

## GENERAL


The ST-25A is a voice encryption device used to secure two way radio communication systems. The cipher process uses a proprietary microprocessor controlled analog scrambling algorithm. Each unit can be programmed with four User Code Keys, with over 4 billion code keys to choose from. Special factory set master code key groups are reserved to provide extra security for special services. Each master code key group has over 268 million possible code keys. To maintain security, code keys are never transmitted. Audio processing filters provide high quality low distortion recovered audio. The small size and low power requirements make it ideal for portable, mobile, and base station use.

Field programming is accomplished with either the ST-905 Keypad Programmer or the ST-907 PC based programmer. The ST-905 Keypad Programmer must be Version 1.3 or greater. The version can be found on the bottom of the unit printed on a small white tag. Version 1.3 will read "V1.3". The ST-907 must be Version 3.1 or greater. Version 3.1 will be noted on the distribution disk for ST-CONFIG, and displayed as Ver 3.1 in the upper right hand corner of the display screen when running the ST-CONFIG program. **Older versions of either the ST-905 or ST-907 will not properly program the ST-25A**

## SPECIFICATIONS

Total Code keys:	Over 4 billion
Operating Voltage:	5.2 to 18Vdc
Operating Current:	< 8mA
User Code keys:	Over 268 million
Ciphered Algorithm:	Real time frequency domain
Synchronization:	Initial and maintenance bursts
Delay Before Initial Synchronization:	Programmable 50mS to 1.2S
Audio Input Level:	0.01 to 2.5 Vpp ac
Audio Output Level:	0.01 to 2.5 Vpp ac
Input to Output Gain:	LESS THAN $\pm$ 0.5 dB
Frequency Response:	300 Hz to 2600 Hz.
ST-25A Programming:	External Keypad (ST-905 V1.3) PC Programmer (ST-907 VER 3.1)
Memory:	Non-volatile EEPROM
Indicators:	Visual (LED) or audible (Spkr. Beep)
Digital Inputs:	Logic Low, less than 1 Vdc Logic High, Greater than 4 Vdc
Temp. Range:	30°C to +70°C
Interface:	18" flying leads terminated at a low profile connector
Size:	1.00"W X 1.50"L X 0.25"H (25.4mm X 38.20mm X 6.35mm)

## OPERATION

 **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.

Operation is almost transparent to the user. The user may select any one of 4 previously programmed code keys. The user then enables or disables the transmit cipher mode. Once enabled all subsequent transmissions will be ciphered using the selected code key. Ciphered reception is automatic; other units transmitting with the selected code key will be automatically deciphered. Clear transmissions will also be received automatically.

Each radio model provides different operational challenges. This is generally due to availability of unassigned switches or blank panel space capable of supporting accessory switches. To accommodate these varying situations the ST-25A provides two modes of operation for enabling and disabling transmit cipher operation, and making User Code Key selections.

### SWITCHED MODE

This is the default mode of operation, as shipped from the factory. Clear/Ciphered switching is achieved by a dedicated switch providing a single closure to (-) Supply. User Code Key selection is also selected by a dedicated switch providing a binary input to the two Code Select lines on the ST-25A.

### DOUBLE CLICK MODE

This mode of operation is enabled during programming. Operation with this mode minimizes accessory switch requirements on the radio. The Clear/Ciphered line is connected to any switch (except PTT) capable of providing momentary closures to or away from ground. The switch retains its normal functions; however the user can toggle between Clear/Ciphered by operating the switch two times in rapid succession (Double Clicking). The ST-25A will then provide a tone output to the radio speaker. A high frequency beep or series of beeps indicate subsequent transmissions will be ciphered. A low frequency tone for .5 Sec. indicates subsequent transmissions will be in the Clear (NOT Ciphered).

User Code Keys are selected by operating the same switch four times in rapid succession (Quad Clicking). Quad Clicking permits switching between User Code Keys when in the transmit Cipher Mode (Double Click selection). Each Quad Click transaction advances the selected User Code Key one step around a loop of possible selections (Primary, Alt #1, Alt #2, Alt #3, Primary ...). Following a Quad Click sequence the ST-25A responds with speaker beeps to indicate the selection position (Primary: 1 Beep, First Alt: 2 Beeps, Second Alt: 3 Beeps, Third Alt: 4 beeps). When returning to cipher mode from clear mode,

the last used User Code Key will be selected and indicated with speaker beeps. Following power-up Cipher operation will select the Primary User Code Key. Slow switching of this control permits operation in a normal manner as assigned by the radio manufacturer. Typically this is connected to the monitor switch, but other switches can be used (freq. select).

In either mode a visual cipher indicator is available. An LED can be used to indicate reception of a valid cipher signal as well as transmit in cipher.

### INITIAL SYNCHRONIZATION DELAY

All radio systems have an operating delay. This is the time between PTT activation at a transmitter and speaker audio being available at the receiving point. This time may vary considerably from system to system or even from transmission to transmission. For reliable cipher operation the ST-25A must wait for this time period before signaling the beginning of a ciphered transmission. System delays must be evaluated and accommodated for with the INITIAL SYNCHRONIZATION DELAY parameter.

For many radio operators it is difficult to reliably know how long to wait before speaking in ciphered mode. This can cause loss of the beginning of a message. The ST-25A can be programmed to accommodate this problem. For cipher transmissions the ST-25A will provide all the necessary timing and beep the speaker as a "GO AHEAD" and speak indication.

### USER CODE KEYS

Of the more than 268 million available code keys, four may be selected and easily accessed as User Code Keys for each unit. These may be used to provide different levels of security within a particular radio system (officers, sergeants, lieutenants, captains).

## INSTALLATION

Installation should be done only by a qualified two-way radio technician. Installation consists of programming, then mounting the unit in the radio set, and making the electrical connections.

Installation of secure speech equipment is often time consuming and costly due to the application requirements presented by the radio equipment. Selectone may be able to provide a substantial cost savings for installation. Please contact the Selectone Sales Department for details on factory installation of secure speech equipment.

Selectone supports this product with application assistance on our Toll Free phone line and with APPNOTES (Application Notes). We encourage use of our application service to determine hookup. Most radios do not provide an interface connector for easy installation of voice encryption equipment as is often provided for CTCSS applications. Radios that are not in our application library will receive special consideration and may qualify for sample installation of two units at the Selectone factory for no cost.

Installation requires a minimum of eight external connections. These connections are Power, Ground, Transmit Audio Input and Output, Receive Audio Input and Output, PTT Input, and the Clear/Ciphered Input. The most critical connections are

Transmit Audio Input and Output, and Receive Audio Input and Output. Improper installation of these connections can result in distorted audio, and the loss of either high or low frequency voice components.

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

### [3] POSITIVE (+) SUPPLY (RED)

This wire should be connected directly to a filtered source of continuous positive DC voltage in the range of +5.2Vdc to +18.0Vdc. This connection should be made "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 microphone audio is passed through the ST-25A and use of a quiet and stable source of DC voltage inside the radio set will reduce the possibility of picking up power supply noise that may affect audio signals.

### [9] NEGATIVE (-) SUPPLY (BLACK)

This wire should be connected to a location inside the radio that will supply a DC power ground return to the ST-25A. 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.

### [10] CLEAR/CIPHERED INPUT (BLACK/YELLOW)

**Switched Mode:** This wire is used to select the transmit cipher mode when pulled to logic low (< 1Vdc). This may be accomplished with an ON/OFF SPST switch. When this lead is at logic high (> 4Vdc) the ST-25A will operate in clear mode when transmitting.

**Double Click Mode:** This wire is used as an input line for the Double Click and Quad Click signal. It is normally tied to the monitor switch of the radio, however any switch can be used. The connection point in the radio must switch between logic high (>4Vdc) and logic low (< 1Vdc). The ST-25A analyzes transition between these levels and is not concerned with the resting state. This lead is intended to operate in parallel with the existing radio function without effecting radio operation.

### [12] TRANSMIT AUDIO INPUT (GREEN)

### [13] TRANSMIT AUDIO OUTPUT (WHITE/GREEN)

These two wires should be connected in series with the transmit microphone audio signal path inside the radio set. 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 pre-emphasis and 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.

### [6] PTT INPUT (YELLOW)

The PTT Input detects a pull to ground on the PTT line in the radio set to indicate a transmit condition. To install the PTT Input line on the ST-25A, connect this wire to the PTT line in the radio set at a convenient location.

### [11] RECEIVE AUDIO INPUT (BLUE)

### [1] RECEIVE AUDIO OUTPUT (WHITE/BLUE)

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 detector circuit BEFORE any audio processing circuits (de-emphasis). This connection location will provide high quality audio recovery. Be sure not to break the audio path between the detector and the squelch circuit, or between the detector 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.

### [7] EE CS (BROWN)

**Switched Mode:** This input is only used for programming and the lead should be removed from the connector.

**Double Click Mode:** Speaker beep is vital to operation in this mode. This lead is the beep output. It may usually be connected directly to the high side of the speaker. In some applications direct speaker connection may not be usable. In these cases connect to the input of the receiver audio amplifier through a series resistor. The value of the series resistor will have to be determined experimentally.

**NOTE:** Many portables power down the receiver audio amplifier when squelched. Refer to [4] Code Select 1 Input, Double Click Mode for additional information.

### [2] EE DI/DO (VIOLET)

This input is only used for programming and the lead should be removed from the connector.

### [4] CODE SELECT 1 INPUT (WHITE/ORANGE)

### [5] CODE SELECT 2 INPUT (BLACK/ORANGE)

**Switched Mode:** These two inputs are used for selecting up to four unique code keys on the ST-25A. These inputs may be left unconnected if only the Primary User Code Key is to be used. The three Alternate User Code Keys are selected by connecting these leads to a binary coded switch. The leads are pulled to logic high by 47K resistors on the ST-25A board. The switch must cause switching to ground (logic low) as indicated in Table 1 (Logic High = Open, Logic Low = Grounded).

CODE KEY	Code Select 1	Code Select 2
Primary	Open	Open
1 <sup>st</sup> Alternate	Grounded	Open
2 <sup>nd</sup> Alternate	Open	Grounded
3 <sup>rd</sup> Alternate	Grounded	Grounded

TABLE 1

**Double Click Mode:** In this mode CODE SELECT 1 is redefined and provides an output to enable the receiver audio amplifier for speaker beeping. When beep tones are not present this lead is high impedance. During beeping it is switched to ground through a series 10K resistor. If the receiver audio amplifier is turned off while the receiver is squelched, this output may be used to enable the amplifier for speaker beeping.

### [8] EE SK & CIPHERED/CLEAR LED (BLACK/BROWN)

This output is used to drive an LED. Since the output drive current is only 8mA, a low current high efficiency LED must be used. The CIPHERED/CLEAR LED output should be connected directly to the anode of the LED. The cathode of the LED must be connected directly to ground. This lead is also used for programming and may be left unconnected if not required.

## MOUNTING

Use of a double-sided adhesive pad eliminates hardware requirements. Mount the ST-25A on a clean, dry surface oriented to allow future adjustments should they be necessary. Press firmly after mounting to insure good contact of adhesive. Do not touch the adhesive or attempt to reposition the unit after mounting.

The clear shrink wrap attached to this manual can be used to insulate the ST-25A after all of the adjustments have been made.

## ADJUSTMENTS

### GAIN SETTINGS:

As shipped from the factory, the ST-25A is fully functional for many applications. However experience indicates the ST-25A functions best when audio signals internal to the ST-25A are at or near pre-determined levels. To optimize operation, receive and transmit levels must be evaluated independently and the proper gain setting resistors must be installed. Use the following procedures to determine the input level for the receive and transmit audio paths. The measured levels are for evaluation with TABLE 2. Use TABLE 2 to select resistor values for optimum operation. Measurements may be made with an oscilloscope or an AC level meter. For convenience TABLE 2 presents input levels in mV peak to peak and mVrms.

Input Level				Gain Resistor	
mVpp		mVrms		TX R47 RX R7	TX R46 RX R22
From	To	From	To		
10	21	3.5	7.5	7.5 K	8.2 K
22	39	7.6	14	15 K	15 K
40	72	15	25	27 K	27 K
73	133	26	50	51 K	56 K
134	243	51	85	100 K	100 K
244	446	86	160	180 K	200 K
447	818	161	290	430 K	470 K
819	1499	291	530	1.2 M	1.5 M
1500	2500	531	885	---	---

TABLE 2

**Receive:** Measure the level on the [11] **RECEIVE AUDIO INPUT (BLUE)** lead while receiving a full quieting signal modulated at full system deviation. Use this level to select R7 and R22 from TABLE 2.

**Transmit:** The RF generated by the transmitter often makes it difficult to make accurate measurements for the microphone circuit. Two methods of measurement are presented, the first does not always produce accurate results. If method 1 does not appear effective use method 2.

#### METHOD 1

Key the transmitter and while speaking loudly into the microphone, measure the level on the [12] **TRANSMIT AUDIO INPUT (GREEN)** lead. Use this level to select R47 and R46 from TABLE 2.

#### METHOD 2

Disconnect the [12] **TRANSMIT AUDIO INPUT (GREEN)** from its connection in the radio. Use an audio signal generator to inject a 1KHz tone into this lead. Key the transmitter and adjust the output level from the signal generator to produce 2/3 system deviation as measured on a service monitor. Un-key the transmitter and measure the output level from the signal generator. Use this reading multiplied times 3 to select R47 and R46 from TABLE 2.

**NOTE:** In some cases the output level from the signal generator may be too low for accurate readings, or the level may be difficult to adjust. In these cases build a resistive divider with the supplied 7.5K and 15K resistors from the resistor packs. Don't damage the resistors they may be required as gain resistors. Connect the 15K to the output of the signal generator, connect the 7.5K to (-) Supply for the ST-25A, and connect the junction between the resistors to [12] **TRANSMIT AUDIO INPUT (GREEN)**. Key the transmitter and adjust the output level from the signal generator to produce 2/3 system deviation as measured on a service monitor. Measure the output level from the signal generator. Use this reading to select R47 and R46 from TABLE 2.

Don't forget to reconnect the [12] **TRANSMIT AUDIO INPUT (GREEN)** lead in the radio.

### SYNCHRONIZATION LEVEL:

During cipher transmissions the ST-25A transmits synchronization information approximately twice per second. This signal carries no coding information but is necessary for proper operation. For optimum performance the synchronization bursts should be adjusted to produce 1/2 system deviation.

After installation is complete, switch to the cipher mode and key the transmitter. Using a service monitor with an oscilloscope display, adjust R10 for a peak reading of  $\pm 1/2$  system deviation. Deviation readings made with a deviation meter may not accurately measure the intermittent synchronization burst signal. If proper adjustment is difficult or not possible, the transmit audio gain may be set incorrectly. Repeat the gain setting procedure for the transmitter using METHOD 2. If difficulties continue, contact the Selectone Applications Department for assistance.

## PROGRAMMING

Field programming is accomplished with either the ST-905 Keypad Programmer or the ST-907 PC based programmer. The ST-905 Keypad Programmer must be Version 1.3 or greater. The version can be found on the bottom of the unit printed on a small white tag. Version 1.3 will read "V1.3". The ST-907 version must be Version 3.1 or greater. Version 3.1 will be displayed as VER 3.1 in the upper right hand corner of the display screen when running the ST-CONFIG program. **Older versions of either the ST-905 or ST-907 will not properly program the ST-25A**

Whether using the ST-907 or the ST-905 there are 6 parameters to be considered for programming. They are:

- |                |  |
|----------------|--|
| 1. Parameter 0 | Initial Synchronization Delay                              |
| 2. Parameter 1 | First Alternate User Code Key                              |
| 3. Parameter 2 | Second Alternate User Code Key                             |
| 4. Parameter * | Third Alternate User Code Key                              |
| 5. Parameter 3 | Primary User Code Key                                      |
| 6. Parameter 9 | Operating Mode<br>(Switched/Double Click,<br>Clear/Cipher) |

The ST-907 uses the DOS program ST-CONFIG and provides all necessary hookup and programming information as screen prompts.

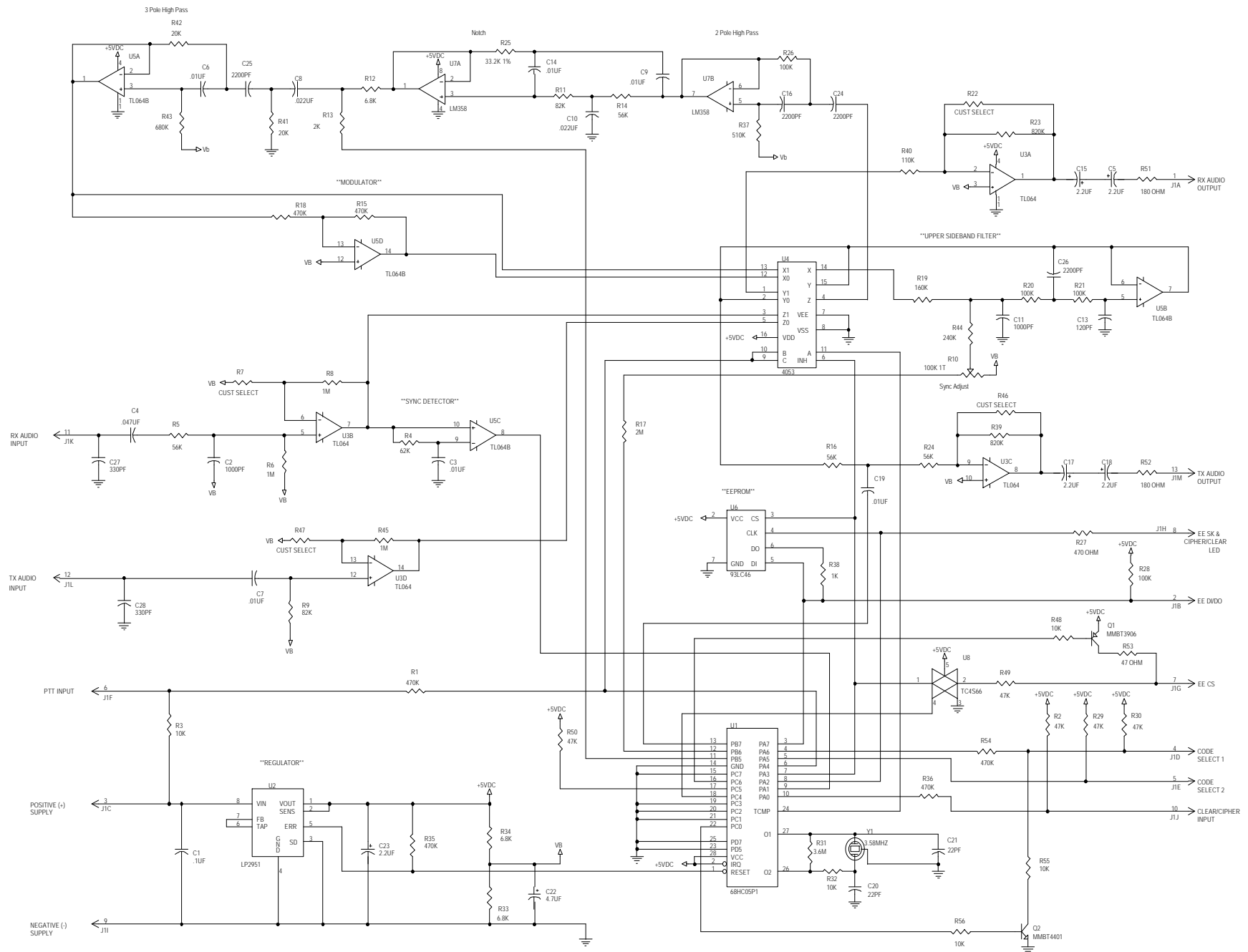
To use the ST-905 use the following procedure.

1. Connect the Red (+) and Black (-) leads of the ST-905 to a 6 to 18 Vdc power source (a 9 Vdc transistor battery is an acceptable power source.)
2. Connect the ST-905 to the ST-25A with the supplied cable.
3. Enter the value desired.
4. Press \* and # simultaneously [\*#].
5. Enter the parameter number.
6. Repeat steps 3 through 5 for each parameter.

### INITIAL SYNCHRONIZATION DELAY (Parameter 0)

Nine possible entries are available for this parameter. The value selected determines the delay time the ST-25A will use between operation of the PTT and Initial Synchronization. Delays are available in 100mS steps from 50mS to 850mS. The value entered is the 100's digit of the required delay. For example 0 = 50mS, 1 = 150mS, 2 = 250mS etc. Factory default is 2 or 250mS.

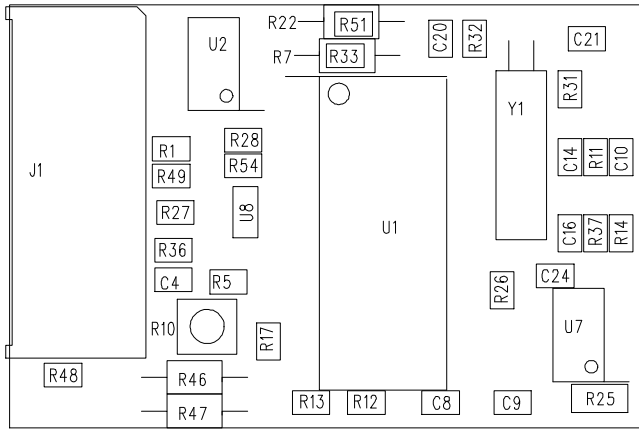
If 9 is entered the delay is set to 1.2 Sec. At the end of this time period an audible beep is sent to the speaker. The beep indicates "GO AHEAD" and speak. For most operations the 9 selection will provide the most friendly user interface. However the beep outputs must be connected for this feature to be effective.



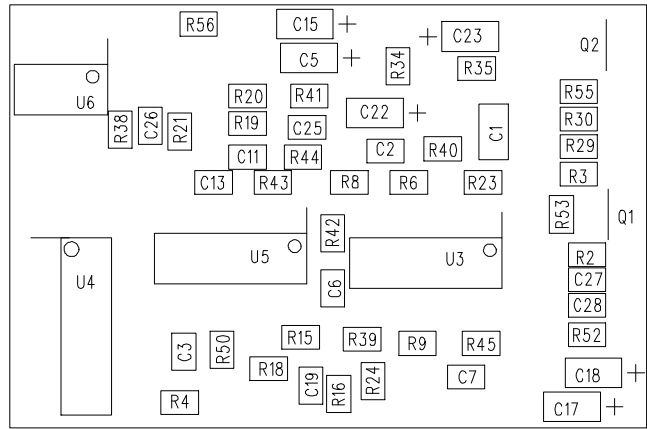
Note: Sync level set = 2.5Vp-p



# ST-25A Component Locator



TOP SIDE



BOTTOM SIDE

The ST-25A uses a multi-layer printed circuit board. Field repair is not recommended.

## USER Code Keys (PARAMETERS 3, 1, 2, \*)

**Note:** The security of your system depends on the secrecy of your code keys. For secure operation we recommend changing your code keys often. ST-905 or ST-907 CAN NOT be used by another party to compromise your code key selections.

Each of the four User Code Keys may be any combination of keypad characters in a seven digit sequence. This seven digit sequence allows for more than 268 million code keys. It is not necessary to program the alternate User Code Keys if they are not used. The default values for the four User Code Keys are as follows.

USER CODE KEY	PARAMETER	DEFAULT CODE KEY
Primary	3	4444444
1st Alternate	1	2222222
2nd Alternate	2	3333333
3rd Alternate	*	1111111

## OPERATING MODE (Parameter 9)

This parameter has three possible values.

- [1] Double Click Mode, power up Clear
- [2] Switched mode
- [3] Double Click Mode, power up Cipher

## PROGRAMMING EXAMPLE:

INITIAL SYNCHRONIZATION DELAY = 350 mS  
 Primary USER CODE KEY = 12345AD  
 First ALT. USER CODE KEY = DA54321  
 Second ALT. USER CODE KEY = 0987654  
 Third ALT. USER CODE KEY = \*\*\*##6  
 OPERATING MODE = Double Click

## KEY STROKES

3[\*#] 0  
 12345AD[\*#]3  
 DA54321[\*#]1  
 0987654[\*#]2  
 \*\*\*##6[\*#]\*  
 1[\*#]9

**Note:** Export of this product is under the jurisdiction of the U.S. Department of State, Office of Defense Trade Control. **An Export License is Required**

## 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 date of purchase. Special configurations and nonstandard systems are also 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 a replacement unit postpaid via airmail or UPS Blue Label (air), and will issue full credit, including freight, upon the return of defective unit(s). For special warranty replacement service, call the Selectone Customer Service Department TOLL FREE at 1-800-227-0376. C.O.D. customers must return defective equipment prior to exchange or will receive the replacement C.O.D. with credit issued only on return of the defective equipment.

After 90 days, this warranty is specifically limited to correction of the defects by factory repair 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 alteration or modification of the equipment, damage 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, LED's, fuses, lamps, and damage caused by lightning, power surges, or mechanical abuse.

Equipment for repair may be returned to the factory without prior written authorization; however, a note must be sent with the packing list briefly describing the nature of the defect.



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