# TONE GRABBER 2 DTMF DECODER KIT

Ramsey Electronics Model No.   TG2

Ever wonder what numbers were being dialed on the phone or radio? Do you need to see what DTMF codes have been used during the day on the local repeater? Well, this is the kit for you! Using the power of a microprocessor this unit can record over 600 numbers, and store them in FLASH memory even after power is removed!

- **Full microprocessor control for simple, but comprehensive features.**

- **640 memory locations - FLASH memory holds data for years!**

- **Automatically places dashes between sets of numbers for easy reading of codes!**

- **Eight LED displays; see any 8 digits at any time.**

- **Able to scroll through memory while unit is operating to see all memory locations.**

- **Decodes all sixteen DTMF codes!**

- **Built-in RJ-11 jack for easy interfacing with your phone line as well as a highly sensitive audio input for custom monitoring!**

- **Built-in 1 to 60 digit Data Latch for custom controller applications!**

- **Accepts a wide range of supply voltages between 8-15VDC.**
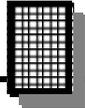
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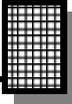- · **QRP Power Amplifiers**

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TG2 KIT INSTRUCTION MANUAL
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KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

TONE GRABBER 2 DTMF DECODER KIT

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INTRODUCTION

The Ramsey TG2 is a dual tone multi-frequency (DTMF) decoder with data retention, 8 character display, and a trigger output enabling the user to activate an external device when a user selected data match occurs. It decodes all sixteen DTMF characters and stores them in non-volatile FLASH memory. It automatically places a dash between incoming codes that have a 3 second spacing between them to make viewing the data at a later time easier to understand. To ensure data security, the FLASH memory micro-controller can store saved codes with the power off for more than 10 years!

CIRCUIT DESCRIPTION

Take a look at the TG2's Schematic Diagram as we walk through the circuit description. As you can see there is not much to the Tone Grabber component-wise; most of the work is done internally by the IC's.

The DTMF audio input circuitry has been split into two sections to make interfacing with the TG2 easier. The 'Audio In' (J4) RCA jack accepts line-level input from almost any audio source and presents it to the DTMF decoder IC. Pretty simple. The 'Phone Line Monitor In' (J3) RJ-11 jack allows you to quickly hook the TG2 directly to any phone line and continually monitor and 'grab' any DTMF data on the line (keep in mind it does not display digital caller-ID data)! The audio sniffer formed by C14, C15, R8, R9, and R10 will not capture the line so it does not interfere with the normal use of your phones. It quietly feeds any DTMF audio tones to the decoder IC for processing. Protection diodes D2 and D3 limit the incoming signal to +- 0.7 V so that potentially damaging voltages like the 90 Vp-p 'Ring' signal does not blow-up your decoder IC!

The real heart of the circuit is U3, the tone decoder IC. This chip has the task of decoding the input tone data from the phone line, or other audio source, and presenting it in a 4 bit digital fashion to the micro-controller. Internally, this chip has a set of counters that latch different outputs depending on the tones. The internal counters are referenced to a television color-burst crystal operating at 3.579 MHz. Some of this reference frequency signal is taken from pin 7 of U3 and is also used to operate the timing control for U1, the micro-controller.

U1 is the preprogrammed 68HC908JK1 micro-controller. This IC contains the developed code required to take the DTMF tone data from U3 and process it while updating the displays, reading and writing the data into FLASH memory, and driving the external 'Trigger Output' (J2, more on this in a moment). It also continually monitors the front panel arrow buttons and takes action accordingly when the user requests to scan through the stored data or clear the memory.

The previously mentioned external 'Trigger Output' on J2 is an Open Collector transistor driver formed by R7, Q1, and protection diode D4. The micro-

controller switches Q1 'On' or 'Off' providing the user with a closure to ground that can be used to drive an external device such as an event counter, further logic controllers, or even a relay circuit that sets off an alarm (let your imagination run wild)! Whenever the TG2 grabs a DTMF tone, it compares that data to the very first code in memory; this is your Trigger Code. The Trigger Code may be any 1 to 60 digit combination of the 16 different valid DTMF characters. This means you can look for a particular string, or series, of data tones that may be embedded within a larger string of data and the TG2 will alert you by activating Q1 whenever there is a match.

To tell the micro-controller how and when to turn on Q1, jumper blocks J5 and J6 are set by the user. J5 (Series Mode) handles the 'when' aspect of Q1's operation. By setting the jumper block for 'exact match' (J5 jumper Off) or 'contains match' (J5 jumper On), the micro-controller will compare the incoming DTMF data to that of the very first entry to see if the sequential series matches up. An 'exact match' means that the DTMF entries were exactly the same with no other digits preceding or following the series (note: there is a 3 second delay before the Trigger activates to ensure no other data has come in). This is useful for precise code applications to switch a device on or off. The 'contains match' setting means that the proper series was present within a string of received data. This setting can be used to look for a specific series embedded within a long entry of data; like looking for the last 7 digits of a restricted phone number!

The J6 (Trigger Mode) jumper determines 'how' Q1 will function when a series match does occur as specified by the user. By setting the jumper block for 'pulse mode' (J6 jumper Off), Q1 will turn on and provide a closure to ground (40VDC @ 2000 mA max) for 1 second before turning off. In 'toggle mode' (J6 jumper On), Q1 will alternately toggle on and off each time a series match is received.

To this point, the only chip we haven't talked about is U2, a serially loaded seven segment display driver. This chip can be fully configured by software to cover things including brightness, testing of the display, low power mode, and different decode modes for custom characters! It is a really versatile IC and makes driving the displays much easier for the micro-controller.

VR1 and the surrounding parts C3, C4 and the polarity protection diode D1 form a simple voltage regulator to supply a steady 5 VDC to the ICs on the board. By using this scheme, we can operate the unit with a wide range of input supply voltages anywhere from 8 to 15 Volts DC (positive tip on J1).

TG2 PARTS LAYOUT DIAGRAM
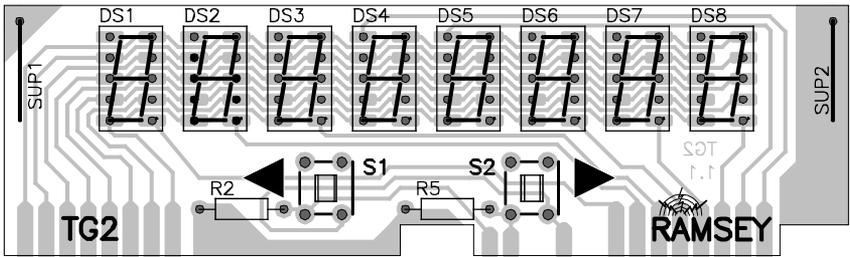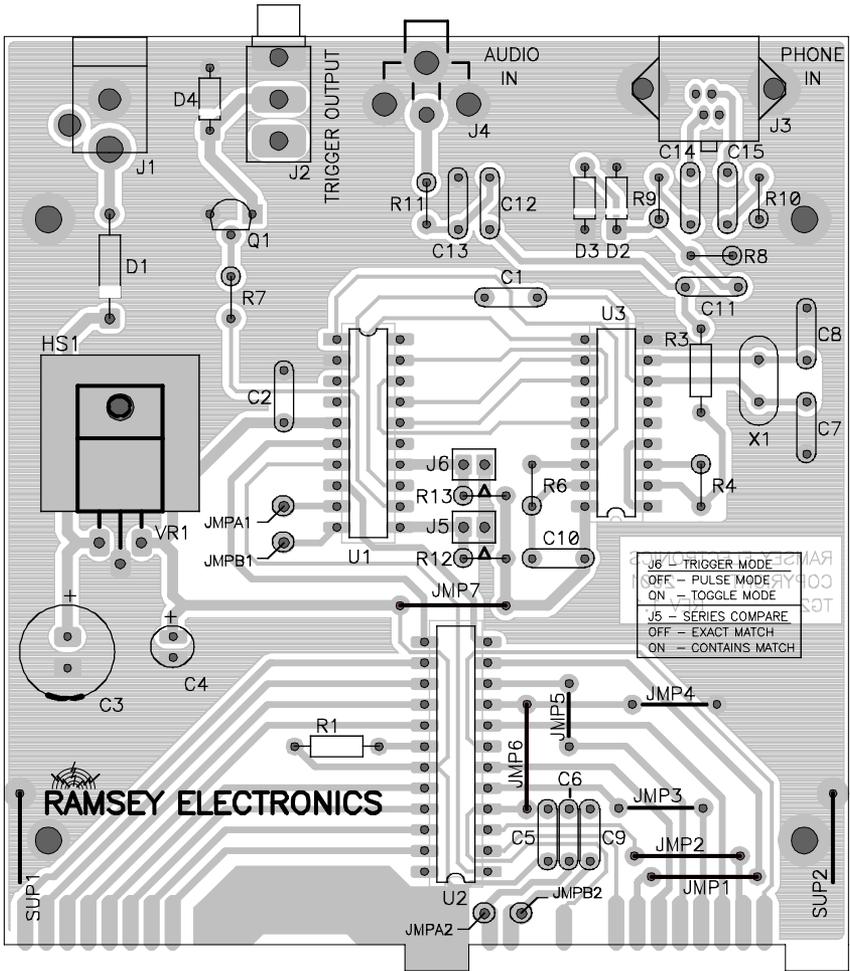
PARTS SUPPLIED WITH YOUR TG2 KIT

Capacitors
- ☐ 2   22 pF disc capacitor (marked 22 or 221) [C7,8]
- ☐ 1   470 pF disc capacitor (marked 470 or 471) [C1]
- ☐ 7   .01 µF disc capacitor (marked .01 or 103 or 10 nF) [C2,5,6,9,13,14,15]
- ☐ 3   .1 µF disc capacitor (marked .1 or 104 or 100 nF) [C10,11,12]
- ☐ 1   10 µF electrolytic capacitor [C4]
- ☐ 1   100 µF electrolytic capacitors [C3]

Resistors and Potentiometers
- ☐ 1   1K ohms (brown-black-red) [R3]
- ☐ 9   10K ohms (brown-black-orange) [R1,2,5,7,8,9,10,12,13]
- ☐ 1   47K ohms (yellow-violet-orange) [R11]
- ☐ 1   100K ohms (brown-black-yellow) [R4]
- ☐ 1   330K ohms (orange-orange-yellow) [R6]

Semiconductors and Integrated Circuits
- ☐ 1   1N4000 series diode (black with white band) [D1]
     -Note that 1N4002-1N4007 diodes may used.
- ☐ 3   1N4148 diodes (small glass diode) [D2,3,4]
- ☐ 1   2N3904 transistor (three leads TO-92 package marked 3904) [Q1]
- ☐ 1   78L05 +5 volt voltage regulator [VR1]
- ☐ 1   HT9170B DTMF decoder IC (18 pin DIP) [U3]
- ☐ 1   MAX7219 eight digit display driver (24 pin DIP) [U2]
- ☐ 1   68HC908JK1 pre-programmed micro-controller (20 pin DIP) [U1]
     (marked with a sticker labeled TG2)

Miscellaneous Components
- ☐ 8   Seven Segment LED displays [DS1,2,3,4,5,6,7,8]
- ☐ 1   3.579 MHz crystal (Marked 3.579 or 3.579545) [X1]
- ☐ 1   2.1 mm DC power jack [J1]
- ☐ 1   3.5 mm mono jack (3 leads) [J2]
- ☐ 1   RJ11 modular phone jack (PCB mount) [J3]
- ☐ 1   RCA jack (PCB mount) [J4]
- ☐ 2   Two pin jumper and jumper block [J5,6]
- ☐ 1   20 pin socket for U1
- ☐ 2   SPST, miniature push button switches (PCB mount) [S1,2]
- ☐ 1   Heatsink, 3/4" x 3/4" layout [HS1]
- ☐ 1   #4-40 Kep nut (HDWE52)
- ☐ 1   #4-40 3/8" screw (HDWE10)
- ☐ 4"   #24 AWG Red & Black insulated hookup wire
- ☐ 4"   length of #20 buss wire

RAMSEY "Learn-As-You-Build KIT ASSEMBLY

There are numerous solder connections on the TG2 printed circuit board. Therefore, PLEASE take us seriously when we say that good soldering is essential to the proper operation of your Tone Grabber kit!

- Use a 25-watt soldering pencil with a clean, sharp tip.
- Use only rosin-core solder intended for electronics use.
- Use bright lighting; a magnifying lamp or bench-style magnifier may be helpful.

Do your work in stages, taking breaks to check your work. Carefully brush away wire cuttings so they don't lodge between solder connections.

We have a two-fold 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. This entails describing the circuit that you are building, instead of just blindly installing components. We hope that this will not only make assembly of our kits easier, but help you to understand the circuit you're constructing.

For each part, our word "Install" always means these steps:

1. Pick the correct component with the proper value to start with.

2. Insert it into the correct PC board location.

3. Orient it correctly, following 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.

5. Trim or nip the excess component lead wire after soldering.

NOTE: Save some of the longer wire scraps nipped from resistors and capacitors. These will be used to form wire jumpers (JMP1, etc.) to be soldered in just like parts during these construction steps.

Enough of that ... let's get started!

TG2 TONE GRABBER KIT ASSEMBLY

Although we know that you are anxious to complete the assembly of your Tone Grabber kit it is best to follow the step-by-step instructions in this manual. Try to avoid the urge to jump ahead installing components.

Since you may appreciate some warm-up soldering practice as well as a chance to put some landmarks on the PC board, we'll first install some of the larger mounting components. This will also help us to get acquainted with the up-down, left-right orientation of the circuit board. Remember that all of the components will be mounted on the component side of the circuit board and soldered on the solder side of the circuit board (the side that contains the printed circuit traces). Have a look at the parts layout diagram to help with your assembly.

Use the boxes to check off your progress.

Check all received parts against the parts list. The parts list describes the various markings that may be found on the kit parts. Carefully sort the parts into small piles, (an empty egg tray does nicely for this purpose) to aid in finding the correct part at the required time.

Today's IC's have achieved remarkable performance levels and it is extremely unlikely that any of your chips will have problems, yet we know that some of our hobbyists insist on socketing all IC components. The addition of these will not "void" your warranty, but if a problem arises from a socketed component you will be required to pay the additional technician fee for labor in the repair of your kit, if necessary.

Now we will install the input and output connectors of the circuit. We use several printed circuit (PC) type jacks to accomplish our interfaces. These jacks typically have several mounting pins associated with each connector. Notice on the schematic how these connectors use extra contacts as switches so that when the plug is inserted the contacts will open. That's how your transistor radio turns off the speaker when you plug in your headphones!

Proper Component Installation:
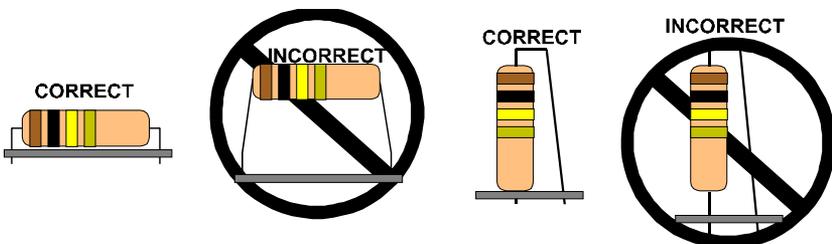
☐ 1. Locate and install the large modular phone jack, J3.

☐ 2. Install R9, 10K ohms (brown-black-orange).

☐ 3. Install C14, .01µF ceramic capacitor (marked .01, 103 or 10 nF). Disc capacitors are not polarized so they can be installed in either direction. The reason we call them "disc" caps can be seen by the package style. The capacitor itself is two conductive discs separated by a dielectric compound.

Cathode   Anode
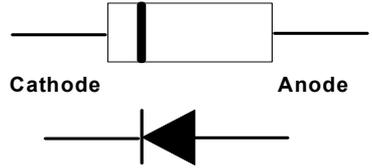
☐ 4. Install C15, .01µF ceramic capacitor (marked .01, 103 or 10 nF).

☐ 5. Install R10, 10K ohms (brown-black-orange).

☐ 6. Install R8, 10K ohms (brown-black-orange).

☐ 7. Install C11, .1µF ceramic capacitor (marked 104 or .1).

☐ 8. Install D2, one of the 1N4148 diodes (small glass diode with black band). The lead closest to the black band is the Cathode end. Make sure it lines up with the white band shown on the PC board silkscreen and the Parts Layout Diagram. Be gentle with this fragile part and double check the orientation before soldering.

☐ 9. Install D3, another 1N4148 diode in the same fashion as D2.

☐ 10. Install J4, the RCA type audio jack, by the edge of the board.

☐ 11. Install R11, 47K ohms (yellow-violet-orange).

☐ 12. Install C13, .01µF ceramic capacitor (marked .01, 103 or 10 nF).

☐ 13. Install C12, .1µF ceramic capacitor (marked 104 or .1).

You've just finished phone line audio monitor through J3 and the line level audio monitor through J4 input circuitry! Make sure you're saving those clipped off leads to use as jumpers later. We'll need 7 of them!

☐ 14. Install U3, the 18 pin DIP tone decoder chip marked HT9170B. Make absolutely sure it is mounted in the proper direction. The small semi-circle on the IC represents pin 1 and should be mounted in the same direction as in the Parts Layout Diagram. Not all ICs in this kit are mounted in the same direction as this one so keep this in mind with later IC installations.

☐ 15. Install R3, 1K ohms (brown-black-red).

☐ 16. Install R4, 100K ohms (brown-black-yellow).

☐ 17. Install X1, the 3.579 MHz crystal (silver metallic can marked 3.579).

Make sure it is flush to the board before soldering.

- ☐ 18 Install C8, 22 pF disc capacitor (marked 22).

- ☐ 19. Install C7, 22 pF disc capacitor (marked 22).

- ☐ 20. Install R6, 330K ohms (orange-orange-yellow).

- ☐ 21. Install C10, .1µF ceramic capacitor (marked 104 or .1).

This concludes the assembly of the entire DTMF decoder section!!! Now let's tackle the micro-controller and a few of its peripherals.

- ☐ 22. Install the 20 pin DIP socket for U1, the 68HC909JK1 micro-controller IC. It doesn't matter which way the socket is oriented, as long as the chip is placed in the socket correctly. You can bend two of the corner leads out slightly to hold the socket in place when you flip the board over to solder it in. Be sure to solder all 20 pins.

- ☐ 23. Now insert U1, the micro-controller marked with a sticker labeled TG2 into the socket. Orient the notched end as shown on the PC board silkscreen, toward J4. Before you push it down into the socket check to be sure that none of the pins are bent under or outside of the socket. When you're sure the pins are where they belong, press it down so that it is seated flat within the socket.

- ☐ 24. Install C1, 470 pF disc capacitor (marked 470 or 471). This capacitor couples over a bit of the X1 clock signal from U3 to run the micro-controller.

- ☐ 25. Install C2, .01µF ceramic capacitor (marked .01, 103 or 10 nF).

- ☐ 26. Install J6, the two pin 'Trigger Mode' jumper. Once it is soldered in you can place the jumper block on it so that you don't lose it! Notice the quick reference silkscreen on the board listing the jumper configuration setups.

- ☐ 27. Install R13, 10K ohms (brown-black-orange).

- ☐ 28. Install J5, the other two pin jumper. This one is for the 'Series Compare' user configuration setting.

- ☐ 29. Install R12, 10K ohms (brown-black-orange).

Now for the external trigger circuitry that is controlled by the micro-controller.

- ☐ 30. Install D4, the last 1N4148 diode with the glass body.

- ☐ 31. Install J2, the mono 3.5 mm external 'Trigger Output' jack. Proper positioning of this part will help you later with case-up so be sure it's where you want it before soldering.

- ☐ 32. Install Q1, the transistor marked 2N3904. The flat side must be placed as shown on the PC board. Mount it as close to the board as possible without forcing it. This component provides you with the Open Collector

trigger output.

☐ 33. Install R7, 10K ohms (brown-black-orange).

Take those clipped off scrap leads from the components you've installed and let's put in jumper wires 1 through 7. These act like electronic bridges that connect circuit traces over the top side of the PC board.

☐ 34. Using one of the scrap component leads, install JMP1. Form it into a staple-like shape and insert it into the holes shown on the silkscreen of the PC board. Make sure you solder both ends of the wire to ensure proper operation. See the Parts Layout Diagram for clarification if necessary.

☐ 35. In the same fashion as JMP1, install JMP2, 3, 4, 5, 6, and 7.

On to the display driver!

☐ 36. Install U2, the 24 pin DIP marked MAX7219. This is the display driver chip that runs the eight displays on the display board. Be careful soldering this part as it is easy to forget a pin or solder a pin to a nearby lead. Also make sure and check its orientation in comparison to the Parts Layout Diagram before soldering.

☐ 37. Install R1, 10K ohms (brown-black-orange).

☐ 38. Install C5, .01μF ceramic capacitor (marked .01, 103 or 10 nF). There is not much to this section but the actual displays are yet to come!

☐ 39. Install C6, .01μF ceramic capacitor (marked .01, 103 or 10 nF).

☐ 40. Install C9, .01μF ceramic capacitor (marked .01, 103 or 10 nF). Note that C6 and C9 are actually part of the user switch assembly (S1 and S2). This was just the best time to put them in!

We'll finish off the component section of the main board now by building up the power supply circuitry.

☐ 41. Identify and install the power connector J1, the 2.1 mm DC power jack at the edge of the PC board. Gently slide the leads through the component side of the circuit board until the connector is mounted flush. Solder all three connections using enough heat to flow the ground connection completely.

☐ 42. Install D1, the 1N4004 diode (black epoxy body with a white band). Watch your polarity like you did with D2!

☐ 43. Install VR1, the 7805, 3 terminal voltage regulator. Place the heatsink, HS1, on the circuit board, lining it up with the silkscreen so that the hole in the heatsink matches the hole in the board. Take the 7805 and place it on top of the heatsink so that the hole in the regulator lines up with the other two. This will show you where to bend the leads down so that the part fits in the PC board holes and lays flat on the heatsink allowing maximum "bleed

off" of heat from the part. Once the leads are bent and through the PC board holes, take the screw and nut and attach the 7805 and the heatsink to the board. In order for the unit to properly mount in its case, insert the screw from the bottom side of the PC board and place the holding nut on the top side. Once the screw is tightened and holding everything in place solder the three leads of the 7805.

☐ 44. Install C3, 100 µF electrolytic capacitor. This part also must be installed properly to function. In fact, this capacitor has the potential to explode if installed in reverse polarity! The PC board silkscreen shows the positive hole and the band on the capacitor shows the negative side. You'll also note that the lead closest to the stripe is shorter than the other lead; this also indicates the negative side.

☐ 45. Install C4, 10 µF electrolytic capacitor. Watch that polarity!

☐ 46. Locate the Red and Black #24 AWG insulated hookup wire provided in your kit. Strip both ends of each wire back approximately 1/4" and "tin" (melt solder on) all four ends to hold the loose strands together.

☐ 47. Using the Red wire, install the jumper between the holes marked JMPA1 and JMPA2.

☐ 48. With the Black wire, jumper between the holes marked JMPB1 and JMPB2. These feed the front panel user switch info to the micro-controller.

Now here comes the fun part, the front panel display board! Take your time on the next few stages as they can make or break your kit. Don't be in a rush to get it done, hook it up, and find you misinterpreted a step and cause big trouble! Play it smart and have patience and your kit will make you proud when it works the first time!

☐ 49. Install DS1, one of the seven segment displays. Pay very close attention to where the decimal point is! It should be positioned in the lower right hand corner when installed correctly. Check and double check orientation before soldering, since desoldering on these fine traces will absolutely destroy them. Make sure the display is flush to the board before soldering; you can bend a few leads slightly over to assist in holding it there while you solder. Use the specialized soldering skills that you learned earlier in this kit, and make sure that there are no solder bridges between pins and other traces on the board. Also make sure you still heat the joints hot enough for a good solid connection.

☐ 50. Hope you had an OK time doing the first display; now you get to do it seven more times! Install DS2 - DS8 using the same technique as before. Start with DS2 and proceed in order, ending with DS8. This prevents finger squeezing and much ranting and raving.

☐ 51. Install R2, 10K ohms (brown-black-orange). Keep it close to the board!

☐ 52. Install R5, 10K ohms (brown-black-orange). Keep it close again!

☐ 53. Install S1, one of the pushbutton switches. Notice that this part only fits comfortably in one direction. Mount this switch flush to the board.

☐ 54. Install S2 in the same fashion, making sure that it to is flush to the board.

Whew! That was some work. But we're almost done. Now is a good time to recheck all your work up to this point. Carefully inspect the circuit boards for stray leads or open solder connections, trim and touch up any that need work.

Now here comes some more fun! It's time to join the two boards together.

☐ 55. Notice the holes in the main board and the display board where SUP1 and SUP2 are located. Using two pieces of stiff buss wire or spare component leads, install the supports to hold the main board and the display boards at a 90 degree angle to each other. Note how the display board is mounted with the solder side toward the main board. Do not solder the display board ends of the supports until after the finger tabs are attached in the next step. This will give you a bit more flexibility and make it easier to position the display at the proper angle.

☐ 56. The display board mounts at a right angle to the main board with solder pads providing both mechanical support and electrical connection between the two boards. The display board is placed against the main board so that the solder pads on the display board line up with the solder pads on the main board. Solder the display board pads flush with the main board pads. Check to be sure the two boards are perpendicular and not tilted, then solder all remaining pads. Use enough solder to provide a good
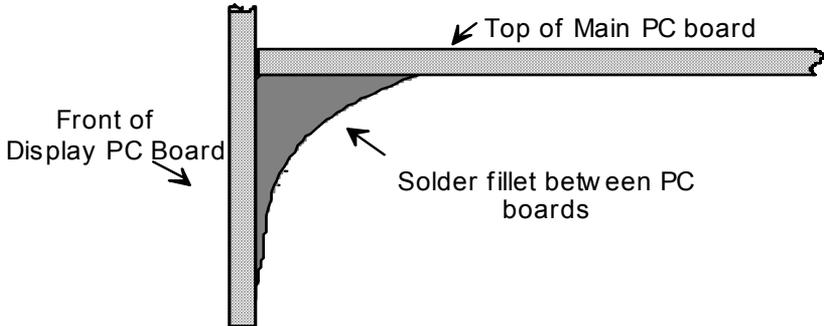

Support wire

Display board

Solder fillet

Main board
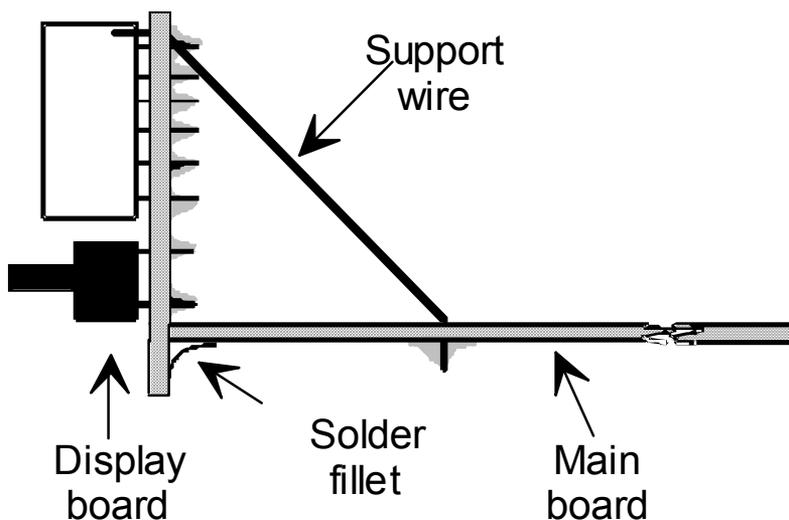
mechanical connection, but don't cause any solder bridges between adjacent pads.

❒ 57. Solder the display board ends support wires in position to add to the structural integrity of the entire board assembly.

CONGRATULATIONS !

Top of Main PC board

Front of
Display PC Board

Solder fillet between PC boards

Your DTMF Tone Grabber is now complete! Have a final look over your work, paying particular attention to the orientation of diodes, capacitors, and IC's. Remember that any problems you find now can save time and effort after the unit has been cased up.

ASSEMBLY INSTRUCTIONS FOR CUSTOM CASE

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

❒ 1. Lay the front and rear plastic plates over their corresponding labels to verify which sticker goes with which panel. You'll want to work with one panel at a time to avoid possible mix-ups.

☐ 2. The front panel sticker will need to be cut to size before you position it on the red front lens panel. Use a sharp hobby knife and a straight edge to trim off the upper half of the front panel sticker that says "CUT OFF BELOW DOTTED LINE". Cut below the dotted line to ensure that the decimal point positions of the LED displays do not get covered by the sticker.

☐ 3. To make sure you know the up/down and left/right orientation of the panels, try positioning them in place before you mount the stickers. This will keep you from accidentally putting the sticker on the wrong side of the panel you are working with. Remove the panels from the case before you attach the stickers or alignment will be very difficult.

☐ 4. Remove the backing material from one of the stickers and line it up properly on its pre-punched panel. Make sure that they are aligned correctly before allowing them to touch the plastic plates. They stick the first time; line them up right!

☐ 5. Use a sharp hobby knife to cut out the holes in the labels along the pre-punched holes. A short sawing motion works well around the inner circumference of the holes.

☐ 6. Repeat the above steps for the other panel.

☐ 7. Insert the board into the case with the push button switches extending through the holes in the front panel.

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

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

TG2 INITIAL TESTING:

Now that the assembly of the unit has been completed, we can move on to testing it! To start with, we are going to need to gather a few items to help us test the circuitry.

- A radio, or a DTMF generator, with an RCA audio patch cable (J3).

                                    OR

- A phone line, with an RJ-11 telephone patch cable, and a phone (J4).

- A power supply 8-15 VDC @ 500 mA (J1)
  (The Ramsey AC125 is ideal 12 VDC @ 500 mA)

☐ 1.   Verify that all parts are mounted and soldered in the correct places. Make sure there are no solder bridges or cold solder joints.

☐ 2. Connect the audio source with the DTMF tones to J3 or J4 respectively.

☐ 3. Carefully plug in the power to your kit (J1) making sure the center pin is positive. The display will briefly flash all "8"s to test each segment.

[On first time power up the memory should be all dashes except for one test phone number that has been programmed into memory as the initial Trigger Code.] If nothing lights on your first power up, quickly unplug the power and consult the troubleshooting section of the manual. If all of the displays light in some fashion, then you're OK for now.

☐ 4. Press and hold both buttons at the same time until the display begins to flash. This is how to clear the regular data memory. To clear the Trigger Code you'll need to press a both buttons again; this prevents having to reenter the Trigger Code ever time the memory is full. Note that this takes about a second or more to do when operating correctly.

☐ 5. Press and hold the left button, and then the right to verify that the decimal point moves in the proper directions. These buttons scroll the "window" across the available 640 memory locations.

☐ 6. Generate some tones into your Tone Grabber with the decimal point lit on the right most display. You should see the appropriate numbers and characters light on the display and scroll to the left.

☐ 7. Generate a series of eights to verify that all of the segments of your displays are operating properly.

If you have made it this far with your kit and have had no problems, you're all set to go! If not, consult the troubleshooting guide in the manual to determine the cause of the problem and how to go about solving it.

TROUBLESHOOTING GUIDE

If your TG2 does not work at all, recheck the following:

- correct orientation of U1, U2 and U3 (see PC board layout diagram)
- correct polarity of all electrolytic capacitors.
- correct orientation of diodes D1 through D4
- all solder connections
- jumper wires at all JMP locations.

Still having trouble?

While we had hoped that it wouldn't come to this, if you are still having trouble with your TG2, here are a few additional suggestions.

PROBLEM: None of the displays light and VR1 regulator gets hot fast.
SOLUTION: You likely have a short across the power supply or you have a component placed in the incorrect orientation. Check all of your parts to make sure they correlate with those in the Parts Layout Diagram.

PROBLEM: None of the displays light and VR1 remains cool.
SOLUTION: Using an oscilloscope or a frequency counter to verify that there is a 3.579 MHz signal on pin 7 of U3 and pin 3 of U1. It should be approximately 0.5 Vp-p or greater. If you cannot check the oscillator, verify that 5 Volts DC is present on the IC power pins (U1:5, U2:19, and U3:18). If not, check VR1 for 5 VDC output with at least 8 VDC input from your power supply.

PROBLEM: Some displays and segments light but others do not.
SOLUTION: There are only two possibilities for this problem. First check with a magnifier to verify that there are no shorts or cold solder joints on the display board behind the displays. Also check the interface between the two boards to make sure everything has been done correctly. Second, you may have a faulty display. Since this is very unlikely, check all of your solder joints again to make sure they are OK. If everything is fine, then see the warranty section of the manual.

PROBLEM: Everything is OK, but no tones can be detected.
SOLUTION: Check around U3 and J3 and J4 for bad solder joints. Also check your audio connections to the unit.

Have another set of eyes look over your work. Here at the shop we have often run into a "stone wall" of a problem only to have a fellow technician see our obvious error. It is sometimes very difficult to see your own mistakes.

USING YOUR TG2

Now we're ready for the moment of truth, the initial power up and running of your TG2! Connect your power supply (8 to 15 VDC) to the J1 power jack and your audio source with the DTMF codes you wish to detect, i.e. the phone line (J3) or radio line out (J4). You can leave it running all day and come back later to review the codes that were used. The unit automatically inserts dashes so that you can easily tell one code set from another (if you fill all 640 memory slots the unit will begin to flash). The front panel arrow buttons allow you to scroll through the stored data and view up to 8 characters at a time; note that the decimal point marks the position of the next open data field. To clear the memory, press both arrow keys for 1 second. This will remove all stored data except for the first entry (the series up to the first dash), this is your "Trigger Code". Double clearing the memory will remove the old "Trigger Code".

User Controls:
1. Left arrow button scrolls through the data to the left.
2. Right arrow button scrolls through the data to the right.
3. Both buttons (for 1 second) to clear all but the "Trigger Code".
4. Both buttons again (for 1 second) to clear "Trigger Code".
5. Jumper block J5 sets the "Series Compare" operation.
   - J5 OFF - Data series must be an "Exact Match" of the "Trigger Code".
   - J5 ON - Data series must only "Contain Match" of the "Trigger Code".
6. Jumper block J6 sets the "Trigger Mode" operation.
   - J6 OFF - Toggle output On (active GND) and Off with each match.
   - J6 ON - Pulse output On (active GND) for 1 second.

Automated Data Handling:
1. A dash "-" is automatically inserted between data stings after 3 seconds.
2. A decimal point shows the location of the next data entry.
3. The 1st data series up to the 1st dash is the "Trigger Code" .
   -To change the "Trigger Code" you must first double clear the memory.

"Trigger Output" (J2) External Connections:
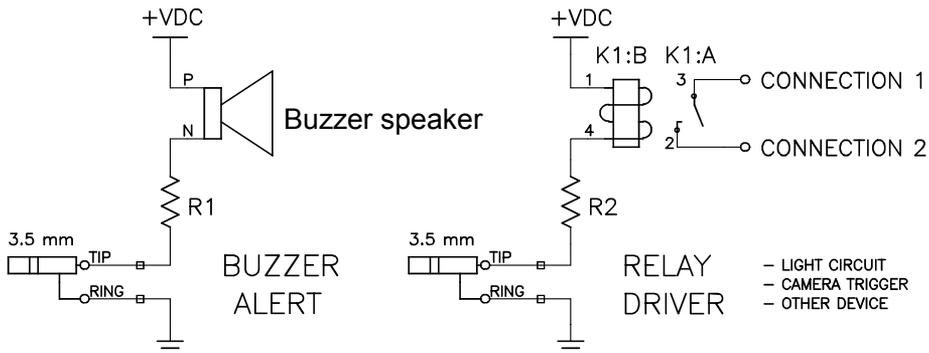
"Trigger Output" Match Examples:

Using the data match feature of the TG2 is very easy. When a match is made between the first entered data series, up to the first dash, and any other data string that follows, the output of J2 will be pulled from its Hi-Z 'Off' state down to the ground (GND) potential. Here is an example of a stored data series and how the J5 and J6 jumper block settings control the J2 "Trigger Output":

J6 - TRIGGER CODE
OFF - PULSE MODE
ON - TOGGLE MODE
J5 - SERIES COMPARE
OFF - EXACT MATCH
ON - CONTAINS MATCH

1234-0-411-18004462295-15859244560-0123456789-1234-.

Data string break down:
- A. 1234 <<< first entry "Trigger Code"
- B. 0
- C. 411
- D. 18004462295
- E. 15859244560
- F. 0123456789
- G. 1234

J2 activation (active low) for the above codes:
(Toggle = change On or Off state of J2 based on its prior state)
(Pulse = turn On (pull low to ground) for 1 second and then Off again)

1. J5 - Off / J6 - OFF => J2 is pulsed low by entry 'G'.
2. J5 - Off / J6 - On => J2 is toggled (On or Off) by entry 'G'.
3. J5 - On / J6 - OFF => J2 is pulsed low entries 'F' & 'G'.
4. J5 - On / J6 - On => J2 is toggled (On or Off) by entries 'F' & 'G'.

With a bit of imagination, you can find many useful applications for the data match trigger capability of your new TG2. Use the unit wisely and you'll be happy with its performance for years to come!

TG2 TONE GRABBER SPECIFICATIONS

Power Supply and External Signal Level Information:
J1 Power Input
 - Input working voltage range: 8 - 15 VDC
 - Max TG2 current draw is between 400 - 450 mA.

J2 "Trigger Output"
 - Active Low - On = ground (0VDC)
 - Hi-Z Off state
 - Max Voltage Rating = 40V
 - Max Current Rating = 200mA

J3 & J4 DTMF Audio Input
 - Signal Level = -29 to 1 dBm
 - Dial Tone Tolerance = 10 dB
 - Noise Tolerance = -12 dB
 - Third Tone Tolerance = -16 dB
 - Frequency Deviation Acceptance = +- 1.5%

Miscellaneous Information:
 - PCB Dimensions: 4.5" L x 4.0" W x 1.2" H

CONCLUSION

We sincerely hope that you enjoy the use of this Ramsey product. As always, we have tried to compose our manual in the easiest, most user-friendly format that is possible. As our customers, we value your opinions, comments, and additions that you would like to see in future publications. Please submit comments or ideas to:

> Ramsey Electronics Inc.
> Attn. Hobby Kit Department
> 590 Fishers Station Drive
> Victor, NY 14564

Please also feel free to visit our Website at www.ramseyelectronics.com and offer your observations to other kit enthusiasts as well.

> And once again, thanks from the folks at Ramsey!

The Ramsey Kit Warranty

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

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

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

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

3. FACTORY REPAIR OF ASSEMBLED KITS:
To qualify for Ramsey Electronics factory repair, kits MUST:
1. NOT be assembled with acid core solder or flux.
2. NOT be modified in any manner.
3. BE returned in fully-assembled form, not partially assembled.
4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of $25.00, or authorization to charge it to your credit card account.
5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.

The repair is $50.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

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

TG2 TONE GRABBER KIT
Quick Reference Page Guide

REQUIRED TOOLS

- Soldering Iron   Ramsey WLC-100,
- Thin Rosin Core Solder   Ramsey RTS12
- Needle Nose Pliers   Ramsey RTS05
- Small Diagonal Cutters   Ramsey RTS04
  <OR> Complete Soldering Tool Set RS64-2801

ADDITIONAL SUGGESTED ITEMS

- Optivisor Magnifier Headband   Ramsey OPMAG
- Holder for PC Board/Parts   Ramsey RTS13,
- Desoldering Braid   Ramsey RTS08

Price: $5.00
Ramsey Publication No. MTG2
Assembly and Instruction manual for:
RAMSEY MODEL NO. TG2

TOTAL SOLDER POINTS
270
ESTIMATED ASSEMBLY TIME
Beginner .... 3.0 hrs
Intermediate ....2.5 hrs
Advanced ....1.5 hrs

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