

### GENERAL

The Selectone Model ST-022 is a Miniature Voice Scrambler used in secure two-way radio voice communication systems. The cipher process uses speech inversion and is capable of any 1 of 4 of the most commonly used inversion carrier frequencies. The ST-022 is ideal for commercial, marine, law enforcement, public safety, and government communication systems that require basic protection from casual eavesdroppers. Though the ST-022 is low in cost, the process of speech inversion provides for late entry reception unlike many more expensive units. The ST-022's efficient design provides small size and low power consumption ideal for base station, mobile and portable two-way radio installations. Input and output audio processing filters provide for high quality low distortion audio recovery.

### OPERATION

Operation is almost transparent to the user. The Clear/Cipher Input, which is used to enable and disable the cipher mode, is the only user control. Unlike other units, signalling tones, such as DTMF, will generally work when passed through the ST-022 in cipher mode.

#### Clear/Ciphered Mode:

The ST-022 is a full duplex device, and therefore does not need a PTT Input line to switch between receive and transmit conditions. The receive and transmit audio paths are always active in the unit. If the Clear/Cipher Input is pulled to (-) Supply, the ST-022 will encrypt both transmit and receive audio. If the Clear/Cipher Input is floating or pulled high to a voltage greater than 1 volt, the ST-022 will pass receive and transmit audio unaltered.

**NOTE:** Reception of clear audio with the Clear/Cipher Input being held to GND will produce unintelligible receive audio. Switch the Clear/Cipher input away from GND to receive clear audio.

#### IMPORTANT NOTE:

Operation of radio equipment with encrypted speech capability may be government regulated. You are responsible for compliance with applicable radio regulations regarding operation of this equipment.

#### Did You Know...?

Since the ST-022 is full duplex, it is ideal for use in a repeater/telephone interconnect application.

### OPERATING SPECIFICATIONS

Operating Voltage:	+5.5Vdc to +24Vdc
Operating Current:	Less than 4.5mAdc
Cipher Process:	Frequency Inversion
Synchronisation:	Not Required (Late arrivals accepted)
Audio Input Level:	0 - 2.5 Volts P-P AC coupled, Hi-Z
Audio Output Level:	0 - 2.5 Volts P-P AC coupled, Low-Z
Audio Input / Output Gain:	Less than $\pm 5$ dB
Audio Frequency Response:	300 Hz to 3000 Hz
Carrier Suppression:	Greater than 45 dB
Programming:	2 lines, to select 1 of 4 carrier frequencies
PTT Input:	Not required, unit is full duplex
Clear / Cipher Input:	Pull to (-) Supply for Cipher
Temperature Range:	30°C to +60°C
Interface:	8" Flying Leads
Size:	0.77in X 0.96in X .15in 20mm X 25mm X 4mm

### INSTALLATION

Installation should be done only by a qualified two-way radio technician. Installation consists of selecting an inversion carrier frequency, mounting the ST-022 in the radio set, and making the electrical connections.

The following paragraphs describe each of the external connections. Numbers shown in brackets [#] refer to the 13 connector pin number.

**[3] Positive (+) Supply (RED):** Connect to (+) Supply (+5.5Vdc to 24Vdc). This wire should be connected directly to a filtered source of continuous positive DC voltage in the range of +5.5Vdc to +24Vdc. Make this connection "downstream" from the power switch and the power supply filter components in the radio set. If a regulated source of DC voltage is available, it should be used. Low level audio signals are passed through the ST-022. Use of a quiet and stable source of DC voltage inside the radio will reduce the possibility of picking up power supply noise that may affect these audio signals.

**[9] Negative (-) Supply (BLACK):** Connect to System (-) (Ground). This wire should be connected to a location inside the radio that will supply a DC power ground return to the ST-022. To eliminate ground loops and power supply noise, the ground return should be the same power supply ground used in the transmit and receive audio stages.

**[4] Code Select 1 (WHT/ORG) and**

**[5] Code Select 2 (BLK/ORG):** Used for selecting up to four unique inversion carrier reference frequencies on the ST-022. These leads may be removed from the connector or left open for new system applications. Systems using the ST-022 as an addition to an existing inversion scrambling will have to reference the following frequency chart for compatibility.

**FREQUENCY CHART**

1=Line Floating / Unconnected; 0=Connection to (-) Supply

Freq.	J1-4	J1-5	Usable Voice Band Freq.
3107 Hz	1	1	280 ~ 2830 Hz
3290 Hz	1	0	290 ~ 3000 Hz
3496 Hz	0	1	310 ~ 3190 Hz
3729 Hz	0	0	330 ~ 3400 Hz

**[12] Transmit Audio Input (GREEN) and**

**[13] Transmit Audio Output (WHT/GRN):** These two wires should be connected in series with the transmit microphone audio signal path inside the radio. The optimum location for connection, is directly in series with the microphone. If the microphone requires bias, then the audio path MUST be broken “downstream” of the bias source. In order to provide the best transmit audio quality, be sure that the transmit audio signal path is broken BEFORE the transmit modulation limiter circuit. Also, be sure that the transmit audio path is broken next to a “DC blocking” capacitor, or in such a location as not to upset any internal DC bias voltages in the transmit audio stages. After

the installation is complete, it may be necessary to readjust the transmit modulation slightly in order to compensate for the installation of the ST-022.

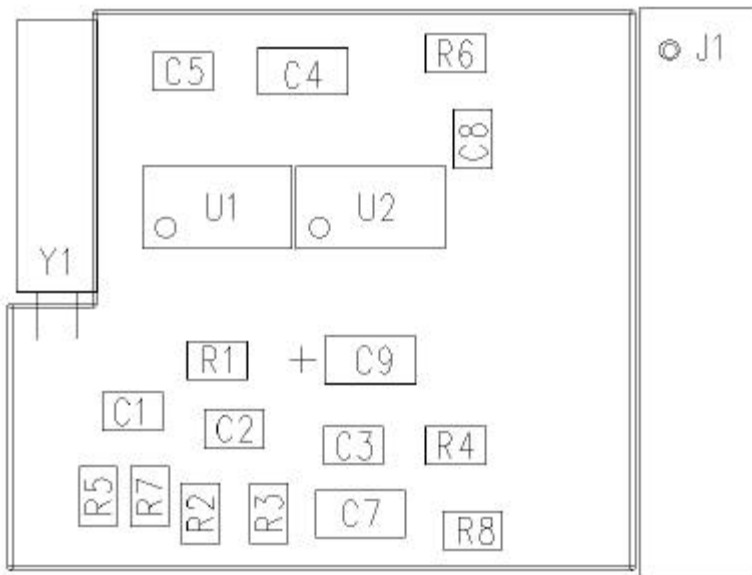
**[10] Clear/Cipher Input (BLK/YEL)**

This wire is used to activate the transmit and receive cipher mode when pulled to ground and may be connected to a two position ON/OFF SPST switch that can be used to enable and disable the cipher mode. If this wire is floating or above 1 volt, the ST-022 will remain in the clear mode.

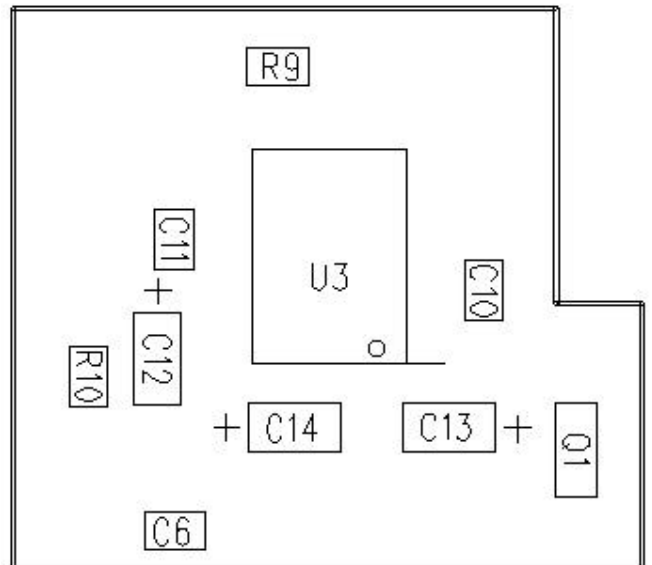
**[11] Receive Audio Input (BLUE) and**

**[1] Receive Audio Output (WHT/BLU):** These two wires should be connected in series with the receive audio path inside the radio. The optimum location for connection is directly off the receiver discriminator circuit BEFORE any audio processing circuits. This connection location will provide high quality audio recovery. Be sure not to break the audio path between the discriminator and the squelch circuit, or between the discriminator and the CTCSS decoder if one is used. Also, be sure that the receive audio path is broken next to a “DC blocking” capacitor, or in such a location as not to upset any internal DC bias voltages in the receiver audio stages. If you find it necessary to break the audio path after a CTCSS decoder, be sure to disable or bypass the CTCSS high pass filter if one is used. The ST-022 will filter out any CTCSS tones as it contains a CTCSS high pass filter.

**ST-022 Component Locator**



**Top Side View**



## Bottom Side View

### ADJUSTMENTS

The transmit and receive audio levels are passed through the ST-022 at near unity gain in clear and cipher modes. In clear and cipher mode, operation should be near transparent compared to unmodified operation.

### Inversion Carrier Frequency Selection:

The four available carrier frequencies are inversion carriers ON or NEAR carrier frequencies commonly used by manufacturers of similar equipment. Applications requiring multiple codes for co-channel users, should be considered carefully. The ST-022 will provide speech security for casual listeners (scanners), or non-equipped co-channel users. Co-channel users with different carrier frequencies may be able to decipher each other. Co-channel users capable of switching carrier frequencies cannot be protected against. Experimentation was done using listeners having minimal radio experience. The results were as follows: Most listeners could derive intelligibility when carrier frequency differences were less than 300 Hz, a few listeners could understand communications with differences up to 500 Hz, and experienced radio operators could often discern communications with differences as great as 900 Hz. For MOST applications the 3107 Hz default carrier is the best choice. Carrier frequency switching should NOT be made available to users. For high security applications, we recommend use contacting the Selectone Sales department for information on products offering increased security.

### WARRANTY POLICY

All standard Selectone products are guaranteed to meet or exceed published performance specifications and are warranted against defects in material and workmanship for a period of five years from the date of purchase. Special configurations and non-standard systems are warranted for a period of one year.

If any standard Selectone product fails to operate within the first 90 days from the date of purchase, Selectone will immediately send out a replacement unit and will issue full credit, including freight, upon the return of the defective unit(s). All prepay/C.O.D. customers must return the defective equipment prior to exchange, otherwise the customer will be required to prepay for the new unit(s) with credit issued only on the return of the defective equipment.

After 90 days, this warranty is specifically limited to correction of the defects by factory or replacement of faulty equipment or parts.

All warranty repairs must be performed at the Selectone factory in Hayward, California. No credit will be given for unauthorized repair work attempted by the customer. Any unauthorized alterations or modification of the equipment, damage caused by external sources, or removal or alteration of the serial number label or date code, will void the warranty. Specifically excluded from this warranty are batteries, fuses, lamps, and damage caused by lightning, power surges, or mechanical abuse.

For equipment to be returned to the factory for repair, you must first call and get an RMA# from Customer Service. The RMA# must be written on the outside of the package, otherwise receiving will reject the shipment. In addition, a note must be sent with the packing list briefly describing the nature of the defect.

For special warranty replacement service, or if any other assistance is required, contact Selectone Customer Service Department at (800) 227-0376, FAX (510) 781-5454, E-Mail [techsupport@selectone.com](mailto:techsupport@selectone.com), or on the WEB at [www.selectone.com](http://www.selectone.com).

**All repairs and returns are to be sent to:**

**Selectone**

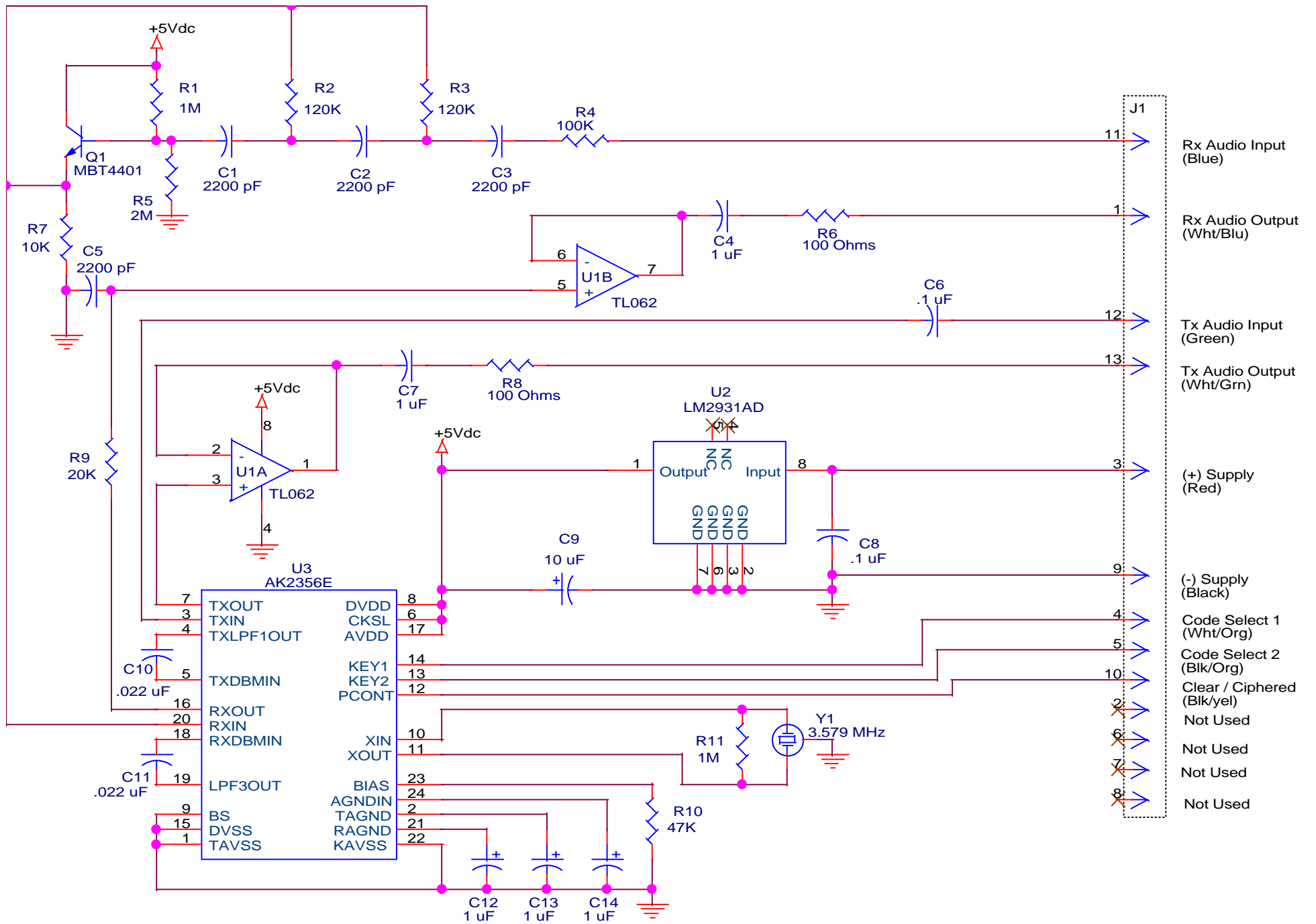
23210 Bernhardt St.

Hayward, CA 94545

Attn: Customer Service

### !! IMPORTANT !!

Selectone supports this product with application assistance on our Toll Free (800) phone line and with APPNOTES (Application Notes). Most radio equipment DOES NOT make provision for easy application of voice encryption equipment by providing an interface connector, as is often provided for CTCSS applications. We recommend use of our application service to determine hookup. Due to our experience with this product, we may be able to provide complete installation more economically than local installation. Please contact our sales department for a quotation. Installation requires a minimum of seven external connections. These connections consists of Power and Ground, Transmit Audio Input and Output, Receive Audio Input and Output, and the Clear/Cipher Input. The most critical connections are the Transmit Audio Input and Output, and the Receive Audio Input and Output. Improper installation of these connections typically results in distorted audio, and the loss of either high or low frequency voice components.



**ST-022 Schematic Diagram**