

Selectone

User's Guide to
Installation and Operation

**Model ST-180 Digitone™
Shared Repeater Panel**



COMMUNICATIONS SPECIALISTS, INC.

426 WEST TAFT AVENUE • ORANGE, CA 92865-4296
(714) 998-3021 • FAX (714) 974-3420

Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

<http://www.com-spec.com>

CONTENTS

SPECIFICATIONS	iv
DESCRIPTION	1
INSTALLATION:	
Mounting	2
Interface	2
SETUP:	
Programming Description	3
Programming Setup	4
Programming Single CTCSS Tone User	4
Programming Multiple CTCSS Tone Users	5
Programming Separate Encode and Decode CTCSS Freq.	5
Level Adjustments Description	6
Level Adjustments Setup	7
Level Adjustments	7-8
OPTIONAL FEATURES:	
Busy Channel Lock Out Defeat	9
Local Tone ON/OFF Operation	9
Remote Tone ON/OFF Operation	9
Local/Repeat Operation	9
SUMMARY OF CONTROLS AND ADJUSTMENTS:	
Adjustments	10
Switches	10
Test Points	10
Jumpers	10
REPLACEABLE PARTS LIST	16

LIST OF ILLUSTRATIONS

MX-COM Frequency Programming Chart (TABLE 1)	4
Time-out Timer Settings (TABLE 2)	8
Cable Assembly and Wiring Details	11
Label Diagram	13
Repeater Panel Component Locator	14
Repeater Panel Circuit Schematic	15

DESCRIPTION

The ST-180 is a Shared Repeater Panel for up to eight users. It allows a 2-way FM radio, capable of full-duplex operation, to be modified into a repeater. The ST-180 has been designed as a low-cost high-performance unit. It offers the advanced features found in more expensive repeater panels, but without the added cost of lights and read-outs. After the original setup by a technician using standard radio shop equipment, no further adjustments or changes should be necessary.

Shared usage of the repeater is determined by one to eight tones, each assigned to a specific user. User tones (decode and encode) must be set up at the repeater. Each DECODE frequency is determined by placement of six wire jumpers associated with the respective decoder IC. Each ENCODE frequency is programmed in association with a decode frequency. Encode frequencies are programmed with six DIP switch positions, then written into an EEPROM memory.

The ST-180 is shipped from the factory with one decode circuit and six jumpers for one user tone. Up to seven additional decode circuits with jumpers may be ordered and field-installed for the number of users assigned to the repeater.

Under normal operation, the ST-180 transmits the same tone as it receives. However, it can be set up to transmit a different tone for specific applications. The unit also generates its own squelch signal, allowing the tone squelch and carrier squelch to be AND'ed together so that both must operate before gating can occur.

To prevent co-channel interference and to comply with the standards for maximum repeater keying times imposed by most governments worldwide, the ST-180 limits keying to user-selectable time periods ranging from 1.5 to 5 minutes.

User tones can be activated and deactivated locally, or by means of remote signaling to toggle user tones ON and OFF. The Selectone Model ST-800RPT Remote Control Decoder Module is available as an option to the ST-180 for remote ON/OFF toggling.

The ST-180 is contained in a metal chassis designed for mounting in a standard 19" equipment rack. The chassis requires one module (1-3/4") rack space. The front panel is removable for easy access to the circuit board. Interconnection to audio and power is from the rear of the chassis by a 36" external cable.

PROGRAMMING DESCRIPTION

The ST-180 is shipped from the factory with one tone decoder IC installed at U3. Up to seven additional tone decoders may be installed as options at U4 through U11. Each tone decoder IC is programmed for its individual tone frequency using wire jumper fields adjacent to the chip location. The **ENCODE** tone frequency data is programmed by the settings of switch S2 positions one through six. This binary data is written to an Electrically Erasable Programmable Read Only Memory (EEPROM) device at location U12 during programming. No data is contained in the encoder/decoder IC's themselves. As a result, if an operational failure should occur it is possible to freely swap IC's from one position to another (U3-U11 and U13) for troubleshooting. In fact, as long as IC's are always installed at locations U3 and U13 it is not necessary to fill the optional IC sockets sequentially.

Actual programming of the ST-180 does not require any external test equipment since all required programming signals are generated internally. Programming is accomplished by connecting the encode output of U13 (pin 15) to the paralleled inputs of U3 through U11 (pin 21) via S2 position 7.

This provides a test signal which is interpreted by one of the eight possible tone decoders as an on-frequency tone signal. This one of eight signal is fed to the ADDRESS input pins of U12. The encode data presented to the DATA input/output pins of U12 by S2 positions 1 through 6 is then written to the address defined by this one of eight signal when S1 is pressed. **It is imperative therefore that S1 be pressed only when actual programming is intended since pressing S1 when the address and data inputs of U12 are not set up properly will cause operational problems as the result of storing erroneous information.** Transmit time out time is programmed by the remaining switch positions of S2 (9 and 10) as shown in TABLE 2 . The setting of the time out timer is not stored in memory and does not require S1 to be pressed.

PROGRAMMING MULTIPLE CTCSS TONE USERS

1. Perform the steps shown in PROGRAMMING SETUP.
2. Set the tone decode jumpers for all the tone locations that are installed according to TABLE 1. (Refer to the component locator to find the location of position one in the jumper field.)
3. Turn power on to the ST-180.
4. Set S2 positions 7 and 8 to ON.
5. Set S2 positions 1 through 6 to the same tone frequency as was set in step 2 for the first decode location to be programmed.
IMPORTANT! Verify that both the decode jumpers and the encode programming switches are set to identical tone frequencies.
6. Press S1.
7. Set S2 positions 1 through 6 to the same tone frequency as was set in step 2 for the next decode location to be programmed. **IMPORTANT! Verify that both the decode jumpers and the encode programming switches are set to identical tone frequencies.**
8. Press S1
9. Repeat steps 6 and 8 until each tone position in sequence has been programmed.
10. Set S2 positions 1 through 8 to OFF.
11. Reset R61 (if necessary) as outlined in LEVEL ADJUSTMENTS.

PROGRAMMING SEPARATE ENCODE AND DECODE CTCSS FREQUENCIES

1. Program as shown above in PROGRAMMING SINGLE or MULTIPLE TONE USERS using the desired ENCODE tone frequency.
2. When programming is complete reset the DECODE tone frequency programming jumpers to the desired DECODE tone frequency.

SETUP

LEVEL ADJUSTMENTS SETUP

1. Set JU9 to center to A for direct FM or center to B for phase modulated transmitters.
2. Apply power to the ST-180 and the receiver/transmitter under test.
3. Connect a communications service monitor in duplex mode to the receiver/transmitter under test.
4. Using a voltmeter measure the voltage at U1-7. (J2-1 can be used as a ground reference for the voltmeter.) Adjust R7 until the voltage present at U1-7 toggles from approximately 12Vdc to approximately 0Vdc. The squelch is now closed.

LEVEL ADJUSTMENTS

1. Inject a full quieting, on channel, RF carrier modulated with a 1KHz tone at $\pm 3.0\text{KHz}$ of deviation.
2. Using an oscilloscope adjust R4 (input audio gain adj.) for 4.8Vp-p (1.7Vrms) at TP1.

NOTE

When making the input audio level adjustment (R4) if you are unable to obtain sufficient signal level at TP1 a second 100K ohm resistor may be tacked on in parallel with R3 to increase the input amplifier gain.

NOTE

When making the squelch adjustment (R7) if you are unable to cause the squelch gate signal to toggle properly the problem is likely due to a poor choice of audio pick up point in the receiver. The receiver audio MUST be recovered directly from the discriminator stage before any filtering takes place.

3. Turn off the carrier from the service monitor.
5. Set the service monitor to provide a carrier modulated with one of the previously programmed CTCSS tones at $\pm 0.75\text{KHz}$ of modulation. (The transmitter under test should key.)
6. Adjust R61 for $\pm 0.75\text{KHz}$ of CTCSS tone modulation at the output of the transmitter under test.
7. Turn off the CTCSS tone modulation from the service monitor but retain the RF carrier. (The transmitter under test should un-key after a short delay.)

OPTIONAL FEATURES

BUSY CHANNEL LOCKOUT DEFEAT

If busy channel lockout is undesirable in your application it can be defeated by removing U11.

LOCAL TONE ON/OFF OPERATION

Any user tone can be toggled from on to off or vice versa by injecting a carrier modulated with the CTCSS tone in question and pressing S1.

REMOTE TONE ON/OFF OPERATION

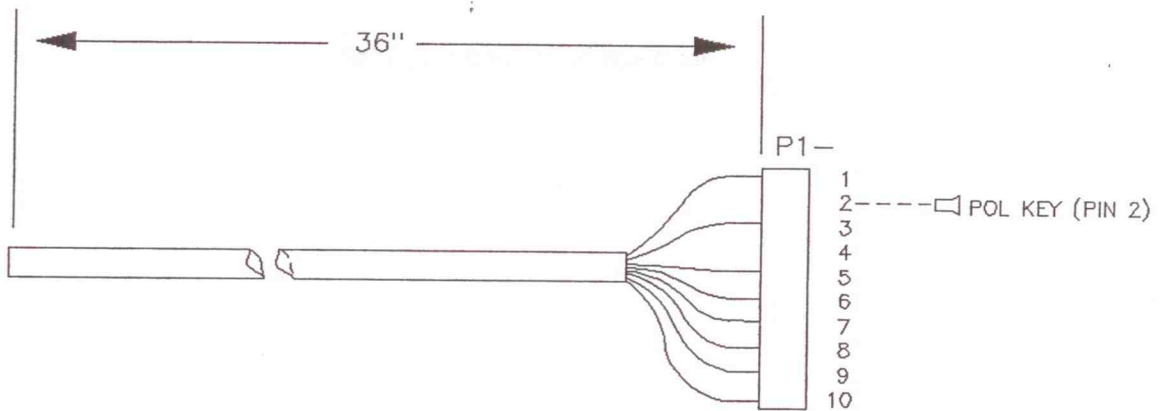
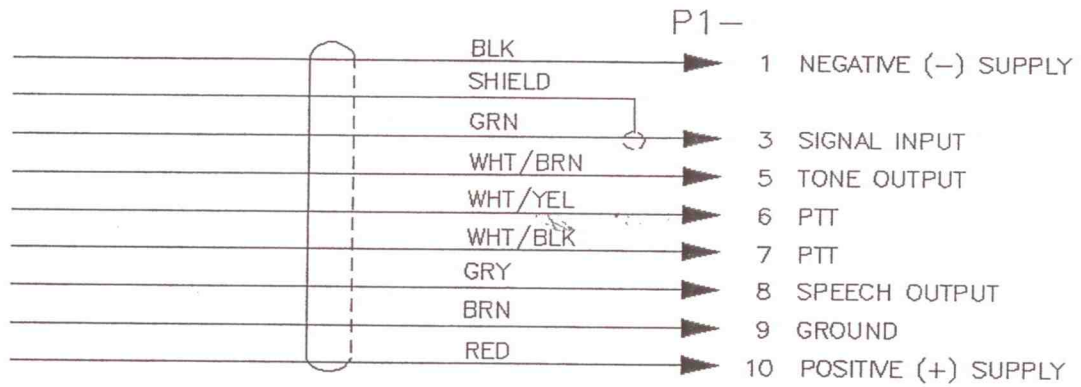
Using the ST-800RPT any user tone can be toggled from on to off or vice versa remotely by transmitting a carrier modulated with the CTCSS tone in question and sending the proper DTMF control code. The ST-800RPT is available from Selectone as an option for the ST-180. Specifications and details of programming that device are included in the documentation provided for that product.

LOCAL/REPEAT OPERATION

Occasionally it is desirable to operate the host radio in both the local and repeat mode. Under these conditions it is important that the proper CTCSS tone be encoded when local (not generated by the ST-180) push to talk is activated. As with the repeat operation encode/decode tone frequencies it is also possible to program the idle CTCSS tone encoded by the ST-180 to allow for this mode of operation.

1. Temporarily cut CR12.
2. Set S2 position 8 to on.
3. Set S2 positions 1 through 6 to the desired tone frequency or tone off if required.
4. Verify that U1-7 is low (0 volts).
5. Press S1.
6. Set S2 positions 1 through 8 off. (The transmitter will key.)
7. Push S1. (The transmitter will un-key.)
8. Restore CR12 by soldering the cut lead.

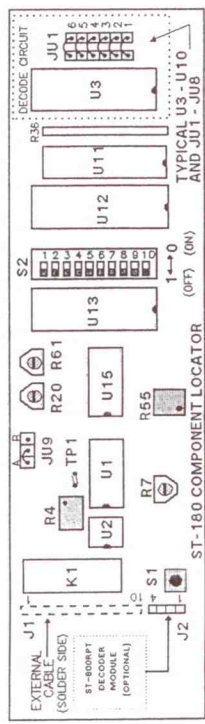
The repeater will now act as before but when local push to talk is activated with no signal present at the receiver the ST-180 will encode the local operation CTCSS tone.



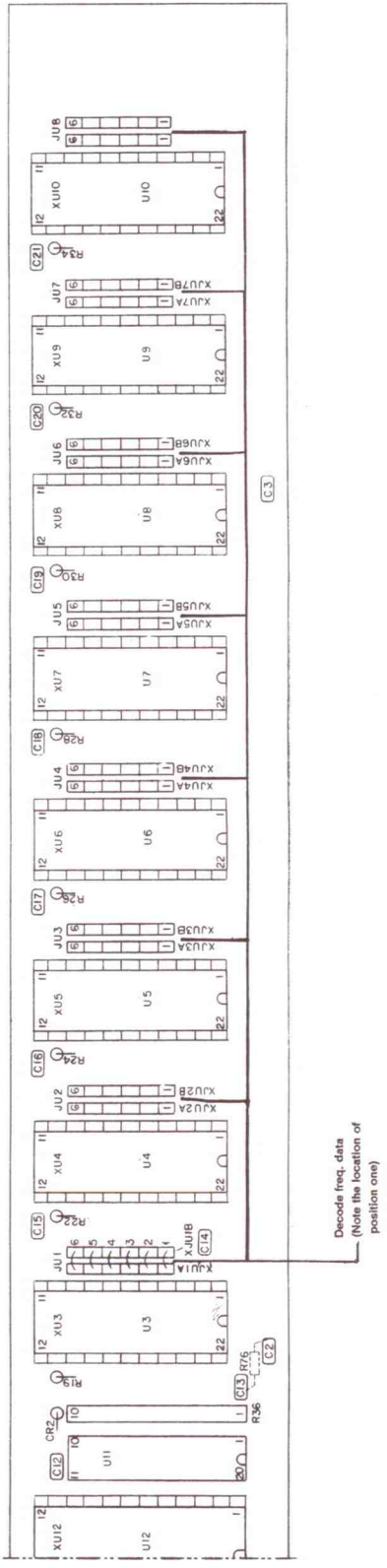
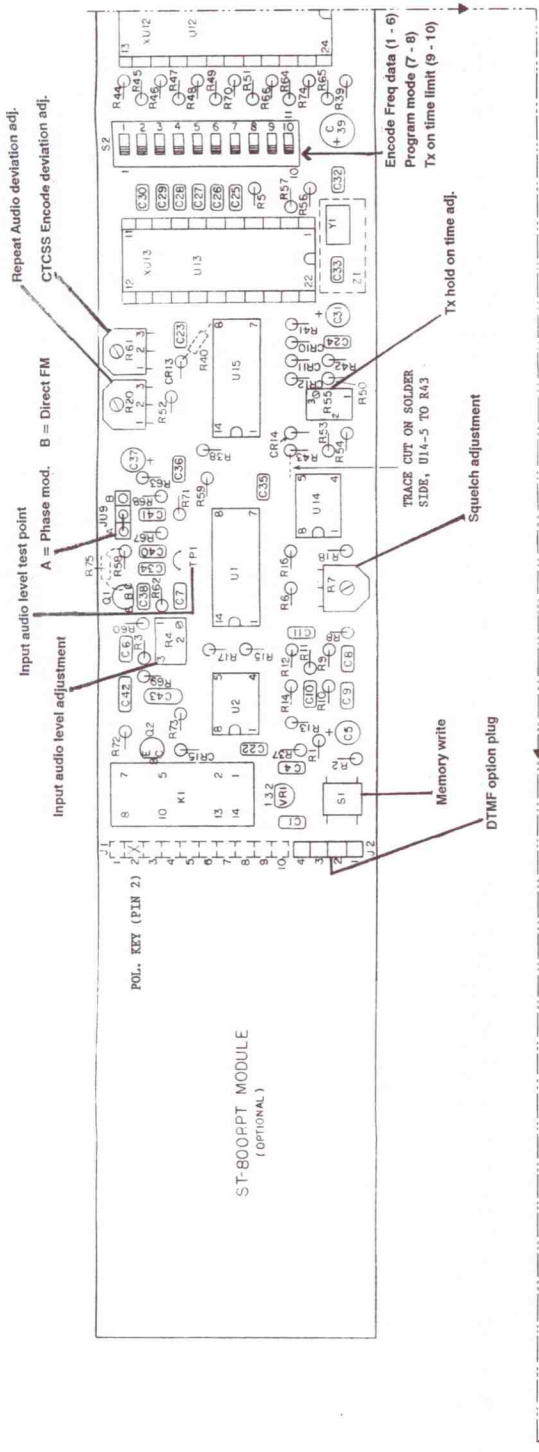
P1 MATES WITH J1 ON THE ST-180 REPEATER PANEL

WIRING INTERFACE:		ADJUSTMENTS (CONT'D):		PROGRAMMING:		S2 SECTIONS		S2 SECTIONS		FREQ IN/MHZ		S2 SECTIONS		FREQ IN/MHZ		S2 SECTIONS		FREQ IN/MHZ	
P1-10 POS (+) SUPPLY (RED)		TP1: 1 KHz MODULATION ± 3 KHz		SET DECODE NUMBERS AND S2 SECTIONS 1-8 FROM THE		1 2 3 4 5 6		1 2 3 4 5 6		107.2		1 2 3 4 5 6		157.9		1 2 3 4 5 6		157.9	
P1-1 NEG (-) SUPPLY (BLU)	TP2: 1.5 MINUTES ON OFF	TP3: 2.0 MINUTES ON OFF	TP4: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	71.9	0 1 1 1 1 1	110.6	0 1 1 0 1 0	173.6	0 1 1 0 1 1	173.6	0 1 1 0 1 1	173.6	0 1 1 0 1 1	173.6	0 1 1 0 1 1	173.6	0 1 1 0 1 1
P1-2 NEG (-) SUPPLY (BLU)	TP5: 1.5 MINUTES ON OFF	TP6: 2.0 MINUTES ON OFF	TP7: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	74.4	0 1 1 1 1 1	114.8	0 1 1 0 1 0	179.9	0 1 1 0 1 1	179.9	0 1 1 0 1 1	179.9	0 1 1 0 1 1	179.9	0 1 1 0 1 1	179.9	0 1 1 0 1 1
P1-3 NEG (-) SUPPLY (BLU)	TP8: 1.5 MINUTES ON OFF	TP9: 2.0 MINUTES ON OFF	TP10: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	77.7	0 1 1 1 1 1	120.0	0 1 1 0 1 0	182.6	0 1 1 0 1 1	182.6	0 1 1 0 1 1	182.6	0 1 1 0 1 1	182.6	0 1 1 0 1 1	182.6	0 1 1 0 1 1
P1-4 SPEECH OUTPUT (GRY)	TP11: 1.5 MINUTES ON OFF	TP12: 2.0 MINUTES ON OFF	TP13: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	82.5	0 1 1 1 1 0	127.3	0 1 1 0 0 1	203.5	0 0 0 0 1 1	203.5	0 0 0 0 1 1	203.5	0 0 0 0 1 1	203.5	0 0 0 0 1 1	203.5	0 0 0 0 1 1
P1-5 TONE OUTPUT (GRY)	TP14: 1.5 MINUTES ON OFF	TP15: 2.0 MINUTES ON OFF	TP16: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	85.4	0 1 1 1 1 0	131.8	0 1 1 0 0 1	210.7	0 0 0 0 1 1	210.7	0 0 0 0 1 1	210.7	0 0 0 0 1 1	210.7	0 0 0 0 1 1	210.7	0 0 0 0 1 1
P1-6 PTT (WHT/YEL)	TP17: 1.5 MINUTES ON OFF	TP18: 2.0 MINUTES ON OFF	TP19: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	88.3	0 1 1 1 1 0	136.3	0 1 1 0 0 1	219.6	0 0 0 0 1 1	219.6	0 0 0 0 1 1	219.6	0 0 0 0 1 1	219.6	0 0 0 0 1 1	219.6	0 0 0 0 1 1
P1-7 PTT (WHT/YEL)	TP20: 1.5 MINUTES ON OFF	TP21: 2.0 MINUTES ON OFF	TP22: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	91.5	0 1 1 1 0 1	141.3	0 1 1 0 0 0	228.7	0 0 0 0 0 1	228.7	0 0 0 0 0 1	228.7	0 0 0 0 0 1	228.7	0 0 0 0 0 1	228.7	0 0 0 0 0 1
P1-8 TONE OUTPUT (WHT/GRN)	TP23: 1.5 MINUTES ON OFF	TP24: 2.0 MINUTES ON OFF	TP25: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	94.8	0 1 1 1 0 1	146.2	0 1 1 0 1 1	233.6	0 0 0 0 0 1	233.6	0 0 0 0 0 1	233.6	0 0 0 0 0 1	233.6	0 0 0 0 0 1	233.6	0 0 0 0 0 1
P1-9 TONE OUTPUT (WHT/GRN)	TP26: 1.5 MINUTES ON OFF	TP27: 2.0 MINUTES ON OFF	TP28: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	97.4	0 1 1 1 0 1	151.4	0 0 0 1 1 1	241.8	0 0 0 0 0 1	241.8	0 0 0 0 0 1	241.8	0 0 0 0 0 1	241.8	0 0 0 0 0 1	241.8	0 0 0 0 0 1
P1-10 POS (+) SUPPLY (RED)	TP29: 1.5 MINUTES ON OFF	TP30: 2.0 MINUTES ON OFF	TP31: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	100.0	0 1 1 1 0 1	156.7	0 1 1 0 1 1	250.3	0 0 0 0 0 0	250.3	0 0 0 0 0 0	250.3	0 0 0 0 0 0	250.3	0 0 0 0 0 0	250.3	0 0 0 0 0 0
P1-1 NEG (-) SUPPLY (BLU)	TP32: 1.5 MINUTES ON OFF	TP33: 2.0 MINUTES ON OFF	TP34: 5.0 MINUTES ON OFF	ST ON (= 1.7Vrms).....R7	ST OFF (= 1.7Vrms).....R7	103.3	0 1 1 1 0 0	162.2	0 0 0 1 1 0	259.3	0 0 0 0 0 0	259.3	0 0 0 0 0 0	259.3	0 0 0 0 0 0	259.3	0 0 0 0 0 0	259.3	0 0 0 0 0 0

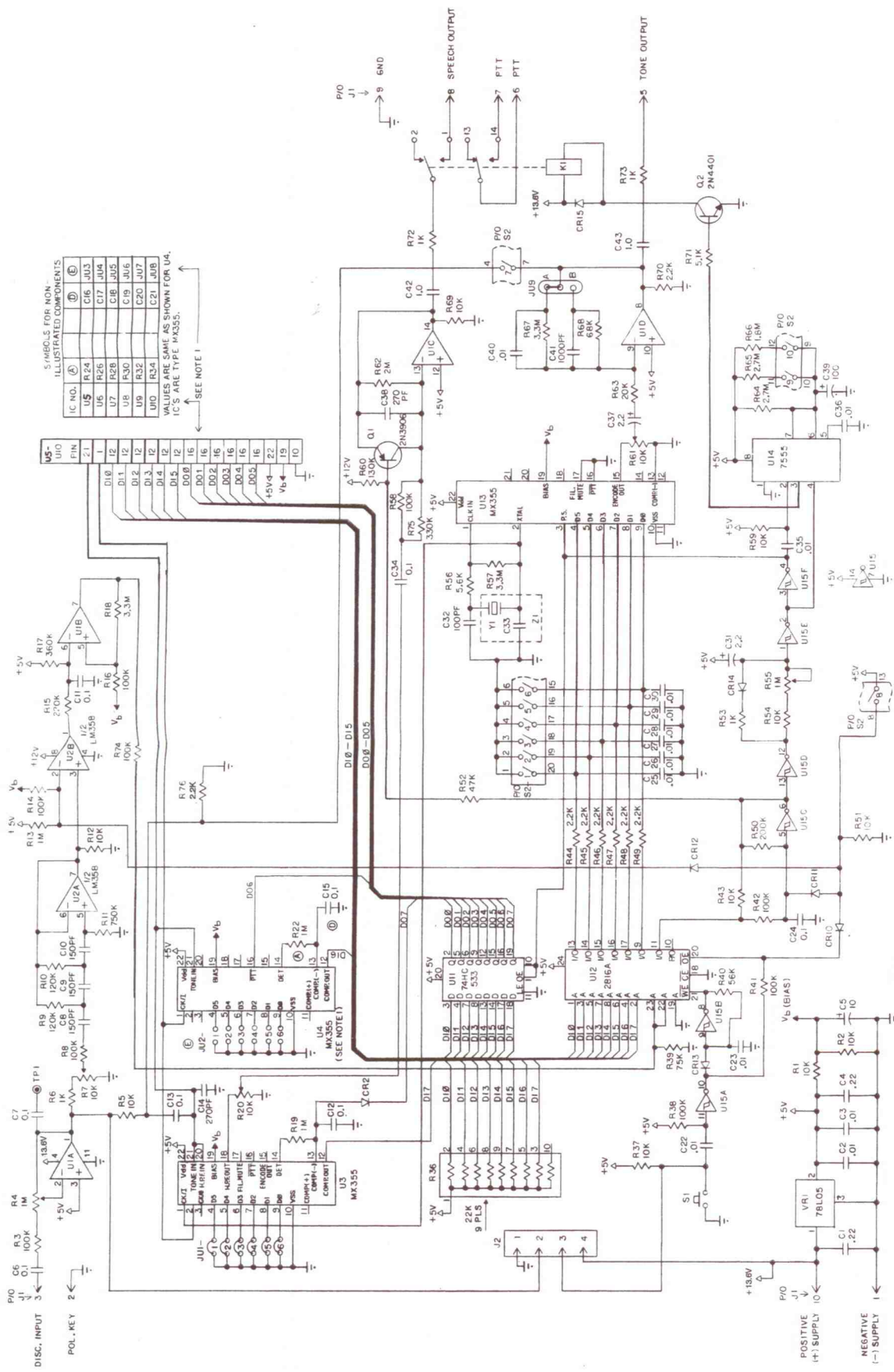
SETUP LABEL



COMPONENT LOCATOR LABEL



- NOTES:
1. J1 IS INSTALLED ON THE SOLDER SIDE OF THE PRINTED CIRCUIT BOARD. J1 MATES WITH P1 IN THE EXTERNAL CABLE ASSEMBLY
 2. J2 MATES WITH P2 IN THE OPTIONAL STBOORPT DTMF DECODER WIRING HARNESS.
 3. COMPONENTS U4 - U10 AND J2 - J8 ARE USER-LOADED WITH AN OPTIONAL SELECTONE ST18K1 KIT FOR EACH ADDITIONAL USER TONE.



Repeater Panel Circuit Schematic

- NOTES:
- COMPONENTS U1 THRU U10 AND J01 THRU J08 ARE UNBROKENED WITH AN OPTIONAL SET OF 18X1K RT FOR EACH ADDITIONAL USER TONE.
 - U15 IS TYPE 74HC14.
 - UNLESS OTHERWISE INDICATED:
RESISTANCE VALUES ARE IN OHMS, 10K, 5K, CARBON FILM.
CAPACITANCE VALUES ARE IN MICROFARADS.
DIODES ARE TYPE 1N914.

GENERAL ASSEMBLY:

Ref	Part Num.	Description
	501-0620	Printed Circuit Assembly
	501-0480	Chassis Assembly
	501-0470	Cable Assembly External
	501-1860	Front Panel Assembly

PRINTED CIRCUIT ASSEMBLY:

Ref	Part Num.	Description
C1	028-2203	Capacitor 0.22uF Z5U 50V 20%
C2-C3	026-1002	Capacitor 0.01uF X7R 50V 10%
C4	028-2203	Capacitor 0.22uF Z5U 50V 20%
C5	034-0000	Capacitor 10uF Tant 16V 20%
C6-C7	026-1003	Capacitor 0.1uF X7R 50V 10%
C8-C10	026-1500	Capacitor 150pF X7R 50V 10%
C11-C13	026-1003	Capacitor 0.1uF X7R 50V 10%
C14	026-2700	Capacitor 270pF X7R 50V 10%
C15-C21	026-1003	Capacitor 0.1uF X7R 50V 10%
C22-C23	026-1002	Capacitor 0.01uF X7R 50V 10%
C24	026-1003	Capacitor 0.1uF X7R 50V 10%
C25-C30	026-1002	Capacitor 0.01uF X7R 50V 10%
C31	034-0001	Capacitor 2.2uF Tant 16V 20%
C32	033-1000	Capacitor 100pF COG 100V 10%
C33		PART OF Z1
C34	026-1003	Capacitor 0.1uF X7R 50V 10%
C35-C36	026-1002	Capacitor 0.01uF X7R 50V 10%
C37	034-0001	Capacitor 2.2uF Tant 16V 20%
C38	026-2700	Capacitor 270pF X7R 50V 10%
C39	020-0000	Capacitor 100uF Alum Elec 16V 20%
C40	026-1002	Capacitor 0.01uF X7R 50V 10%
C41	026-1000	Capacitor 1000pF X7R 50V 10%
C42-C43	028-1004	Capacitor 1.0uF Z5U 50V 20%
CR1		Component not used
CR2	066-0000	Diode 1N914 Silicon
CR3-CR9		Components not used
CR10-15	066-0000	Diode 1N914 Silicon
J1	056-0008	Connector 10 Pin Male Molex
J2	056-0004	Connector 4 Pin Male Molex
(JU1-1)-(JU1-6)	959-0002	Jumper Wire
JU2-JU8		Components not used
JU9	999-0002	Jumper Wire
K1	123-0003	Relay D.P.D.T.
Q1	209-0002	Transistor 2N3906 PNP
Q2	210-0000	Transistor 2N4401 NPN
R1-R2	146-1002	Resistor 10K 1/8W 5% C.F.
R3	146-1003	Resistor 100K 1/8W 5% C.F.
R4	112-0008	Potentiometer 1M 12-Turn
R5	146-1002	Resistor 10K 1/8W 5% C.F.
R6	146-1001	Resistor 1K 1/8W 5% C.F.

PRINTED CIRCUIT ASSEMBLY (Continued)

Ref	Part Num.	Description
R7	111-0002	Potentiometer 10K 1-Turn Thin
R8	146-1003	Resistor 100K 1/8W 5% C.F.
R9-R10	146-1203	Resistor 120K 1/8W 5% C.F.
R11	146-7503	Resistor 750K 1/8W 5% C.F.
R12	146-1002	Resistor 10K 1/8W 5% C.F.
R13	146-1004	Resistor 1M 1/8W 5% C.F.
R14	146-1003	Resistor 100K 1/8W 5% C.F.
R15	146-2203	Resistor 220K 1/8W 5% C.F.
R16	146-1003	Resistor 100K 1/8W 5% C.F.
R17	146-3603	Resistor 360K 1/8W 5% C.F.
R18	146-3304	Resistor 3.3M 1/8W 5% C.F.
R19	146-1004	Resistor 1M 1/8W 5% C.F.
R20	111-0002	Potentiometer 10K 1-Turn Thin
R21		Component not used
R22	146-1004	Resistor 1M 1/8W 5% C.F.
R23		Component not used
R24	146-1004	Resistor 1M 1/8W 5% C.F.
R25		Component not used
R26	146-1004	Resistor 1M 1/8W 5% C.F.
R27		Component not used
R28	146-1004	Resistor 1M 1/8W 5% C.F.
R29		Component not used
R30	146-1004	Resistor 1M 1/8W 5% C.F.
R31		Component not used
R32	146-1004	Resistor 1M 1/8W 5% C.F.
R33		Component not used
R34	146-1004	Resistor 1M 1/8W 5% C.F.
R35		Component not used
R36	130-0001	Resistor Array 9x22K 10 Pin Slip
R37	146-1002	Resistor 10K 1/8W 5% C.F.
R38	146-1003	Resistor 100K 1/8W 5% C.F.
R39	146-7502	Resistor 75K 1/8W 5% C.F.
R40	146-5602	Resistor 56K 1/8W 5% C.F.
R41-R42		Resistor 100K 1/8W 5% C.F.
R43	146-1002	Resistor 10K 1/8W 5% C.F.
R44-R49	146-2201	Resistor 2.2K 1/8W 5% C.F.
R50	146-2003	Resistor 200K 1/8W 5% C.F.
R51	146-1002	Resistor 10K 1/8W 5% C.F.
R52	146-4702	Resistor 47K 1/8W 5% C.F.
R53	146-1001	Resistor 1K 1/8W 5% C.F.
R54	146-1002	Resistor 10K 1/8W 5% C.F.
R55	112-0008	Potentiometer 1M 12-Turn
R56	146-5601	Resistor 5.6K 1/8W 5% C.F.
R57	146-3304	Resistor 3.3M 1/8W 5% C.F.
R58	146-1003	Resistor 100K 1/8W 5% C.F.
R59	146-1002	Resistor 10K 1/8W 5% C.F.
R60	146-1303	Resistor 130K 1/8W 5% C.F.
R61	111-0002	Potentiometer 10K 1-Turn Thin
R62	146-2004	Resistor 2M 1/8W 5% C.F.
R63	146-2002	Resistor 20K 1/8W 5% C.F.
R64-R65	146-2704	Resistor 2.7M 1/8W 5% C.F.

PRINTED CIRCUIT ASSEMBLY (Continued)

Ref	Part Num.	Description
R66	146-1804	Resistor 1.8M 1/8W 5% C.F.
R67	146-3304	Resistor 3.3M 1/8W 5% C.F.
R68	146-6802	Resistor 68K 1/8W 5% C.F.
R69	146-1002	Resistor 10K 1/8W 5% C.F.
R70	146-2201	Resistor 2.2K 1/8W 5% C.F.
R71	146-5101	Resistor 5.1K 1/8W 5% C.F.
R72-R73	146-1001	Resistor 1K 1/8W 5% C.F.
R74	146-1003	Resistor 100K 1/8W 5% C.F.
R75	146-3303	Resistor 330K 1/8W 5% C.F.
R76	146-2201	Resistor 2.2K 1/8W 5% C.F.
S1	185-0005	Switch Push-Button
S2	180-0003	Switch DIP 10 POS
T1	999-0002	Jumper Wire
U1	085-0002	IC LM324 Quad Op Amp
U2	085-0003	IC LM358 Dual Op Amp
U3	087-0016	IC MX355P CTCSS Encr/Dec
U4-U10		Components not used
U11	088-0013	IC 74HC533 Tri-State Octal Latch
U12	082-0018	IC Type 2816A 16K EEPROM
U13	087-0016	IC MX355P CTCSS Encr/Dec
U14	087-0007	IC LM555 CMOS Timer
U15	080-0016	IC 74C14 CMOS Hex Schmitt Trig
VR1	086-0004	IC 78L05 Voltage Reg 5V
XJU1A/B	167-0005	Socket 6-Pin Slip
XJU2A/B	167-0005	Socket 6-Pin Slip
XJU3A/B	167-0005	Socket 6-Pin Slip
XJU4A/B	167-0005	Socket 6-Pin Slip
XJU5A/B	167-0005	Socket 6-Pin Slip
XJU6A/B	167-0005	Socket 6-Pin Slip
XJU7A/B	167-0005	Socket 6-Pin Slip
XJU8A/B	167-0005	Socket 6-Pin Slip
XJU9	167-0002	Socket 3-Pin Slip
XU10	167-0028	Socket 22-Pin Dip
XU11	167-0015	Socket 20-Pin Dip
XU12	167-0016	Socket 24-Pin Dip
XU13	167-0028	Socket 22-Pin Dip
Y1		Part of Z1
Z1	501-0060	Frequency Determining Element

NOTE:
C33 and Y1 are matched components. Do NOT replace with unmatched components.

Replaceable Parts List