SOLDER SIDE

COMPONENT SIDE

TONE OUTPUT (WHT/GRN)
(−) SUPPLY (BLK)
(+) SUPPLY (RED)

FIGURE "A"

MIC

AUDIO AMP AND DEV. LIMITER

WHT/GRN FROM TONE OUTPUT ST-100
(PHASE MODULATION)
R_A
PHASE MODULATOR

FIGURE "B"

WHT/GRN FROM TONE OUTPUT ST-100
(DIRECT FM)
R_A
OSCILLATOR
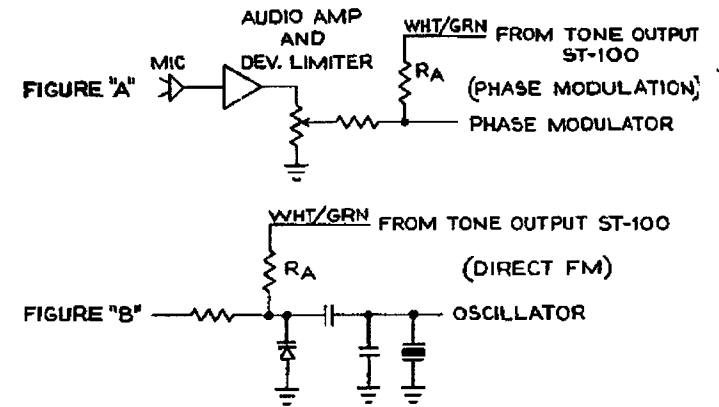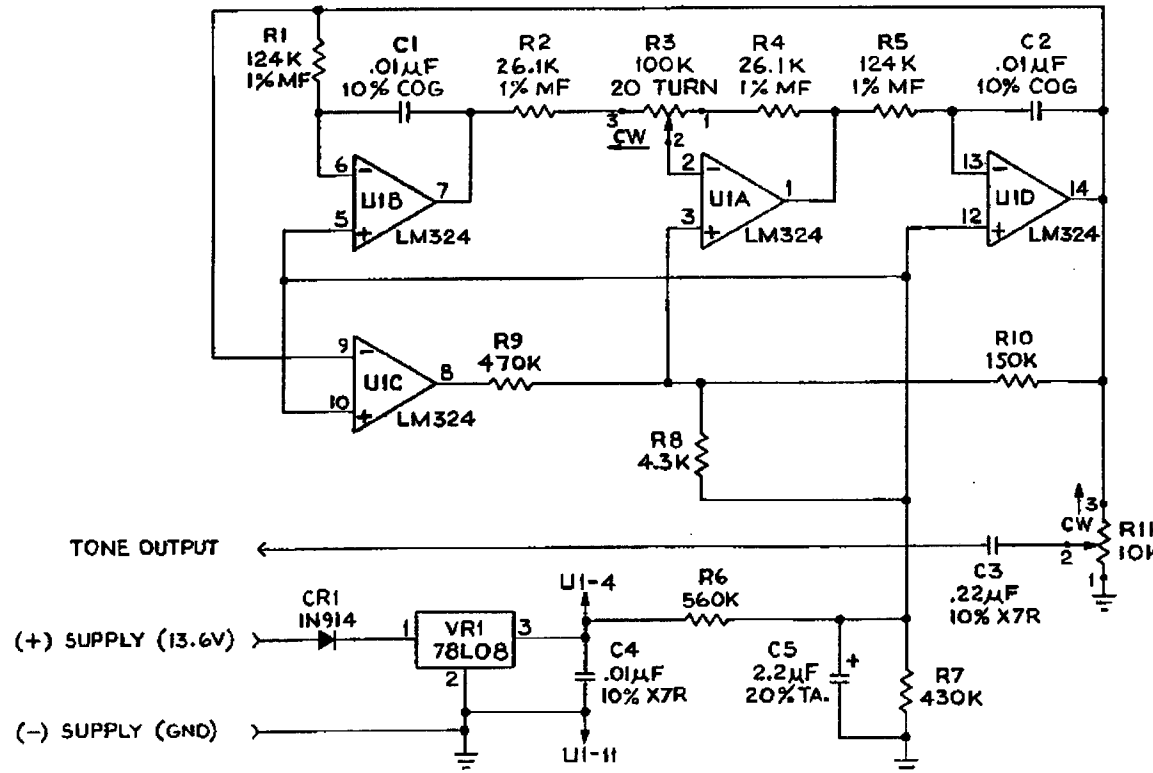
NOTE: UNLESS OTHERWISE INDICATED
ALL RESISTORS ARE 1/8W, ±5%

R1
124K
1%MF

C1
.01µF
10% COG

R2
26.1K
1% MF

R3
100K
20 TURN
CW

R4
26.1K
1% MF

R5
124K
1% MF

C2
.01µF
10% COG

U1B
LM324
6 7 5

U1A
LM324
2 1 3

U1D
LM324
13 14 12

U1C
LM324
9 8 10

R9
470K

R10
150K

R8
43K

R11
10K
CW

C3
.22µF
10% X7R

TONE OUTPUT

CR1
1N914

VR1
78L08

U1-4

R6
560K

C4
.01µF
10% X7R

C5
2.2µF
20%TA.

R7
430K

U1-11

(+) SUPPLY (13.6V)

(−) SUPPLY (GND)

ASSEMBLY & SCHEMATIC
ST-100 CTCSS ENCODER

S C1109

Installation Instructions

Midland Syn-Tech LMR CTCSS Encoder/Decoder

General

The C1109 CTCSS Encoder/Decoder has been designed specifically for the Midland range of mobile radios. The C1109 is designed to connect to both the Midland Syn-Tech LMR and the Midland 8 channel LMR. The C1109 is compatible with all systems using the standard EIA CTCSS tone frequencies and fully complies with EIA RS-220-A.

Mounting

Remove the four (4) screws securing the radio top and bottom covers and remove the covers. Turn the radio upside down on the bench. Screw the threaded standoff supplied with the CTCSS board into the left-hand hole located in the option area in front of the receiver board. The C1109 is mounted connector side down on the standoffs using the three (3) screws supplied.

TX Lockout Option

The TX Lockout option is often used in community repeater systems. The TX lockout mode the radio will only transmit if:

(a) There is no carrier present, OR

(b) There is carrier present AND it has the correct CTCSS tone.

To install TX Lockout the optional components shown on the circuit diagram overleaf must be loaded. Cut track "C" on the C1109 p.c.b. The input J359-3 on the Midland Syn-Tech must be linked to the carrier detect input on the C1109.

The radio's monitor switch, and corresponding LED, should be disconnected when in the TX lockout mode. The correct way to do this is to unfasten the front panel of the radio and identify the monitor switch and LED connections on the solder side of the PCB (refer to the radio service manual). Isolate the monitor and LED connections by cutting the respective tracks directly from the monitor switch.

Tone Frequency Selection

As supplied, the C1109 can be programmed to encode and decode any of the 31 EIA Group A and B tones. The module can also be programmed for group C frequencies, or for certain combinations of group A, B and C frequencies. Refer to the chart for details.

The chart adjacent lists the programme code and the corresponding CTCSS tones as a function of the conditions of "Y" (pin 22 of U1 of the C1109) and "F" (pin 17 of U1 of the C1109). "Y"(U1 pin 22) is normally connected to earth via pin 15 and 14 on U2 and then PCB track "A". This is referred to as "Y=0". If track "A" is cut and tied to +5V, the condition is referred to as "Y=1". Similarly, "F"(U1 pin 17) is normally not connected. This condition is referred to as "F=1".

When a wire link is placed from pin 17 to earth, this is referred to as "F=0". Note: Non-valid programme code/combinations are indicated in the chart by a "-". If such a combination is selected, the module will NOT encode and will assume the decoded state. This non-valid code combination may be used where networks contain both CTCSS and non CTCSS channels.

"Y"	=	U1 pin 22
"F"	=	U1 pin 17
"0"	=	Earth
"1"	=	NC

Prog Code	Y=0 F=1	Y=1 F=1	Y=0 F=0	Y=1 F=0
0	-	-	-	-
1	241.8 (B)	-	71.9 (B)	77.0 (A)
2	233.6 (A)	-	79.7 (C)	85.4 (C)
3	225.7 (B)	-	82.5 (B)	88.5 (A)
4	218.1 (A)	-	91.5 (C)	*97.4 (C)
5	210.7 (B)	-	94.8 (B)	100.0 (A)
6	203.5 (A)	-	103.5 (B)	110.9 (B)
7	192.8 (B)	-	107.2 (A)	114.8 (A)
8	186.2 (A)	-	118.8 (B)	127.3 (B)
9	179.9 (B)	-	123.0 (A)	131.8 (A)
10	173.8 (A)	-	136.5 (B)	146.2 (B)
11	167.9 (B)	-	141.3 (A)	151.4 (A)
12	162.2 (A)	-	156.7 (B)	167.9 (B)
13	156.7 (B)	-	162.2 (A)	173.8 (A)
14	151.4 (A)	-	179.9 (B)	192.8 (B)
15	146.2 (B)	-	186.2 (A)	203.5 (A)
16	141.3 (A)	-	210.7 (B)	225.7 (B)
17	136.5 (B)	-	218.1 (A)	233.6 (A)
18	131.8 (A)	-	241.8 (B)	-
19	127.3 (B)	-	250.3 (A)	-
20	123.0 (A)	-	-	-
21	118.8 (B)	*97.4 (C)	-	-
22	114.8 (A)	-	-	-
23	110.9 (B)	91.5 (C)	-	-
24	107.2 (A)	-	-	-
25	103.5 (B)	85.4 (C)	-	-
26	100.0 (A)	-	-	-
27	94.8 (B)	79.7 (C)	-	-
28	88.5 (A)	-	-	-
29	82.5 (B)	74.4 (C)	-	-
30	77.0 (A)	-	-	-
31	71.9 (B)	**67.0 (C)	-	-

* Not defined by EIA but is often referred to as a group "C" tone.

** This tone is often referred to as an EIA tone group "C" but is in fact a group "A" tone.
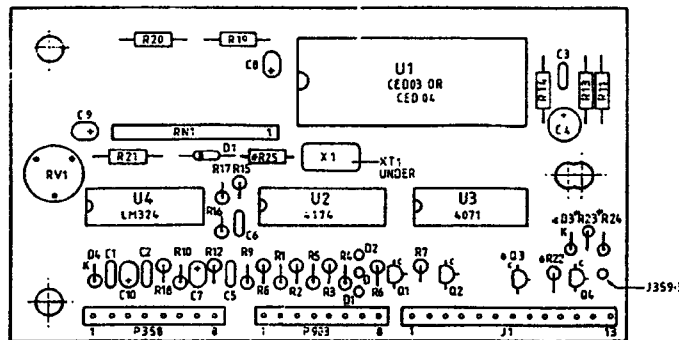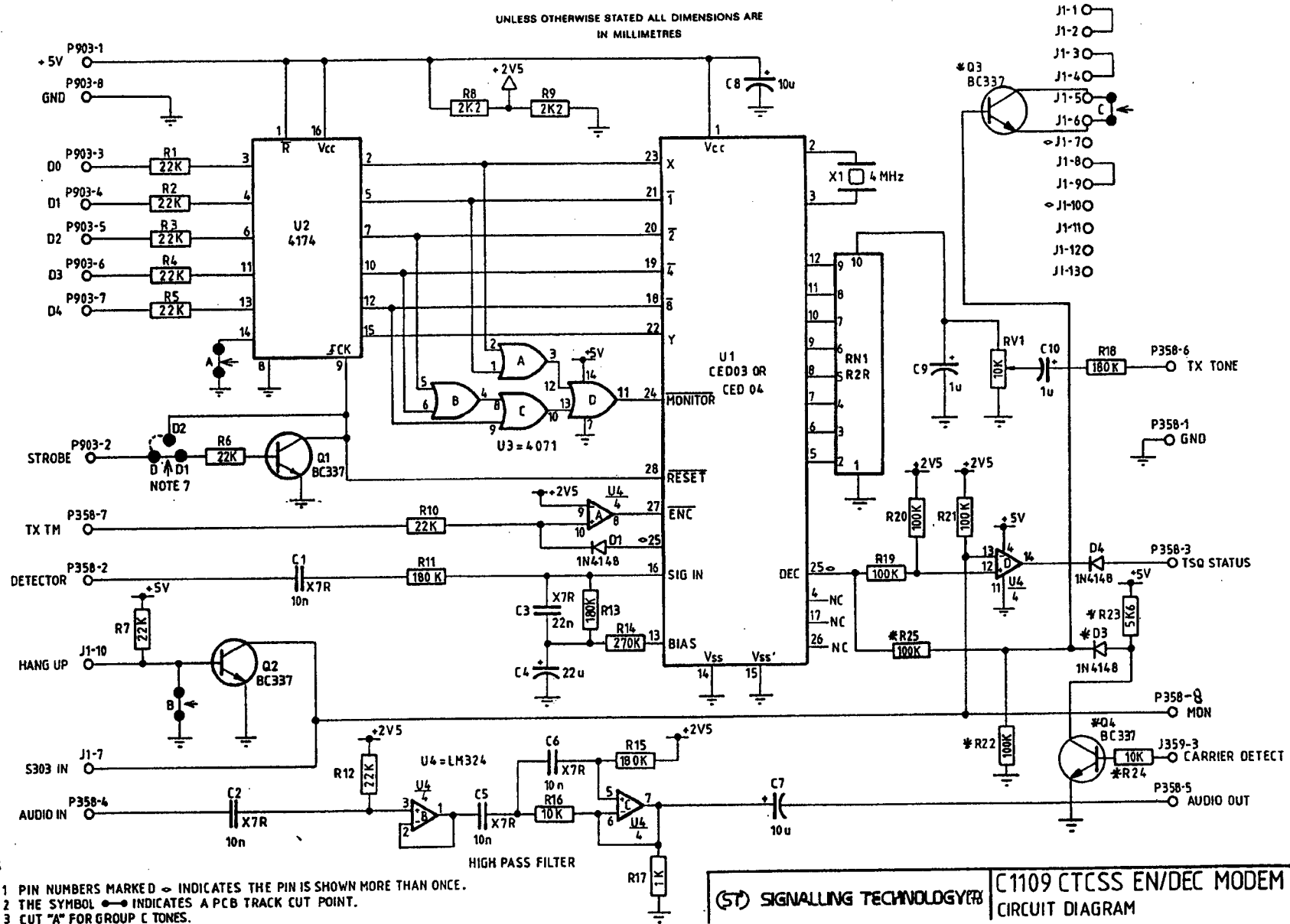
Output Level Adjustment

CTCSS modulation level adjustment is made by the pot RV1, located on the C1109. Refer to the radio service manual for complete alignment instructions.

Warranty

Our products are warranted for a period of 24 months from the date of purchase against faulty materials and workmanship. Should any fault occur the unit should be returned to the Vendor, freight pre-paid. Please include a brief description of the fault to assist with prompt return. Any unauthorised alterations or repairs will invalidate the warranty.

NOTE 1: COMPONENTS MARKED ✱ ARE SUBJECT TO TX INHIBIT OPTION.

Figure 1: Component Layout

UNLESS OTHERWISE STATED ALL DIMENSIONS ARE
IN MILLIMETRES

NOTES

1 PIN NUMBERS MARKED ○ INDICATES THE PIN IS SHOWN MORE THAN ONCE.
2 THE SYMBOL ●—● INDICATES A PCB TRACK CUT POINT.
3 CUT "A" FOR GROUP C TONES.
4 CUT "B" WHEN USING HANG UP BRACKET.
5 CUT "C" WHEN USING SELCALL OR TX INHIBIT OPTION.
6 COMPONENTS MARKED ✱ ARE SUBJECT TO TX INHIBIT OPTION.
7 CUT TRACK AND LINK D - D2 FOR 8 CHANNEL RADIO.

(ST) SIGNALLING TECHNOLOGY(R)

C1109 CTCSS EN/DEC MODEM
CIRCUIT DIAGRAM

SELCALL ENCODER/DECODER

General

The S1509 Selcall Encoder/Decoder is designed to suit the MIDLAND 80 Channel SYN-TECH and 8 Channel LMR model radios.

Signalling Format

General Tone Format

The S1509 uses 5 Tone Sequential Signalling as shown below:

LID = Lead In Delay - Delay before tones are sent.

TP = Tone Period - Length of each tone in the sequence.

R1-R5 = 'Receive Code' or Unit Address Code

T1-T5 = 'Transmit Code' or Base Call Code
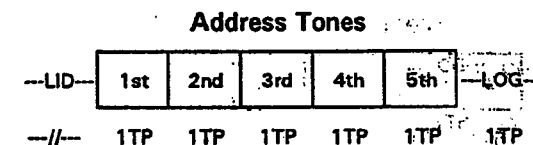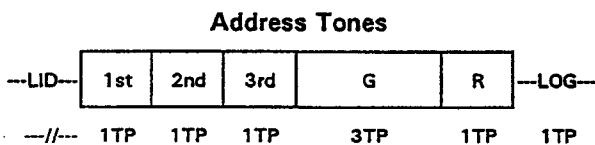
LOG = Lead Out Gap - Quiet period after tones are sent.

Address Tones

---LID---	1st	2nd	3rd	G	R	---LOG---
---//---	1TP	1TP	1TP	3TP	1TP	1TP

Figure 2: Sequence Timing for Group Calls

International Tonesets (TS)

Any one of the tonesets shown in Table 1. may be chosen by simply placing a wire link from the PCB land marked "TS", to one of the SELECT LINES 0-6 as indicated in Table 1. Suitable base encoders providing this group tone format are the S1650 Base Encoder (10 000 calls) and the S1652 Base Encoder (10 calls).

Address Tones

---LID---	1st	2nd	3rd	4th	5th	---LOG---
---//---	1TP	1TP	1TP	1TP	1TP	1TP

Figure 1: Sequence Timing for Individual Calls

Group Tone Format

The S1509 supports the "extended group tone" format which achieves group calling without any added hardware. Groups of 10, 100, 1000 and 10000 mobiles in a fleet may be called. For example: If mobiles from 12000 to 12099 are to be called the base should transmit 120GG (see timing diagram). The first occurrence of the G tone in the tone sequence is extended to 3 times the normal tone period (TP). Any subsequent tones are sent as single tone period, "repeat" or "group" tones.

Table 1: Toneset Frequency Table

	CCIR	EEA	BA	ZVEI1	ZVEI2	ZVEI3	ZVEI	DZVEI
SL-->	0	1	2	3	4	5	6	7
Tone								
0	1981	1981	600	2400	2400	2200	2400	2200
1	1124	1124	741	1060	1060	970	1060	970
2	1197	1197	882	1160	1160	1060	1160	1060
3	1275	1275	1023	1270	1270	1160	1270	1160
4	1358	1358	1164	1400	1400	1270	1400	1270
5	1446	1446	1305	1530	1530	1400	1530	1400
6	1540	1540	1446	1670	1670	1530	1670	1530
7	1640	1640	1587	1830	1830	1670	1830	1670
8	1747	1747	1728	2000	2000	1830	2000	1830
9	1860	1860	1869	2200	2200	2000	2200	2000
R	2110	2110	459	2600	970	2400	2600	2400
G	2400	1055	2151	2800	885	2600	970	825
DEFAULT								
TP-->	100mS	40mS	33mS	70mS	70mS	70mS	70mS	70mS

- The mobile will automatically acknowledge the call if auto-acknowledgement is selected.

- ALL other mobiles are unaffected.

- An alert tone is heard at the 'called' mobile.

- The mobile operator operates his PTT to answer and thereby cancels the audible alert, leaving the receiver enabled.

- The operator now converses normally with the base.

- At the conclusion of the conversation the mobile operator returns his radio to the "QUIET" state by pushing the "QUIET/CALL" button.

- If the operator leaves his S1509 unit in the "OPEN" position, he will still receive a selective call in the the same manner as above.

Group Call

- example: Base calls all mobiles in the group 10000 to 10099 by entering 100GG.

- All the mobiles in the group will hear 3 short beeps and their receivers will be enabled for 20 seconds.

- If the base repeats the call within the 20 seconds the mobiles remain unmuted until reset by the mobile operator pushing his "QUIET/CALL" button.

- No acknowledgement is transmitted by the mobile.

Mobile to Base

- When the mobile powers up it will be in the "OPEN" state. If the QUIET/CALL button is pushed the radio will enter the "QUIET" state.

- Each push of the QUIET/CALL button is accompanied by a beep tone. A high pitched beep means the radio is "OPEN" and a low pitched beep means the radio has been placed in the "QUIET" state.

To Make A Call

- The mobile operator must switch his mobile to the OPEN state by pushing his "QUIET/CALL" button.

- The operator must then hold his "QUIET/CALL" button down until a beep is heard. This indicates that the SELCALL transmission has occurred.

- At the conclusion of his conversation he may return the radio to the QUIET state by pushing the QUIET/CALL button again. (A low pitched beep is heard.)

- Transmission is inhibited in the QUIET state.

Options

Option 1 - Multicall

Multiple calling can be achieved by fitting the S1509/01 MULTI-CALL board to the S1509. See the S1509/1 Installation Instructions for details.

Option 2 - ANI

An ANI option is provided which operates on the leading edge of each PTT. To install ANI remove the solder bridge from the three-way pad labelled 'A' and bridge the dual pads labelled 'B'.

The pushbutton switch now behaves only as a "QUIET/OPEN" control and can no longer be used to send SELCALL's. An ANI transmission will be sent on every activation of the PTT switch.

Option 3 - CALL LED

The output J1-13 will illuminate the LED called "PRI" (if available) on the front panel of the radio being fitted with selcall. "ON" would indicate "OPEN" and "OFF" would indicate "QUIET".

CTCSS Compatibility

The S1509 module fits alongside the C1109 CTCSS module and to allow concurrent operation P1 should be unplugged from the C1109 and transferred to the S1509. The 4 way cable (CA1509) from the S1509 may now be plugged into the vacated 13 way socket on the C1109.

The C1109 modules of issue F or later have the facility for including a TX LOCKOUT feature by inserting a few additional components. If carrier is detected , transmission will be inhibited unless the correct CTCSS tone is also decoded.

The components are R22, R23, R24, D2, D3, Q3, Q4. If this feature is being used the track "D" on the S1509 module must be cut AND a similar track "C" on the C1109 module must also be cut.

All C1109 modules up to and including issue F must have a diode fitted when being used with an S1509.

FIG 4. CIRCUIT DIAGRAM
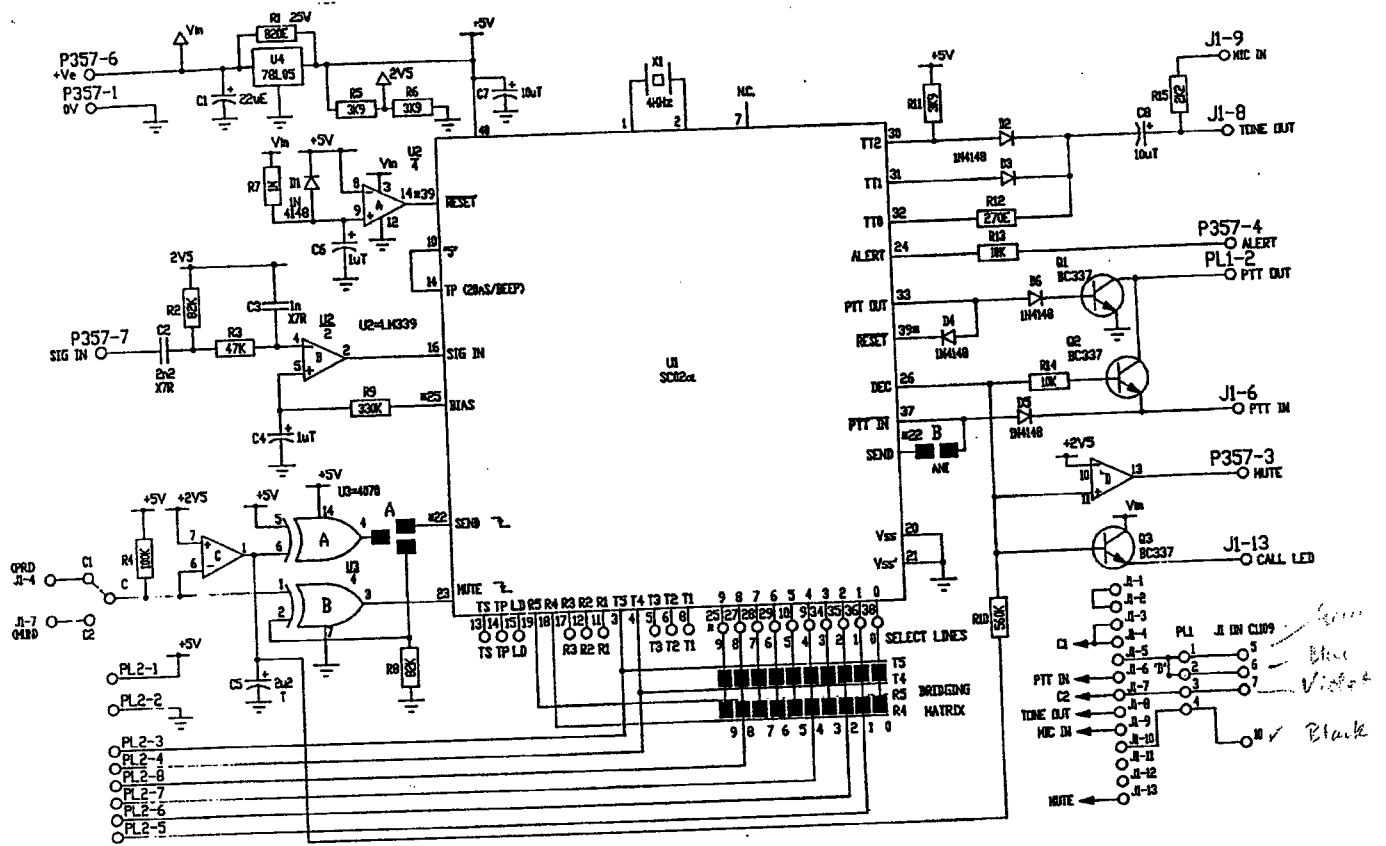
NOTES 1 : BRIDGE 'A' FOR SINGLE BUTTON OPERATION.
       2 : BRIDGE 'B' FOR AND OPERATION.
       3 : CUT LINK 'C' WHEN USING TX INHIBIT ON C1109.

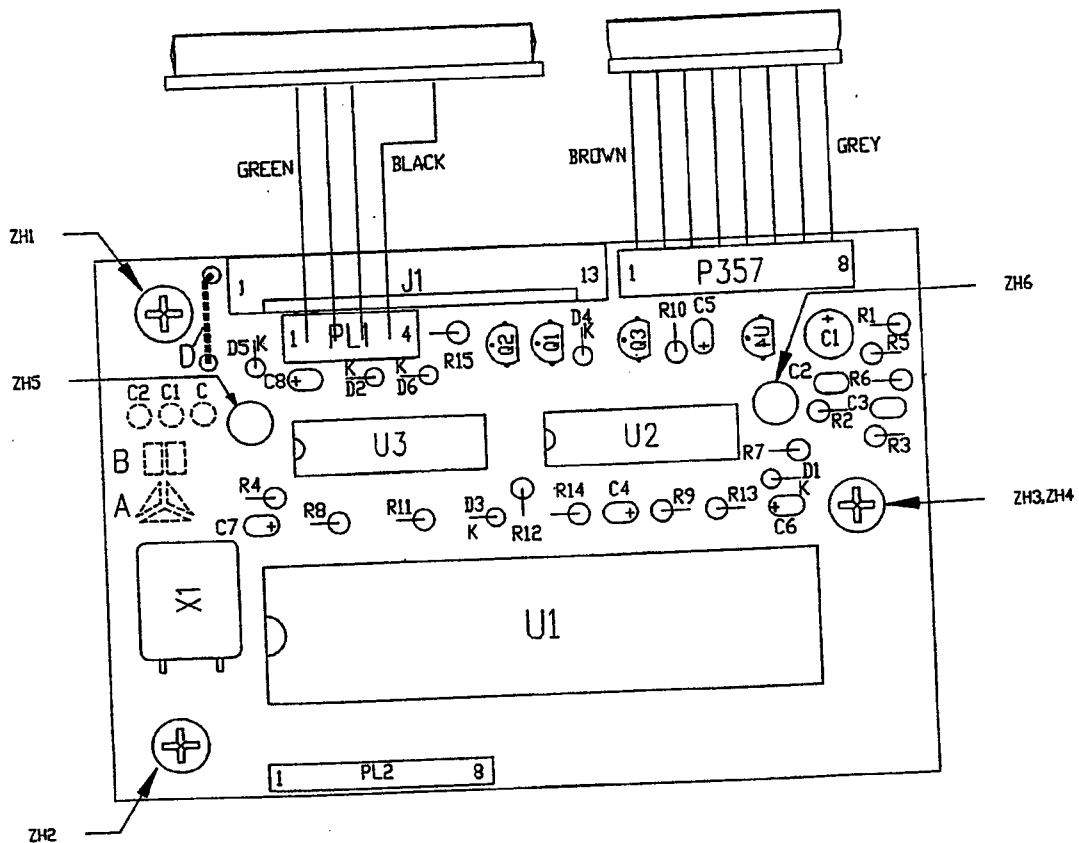FIG 5. COMPONENT LAYOUT