Selectone

GENERAL

The ST-104 Econotone is a low cost version of our popular ST-101 CTCSS Encoder/Decoder. Cost of purchase and installation have been primary design considerations. Our extensive applications experience has provided insight for design modifications to simplify field installation. Although these modifications have resulted in a slight increase in board size over the ST-101, the ST-104 will be significantly less expensive for most mobile applications.

Like the ST-101 and ST-102, the ST-104 is fully compatible with all major CTCSS systems, including Motorola "Private Line", General Electric "Channel Guard", and RCA "Quiet Channel".

Because of our comprehensive warranty policy, you should probably not have to consider any field repair; however, if repair is unavoidable, all parts are clearly labeled on our diagram and should be generally available through component distributors.

Application notes are available for over 100 different radio models. These notes provide mounting details, connection points, and radio modifications required (if any). If you would like application details for a specific radio, please call us TOLL FREE at (800) 227-0376, or in California call (415) 887-1950. Together we may be able to save you some time and money.

OPERATING SPECIFICATIONS

OPERATING VOLTAGE:	10.5Vdc to 30Vdc (reverse polarity protected); or 5Vdc to 16Vdc (for use on regulated supply)
OPERATING CURRENT:	Less than 7mA 10.5Vdc to 30Vdc; or less than 5mA 5Vdc to 16Vdc (with voltage regulator removed)
FREQUENCY RANGE:	67Hz to 250.3Hz (Continuously Tunable)
OPERATING TEMP. RANGE	Exceeds EIA RS220A (-30°C to +60°C)
FREQUENCY STABILITY:	Exceeds EIA RS220A (less than ±.5%); typically less than ± .2%
ENCODER OUTPUT LEVEL:	Adjustable 0 to 1Vrms (10.5 Vdc to 30Vdc supply)
ENCODE OUTPUT LEVEL STABILITY:	Less than ± 1dB change 67Hz to 250.3Hz
SINE WAVE OUTPUT PURITY:	Less than 1% THD
DECODER INPUT LEVEL:	20mVrms to 2Vrms
DECODER INPUT IMPEDANCE:	Greater than 100K
HIGH PASS FILTER:	May be muted by decode output
DECODER ACTIVATE:	Field selectable (+) or (-) logic
DECODER OUTPUT:	Open collector sink 40mA to (-) supply or source (+) voltage. Four possible output conditions or H.P. filter muting.
INTERFACE:	18" flying leads terminated to Molex plug on ST-104; or specific application interface harness
SIZE:	2" L x 1.5" W x .38" top of components (.6" top of plug)
MOUNTING:	Double sided pressure sensitive tape

INSTALLATION

We have attempted to configure the ST-104 to require minimum installation time for most radios. If you do not have application information for your particular radio call us at (800) 227-0376 outside California or (415) 887-1950 in California. We want your ST-104 application to be as inexpensive for you as possible.
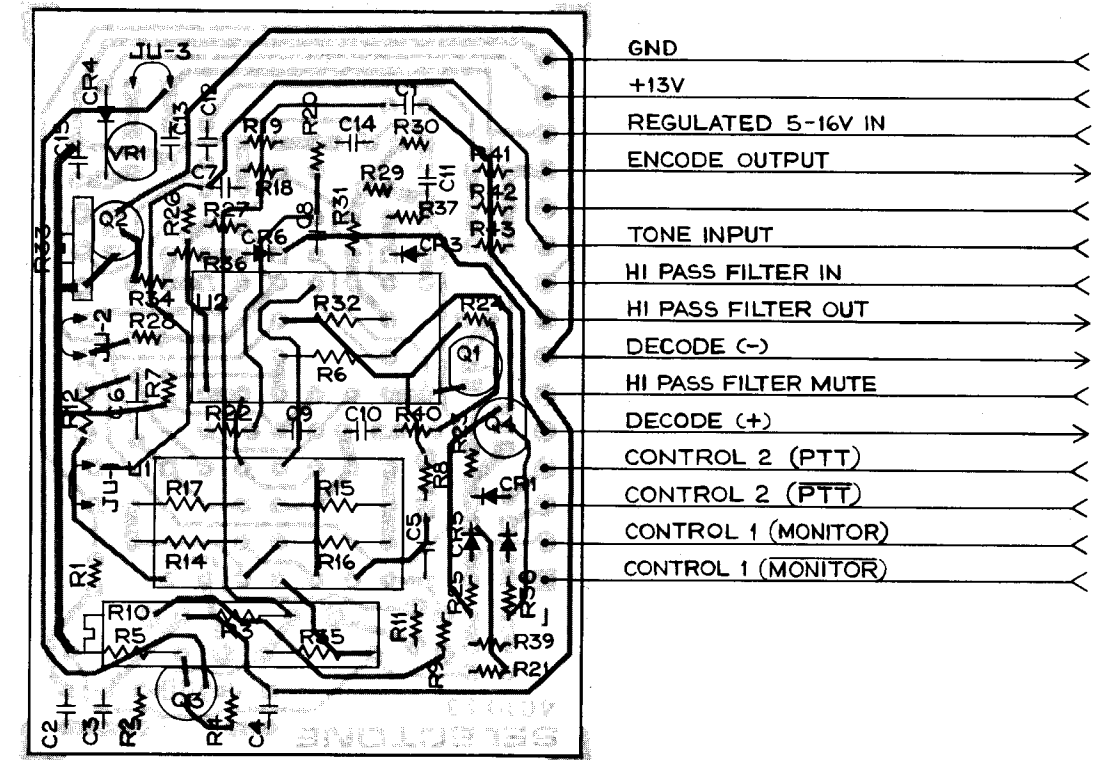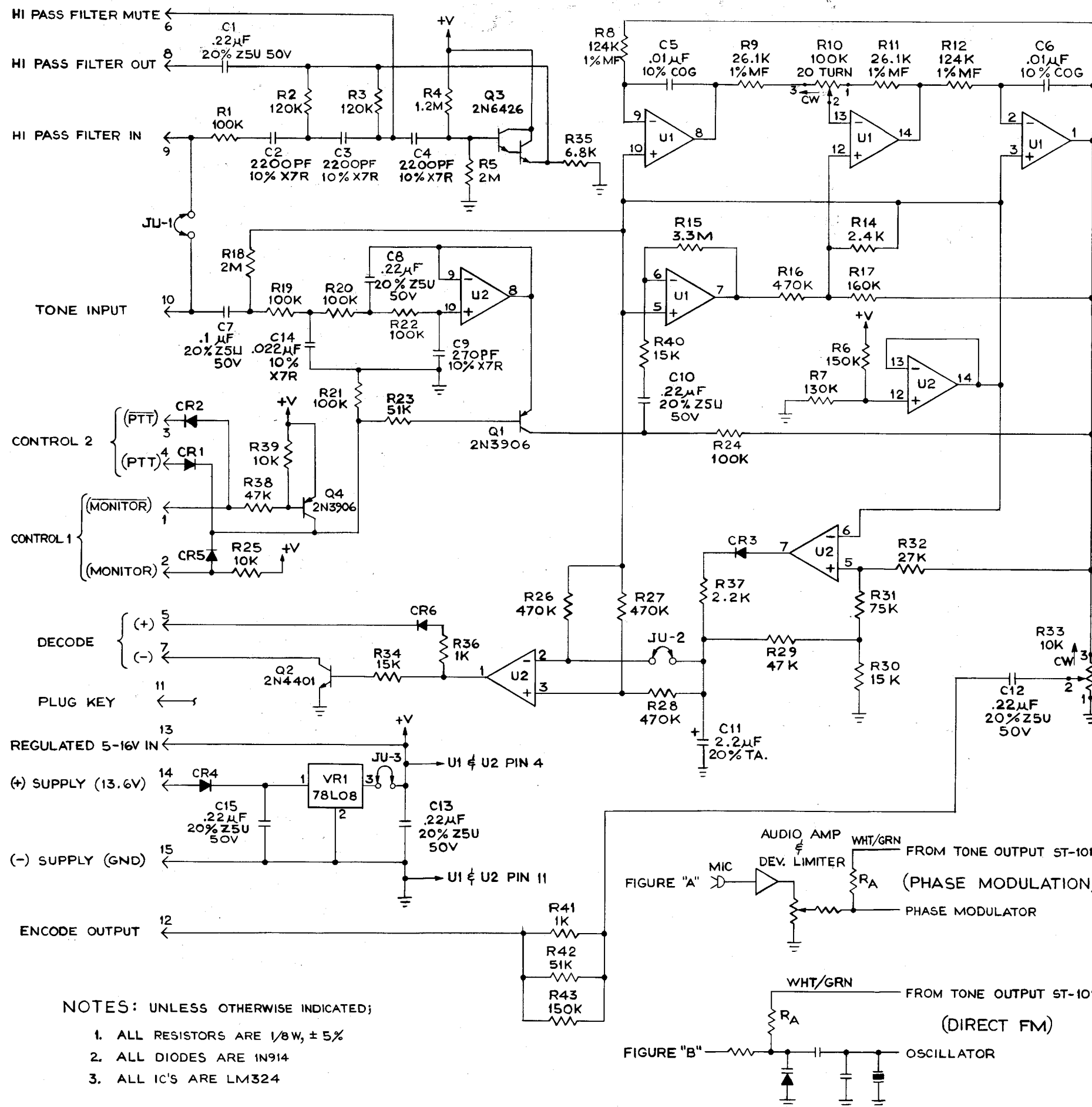
The following (5) leads supplied connected to the Molex plug will generally be used for all applications.

(15) (-) Supply (Black): Connect to system (-) (ground)

(12) Tone Output (Wht/Grn): Connection should be similar to figure A or B. R_A is to avoid modulator loading. Cut R41 or R42 to to make R_A larger.

(10) Tone Input (Green): Jumpered to Hi Pass Filter Input by JU1. Connect directly to FM receiver detector audio output. Breaking the audio path at this point will allow insertion of the Hi Pass Filter. If it is not practical to break the audio path at this point refer to (9) Hi Pass Filter Input (Blue).

(8) Hi Pass Filter Output (Wht/Blu): Connect to place Hi Pass Filter in series with receiver audio path.

(2) Control 1—Monitor (Brown): Primary control of Encoder/Decoder functions. Connect to (-) supply (ground) through monitor/hookswitch to mute the radio. Open from (-) supply (ground) to encode and monitor. If your monitor switch closes to ground to monitor, connect control 1 directly to (-) supply (ground) and refer to (1)control 1A for switch hook-up.
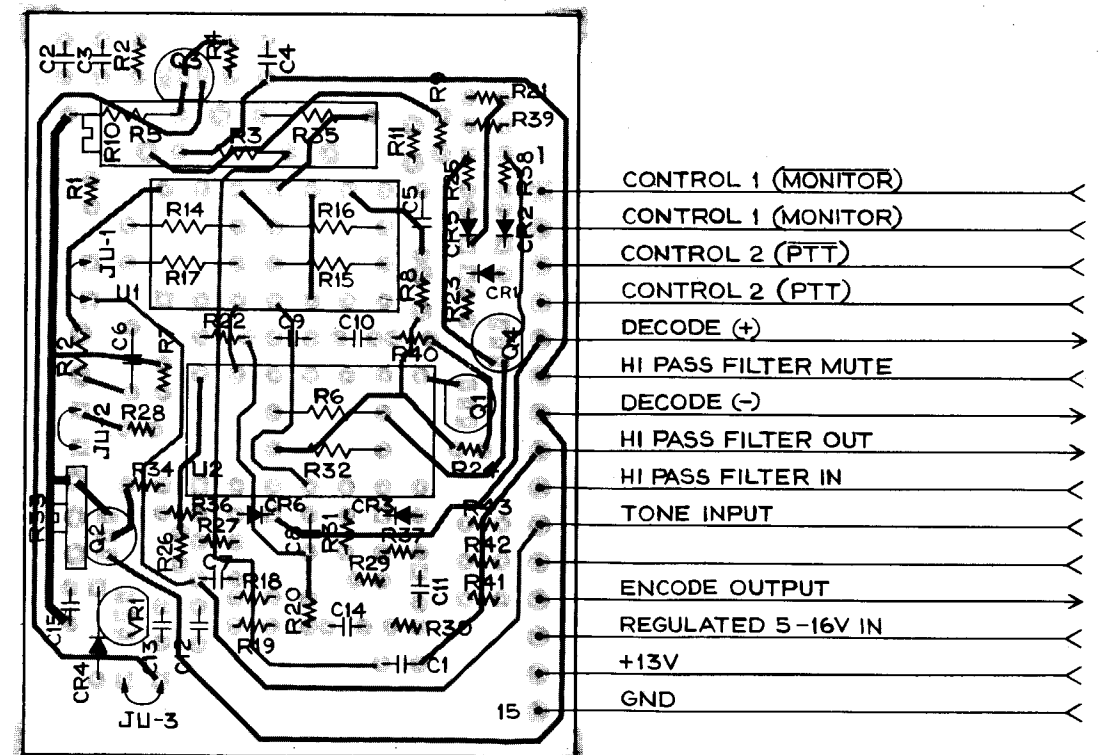
The remaining leads **must be added** to the ST-104 connector to fill specific applications requirements. Insert Molex pins in the appropriate connector position according to your application.

(14) (+) Supply 10.5Vdc to 30 Vdc
(13) (+) Supply 5Vdc to 16Vdc regulated (clip JU3) — Connect (Red) to (+) supply

(9) Hi Pass Filter Input (Blue): Use only when (10) Tone Input (Green) can not be used for H.P. filter input. Cut JU1. For applications where breaking the audio path at the FM receiver detector is not practical. Hi Pass Filter Input audio should be taken at the most convenient point. NOTE: Will not work in Hi Level audio stages (Speaker Leads).

(7) Decode/Mute (-): For applications where the radio mute point must be held at (-) supply (ground) **until** decode or monitor.

(7) Decode/Mute (-) JU 2 Cut: For applications where the radio mute point must be connected to (-) supply **(ground) upon decode or monitor.**

(5) Decode/Mute (+): For applications where the radio mute point must be held **(+) until** decode or monitor.

(5) Decode/Mute (+) JU2 Cut: For applications where **(+)** must be **applied** upon decode or monitor.

Connect (wht/org) for your application

(7) Decode/Mute (-) Jumpered
to
(6)Hi Pass Filter Mute — Use the small (wht/org) jumper if none of the above conditions apply. This will mute the Hi Pass filter until decode or monitor.

NOTE: Installation continued on back page.

ASSEMBLY & SCHEMATIC — ENCODER/DECODER

HI PASS FILTER MUTE 6

C1 .22μF 20% Z5U 50V

HI PASS FILTER OUT 8

+V

HI PASS FILTER IN 9

R1 100K
R2 120K
R3 120K
R4 1.2M
Q3 2N6426
R35 6.8K

C2 2200PF 10% X7R
C3 2200PF 10% X7R
C4 2200PF 10% X7R
R5 2M

R8 124K 1% MF
C5 .01μF 10% COG
R9 26.1K 1% MF
R10 100K 20 TURN CW
R11 26.1K 1% MF
R12 124K 1% MF
C6 .01μF 10% COG

U1 (9, 10, 8)
U1 (13, 12, 14)
U1 (2, 3, 1)

JU-1

R18 2M
R19 100K
R20 100K
C8 .22μF 20% Z5U 50V
U2 (9, 10, 8)
R22 100K
C9 270PF 10% X7R

TONE INPUT 10

C7 .1μF 20% Z5U 50V
C14 .022μF 10% X7R

R15 3.3M
R14 2.4K
U1 (6, 5, 7)
R16 470K
R17 160K
+V
R40 15K
C10 .22μF 20% Z5U 50V
R6 150K
R7 130K
U2 (13, 12, 14)

R21 100K
R23 51K
Q1 2N3906
R24 100K

CONTROL 2 (PTT) 3
CR2
CONTROL 2 (PTT) 4
CR1
+V
R39 10K
R38 47K
Q4 2N3906

CONTROL 1 (MONITOR) 1
CR5
R25 10K +V
CONTROL 1 (MONITOR) 2

CR3
U2 (7, 6, 5)
R32 27K
R37 2.2K
R31 75K

DECODE (+) 5
CR6
R36 1K
R34 15K
Q2 2N4401
U2 (2, 1, 3)
DECODE (−) 7

JU-2
R26 470K
R27 470K
R29 47K
R30 15K
R28 470K
C11 2.2μF 20% TA.
R33 10K CW
C12 .22μF 20% Z5U 50V

PLUG KEY 11

REGULATED 5-16V IN 13

+V
JU-3 → U1 & U2 PIN 4
VR1 78L08
C13 .22μF 20% Z5U 50V

(+) SUPPLY (13.6V) 14
CR4
C15 .22μF 20% Z5U 50V

(−) SUPPLY (GND) 15
→ U1 & U2 PIN 11

ENCODE OUTPUT 12
R41 1K
R42 51K
R43 150K

FIGURE "A"
AUDIO AMP & DEV. LIMITER
MIC
WHT/GRN FROM TONE OUTPUT ST-101
R_A
(PHASE MODULATION)
PHASE MODULATOR

FIGURE "B"
WHT/GRN FROM TONE OUTPUT ST-101
R_A
(DIRECT FM)
OSCILLATOR

NOTES: UNLESS OTHERWISE INDICATED;
1. ALL RESISTORS ARE 1/8 W, ±5%
2. ALL DIODES ARE 1N914
3. ALL IC'S ARE LM324

SOLDER SIDE

GND
+13V
REGULATED 5-16V IN
ENCODE OUTPUT
TONE INPUT
HI PASS FILTER IN
HI PASS FILTER OUT
DECODE (−)
HI PASS FILTER MUTE
DECODE (+)
CONTROL 2 (PTT)
CONTROL 2 (PTT)
CONTROL 1 (MONITOR)
CONTROL 1 (MONITOR)

COMPONENT SIDE

CONTROL 1 (MONITOR)
CONTROL 1 (MONITOR)
CONTROL 2 (PTT)
CONTROL 2 (PTT)
DECODE (+)
HI PASS FILTER MUTE
DECODE (−)
HI PASS FILTER OUT
HI PASS FILTER IN
TONE INPUT
ENCODE OUTPUT
REGULATED 5-16V IN
+13V
GND

Installation continued.

(1) Control 1A-Monitor (Blk/Brn): If your monitor switch closes to [-] supply [ground] to monitor, then control 1-monitor must be tied to [-] supply [ground.] Use this lead for close to [-] supply [ground] to monitor/encode.

(3) Control 2 (PTT): For applications with close to [-] supply [ground] for PTT [transmit]

(4) Control 2 (PTT): For applications where a keyed [+] is available during transmit.

} Connect [yellow] for your application

MOUNTING

Use of a double-sided adhesive pad eliminates hardware requirements. Mount the ST-104 on a clean, dry surface oriented to allow future adjustments should they be necessary. Press firmly after mounting to insure good adhesive contact. Do not touch the adhesive or attempt to reposition the unit after mounting.

The ST-104 has been designed for maximum immunity to RF interference; however, an effort should be made to locate the unit as far as possible from the radio's RF power stages. To further minimize RF problems, twist the power leads together and maintain all leads at a minimum length.

ADJUSTMENTS

The ST-104 is continuously tunable over the standard CTCSS frequency range from 67HZ to 250.3HZ. To set frequency, apply power and connect the white/green [tone output] lead to a frequency counter. Adjust R10 for desired CTCSS frequency. You may find the use of a lissajous figure with a known on frequency reference the quickest frequency set up procedure, or as an alternate if a counter is not available. The output level of the ST-104 is set with R33. Adjust R33 for approximately .75 khz deviation.

WARRANTY POLICY

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

If any standard Selectone products 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 this special warranty replacement service, call the Selectone customer service department TOLL FREE at [800] 227-0376 [In California call [415] 887-1950].

After 90 days, this warranty is specifically limited to correction of the defects by factory repair or replacement of the faulty equipment or parts. Any unauthorized alteration or modification of the equipment or damage caused by external sources will void the warranty.

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.

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

PARTS LIST

Schematic Reference	Description	Selectone Part No.
	CAPACITORS	
C1, C8, C10, C12 C13, C15,	.22uf, 50V, 20%, Z5U, Ceramic	5-17-422
C2, C3, C4	2200pf, 50V, 10%, X7R, Ceramic	5-14-222
C5, C6	.01uf, 50V, 10%, COG, Ceramic	5-11-310
C7	.1uf, 50V, 20%, Z5U, Ceramic	5-17-410
C9	270pf, 50V, 10%, X7R, Ceramic	5-14-127
C11	2.2uf, 16V, 20% Tantalum	5-47-522
C14	.022uf, 50V, 10%, X7R, Ceramic	5-14-322
	DIODES	
CR1-CR6	1N914	6-51-914
	INTEGRATED CIRCUITS	
U1, U2	LM324 (National) Op Amp	6-31-324
VR1	78L08 (Motorola)	6-32-808
	RESISTORS	
	Note: Unless otherwise indicated, all resistors are .125 watt, 5%, carbon film.	
R1, 19, 20, 21, 22, 24	100K	7-11-410
R2, R3	120K	7-11-412
R4	1.2M	
R5, R18	2.0M	7-11-512
R6, R43	150K	7-11-415
R7	130K	7-11-413
R8, R12	124K, 1%, MF, RN55D	7-33-124
R9, R11	26.1K, 1%, MF, RN55D	7-32-261
R10	100K, 20 Turn Pot, Spectrol 43P104	7-65-410
R14	2.4K	7-11-224
R15	3.3M	7-11-533
R16, R26, R27, R28	470K	7-11-447
R17	160K	7-11-416
R23	5 1K	7-11-251
R25, R39	10K	7-11-310
R29, R38	47K	7-11-347
R30, R34, R40	15K	7-11-315
R31	75K	7-11-375
R32	27K	7-11-327
R33	10K, Single Turn Pot	7-62-310
R35	6.8K	7-11-268
R36, R41	1K	7-11-210
R37,	2.2K	7-11-222
R42	51K	7-11-351
	TRANSISTORS	
Q1, Q4	2N3906	6-53-906
Q2	2N4401	6-54-401
Q3	2N6426	6-54-426
	CONNECTOR, 15 PIN P.C. MOUNT	8-23-015
	ADHESIVE PAD, SCOTCH #4408	8-18-100

CALL SELECTONE TOLL FREE!
(800) 227-0376