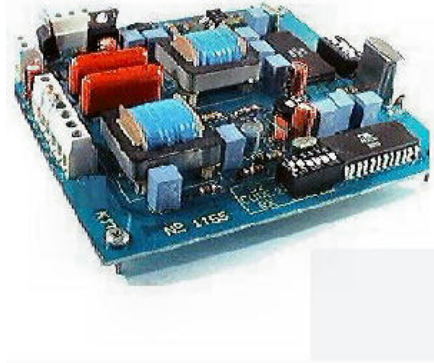


QUASAR KIT No 1155

DUAL CODE TELEPHONE SCRAMBLER

If you think that the bugs live only in their nests without taking care about the human society you are wrong. Even though they aren't visible, they listen and record everything that is relevant to our personal or professional life. Of course, we don't talk about the insects, but about the famous electronic components which are used to overhear telephone conversations.

One way to protect ourselves from such conditions is to use a special detector (Smart Kit 1154). If we are not able to do this, then we can use some other methods. One of them is the use of a dual code (full duplex) telephone scrambler. The scrambler is a pair of circuits that are connected to your telephone device and to the device of the person who is talking with you.



GENERAL DESCRIPTION

The telephone device is one of the simplest and most important devices in the world that makes easier the communication of the people. Also, as you know, it is illegal to eavesdrop on other peoples phone conversations but the reality s that it happens all the time. The only solution is to use a method that corrupts the voice and makes it understandable only by the person who is talking with us.

In order to achieve this, we use special circuits that are known as scramblers. They are structured in pairs and placed at the end of each telephone line in our home. The code that is used to corrupt the voice can be selected by the user. In a telephone conversation, the receiver receives the corrupted voice and starts to decode it using the commands of the selected code. Notice, that the codes which are used during the transmission and the reception must be the same. Hence, even though the bug uses an equivalent decoding circuit it is not so easy to find the code.

TECHNICAL CHARACTERISTICS Supply voltage: 12V to 18V DC. Dissipation current: 30mA DC. 32 combinations dual code.

SCRAMBLING METHODS

The structure is based on two integrated circuits, known as FX224. The two integrated circuits contain two sub-circuits. The first of them is used to codify the voice during the transmission and the other one decodes the corrupted voice. Each time, only one of the two sub-circuits can operate (half-duplex communication), that means, if we wish to have full duplex communication it is necessary to use both of them.

The corruption of the voice is secured by splitting the acoustic spectrum in two bands. The first band contains the low frequencies, while the other one contains the high frequencies. These two bands modulate two carriers. The output signals of the two modulators are added using a mixer and delivered at the output of the FX224. The logic condition on the terminal 8(RX/TX) of the ICs is important for their operation.

This method causes a spectral inversion that is the main reason for the corruption of the voice. The cut-off frequencies of the filters which define the width of each band are programmed using a five digits binary number. Thus, the spectral inversion combined with the different passbands filters realizes the codification of the voice in 32 different combinations making the decoding infeasible.

During the reception of the signal the procedures that are used are the opposite. Considering that the five digits binary number remains the same, the second FX224 that is used as a receiver, demodulates the receiving signal, and sets the low and high frequencies within the acoustic spectrum, delivering the original voice.

A crystal of 1MHz is needed for the right operation of the FX224 without using many external components. Notice that the supply voltage for the FX224 is +5V (DC) and the dissipation current is 8mA.

CIRCUIT OPERATION

Figure 2 shows the points where the device is connected. The signals from the handset microphone are driven to the pins 4 and 9 of the p.c. board.

The signals that are coming from the loudspeaker are applied (through a green wire and a white wire) to the pins 10 and 11 of the p.c. board.

From the other side of the p.c. board, four cables are used to connect the board to the main telephone device. Hence, the scrambler is connected in series to the handset. The electronic diagram of the circuit is shown in figure 1. The integrated circuits IC1, IC2A, IC3A, IC5, IC3B, the transformer T1 and the external resistors and capacitors of them configure the transmission sector of the scrambler.

The IC1 is connected as a current source and it is used to supply the microphone of the telephone device. If your telephone device is a new one, then the IC2 is used as an amplifier.

The signal that is produced at the output of the microphone is appeared at the node, that is configured by the components C1, R5, C4 and C3. Then, it is driven through the IC3A, to the IC5 which is used to code the produced signal.

The circuit that is configured by the components R5, R6, R7 and C4 around the IC3A, is used to develop a pre-emphasis that results in the high frequencies signal improvement of the transmitted acoustic spectrum.

The output TXOUT of the IC5, produces the corrupted signal, that is driven to the low frequencies active filter configured by the IC3B and the components C1, R14, R15, C14 and C15.

The operation of the filter is very important since it eliminates the undesirable spectral components of the decoder output signal. The output signal of the active filter is driven to the transformer T1 and then to the telephone device.

The receiver is configured by the transformer T2, the integrated circuits IC4A, IC6, IC4B and the external resistors and capacitors. The coded signal is applied to the input pins 8 and 9 and then to the loudspeaker of the handset.

The same signal is insulated using the transformer T2. The secondary winding of the T2 drives an adjusted gain amplifier.

The IC4A is the active component of the amplifier and it is used to keep the signal level that is received by the decoder (IC6) stable and independent from the quality of the telephone network. The adjustment of the gain is realized using the trimmer P1. The output of the IC6 (pin 15) produces the demodulated signal that is applied to the de-emphasis circuit, configured by the IC4B, C21, C22, R20, R21, C26, R22. Then the same signal, through the C27, is applied to the output pins 10, 11 and from there to the loudspeaker of the handset.

The two FX224 are supplied by an oscillator circuit that is configured by the crystal Y1 (1MHz) and the components R10, R1, C10, and C9.

The IC6 is supplied by the timing circuit of the IC5 and so the use of a second crystal is not necessary.

The capacitors C6, C7, C8, C23, C24, C25 that are placed around the IC5 and IC6, secure the normal operation of the modulators and demodulators which are included within them.

The DIP switches are used to insert the five digits binary numbers which are used to program the two FX224. The switches of the DIP switch S1 are used to select the

transmission code CODE 1 TX. The switches of the DIP switch S2 are used to select the reception code CODE 2 RX.

Notice, that the mode switch is used to make inactive the use of the SCRAMBLER when the other person does not have the same KIT.

The IC7 is a voltage regulator, which supplies the IC5 and IC6 with a +5V DC, while the components R12, R13, C13 configure the biasing circuit of the IC2, IC3 and IC4. The capacitors C28, C29, C20, C12, are de-coupling capacitors. The diode DI is used to protect the circuit when an inverting polarity supply voltage of 12V DC is applied to the pins 12 and 13. As a power supply circuit you can use the KIT 1061.

CONSTRUCTION

Before the construction of the SCRAMBLER you must follow the following basic instructions.

- 1) All the components must be adjoined to the p.c. board and their terminals must be bent very closely to the upper side of the p.c. board
- 2) Special care should be taken for the polarity of the electrolytic capacitors and the diodes. Notice that the sockets must be located in the same way as it is shown in the layout of the p.c. board.
- 3) Use a 25W soldering iron, together with good quality solder.

Attention: Some components are soldered on both sides of the p.c. board

Begin to place and solder the integrated circuits IC2, IC3, IC4, IC5 and IC6. It is necessary to solder their terminals on both sides of the p.c. board, beginning from the back side. Then place and solder the resistors. The resistors R8, R9, R12, R16 and R19 must be soldered on both sides of the board.

Place the diode DI and solder it on both sides. Then solder the electrolytic capacitors. The capacitor C28 is soldered on both sides, too. Notice that the rest of the components are not necessary to be soldered on both sides of the p.c. board.

Then place the pins and the DIP switches. For more information look at the figure 4.

Finally, place and solder the IC1, IC7, the crystal Y1, the trimmer PI and the transformers T1 and T2.

CONNECTIONS - TEST

In order to test the operation of the scrambler you will need a phone set, from which you will disconnect the handset. Then connect the helix cable of the handset to one of the two plugs of the 4x4 modular.

Connect the wires of the helix cable to the p.c. board in a such way, that the red wire to be resulted to the pin 3, the black one to the pin4, the white one to the pin 11 and the green one to the pin 10 (see figure 2). Use short wires to connect the point 5 to 8 and the point 6 to 9.

Connect the ON - OFF MODE SWITCH as it is shown in the figure 2. Choose the same code for the transmission (CODE 1 TX) and the reception (CODE 2 RX).

Supply the 12V DC voltage. Check if you can listen to your voice from the loudspeaker of the handset when you speak to the microphone.

Adjust the trimmer PI in order to decrease the volume. Check for the good operation of the MODE SWITCH. Change the one of the two codes and check if the corrupted voice is understandable. You will find out that the voice is not understandable when the MODE SWITCH is in the SCRAMBLER position.

Disconnect the supply voltage and remove the short circuits between the points 5 - 8 and 6-9.

Now connect the p.c. board to the phone set using a piece of helix cable and the second

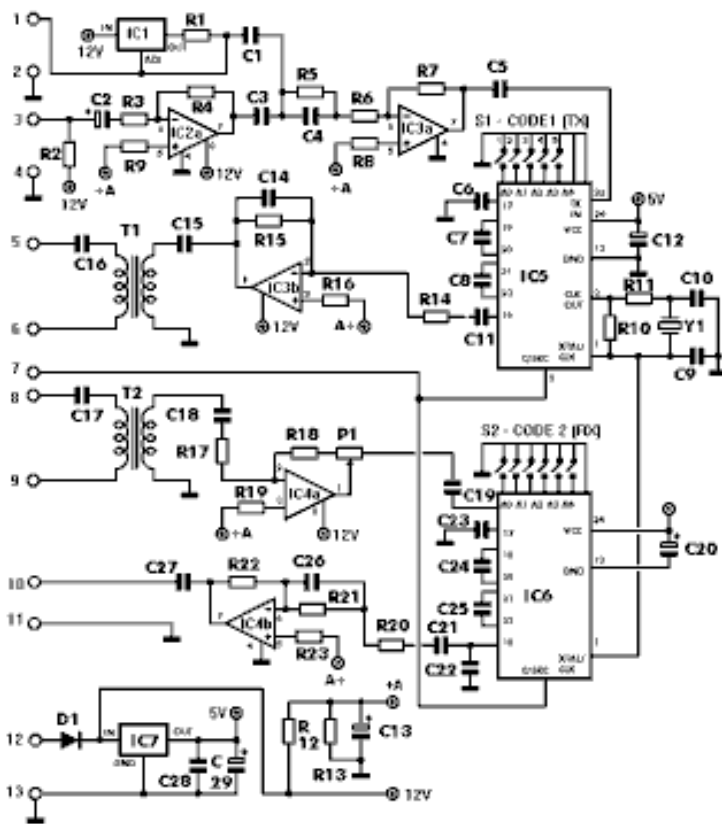
4x4 modular. Connect the black wire of the cable to the pin 5, the red one to the pin 6, the white to the pin 9 and the green to the pin 8 (see figure 2).

Place the handset on the phone set. Connect the supply voltage to the p.c. board. Your device is ready to work with or without the scrambler according to the position of the MODE SWITCH.

Notice that if you want to speak to another person who also has the same SCRAMBLER, it is necessary the CODE 1 TX to be identical with the CODE 2 RX.

NOTE: In the case you use an electronic telephone device, you need a resistor $R_S = 1K\Omega$ in order to connect it to the KIT 1155. The resistor must be connected between the points 8 and 9 of the p.c. board. If it does not work, disconnect the supply voltage and the p.c. board from the handset and check if there are any short circuits.

SCHEMATIC DIAGRAM



PARTS LIST

All components including printed circuit board, assembly instructions including schematics and detailed parts list are supplied when you purchase the kit.

ORDERING

For pricing info and online ordering please visit:

<http://www.quasarelectronics.com/1155.htm>

For further info please contact us by e-mail:

mailto: sales@QuasarElectronics.com