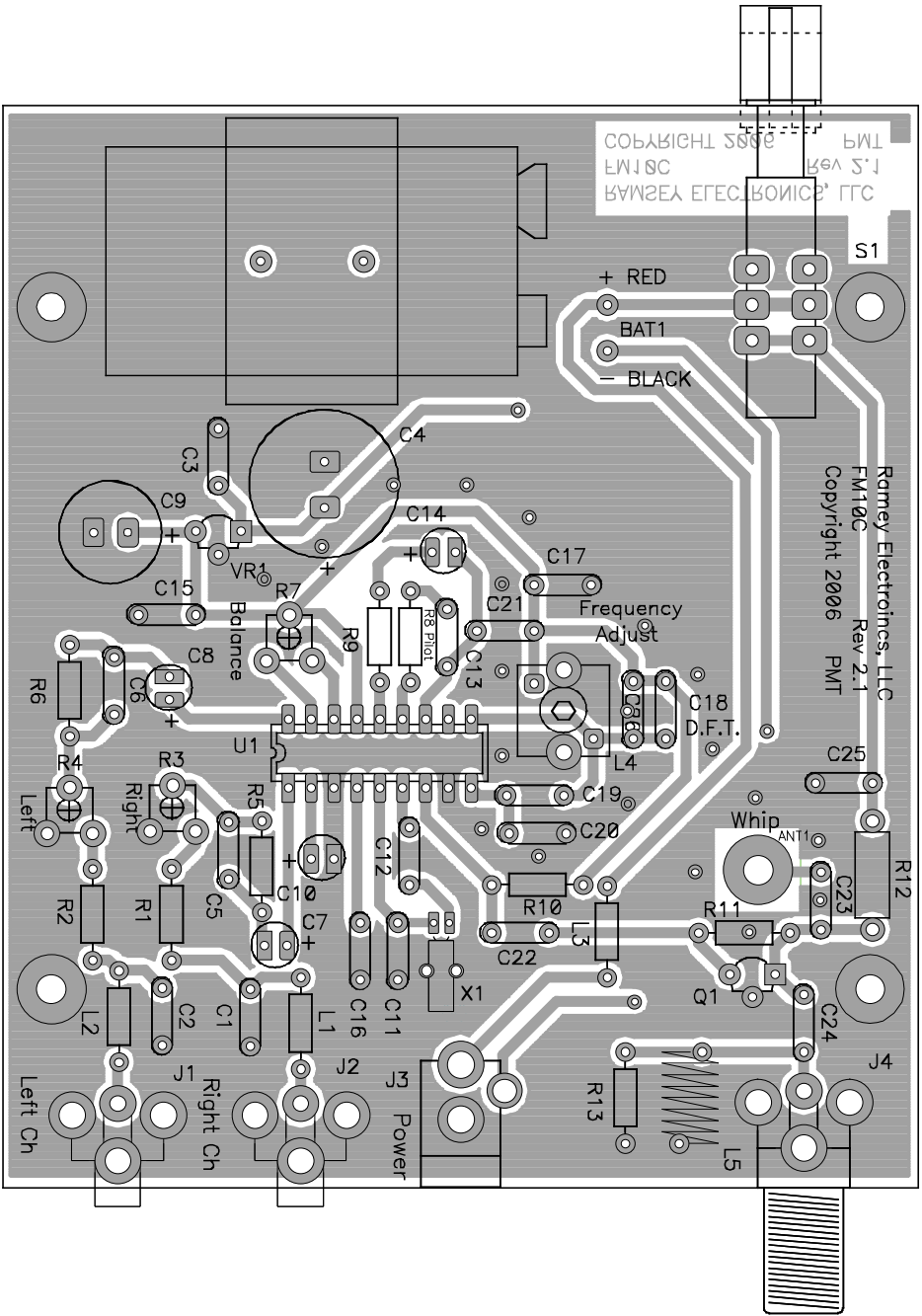
C22 is a coupling capacitor that allows the RF output at U1 pin 7 to be passed to the transistor Q1. R11 sets the bias or operating point of Q1. R12 is the collector load resistor that develops the output signal and brings in DC power.

**RF Output**

C23 couples the RF output signal to the on-board whip antenna if used (not used if external output jack is used).

C24 couples the RF signal to the RF output jack J4. L5 clamps the DC level from the antenna to the ground plane of the circuit board. R13 helps prevent static discharges from damaging the RF amp.

# FM10C PARTS LAYOUT DIAGRAM



## **PARTS LIST**

### **CAPACITORS**

- 1 1 pf disc capacitor [marked 1] (C26)
- 4 10 pf disc capacitor [marked 10 or 10K] (C11,12,19,20)
- 1 15 pf disc capacitor [marked 15] (C18, see note #1 at end of list)
- 1 22 pf disc capacitor [marked 22] (C18, see note #1 at end of list)
- 1 27 pf disc capacitor [marked 27] (C18, see note #1 at end of list)
- 3 100 pf disc capacitor [marked 100 or 101] (C1,C2,C3)
- 1 220 pf disc capacitor [marked 220 or 221] (C13)
- 8 .001  $\mu$ F disc capacitor [marked .001 or 102 or 1 nf] (C15,16,17,21,22,23,24,25,)
- 2 .0047 $\mu$ F disc capacitors [marked 472] (C5,6)
- 4 10  $\mu$ F electrolytic capacitors [C7,8,10,14]
- 1 100  $\mu$ F electrolytic capacitor (C9)
- 1 1000  $\mu$ F electrolytic capacitor (C4)

### **INDUCTORS**

- 3 2.2 uH [red-red-gold] (L1,2,3)
- 1 13 turn air core inductor (L5)
- 1 Adjustable shielded inductor coil (L4) [small square silver “can”]

### **RESISTORS**

- 1 200 ohm 1/2 watt [red-black-brown] (R12)
- 1 270 ohm [red-violet-brown] (R10)
- 1 1K ohm [brown-black-red] (R13)
- 1 4.7K ohm [yellow-violet-red] (R9)
- 3 10K ohm [brown-black-orange] (R11,5,6) (R5,6 see note #3 at end of list)
- 2 13K ohm [brown-orange-orange] (R1,2)
- 2 15K ohm [brown-green-orange] (R5,6) (R5,6 see note #3at end of list)
- 1 180K ohm [brown-gray-yellow] (R8) (see note #2)
- 1 220K ohm [red-red-yellow] (R8) (see note #2)
- 1 470K ohm [yellow-violet-yellow] (R8) (see note #2)
- 2 1K yellow trimmer potentiometer [marked 102] (R3,R4)
- 1 100K yellow trimmer potentiometer [marked 104] (R7)

### **SEMICONDUCTORS**

- 1 78L02 +2V regulator(VR1)
- 1 2SC2570A NPN VHF transistor (Q1)
- 1 BA1404 Stereo modulator IC (U1)



## **Jacks**

- 2 RCA-type PC-mount jacks (J1,2)
- 1 2.1 MM power jack (J3)
- 1 F-type PC-mount jack (J4)

## **HARDWARE AND MISCELLANEOUS**

- 1 Ramsey FM10C Printed circuit board
- 1 38 KHz crystal [small silver cylindrical "can" with 2 small leads], taped to a piece of paper.
- 1 PC board mounted DPDT switch
- 1 18 pin IC socket for BA1404
- 1 9-volt battery hold-down clamp
- 1 9-volt battery snap connector
- 1 Whip antenna w/screw
- 1 Plastic alignment screwdriver
- 1 Case with top, bottom, front, and back panels
- 4 4-40 x 3/13 (Short) Philips head screws
- 2 4-40 x 1-1/4 (Long) Philips head screws
- 4 Rubber feet
- 1 Button for DPDT switch

## **REQUIRED, NOT SUPPLIED:**

- 9-volt alkaline or heavy-duty battery
- Shielded stereo audio cables
- Line-level output audio source (such as a tape deck or CD player)

## **OPTIONAL**

- LED "power on" indicator and 1K resistor
- Audio switching-mixing accessories of your choice
- External antenna, small gauge coaxial cable with F-connector (example RG-6).

## **NOTES:**

1. **Selecting 18, 22, or 27 pf for C18; establishes the FM-band frequency adjustment range. See "Choosing an Operating Frequency."**
2. **Selecting 180K, 220K, or 470K pf for R8; establishes the stereo pilot level for the desired FM-band frequency to be used. See "Choosing an Operating Frequency."**
3. **R5 and R6 set the pre-emphasis of the transmitter. For 75 uS (USA) use 15K ohm resistors. For 50uS (Europe) use 10K ohm resistors.**

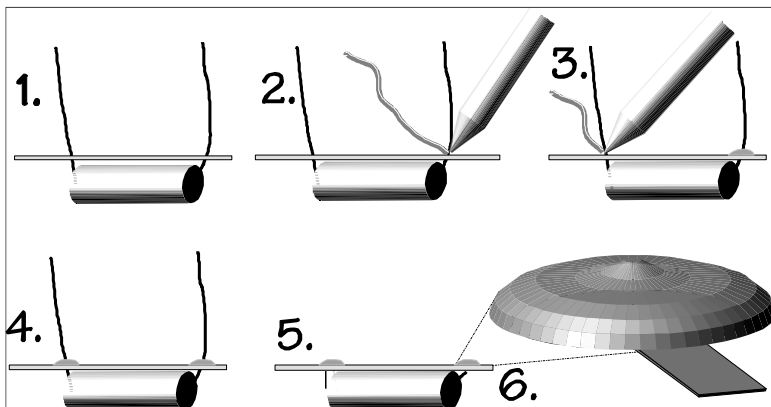
## RAMSEY “LEARN-AS-YOU-BUILD” ASSEMBLY STRATEGY

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:***

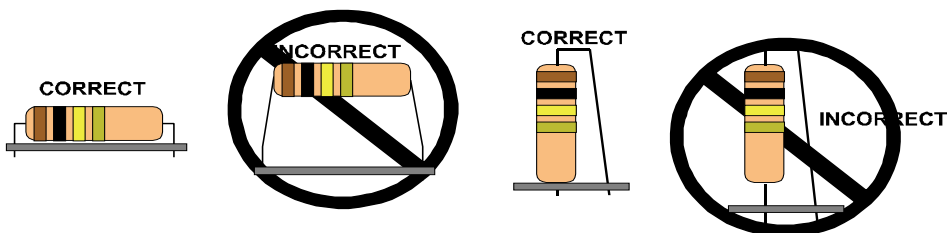
Use a good soldering technique - let your soldering iron tip gently heat the traces to which you are soldering, heating both wires and pads simultaneously. Apply the solder to the iron and the pad when the pad is hot enough to melt the solder. The finished joint should look like a drop of water on paper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

Mount all electrical parts on the topside of the PC board. This is the side that has few or no traces on it, the side with the silkscreen writing. 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 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 close up, clean and smooth with no holes or sharp points (6).



Since this is a “professional” transmitter, we sincerely hope you put this together in a professional manner. This project will not work as well as you wished if you just slap it together without following good assembly techniques and follow all instructions. No matter how clear we may think our manual is, if you have any questions give us a call at the factory. We will be happy to help you with any problems you may run into.

This is a mixed signal project meaning there is digital, audio, and RF circuitry all in one unit. As with all RF circuitry, we want to mount the parts AS LOW AS POSSIBLE to the board. A 1/4” lead length on a resistor not mounted close to the board can act as an inductor or an antenna causing all sorts of problems in your circuit. Be aware though that there are stand up components in your circuit. They don’t need to be squished to the board. Keep the portion of the resistor closest to the board mounted right on the board.



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. Make sure the part is mounted flush to the PC board unless otherwise noted.
- 3. Orient it correctly. Follow the PC board drawing and the written directions for all parts - especially when 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.

## ASSEMBLING THE FM10C

Sort out all of your parts to begin with, making sure you have all of the parts required. You can use old egg cartons to hold various parts to make them easier to find. Make sure to mount parts on the correct side! You will want to use the parts layout diagram to assist you in finding where the parts go.

**Warning:** Use only rosin core solder or solder designed to be used with electronic equipment. Use of acid core solder will void your warranty and produce a board that will disintegrate in a short period of time.

**Note:** Save the excess leads cut from installation of resistors and electrolytic capacitors to use for straps for the crystal and the battery clip.

- ❑ 1. Orient the board in the same direction as the parts layout diagram.
- ❑ 2. Install the 18 pin IC socket. If the socket has a notch in one end, install it in the same position as shown on the Parts Layout Diagram to prevent confusion later.

### **Audio Section**

- ❑ 3. Install L2, a 2.2uH inductor (red-red-gold). Inductors have no polarity so they may be installed in either direction.
- ❑ 4. Install L1, another 2.2uH inductor (red-red-gold).
- ❑ 5. Install C1, a 100pF ceramic capacitor (Marked 101). Ceramic capacitors are just like inductors they have no polarity so they may be installed in either direction.
- ❑ 6. Install C2, another 100pF ceramic capacitor (marked 101).
- ❑ 7. Install R1, a 13K ohm resistor (brown-orange-orange). Resistors are similar to inductors they have no polarity so they may be installed in either direction.
- ❑ 8. Install R2, another 13K ohm resistor (brown-orange-orange).
- ❑ 9. Install R3, a 1K ohm trimmer potentiometer. The top is orange and marked 102. This pot is used to adjust the audio level to the right channel of the modulator IC. Seat it flat before soldering.
- ❑ 10. Install R4, another 1K ohm trimmer potentiometer. (marked 102). This pot is used to adjust the audio level to the left channel of the modulator IC.
- ❑ 11. Install C5, a .0047uF ceramic capacitor (marked 472).
- ❑ 12. Install C6, another .0047uF ceramic capacitor (marked 472).
- ❑ 13. Install R5 and R6, a 15K ohm resistor (brown-green-orange). These resistors set the pre-emphasis characteristics for the FM10C at 75 uS for use in the USA. Pre-emphasis is a technique used in FM transmitters to increase the high frequency signal to noise ratio. For use in Europe and other countries using 50 uS pre-emphasis use 10K resistors (brown-black-orange).

Now we'll install some electrolytic caps. Electrolytic capacitors have a right and wrong way to be installed. Usually, these capacitors have a wide stripe which indicates their polarity. Most of the time this stripe indicates the negative lead. This can be verified by looking for the (-) sign in the stripe. On rare occasions this stripe will have a (+) sign indicating a positive polarity. The PC board or Parts Layout Diagram will show the positive side of the capacitor's installation hole. Be sure to place the

( + ) capacitor lead into the PC board ( + ) hole and the ( - ) lead into the ( - ) hole. Observe correct polarity when installing the electrolytic capacitors.

- 14. Install C7, a 10 uF electrolytic capacitor. Watch that polarity!
- 15. Install C8, another 10uF electrolytic capacitor.
- 16. Install C10, yet another 10uF electrolytic capacitor.
- 17. Install J1, the left channel RCA-type PC-mount jack. After insuring this parts sits flush on the circuit board be sure to solder the ground connections well. They may require more heat but when working with RF, a good ground is essential.
- 18. Install J2, the right channel RCA-type PC-mount jack.

### **Stereo Generator**

- 19. Install X1, the small silver "can" crystal. Be especially careful when installing this part as its leads are very small. This part location has four holes on the circuit board. The leads of the crystal must be installed in the two holes closest to the IC socket. A crystal has no polarity requirements so its leads can be placed in either of the two holes.
- 20. Install crystal strap, using a scrap component lead looped around the crystal and placed through the other two crystal location board holes. It is a good idea to solder the strap to the crystal after they have been installed.
- 21. Install C11, a 10pF ceramic capacitor (marked 10).
- 22. Install C12, another 10pF ceramic capacitor (marked 10).

### **Power Supply Section**

- 23. Install C15, a .001uF ceramic capacitor (marked 102).
- 24. Install VR1, the 78L02 +2 volt regulator. This part looks like a transistor and like a transistor, it must be place correctly to work. Follow the parts layout diagram and PC board silkscreen for orientation. Solder all three pins.
- 25. Install C3, a 100pF ceramic capacitor (marked 100 or 101).
- 26. Install S1, the DPDT push-button switch. You'll want this part to be seated correctly so that the power button moves freely when in the case. Set it flush to the PC board before soldering all six pins.
- 27. Install C9, a 100uF electrolytic capacitor. Remember polarity!
- 28. Install C4, a 1000uF electrolytic capacitor. Polarity.

- ❑ 29. Install L3, a 2.2uH inductor (red-red-gold). This part is located between L4 and the power jack J3.
- ❑ 30. Install C16, a .001uF ceramic capacitor (marked 102). This part is near the audio section.
- ❑ 31. Install J3, the 2.1mm DC power jack. You can gently bend the leads to keep this part from falling out of the board when you flip the board over to solder it.

### **Multiplexer Balance**

- ❑ 32. Install R7, another 100K ohm trimmer potentiometer. (marked 104).

### **Multiplexed Audio/Pilot**

- ❑ 33. Install R9, a 4.7K ohm resistor (yellow-violet-red).
- ❑ 34. R8's value will depend on the frequency band that will be used. It will be calculated and installed in the next section.
- ❑ 35. Install C13, a 220pF ceramic capacitor (marked 221).
- ❑ 36. Install C14, a 10uF electrolytic capacitor. Remember polarity.
- ❑ 37. Install C21, a .001uF ceramic capacitor (marked 102).

### **RF Oscillator**

- ❑ 38. Install C17, a .001uF ceramic capacitor (marked 102).
- ❑ 39. Install C19, a 10pF ceramic capacitor (marked 10).
- ❑ 40. Install shielded slug tuned coil L4. The larger tabs secure the shield can to the ground foil connections, while the two thin leads are the coil connections. If you find that the coil lead wires do not line up with the PC board holes, simply "pull" the coil insert from the shield can, rotate it a quarter-turn and insert back into the can. Make sure L1 is squarely against the top of the PC board before soldering, solid installation of L1 is essential to the frequency stability of your transmitter.
- ❑ 41. Install C20, another 10pF ceramic capacitor (marked 10).
- ❑ 42. Install C26 a 1pF ceramic capacitor (marked 1). A via that connects the ground plane on the top of the circuit board to the one on the bottom is in the middle of C26's pattern. Make sure to use the two outside holes in this pattern.
- ❑ 43. C18's value will depend on the frequency band that will be used. It will be calculated and installed in the next section.

## RF AMP

- ❑ 44. Install R10, a 270 ohm resistor (red-violet-brown).
- ❑ 45. Install C22, a .001uF ceramic capacitor (marked 102).
- ❑ 46. Install R11, a 10K ohm resistor (brown-black-orange).
- ❑ 47. Install Q1, the transistor marked 2N2570. The flat side must be placed as shown on the PC board. Mount it as close to the board as possible
- ❑ 48. Install R12, a 200 ohm 1/2 watt resistor (red-black-brown).
- ❑ 49. Install C25, a .001uF ceramic capacitor (marked 102).

## RF Output

- ❑ 50. Install C23, a .001uF ceramic capacitor (marked 102). Make sure to use the two outside holes in this pattern.
- ❑ 51. Install C24, the last .001uF ceramic capacitor (marked 102).
- ❑ 52. Install J4, the PC mount “F” connector. This is another part that you’ll want to seat correctly before soldering or it won’t fit through the back panel properly. Be sure to solder the ground connections well. .
- ❑ 53. Install R13, a 1K ohm resistor (brown-black-red).
- ❑ 54. Install L5, a 13 turn air core coil. Just as with the other inductors polarity is not an issue.
- ❑ 55. Install ANT1, a telescoping antenna. Insert the screw from the bottom side of the circuit board and tighten the screw using a #1 Phillips screwdriver. The head of the screw should now be soldered to the pad on the board. This allows the antenna to be remove easily without opening the case.
- ❑ 56. Install U1, a BA1404 IC. Carefully insert the FM modulator IC into the socket, taking care that all 18 pins get into their proper holes. The orientation of the notched end, as shown on the Parts Layout Diagram is **critically** important.

## Battery Holder

- ❑ 57. Install the battery hold-down clamp, using a scrap component lead looped through the PC board holes. Solder the pads on the board first then square-up the clamp to the board and solder it to the looped wire.
- ❑ 58. Install the battery snap connector (without battery); The red wire is positive and the black wire is negative.

## FM10C FREQUENCY RANGE SELECTION

Capacitor C18 sets the frequency range of the FM10C. R8 sets the pilot level for the different bands. Values for C18 and R8 are as follows:

<u>Desired Frequency of Transmission</u>		<u>C18 Value</u>	<u>R8 Value</u>
Lower end of FM band	(88-91 MHz)	27 pF	180K
Middle portion of FM band	(90-97 MHz)	22 pF	220K
High end of FM band	(95-108 MHz)	15 pF	470K

If you are not sure "where" you wish to place your FM transmitter in the FM band, we suggest you solder an initial "trial" C18 capacitor and matching R8 resistor with a **small** amount of lead-length to spare, so that they are easy to salvage and replace. This will enable you to properly test your FM10C and then at a later point, you may change C18 and R8 as desired.

- 59. Install C18, either: 15 , 22 or 27 pf (marked 15, 22, or 27).
- 60. Install R8, either a 180K (brown-gray-yellow), 220K (red-red-yellow), or 470K (yellow-violet-yellow) resistor.

That's it! But before you grab the power supply and fire up the FM10C, take a moment to check over your work. Check to be sure that all the parts are installed and the polarity sensitive ones are placed properly. Look for solder joints that could be questionable and need a quick touch-up. Also look for potential solder bridges; the parts layout diagram can help with that. You may want to hurry and get the kit powered up but anything you find now will save you a lot more trouble later. Unless you like the smell of smoke and the sound of things exploding! It's worth the few extra minutes. Looking over the PC board is the first step our Ramsey technicians complete when testing units here at the shop.

## CHOOSING AN OPERATION FREQUENCY

[A] It really is NOT sufficient to just "check" the FM band for an empty frequency, using the FM portable radio closest at hand. It is your responsibility to carefully research what FM stations can be listened to with a good system within the transmitting range of your FM10C. This is especially important in the low end of the FM broadcast band (88-92 MHz), where there are numerous medium power National Public Radio stations perhaps outside your own town, but which your neighbors may enjoy receiving, using a good receiver and outdoor antenna. Interfering with such reception is a direct violation of federal law. The most reliable way of finding a truly open frequency on the FM band is to check the band with a very good FM receiving system using an external antenna. If you do not have access to such a radio, most modern car radios (with exterior antenna) are very sensitive and usable to help you know what stations your



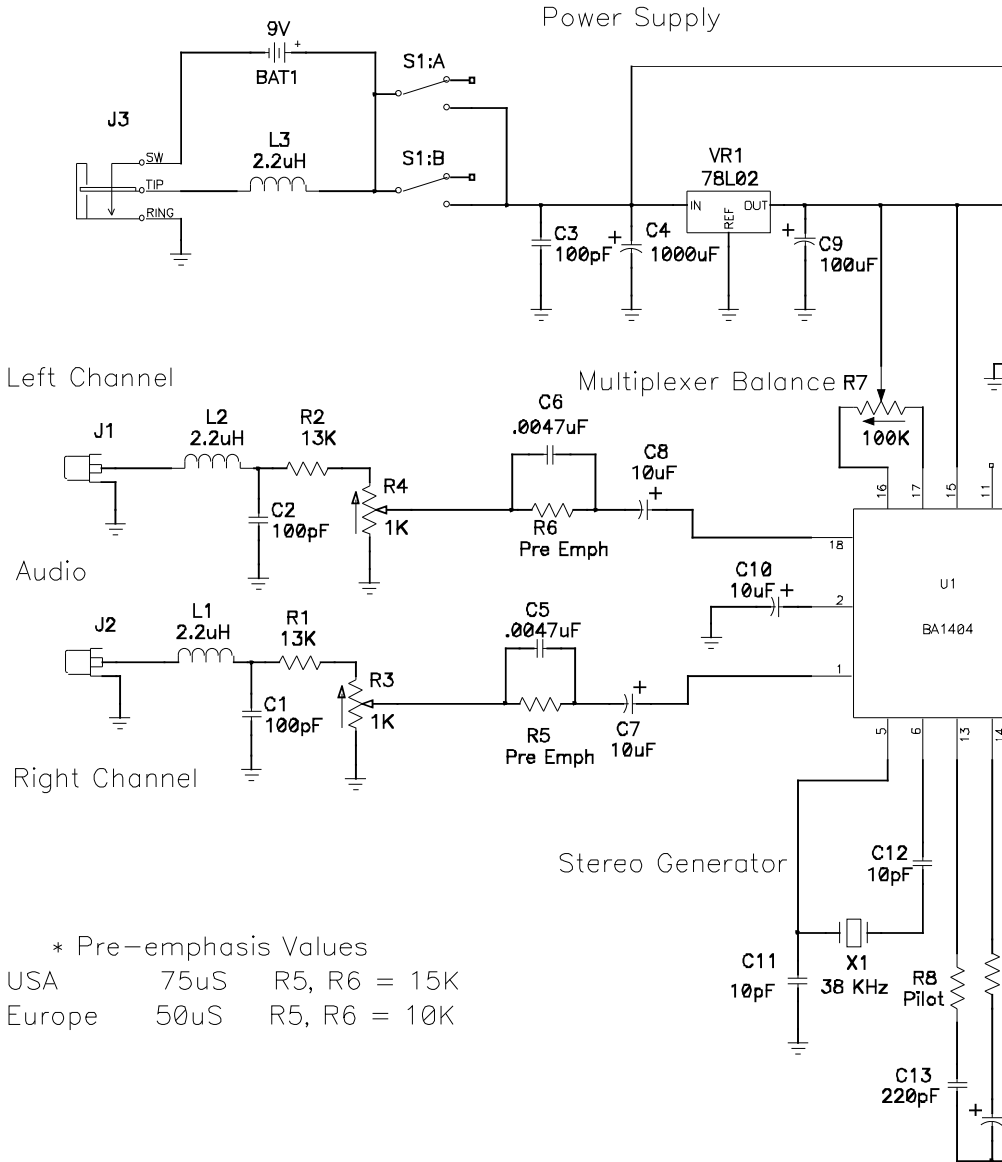
neighbors really can be receiving on a particular frequency.

[B] In choosing an operating frequency, remember that most "digital-tuning" receivers, whether portable, mobile or hi-fi, are designed to tune in 200 KHz increments and therefore might not receive well a signal operating between these pre-tuned standard broadcasting frequencies. In order to comply with Part 15 of FCC regulations, it is your responsibility to determine carefully that your operation will not cause interference to broadcast reception. Please study Appendix A of this manual before using your FM10C.

## **CASE ASSEMBLY**

- 1. Place the case bottom (has four mounting holes for circuit board) in front of you so that the tongue side is on the right and the groove side is on your left.
- 2. Place the front panel in the groove of the case bottom in the side that is facing you.
- 3. Place the circuit board in the case bottom so that the DPST switch comes through the power hole of the front panel.
- 4. Lift the rear of the circuit board so that is at approximately a 45 degree angle.
- 5. Place the rear panel over the jacks on the circuit board.
- 6. Drop the circuit board down while lining up the rear panel to the grooves of the case bottom.
- 7. Install the four 4-40 x 3/8 screws through the circuit board securing it to the case bottom. Do not over-tighten!
- 8. After doing transmitter alignments in the next section, place the top of the case over the bottom so that the antenna goes through the pre-drilled hole.
- 9. Line up the top with the sides of the case bottom, front, and rear panels.
- 10. Secure the top to the bottom with the two 4-40 x 1-1/4 inch screws. Again, do not over-tighten.

# FM10C REV2.1 SCHEMATIC DIAGRAM

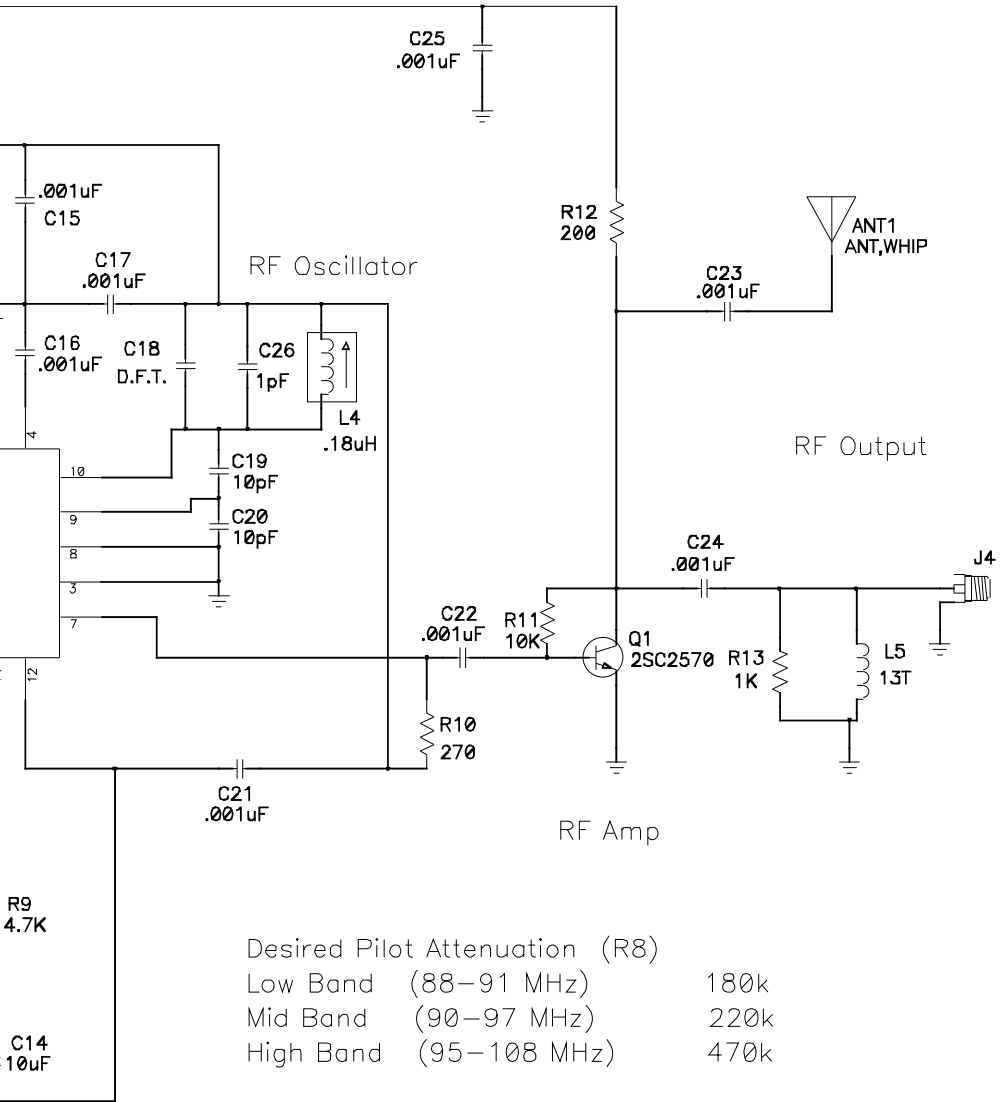


\* Pre-emphasis Values

USA	75uS	R5, R6 = 15K
Europe	50uS	R5, R6 = 10K

Multiple

Desired Frequency of Transmission (C18)		
Low Band	(88–91 MHz)	27 pF
Mid Band	(90–97 MHz)	22 pF
High Band	(95–108 MHz)	15 pF



Desired Pilot Attenuation (R8)		
Low Band	(88–91 MHz)	180k
Mid Band	(90–97 MHz)	220k
High Band	(95–108 MHz)	470k

Fixed Audio/Pilot

## ADJUSTING FM10C TRANSMITTER

Keep all tests very brief until you have carefully chosen an open operating frequency in the FM broadcast band.

### **1. Transmitting Frequency:**

After finding a suitable "open" frequency in the 88-108 MHz FM band, adjust L4 with the plastic alignment screwdriver until you hear the carrier frequency on a nearby FM radio. No audio input is needed to make this first adjustment, you can simply listen for a "quieting" in the normal background noise "hiss."

### **2. Audio Connection:**

Adjust both Left and Right level potentiometers (R3, R4) to full counter-clockwise rotation. This is the minimum level position.

Connect the left channel only. Slowly increase R4 until a distortion is heard in the right channel. Back R4 down slightly until distortion disappears. Repeat the process for the right channel and R3.

Hooking up an audio source to your FM10C is really quite simple. However, there are some general rules:

- A terribly distorted sound is a sign of too much audio level. Simply rotate the level potentiometers, R3 and R4, CCW to reduce the level. Make sure you rotate each one about the same amount to maintain proper stereo balance.
- Stereo LP turntables are low-level output and will require the use of a preamplifier for proper audio input to the FM10C.
- NEVER connect the FM10C audio inputs to speaker outputs of a high power stereo system; such a connection will destroy the IC chip.
- Consider using a mike mixer for professional "radio station" sound. It will allow you to easily fade, mix and switch between various audio sources.

### **3. Stereo balance:**

Adjust R7 for correct stereo balance (near the middle of its range). The better your ear for music and your understanding of quality audio devices and inter-connections, the better will be the performance of your FM10C.

## **USING THE FM10C WITHIN THE HOME**

A most practical use for the FM10C would be to connect it to the main stereo system within a large home so that whatever is playing on the main system can also be tuned-in on portable FM radios in other rooms, the garage or out in the yard.

This connection consists of using shielded audio cables to connect the auxiliary "line audio" output of your cassette deck, CD player or other stereo device to the audio inputs of the FM10C. Consult the literature that came with your stereo equipment.

Even if you intend only this limited convenience use of the FM10C for your own home and family, it is still your responsibility, in accord with Part 15 of the FCC Rules, to ensure that this operation does not cause interference to your neighbors.

## **POWER SUPPLY CONSIDERATIONS**

The FM10C is designed to operate from a single 9-volt battery mounted on the PC board.

Whether an alternative AC adapter can be used depends on the quality of the adapter and its ability to suppress unwanted AC-line hum. Various plug-in adapters and power supplies in the 6 to 12 volt range may be tried, but make sure the unit has DC output (positive tip) and is not merely a transformer relying on rectifier circuitry within the device for which it was originally supplied as an accessory.

## **L.E.D. "POWER ON" INDICATOR**

Since the transmitter consumes power and emits RF whenever it is turned on, a visual "on the air" indicator is desirable and is a fun enhancement of your completed kit. If you are designing the FM10C setup for use by youngsters, a flashing indicator is easily provided using our BL-1 "LED Blinky" kit. Voltage for a standard LED is easily taken from the unused top terminals of S1. The inner pin nearest the black lead of the battery cable is the +9 volt pin. The ground can be taken from the black battery terminal, or the case of any of the jacks, but it CANNOT be the antenna. This positive DC must be connected to the anode (longer wire) of the LED. Use a 1K resistor in series with either wire of the LED. The cathode lead is connected to the negative battery wire. The resistor is omitted if you are using a 1.5 volt battery for prolonged short-range operation.-

## EXPERIMENTAL "BROADCASTING" PROJECTS

To use the FM10C successfully as a "broadcasting" service to interested listeners in a school or immediate neighborhood, most of your effort will be concentrated on smoothly "managing" or mixing the audio signals fed into the transmitter input. Operation of the transmitter itself consists simply of the following:

- 1. Correct construction and adjustment.
- 2. Carefully checking for an open frequency between 88-108 MHz in accordance with FCC Rules, Part 15.
- 3. Setting up a suitable antenna.
- 4. Connecting the audio source to the Left and Right input jacks.
- 5. Turn on the transmitter while you intend to be "on the air" and turn it off when you are finished.

Explaining how to build a simple audio "mixing" panel or box, which is at the heart of any studio operation, is beyond the purpose of this instruction manual. We do recommend that you design and build this mixing system yourself, for several reasons:

1. Parts to do so are readily available at Radio Shack.
2. It would be an excellent class, family or Scout project.
3. Commercially-made stereo mixing consoles, while much less expensive today than a decade ago, will cost much more than did your FM10C kit!
4. The more home-built your complete setup, the more it is in conformity with the spirit of FCC Part 15 regulations.

If you are designing the FM10C and its mixing inputs to serve as an educational and entertaining toy for your children, we suggest that the FM10C PC board be incorporated with the mixing circuits into a durable, non-hazardous enclosure. If infants and very young children are likely to "examine" this magical box when their siblings are not looking, it is better not to use a whip antenna, due to the hazard of eye damage. Also, remember that any broken whips from radios, cordless phones, etc. can become dangerously sharp.

Although many sources exist for audio mixers, the Radio Shack No. 32-1105 is the least expensive commercial device currently available. Bear in mind that specifications and model numbers for such accessory equipment can change from year to year. Also, some home-entertainment audio equipment includes simple mixing capabilities which will permit you to fade and "cue"

music and microphone inputs. Ramsey now sells the MX-5 and MX-10 mixer kits (and wired and tested units!) and the Stereo Transmitter Companion (STC1) for a "radio station" quality home broadcasting set-up.

## **ANTENNA IDEAS**

The simplest, yet very effective, antenna for the FM10C consists of a "dipole", set up either horizontally or vertically, and connected to the transmitter output jack through a few feet of coaxial cable (either RG-58, RG-59 or miniature RG-174, available at Radio Shack and other sources). Correct dipole lengths for major sections of the 88-108 MHz band are:

88 MHz, each side: 2.7 feet; 5.4 feet total

98 MHz, each side: 2.4 feet; 4.8 feet total

108 MHz, each side: 2.2 feet; 4.4 feet total

You can see that there is not a great difference in antenna length from 88 to 107 MHz. Some antenna designers have the view that an "approximate" dipole such as 2.5 ft. on a side will do fine, while others believe it is worth the effort to calculate the length for your exact frequency, using the simple formula of Length (of one side, in feet) =  $234/\text{Frequency in MHz}$ .

If the dipole is installed vertically, the end connected to the center conductor of the coax should be the upper (higher) end. If young children will be around the set-up, a flexible wire antenna is preferable, rather than rigid tubing.

A "ground plane" antenna can be quite effective. A ground plane consists of one vertical element, the same length as one side of a dipole, connected to the center conductor of the coax. Four "radials" are connected to the shielded side of the coax at a 90 to 135 degree angle to the vertical element. The dipole formula is also used to calculate the length of the radial; since radials should be slightly longer than the main element, use 240 rather than 234 in your calculations.

If you are equipped to make the field strength measurements required by Part 15 FCC rules, and if you think it would be best to aim or "focus" your signal in a narrower direction, you can consult an antenna handbook and design a suitable gain antenna. See Appendix A concerning FCC field strength limitations. An FM- VHF TV receiving antenna could be modified for such a purpose. Ramsey now has the TM-100 Tru-match FM broadcast antenna, ideally suited for your FM10C

Ham radio books and magazines are filled with antenna principles and ideas which can be adapted to your application. Also, you may wish to look at Radio Shack book No. 62-1083 on antennas.

## **ANTENNA ALTERNATIVES**

If your situation involves a single large building or multi-level home where reception from the FM10C antenna tends to be uneven because of walls and other VHF path obstacles, you might set up the FM10C's output in a "carrier-current" configuration. If you know how to do correctly, then do so - safely. If not, you can show your FM10C and this book to a licensed radio engineer and negotiate with that person for a safe installation which will feed your signal through interior wiring of your home or building. Do not attempt such an installation unless you know exactly what to do and not to do. Also, because such an installation is beyond the original purpose of this kit and the safety standards intended for all Ramsey kits, and because we have not tested the FM- 10A in such an installation, we cannot provide further details for such an installation.

## **TROUBLESHOOTING GUIDE:**

If your FM10C does not work at all, re-check the following:

- correct orientation of U1 (see PC board parts layout diagram)
- correct polarity of all electrolytic capacitors,
- Correct orientation of regulator VR1
- correct orientation of Q1 transistor,
- correct value of C18,
- complete with no bridges all solder connections.

## **Hints:**

- Frequency drift is usually caused by a weak battery or operation at large temperature extremes.
- Erratic or unstable operation is caused by faulty solder joints or cable connections.

Standard 2SC2570 replacements: ECG10 or SK9139, may be found at most local electronics parts dealers.



## **APPENDIX A: FCC RULES AND INFORMATION**

*The Rules of the FCC (Federal Communications Commission) and your kit built FM Stereo Transmitter.*

An interim explanation of applicable FCC regulations supplied as a personal assistance to FM10C builders, by Dan F. Onley (K4ZRA)

It is the policy of Ramsey Electronics, Inc., that knowing and observing the lawful use of all kits is a first responsibility of our kit user-builders. We do not endorse any unlawful use of any of our kits, and we do try to give you as much common sense help about normal and lawful use as we can. Further, it is the policy of Ramsey Electronics, Inc., to cooperate with all applicable federal regulations in the design and marketing of our electronics kit products. Finally, we urge all of our overseas customers to observe the regulations of their own national telecommunications authorities.

In all instances, compliance with FCC rules in the operation of what the FCC terms an "intentional radiator" is always the responsibility of the user of such an "intentional radiator".

To order your copy of FCC rules part 15, call the US Government, Superintendent of Documents, at 202-512-3238, or fax at 202-512-2250. To order the correct document, ask for "CFR Title 17: Parts 1 to 19." The cost is \$24.00, Master Card and Visa accepted.

### **In the United States, this is how the FCC regards your transmitter kit:**

Licensed FM broadcast stations and their listeners have ALL the rights! Your use of a device such as the FM10C kit MAY have some limited privileges in locally-unused band space.

Unlicensed operation of small transmitting devices is discussed in "Part 15" of the FCC Rules. These Rules are published in 100 "Parts," covering everything imaginable concerning the topic of "Telecommunications." The six books containing the FCC Rules are section 47 of the complete Code of Federal Regulations, which you are likely to find in the Reference section of your Public Library. If you have questions about the legal operation of your FM10C or any other kit or home-built device which emits RF energy, it is your responsibility to study the FCC regulations. It is best if YOU read (and consult with a lawyer if you are in doubt) the rules and do not bother the understaffed and busy FCC employees with questions that are clearly answered in the rules.

Here are the primary "dos and don'ts" picked from the current FCC Rules, as of May, 1990. This is only a **brief look** at the rules and should not be con-

strued to be the absolute complete legal interpretation! It is up to you to operate within the proper FCC rules and Ramsey Electronics, Inc. cannot be held responsible for any violation thereof.

1. In the past, no "two-way communications" use of the 88-108 MHz FM broadcast band was permitted. This prohibition does not appear in the current edition of Part 15. Previous editions of Part 15 discussed "wireless microphones" (such as Ramsey FM-1, FM-4, etc.), while the June 23, 1989, revision eliminates this discussion in favor of more detail regarding computer and TV peripherals and other modern electronic conveniences. However, it is not immediately clear that the 1989 revision of the FCC Rules Part 15 necessarily "cancels" previous regulations. Laws and rules tend to remain in force unless they are specifically repealed. Also, FCC Rule 15.37 discusses "Transitional Provisions for Compliance with the Rules," and states in item (c): "There are no restrictions on the operation or marketing of equipment complying with the regulations in effect prior to June 23, 1989."

2. It is the sole responsibility of the builder-user of any FM broadcast-band device to research and fully avoid any and all interference to licensed FM broadcast transmission and reception. This instruction manual gives you practical advice on how to do a good job of finding a clear frequency, if one is available.

3. For some frequency bands, the FCC sets 100 milliwatts (0.1 watt) as the maximum permitted power output for unlicensed, home-built transmitting devices, and that the combined length of your antenna and feedline (coaxial cable or other) must not exceed 10 feet. The technical standards for 88-108 MHz are very different, primarily concerned with band width and RF field strength.

4. FCC Rules do not differ for "stereo" or "monaural" transmissions.

5. Broadcasting on the grounds of a school (AM emissions only) is specifically permitted and encouraged between 525 and 1705 KHz under Part 15.221. Use our AM-1 AM radio broadcast kit for this use.

6. FCC Rule No. 15.239 specifically addresses operation in the 88-108 MHz FM broadcast band for which your FM10C transmitter kit is designed. However, this Rule does not, by itself, tell you everything you need to know about using a device of this kind. Therefore, we are noting a series of Part 15 regulations which should be observed:

- a. The transmitter must NEVER be tuned to a frequency above 108 MHz, specifically the band 108-121.94 MHz, FCC Rule 15.205 lists this band as restricted, due to potential interference with aircraft navigation

equipment.

- b. The "bandwidth" of your transmission is limited to 200 KHz, centered on the actual operating frequency. Since 200 KHz is enough spectrum space for several different FM stations, this is a "generous" limitation designed to accommodate cruder FM devices. Properly built and adjusted, the FM10CA kit operates well within this limit. In fact, its signal should sound no "wider" than any other FM station when listening on an ordinary FM radio.
- c. FCC Rule 15.215(a) says: "Unless otherwise stated, there are no restrictions as to the types of operations permitted under these sections." This general provision appears to leave you free to use your FM stereo transmitter in a manner similar to operations of an FM broadcasting station, or to use it for any other non-interfering, practical application.
- d. FCC Rule 15.5: General conditions of operation: "(b) Operation...is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical equipment, or by an incidental radiator. (c) The operator of a radio frequency device shall be required to cease operating the device upon notification by a Commission representative that the device is causing harmful interference."
- e. The most specific FCC regulation of 88-108 MHz FM Broadcast band unlicensed operation is that the "field strength" of the signal must not exceed 250 microvolts/meter at a distance of 3 meters from the transmitter (FCC rule 15.239). If you have any concern about this emission limit, have your device checked by a technician with accurate measuring equipment. Remember that the "field strength" of a signal is determined as much by the antenna as by the RF output of the transmitter itself.

## APPENDIX B: UNDERSTANDING LEGAL "FIELD STRENGTH"

A "microvolt" is one-millionth of one volt and designated " $\mu\text{V}$ " in the following explanations.

The new FCC Part 15 Rules specify a maximum "Field Strength" of your transmitted signal. Since it is unlikely that you have the equipment to carry out accurate field strength measurements in microvolts, it is useful to understand at least the theory of field strength so that you can understand both what you can expect from such transmitters, and what limits the FCC intends.

Previous limits on nonlicensed FM-broadcast band devices were defined as a maximum field strength of  $40\mu\text{V}$  per meter measured at a distance of 15 meters. The June 1989 revised rule specifies a maximum of  $250\mu\text{V}$  per meter, but measured at 3 meters from your antenna. Both limitations are the same in practice. " $250\mu\text{V}$  per meter" means that an accurate field-strength meter with a 1-meter antenna may indicate a maximum signal field strength of  $250\mu\text{V}$  (In contrast, non-licensed operation from 26.96 to 27.28 MHz is limited to a field strength of  $10,000\mu\text{V}$  per meter at 3 meters).

In all cases, the field strength of a signal decreases in direct proportion to the distance away from the antenna. Power decreases by the square of distance: for every doubling in distance, the signal power is quartered, but the field strength voltage is only halved. Using this theory, we can construct a simple chart to show the maximum permitted performance of a non-licensed FM band transmitter. The theoretical figures assume a simple 1 meter receiving antenna in all cases and do not take into consideration that reception can be greatly enhanced with larger, multi-element antennas and preamplifiers. In the following chart, the field strength (theoretical minimum) gets even stronger as you move from the edge of these circular boundaries toward the antenna:

This "exercise in meters and microvolts" demonstrates that the FCC clearly intends to limit the theoretical range of non-licensed devices operating in this band. It also shows the potential for causing interference at a home down the street from you. But it also shows that you can legally put out quite a good signal over wider areas than you might have imagined.

For other kinds of radio services, the FCC restricts such factors as transmitter power or antenna height, which cannot really limit the possible "range" of a transmission under good conditions. By restricting the maximum field strength at a specific distance from your antenna, the FCC clearly plans for your signal to "die out" at a specific distance from your antenna, no matter what kind of transmitter power or extra-gain antenna you are using. On the other hand, the FCC standards do make it legal and possible for you to broadcast on a school campus, campground or local neighborhood, as long as you do not

<b>DISTANCE FROM TRANSMITTER ANTENNA</b>			
<b>METERS</b>	<b>FEET</b>	<b>FIELD STRENGTH (<math>\mu</math>V)</b>	<b>TOTAL RECEPTION AREA</b>
<b>3</b>	10	250	314 FT
<b>6</b>	20	125	1256 FT
<b>12</b>	39	63	4800 FT
<b>24</b>	78	31	19113 FT
<b>48</b>	157	15	1.8 ACRES
<b>96</b>	315	7.5	7.2 ACRES
<b>192</b>	630	3.8	28.6 ACRES
<b>384</b>	1260	1.9	114 ACRES
<b>768</b>	2520	.95	458 ACRES
<b>1536</b>	5036	.5	1830 ACRES

cause interference to broadcast reception.

***“Why talk about acres”?***

There are three reasons to translate our look at "field strength" into "acres".

(1) The first one is easy: the numbers would get too cumbersome if we discussed your possible signal coverage in terms of square feet or square meters.

(2) It's very easy to see that your signal can easily and legally serve a school campus or wilderness campground.

(3)And, if we remember that typical urban single-family home sites run from 1/4 to 1/2 acre on the average, it should become extremely clear that your obligation to avoid interfering with broadcast reception can easily involve hundreds of homes, before adding apartments!  
 In fact, the most significant distance in the above chart is the 1.9  $\mu$ V signal strength permissible at 1260 feet (about 1/4 mile), covering a cir-

cular area of about 114 acres. A quick glance at stereo FM receiver specifications shows typical sensitivity of 1.7  $\mu\text{V}$  before considering high-gain antennas or preamplifiers. Your non-licensed signal can provide serious competition to a public broadcast station fifty miles away, a station which someone in your neighborhood may have set up a special antenna to enjoy.

Calibrated "field strength meters" such as described in the ARRL Radio Amateur's Handbook can detect signals down to about 100 microvolts. To measure RF field strength below such a level, professional or laboratory equipment and sensitive receivers are required. A "sensitive" receiver responds to a signal of 1 or even .5 microvolt "delivered" to the receiver input by antenna. If the antenna is not good, the receiver cannot respond to the presence of fractions of a microvolt of RF energy.

## **SUMMARY**

The present edition of Part 15 of the FCC rules does not provide detailed guidance on ALL aspects of using a low-power transmitter such as the FM10C. The main point is that you may not cause any interference whatsoever to licensed broadcast services and that you must be willing to put up with any interference that you may experience.

In addition to operations not requiring authorization, you also have the option of writing a clear and polite letter to the FCC Engineer-in-Charge of your local district, describing your intended operation. Mention the operating frequency and planned hours of operation. This could be a good step to take if your project is on behalf of a school, Scout or community group.

If you become further fascinated with the service rendered by low-power broadcasting, other FCC regulations explain how to apply for a license or other authorization which may permit you to upgrade your FM10C or other equipment to accomplish any objective which the FCC sees to be in the public interest and not interfering with other authorized uses of the radio spectrum.

## **Lawful use suggestions for the FM10C**

1. Build and adjust this kit strictly according to the published instructions.
2. Use the whip antenna supplied with the Ramsey case set, CFM.
3. Do not modify your kit in any way.

4. Check your intended operating frequency very carefully, as clearly explained in this instruction manual, to ensure you will not cause interference to reception of licensed broadcasting.
5. If you receive ANY complaint about your transmissions interfering with broadcast reception, stop or change your operation IMMEDIATELY.
6. If you are contacted by the FCC regarding use of this device, cooperate fully and promptly.
7. Do your own homework and research to understand and comply with present and future FCC rulings concerning devices of this kind.
8. Do not use made-up "station call signs" to identify your transmissions. Only the FCC has the authority to issue such call-signs. Use some other way to identify your transmitting activity, such as "This is Stereo 90.5, Seabreeze School Student Music Radio," and so forth.
9. Identify the location and purpose of your transmissions from time to time. This is common courtesy toward other persons who may hear your signal. The FCC is toughest about clandestine transmission which cost time and money to track down.
10. Do not assume that the mere fact that you purchased this kit gives you any specific right to use it for any purpose beyond generating a low-level RF signal which is barely detectable beyond the perimeter of your personal dwelling space.

Finally, the FCC Rules call for the posting of printed notices on devices intended for non-licensed operation under Part 15 Rules. You will find such notices written up for the front or back of the instruction manual for nearly any computer or video accessory that you have seen in recent months. Consult the Part 15 Rules for the exact wording of such notices. Following is a text for such a notice which responds to FCC rule making intentions:

**NOTICE:**

The radio-frequency "intentional radiator" device which may be constructed from kit parts supplied by us is intended and designed by Ramsey Electronics, Inc. to conform to applicable provisions of Part 15 of FCC Rules. The individual kit-builder and all users of this device assume responsibility for lawful uses conforming to FCC Part 15 Rules. Operation is subject to the following two conditions:

- [1] This device may not cause harmful interference, and  
[2] this device must accept any interference received, including interference that may cause undesired operation.

### **Final comment**

A well-informed person will see today's FCC Rules to be evolving and progressively less-restrictive. Even though today's technology is far more complex than what was possible at the time of the Communications Act of 1934, the FCC rules are becoming more relaxed, giving radio experimenters more and more opportunities to explore many frequency bands, using many communications modes, with no need for a formal license of any kind. A thorough study of Part 15 of the FCC Rules, which is completely beyond the purpose of this kit manual, will show you many legal uses of radio transmitting devices which do not require licensing, either amateur or commercial.

To provide more personal and club radio-learning opportunities, and to cut down on administrative costs, today's FCC permits far more non-licensed activity than at any time in previous history. On the other hand, today's FCC enforcement actions get bigger fines and real prison terms for scofflaws! From CB (now 3 bands of it, for varying applications) to easy entry-level Amateur Radio with long-term licensing, to numerous unlicensed Part 15 operations, the FCC is beginning to look out for the interest and good plans and intentions of private citizens and school-community groups as never before in radio communications history. Learn the rules...observe them...and have fun in radio!

If you enjoyed this Ramsey kit, there're plenty more to choose from in our



## **FM10C SPECIFICATIONS**

Frequency of Operation:	88 to 108 MHz
Bandwidth:	+/- 75 kHz when properly adjusted
RF Output	
Jack:	F
Power:	Approximately 10mW
Antenna on board:	33-1/2 inch (0.85m) telescopic whip
Audio Input	
Jacks:	RCA (x2)
Impedance	< 10k ohms
Signal	1vpp Line Level
Pre-emphasis:	75uS or 50uS (component selected)
Stereo Separation:	45 dB typical
Power Supply Requirements:	
Jack:	2.1mm center (+)
External Supply Voltage	5 to 20 VDC
External Supply Current:	60mA @15 VDC, 50mA @ 12 VDC
Battery Voltage	9 Volt Battery
Battery Current	40mA
Circuit Board Dimensions:	4 in X 4.75 in (101.6mm X 120.4mm)
Case Dimensions:	5 in X 5.25 in X 1.5 in (127mm X 113.4mm X 38.1mm)
Weight completed (with 9V alkaline)	Approx. 10.4oz. (294.8 gr)



# THE RAMSEY KIT WARRANTY

## 1. GENERAL:

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 prior to release of this kit, a varied group of knowledgeable people have assembled this kit from scratch using this manual. During this process, changes and additions are noted by each assembler and integrated into the final version of the manual...which you have! 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! However, customer satisfaction is our goal, so in the event that you do have a problem, please note the following:

## 2. 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 of 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 "damaged it" or "burned it out", we're all human and in most cases, replacement parts are very reasonably priced. Remember, our goal for over three decades is to have a happy customer, and we're here to work WITH you, not AGAINST you!

## 3. MISSING PARTS:

Before assuming a part value is missing, 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 for the component (such as a "100 to 500 uF capacitor"). 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 orange band really does look red!") Ramsey Electronics project kits are packed with pride in the USA by our own staff personnel. While separate QC checks are made on all product kits, we too are human, and once in a great while there is a chance something can get through those checks! If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual for your Ramsey kit, please contact us with information on the part you need. Contact our Repair Department via telephone, email or writing. Please have your invoice number and date of purchase handy.

## 4. REFUNDS:

All Ramsey products, kit or factory assembled units have an unconditional 10 day (from the date of purchase) return policy to examine our products. If you are not satisfied for any reason, you may return your unassembled kit with all the parts and instructions, or your factory assembled and tested product, together with your proof of purchase to the factory for a full refund less shipping. The return package should be packed securely. Insurance and tracking is highly recommended. A reminder, this applies to unassembled kits. They must be in the same new condition as received, not partially assembled! Assembled kits cannot be returned for credit. No RMA's are required; simply return to Ramsey Electronics LLC, Attn: Product Returns, 590 Fishers Station Drive, Victor, NY, 14564. If you have any questions, please contact us at 585-924-4560.

## 5. FACTORY REPAIR OF ASSEMBLED KITS:

Most of us at Ramsey are technically oriented and we do realize that things happen! Even following the best practices, with all of the best intentions, there is that chance that your kit doesn't work when you have completed it. Each manual goes into detailed troubleshooting based on the specific kit to help you troubleshoot the problem. We have found that 95% of returned kits involved wrongly installed components (wrong part or backwards polarity). This section of the warranty assumes you have gone through all those steps, and have now reached the point that you need to send it back.

To qualify for factory repair of customer assembled kits, the following conditions apply:

1. Kits must not be assembled with acid solder flux
2. Kit boards or circuits must not be modified in any manner from the version received
3. Kits must be fully assembled, not partially assembled. Our warranty does not include "finishing" your kit!
4. Must include a full description of the problem encountered including the troubleshooting steps you have already done.
5. Must not include non-standard, non-Ramsey accessories, cases, enclosures, knobs, etc. or any batteries.
6. Must include the minimum repair fee of \$25 USD in the form of check, money order or credit card authorization.
7. Ramsey Electronics, LLC reserves the right to refuse any repair due to excessive errors in construction methods.
8. If, due to customer construction methods, the repair is estimated to exceed the minimum flat rate, Ramsey Electronics, LLC will contact the customer to discuss the repairs needed and to receive authorization and payment for repair prior to repair.
9. In the unlikely case that a defective part is found to be the cause of the problem, the repairs will be made at no-charge to the customer, and any payments received for repair will be returned or credited back to the customer.
10. Properly pack your kit, insure the package, and use a carrier that can be tracked. Ramsey Electronics, LLC is not responsible for any loss or damage in shipment. Send the package together with your repair fee to the return address below. No RMA is required.

## 6. FACTORY REPAIR FEES:

Please understand that our Tech Support Group personnel are not volunteers! They are a dedicated group of highly trained technicians each configured with a very properly equipped test bench. Upon receipt of a repair, the setup, testing, diagnosis, repair, paperwork, and repacking of your kit requires nearly an hour of their time regardless of the size or complexity of the kit! The minimum repair fee represents ½ hour Tech Support time at \$50/hour USD. We try to keep all kit repairs within the realm of the \$25 flat rate whenever possible...and trust us; we exceed that time spent on most kits received more often than not!

## 7. CONTACT INFORMATION AND RETURN ADDRESS:

### Technical Questions

**RAMSEY ELECTRONICS, LLC**  
Attn: Tech Support  
590 Fishers Station Drive  
Victor, NY 14564  
585-924-4560; 585-924-4886 Fax  
techsupport@ramseyelectronics.com

### Product Repair & Returns

**RAMSEY ELECTRONICS, LLC**  
Attn: Repairs  
590 Fishers Station Drive  
Victor, NY 14564  
585-924-4560; 585-924-4886 Fax  
repairs@ramseyelectronics.com

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### REQUIRED TOOLS

- Soldering Iron
- Thin Rosin Core Solder
- Needle Nose Pliers
- Small Diagonal Cutters

### ADDITIONAL SUGGESTED ITEMS

- Helping Hands Holder
- Desoldering Braid

### TOTAL SOLDER POINTS

151

### ESTIMATED ASSEMBLY TIME

Beginner..... 5 hrs  
Intermediate..... 3.3 hrs  
Advanced ..... 2.5 hrs



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**FM STEREO TRANSMITTER**