TE-12P INSTRUCTION SHEET

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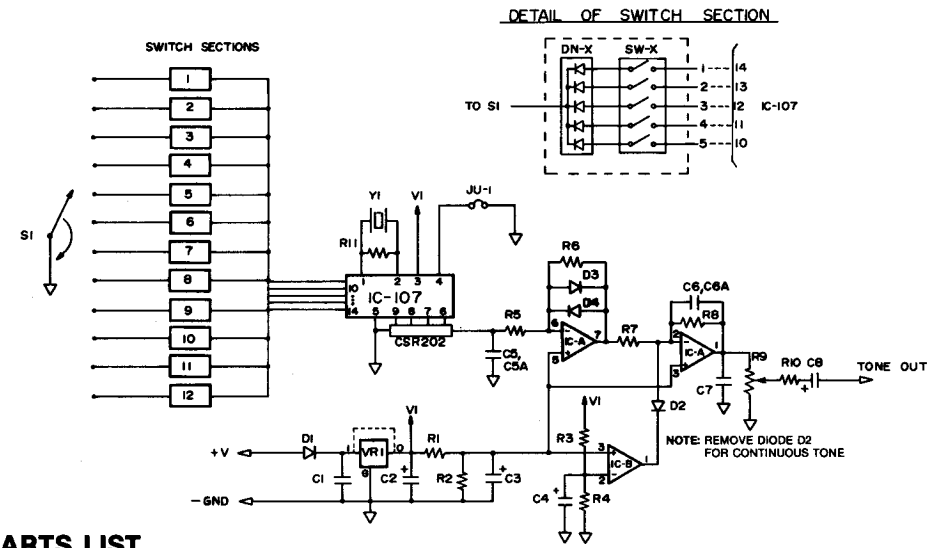
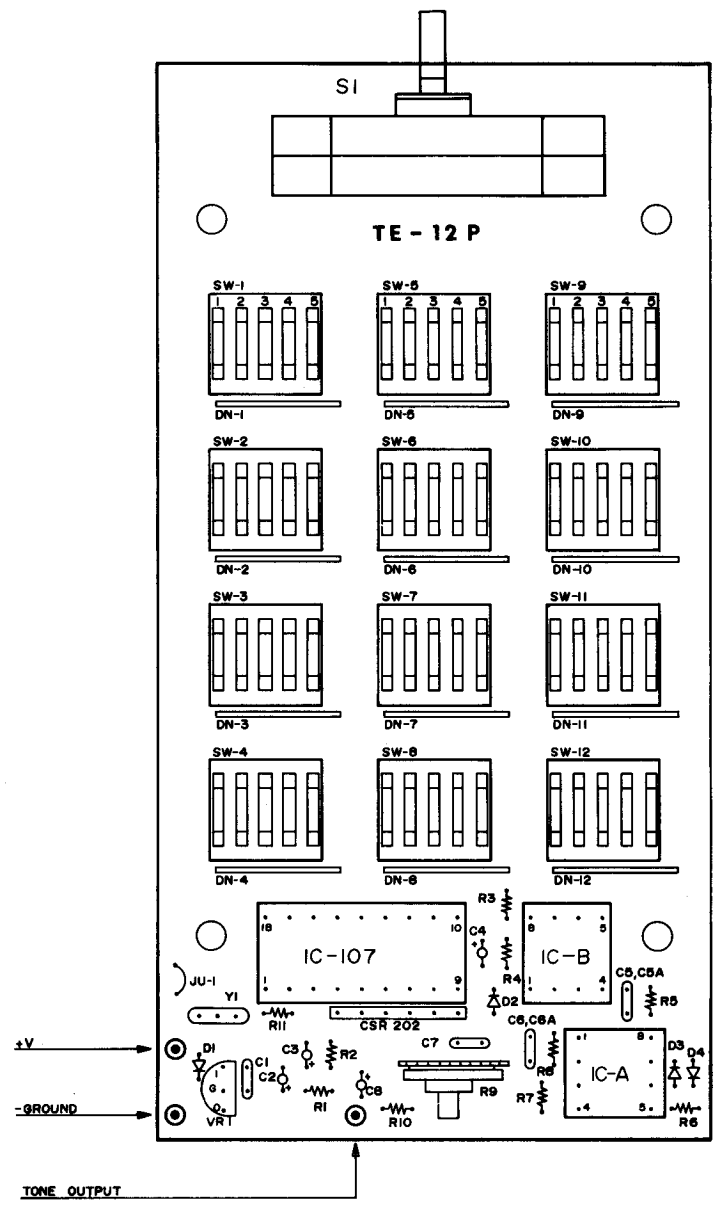


PARTS LIST

R1 -	10K	5%	1/8 watt	resistor	carbon	film	$.31 ea.
R2 -	9.1K	"	"	"	"	"	.31 ea.
R3 -	470K	"	"	"	"	"	.31 ea.
R4 -	1Meg	"	"	"	"	"	.31 ea.
R5 -	68K	"	"	"	"	"	.31 ea.
R6 -	22K	"	"	"	"	"	.31 ea.
R7 -	47K	"	"	"	"	"	.31 ea.
R8 -	270K	"	"	"	"	"	.31 ea.
R9 -	5K	CTS potentiometer (upright)					.60 ea.
R10 -	1.2K	5%	1/8 watt	resistor	carbon	film	.31 ea.
R11 -	10Meg	10%	"	"	"	comp.	.31 ea.
C1 -	.22uf	50V	CW15	ceramic			2.25 ea.
C2 -	1uf	35V	tantalum				1.05 ea.
C3 -	1uf	"	"				1.05 ea.
C4 -	1uf	"	"				1.05 ea.
C5 -	.01uf	50V	CW15	ceramic			1.50 ea.
*C5A -	470pf	"	"	"			1.00 ea.
C6 -	1500pf	"	"	"			1.25 ea.
*C6A -	220pf	"	"	"			1.00 ea.
C7 -	220pf	"	"	"			1.00 ea.
C8 -	1uf	35V	tantalum				1.05 ea.
D1 -	1N4148	silicon	diode				.15 ea.
D2 -	1N4148	"	"				.15 ea.
D3 -	1N4148	"	"				.15 ea.
D4 -	1N4148	"	"				.15 ea.
DN1 -	5 position diode network						1.50 ea.
DN2 -	"	"	"	"			1.50 ea.
DN3 -	"	"	"	"			1.50 ea.
DN4 -	"	"	"	"			1.50 ea.
DN5 -	"	"	"	"			1.50 ea.
DN6 -	"	"	"	"			1.50 ea.
DN7 -	"	"	"	"			1.50 ea.
DN8 -	"	"	"	"			1.50 ea.
DN9 -	"	"	"	"			1.50 ea.
DN10 -	"	"	"	"			1.50 ea.
DN11 -	"	"	"	"			1.50 ea.
DN12 -	"	"	"	"			1.50 ea.
CSR202-	Resistor network						2.30 ea.
Y1 -	1Mhz crystal						7.50 ea.
SW-1 -	5 position	DIP	switch				2.45 ea.
SW-2 -	"	"	"	"			2.45 ea.
SW-3 -	"	"	"	"			2.45 ea.
SW-4 -	"	"	"	"			2.45 ea.
SW-5 -	"	"	"	"			2.45 ea.
SW-6 -	"	"	"	"			2.45 ea.
SW-7 -	"	"	"	"			2.45 ea.
SW-8 -	"	"	"	"			2.45 ea.
SW-9 -	"	"	"	"			2.45 ea.
SW-10 -	"	"	"	"			2.45 ea.
SW-11 -	"	"	"	"			2.45 ea.
SW-12 -	"	"	"	"			2.45 ea.
VR-1 -	78L08 voltage regulator						1.00 ea.
IC-A -	TLO62						2.20 ea.
IC-B -	TLO62						2.20 ea.
IC-107 -	Com-Spec microcircuit						17.50 ea.
2 -	8 pin IC sockets						.39 ea.
1 -	18 pin IC socket						.69 ea.
3 -	AMP chassis pins						.10 ea.
1 -	Printed circuit board						10.00 ea.
1 -	Case with screws						7.50 ea.
S1 -	12-position switch						13.00 ea.
1 -	Front panel w/label						2.00 ea.
1 -	Rear panel						1.50 ea.
4 -	.2" spacers						.25 ea.
1 -	Mounting bracket						2.25 ea.
2 -	Knurled knobs						.60 ea.
4 -	Mounting screws						.05 ea.
1 -	Knob assembly, with cap						1.90 ea.

Used in Group B Model only



THEORY OF OPERATION

The desired encoder output signal is derived from a highly stable 1.000MHz. quartz crystal oscillator. This oscillator is contained inside the IC-107, which is a custom LSI consisting of in excess of 1000 CMOS gates. The output of the oscillator is divided and synthesized to the proper sub-audible frequency according to the programmed setting on the external 5 position DIP switch. This lower frequency is then fed to the resistor network in digital form. The resistor network combines all the outputs from the IC-107, and produces a triangle wave on its output. This output is shaped into a low distortion sinewave by diodes D3 and D4. The sine wave is then filtered and amplified by the op-amp producing a high level sine wave output.

PROGRAMMING

This programmable line of products uses a five position DIP switch to select the frequency desired. When the switches are in any particular position, this binary code tells the integrated circuit on which one of the coded tones the system will operate. For instance, if 1Z (100.0Hz.) is desired, the code rquired is located on the instruction sheet and the switches are programmed accordingly. For example, the code for a 1Z is "11010", thus switch #1 is turned OFF (corresponding to a "1"), switch #2 is turned OFF, switch #3 is turned ON (corresponding to a "0"), switch #4 is OFF, and switch #5 is turned ON. By selecting the variable combinations of switch positions, all 32 tones can be accessed. Special tones are available also by using a different frequency crystal.

DIP SWITCH PROGRAMMING

FOR CTCSS PRODUCTS
GROUP A

#	FREQ.	CODE	SWITCH NUMBER* 5	4	3	2	1
1	67.0	XZ	0	0	0	0	0
2	71.9	XA	0	0	0	0	1
3	74.4	WA	0	0	0	1	0
4	77.0	XB	0	0	0	1	1
5	79.7	SP	0	0	1	0	0
6	82.5	YZ	0	0	1	0	1
7	85.4	YA	0	0	1	1	0
8	88.5	YB	0	0	1	1	1
9	91.5	ZZ	0	1	0	0	0
10	94.8	ZA	0	1	0	0	1
11	97.4	ZB	0	1	0	1	0
12	100.0	1Z	0	1	0	1	1
13	103.5	1A	0	1	1	0	0
14	107.2	1B	0	1	1	0	1
15	110.9	2Z	0	1	1	1	0
16	114.8	2A	0	1	1	1	1
17	118.8	2B	1	0	0	0	0
18	123.0	3Z	1	0	0	0	1
19	127.3	3A	1	0	0	1	0
20	131.8	3B	1	0	0	1	1
21	136.5	4Z	1	0	1	0	0
22	141.3	4A	1	0	1	0	1
23	146.2	4B	1	0	1	1	0
24	151.4	5Z	1	0	1	1	1
25	156.7	5A	1	1	0	0	0
26	162.2	5B	1	1	0	0	1
27	167.9	6Z	1	1	0	1	0
28	173.8	6A	1	1	0	1	1
29	179.9	6B	1	1	1	0	0
30	186.2	7Z	1	1	1	0	1
31	192.8	7A	1	1	1	1	0
32	203.5	M1	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

FOR GROUP B TONES
REMOVE JU-1

#	FREQ. (Hz)	SWITCH NUMBERS* 5	4	3	2	1
1	600.0	0	0	0	0	0
2	1000.0	0	0	0	0	1
3	1500.0	0	0	0	1	0
4	1600.0	0	0	0	1	1
5	1650.0	0	0	1	0	0
6	1700.0	0	0	1	0	1
7	1750.0	0	0	1	1	0
8	697.0	0	0	1	1	1
9	1800.0	0	1	0	0	0
10	1850.0	0	1	0	0	1
11	1900.0	0	1	0	1	0
12	770.0	0	1	0	1	1
13	1950.0	0	1	1	0	0
14	852.0	0	1	1	0	1
15	941.0	0	1	1	1	0
16	2000.0	0	1	1	1	1
17	2100.0	1	0	0	0	0
18	2150.0	1	0	0	0	1
19	2200.0	1	0	0	1	0
20	2250.0	1	0	0	1	1
21	2300.0	1	0	1	0	0
22	2350.0	1	0	1	0	1
23	2400.0	1	0	1	1	0
24	1209.0	1	0	1	1	1
25	2450.0	1	1	0	0	0
26	2500.0	1	1	0	0	1
27	2550.0	1	1	0	1	0
28	1336.0	1	1	0	1	1
29	2175.0	1	1	1	0	0
30	1477.0	1	1	1	0	1
31	1633.0	1	1	1	1	0
32	2805.0	1	1	1	1	1

*CLOSED = 0 (ON)
OPEN = 1 (OFF)

POWER AND GROUND CONNECTIONS

The ground connection is typically very straight forward. The main ground foil on the printed circuit foil works well, or a connection to the chassis. Be careful of a radio which has multiple grounds, such as a chassis ground and a true vehicle ground. A GE Mastr Pro is a good example.

The power connection can be any unregulated positive D.C. voltage from +6.0 to +30.0V. Use a regulated voltage if it is conveniently available. However, with voltages below 9.0VDC, place a wire jumper across the regulator (VR-1) on the circuit board. See the circuit board pictorial for the placement of the jumper. This allows the board to work better at low voltages since the regulator only operates above 9.0V. Higher voltage can also be used, however an external limiting resistor will be required so the input does not exceed 30VDC. To determine the approximate value of the resistor (in Kohms) use the following formula: R = (V - 22) / 8. A two watt resistor should be sufficient for voltages up to 200VDC. Refer to figures 1, 2, 3 for additional information. If polarity is reversed to the unit, it will not operate but will not be damaged. Use the following as a guide for obtaining proper operating voltage in different environments:

Mobiles, 12V negative ground—standard hook-up (see above).
Mobiles, 12V positive ground—reverse board +V and GND connections.
Mobiles, 6V pos. or neg. ground—use B+ dropping method.
Bases—use appropriate figure 1, 2, 3.
Portables, 9V or less—by-pass regulator, VR-1.

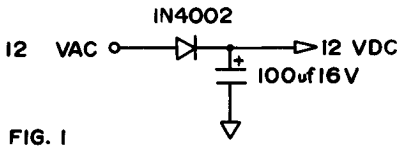


FIG. 1

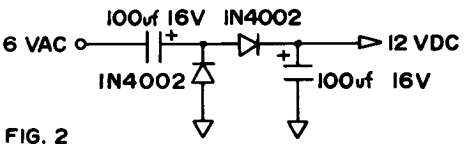


FIG. 2

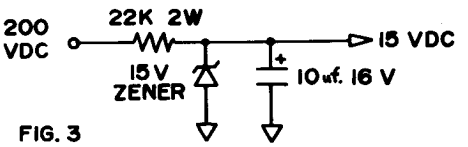


FIG. 3

PROCEDURE FOR CONNECTING SUB-AUDIBLE ENCODER TONE TO TRANSMITTER

The encoder tone output is typically connected just prior to the modulator stage. Typical connections would be to the center of the deviation control, to the input of the final audio driver, to the varactor modulator diodes or to the manufacturer's normal connection point. This connection point varies with each different model radio, and you must determine which provides the best results. In a tube type transmitter, the grid of the modulator is often used, or a varactor kit should be used to modulate the crystal directly in a tube type or solid state transmitter, see figure E1. The VARACTOR (transistor base to collector junction of an NPN silicon transistor) changes A.C. voltage into changing capacitance which truely FM modulates the transmitter. No intermoding or distortion of the voice will be noted with this method. Various values of coupling capacitors are shown for different frequency ranges of the transmitter. A higher value of capacitance will increase the deviation level, however if the capacitance is too high, it may be difficult to set the transmitter on frequency. Varactor Kits are available from us for $3.00 each. Use this method if other connection points prove unsuccessful.

DO NOT connect the encoder tone to the microphone input as this invariably causes excessive tone and harmonic distortion due to the frequency response of the transmitter's speech amplifier. The speech amplifier has a typical response of 300Hz to 3000Hz and does not permit the fundamental tone to be transmitted. This is the usual cause of a distorted tone output as monitored on a deviation scope.

The output of our encoder is low Z, so it is capable of driving low Z loads. Insufficient level output should never be a problem. However, if you are driving a high Z load such as 100k deviation pot, then a series isolation resistor should be used so the encoder will not load down the normal voice modulation. This resistor value must be determined experimentally, but a 100k resistor would be a good starting point. This value could change from 10K to 1 meg depending on the radio used.

If tone distortion continues to be a problem, then a capacitor can be placed on the tone output to provide additional filtering where required, see figure E2. This is most noticeable in phase modulators since the frequency response seems to be quite poor at the low end of the audio range. If you are using a deviation scope, then little spikes will be riding on the sine wave output, and this will sound like a buzz. The additional filtering will cure the problem. True FM modulators do not have this problem and are very easy to work with and interface very well with sub-audible encoders. These modulators can be identified quite easily since the audio is fed into a varactor which is often connected in parallel with the crystal. If the purity of the encoder output is in question, look at the output of the encoder with an oscilloscope.

Most UHF transmitters interface quite well with sub-audible encoders. This is primarily due to the high multiplication factor from the modulator to the final amplifier stage. Because of the lower number of multiplication stages in low band transmitters, sufficient deviation level can sometimes be difficult to obtain.

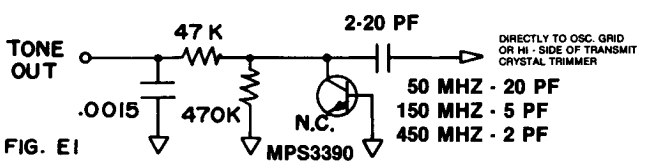


FIG. E1

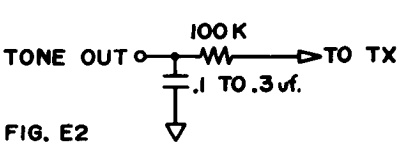


FIG. E2

PROCEDURE FOR CONNECTING AUDIBLE ENCODER TONE TO TRANSMITTER

Audible tone can be connected directly to the microphone input. When driving a high impedance load, a series isolation resistor will be required so the voice modulation will not be affected. If insufficient level seems to be a problem, then inject the tone at the input of the next amplifier stage in the transmitter. Be sure to use a series resistor if modulation level is reduced. If continuous tone is required when encoding from Group B, then remove diode D2, as shown on the CIRCUIT BOARD PICTORIAL. The length of the tone burst may be changed if necessary by adjusting the value of R3. If a longer burst is desired, then increase the value of R3 100K ohms for every 100ms. increase in tone length. The opposite holds true for reduced length.

RF INTERFERENCE

Although our encoders are not susceptable to RF, care must be taken when locating the unit, and how the wires are routed. In most cases of RF interference it has been found that the RF is coupled into the leads of the encoder and then fed back into the radio itself where the RF upsets the bias conditions in the transmitter. This causes distortion and other unusual effects. But under these conditions it will be noted that the encoder is still working properly. This is most common in portable hand held radios, since often the circuitry is compromised slightly to achieve the small size required. Often a small by-pass capacitor such as a 100pf. on the radio's circuit board works quite well. Also, keeping all leads as short as possible or re-routing the wires helps.