FDK

MULTI-700EX

2m FM 1-25W
PLL TRANSCEIVER

INSTRUCTION MANUAL

FUKUYAMA ELECTRONICS CO., LTD.

GENERAL INFORMATION

The Fukuyama Electronics Co., Ltd. (F.D.K) Model : MULTI-700EX mobile and base station two (2) meter transceiver is a reliable and "MULTI" functionable amateur radio transceiver. It is designed and assembled with selected components to give high reliabiliby and is all solid-state. In normal use, and with proper care it will give long and trouble-free service.

Communication range depends upon the usual factors such as antenna in use, operating location, R.F output power level and band conditions. Read the manual carefully before putting the equipment into use.

TABLE CONTENTS

OUTSTANDING FEATURES

The MULTI-700EX is designed using the advanced technology of "FDK" and assembled with the latest techniques to meet the requirements of amateur radio use.

* Four Large LED Digital Frequency Display:

Frequency coverage is 144.000MHz to 145.987.5MHz in 25KHz steps Binary Coded output for accurate frequency indication.

* Provision for Narrow Channel Operation:

Reduced channel widths are expected in the future. The MULTI-700EX provides alternative 12.5KHz steps, at the touch of a buttons.

* Much Improved Cross-Modulation Characteristics:

A total of five stages are employed in an RF resonator section with dualgate MOSFET in RF frontend.

* Built-in Automatic Power-module Protection:

In the even of accidential high VSWR, open or short circuit antenna output, there is automatic power module protection.

* Repeater and Duplex Facility:

Built-in automatic Tone-Burst circuit gives +/−600KHz Transmit shift frequency for repeater or reverse repeater operation and provides +1.6MHz option when used in conjunction with the FDK/ MULTI MUV-430A UHF Transverter.

* Continuous control of RF output power:

The RF output power is continuously adjustable from 1 watt to 25 watts.

* High Stability Fundamental PLL Circuit:

Advanced PLL technology provides high stability and performance with Phase-Looked-Loop circuit.

* Integrated Power Supply Noise Filter:

The supply line from battery to the equipment is a common source of high noise levels as a conductor of ignition and alternator interference. This is eliminated by an effective line filter associated with the power unit.

* Single Knob Selection of 40 Channels Covering One Megahertz:

Full one megahertz coverage in 40 channels per rotation, each in 25KHz switched steps throughout the range. This directly drives the LED display for instant readout.

* Programmable Two Diode Matrix & Priority Crystal Channel:

Any two desired DIODE-MATRIX channels may be programmed with in the frequency range even in 12.5KHz channel steps. In addition two CRYSTAL controlled AUXILIARY channels may be installed.

* Two Scanner Channel Operation:

This provides synthesizer channel and matrix channel scanning or programmable matrix and auxiliary channel scanning operation.

SPECIFICATIONS

GENERAL;

Frequency range:	144.000 – 145.987.5MHz
Channel capacity:	40 channels in 25KHz steps, selected by Main rotary switch plus +12.5KHz step auxiliary push switch gives 80 channels, Two programmable Diode-Matrix and Two Auxiliary crystal channels, give four channels in between the programmable two scanner.
Mode:	F3 (16F3)
Antenna impedance:	50 – 52 ohms (unbalanced).
Supply voltage:	11 – 15 Volts DC (13.8V nominal). Negative ground (–GND).
Consumption power:	5.7 Amps at 25W Max. Transmit, 1.8 Amps at 1W Min. Transmit, 1.7 Amps at Audio Max. Receive, 1.0 Amp at Squelched Receive.
Temperature range:	–10°C to +60°C degrees.
Frequency tolerance:	Within +/–0.002% Ref, @25°C.
Dimentions:	162mm W x 70.5mm H x 260mm D.
Weight:	Approximately 2.3 Kg.

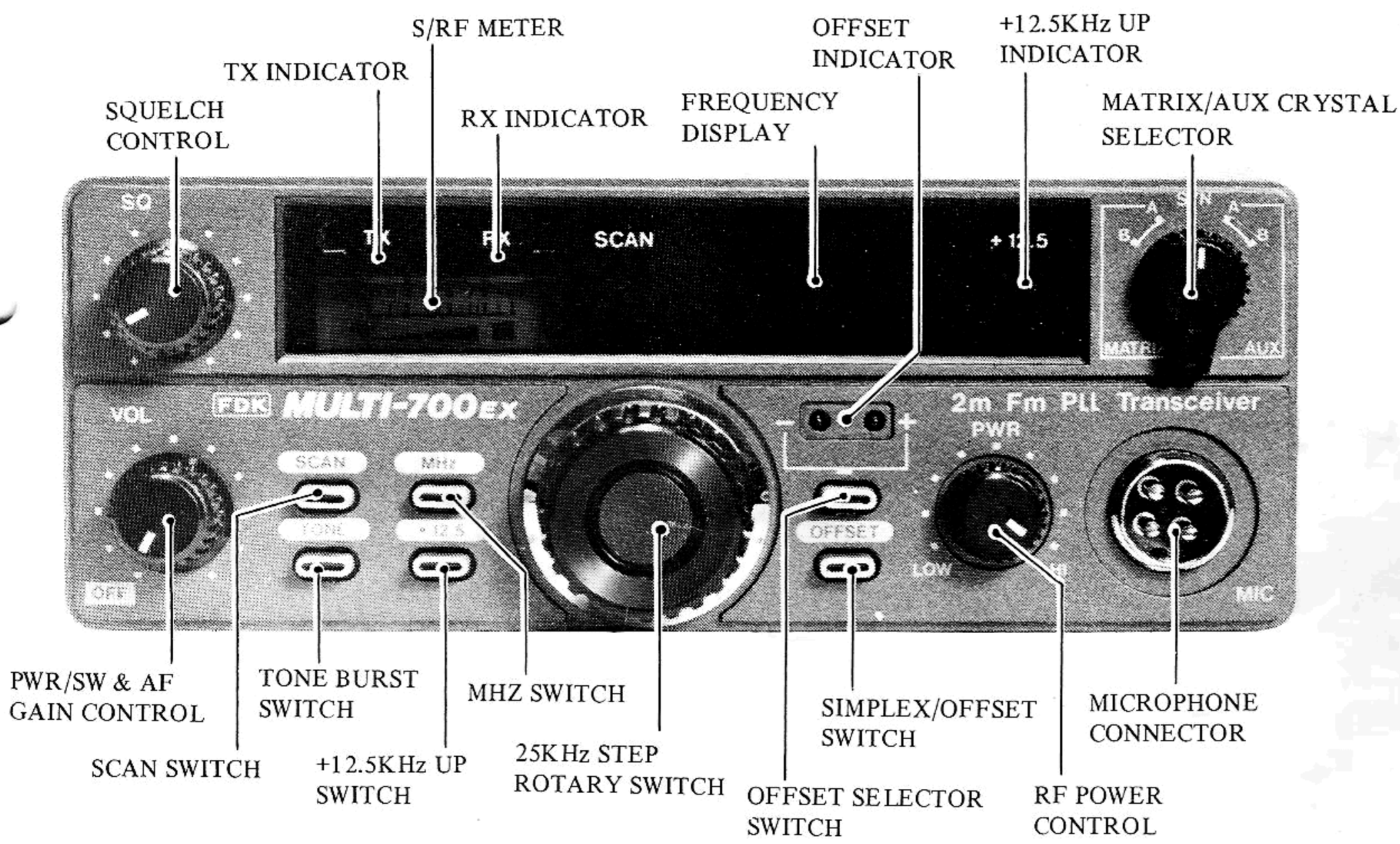
TRANSMITTER;

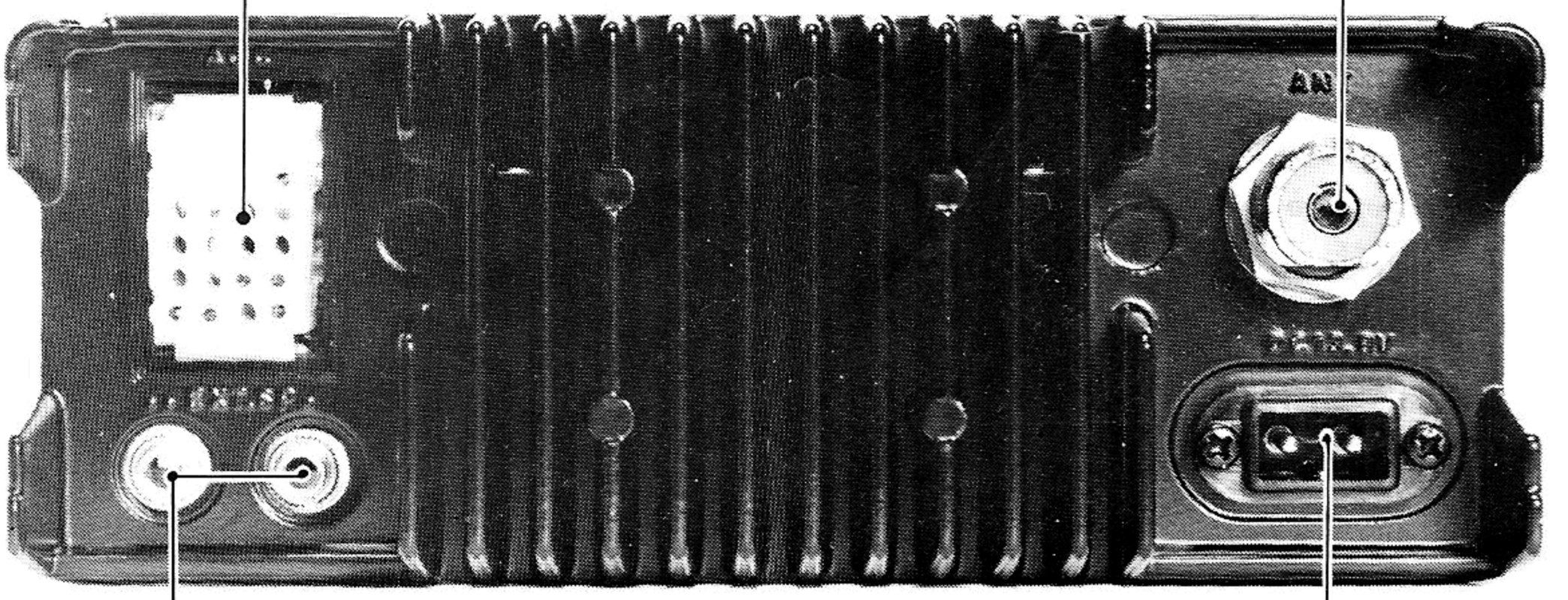
RF output power:	1 – 25 Watts (continuous).
Modulation:	Variable reactance frequency.
Frequency deviation:	+/–5KHz Max. (Factory preset).
Spurious & Harmonics:	Better than 65dB below carr.
Shift frequency:	–600, +600 and +1, 600KHz.
Tone Burst function:	1,750 Hz +/–1Hz. Approx. 1.0 sec, duration automatic operation at start of transmission when Tone-Burst switch selected.
Mic, input sensitivity:	–43Bm dynamic type, 600 ohms with PTT switch function.

RECEIVER;

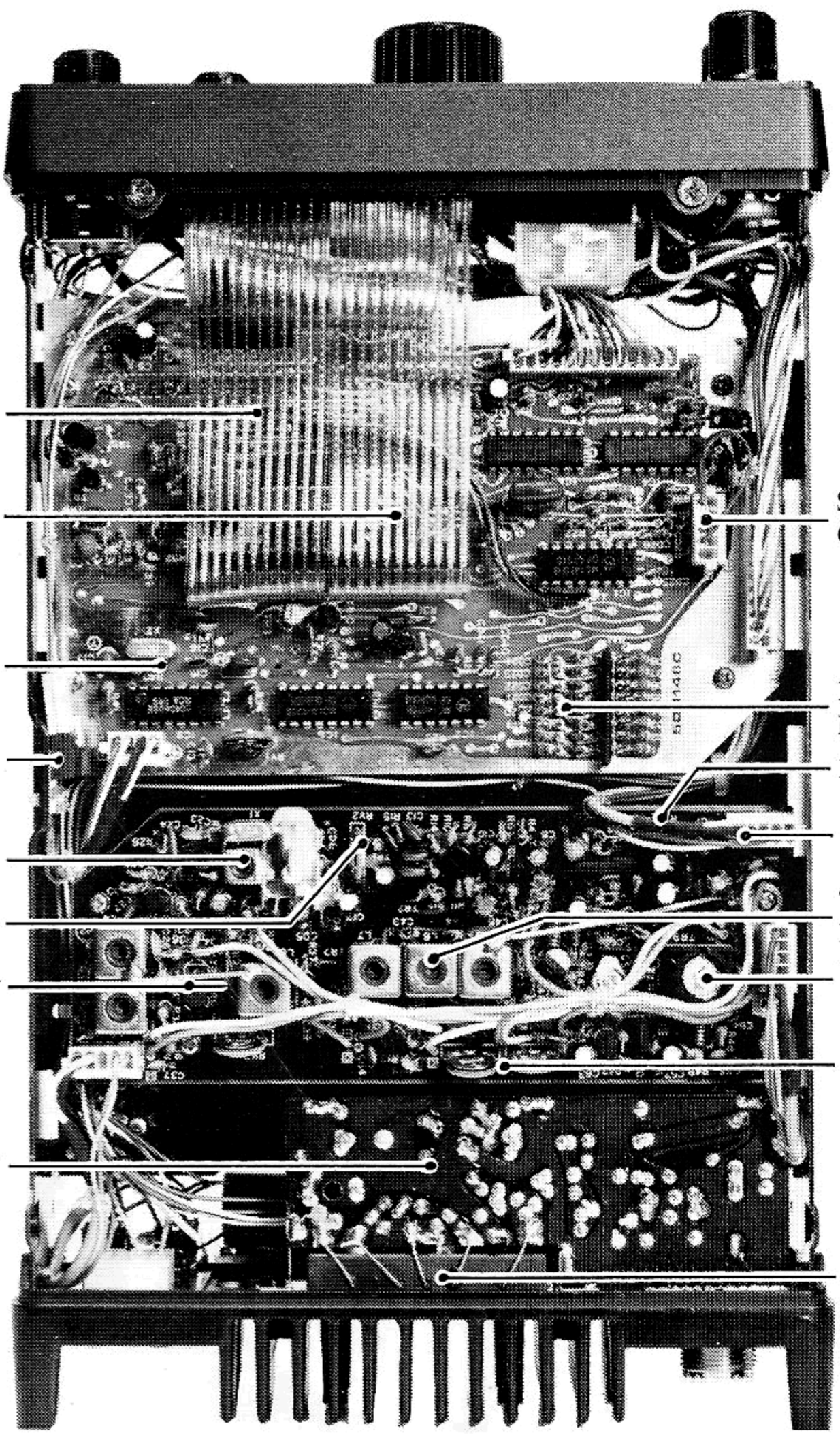
Receiving method:	Double super-heterodyne.
Sesitivity:	Better than –4dBm @20dB N.Q.
Squelch sensitivity:	–5dBu (threshold).
Intermediate frequency:	1st: 16.9MHz, 2nd: 455KHz.
Spurious/Image rejection:	Better than 60dB below carr.
Selectivity:	More than +/– 6KHz at –6dB, Less than +/– 12KHz at –70dB.
Audio output power:	Max. 1.8 Watts at 10% T.H.D.
Audio impedance:	8 ohms.

CONTROLS AND LAYOUT

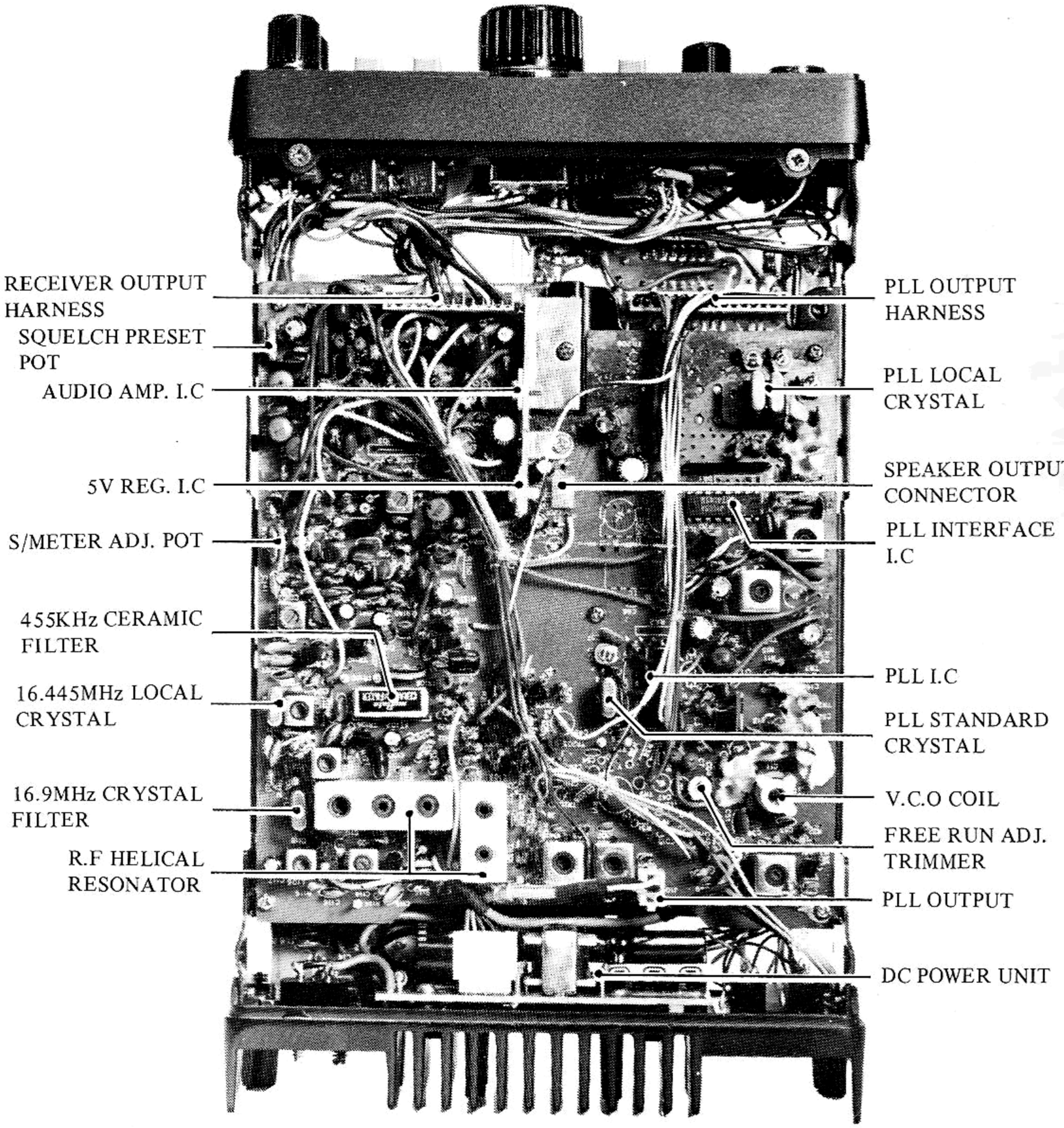




TOP VIEW WITH COVER REMOVED



BOTTOM VIEW WITH COVER REMOVED



NAME OF FUNCTION

* S/RF METER

Indicates the strength of incoming signals on receive, and gives a relative power output indication on transmit. The noamrl reading at full power output is approximately 80% of full scale but, can vary higher or lower if the antenna matching (VSWR) is higher than usual.

* OFF/VOL KNOB

This is a combined ON/OFF power switch and volume control, which adjusts the received signals to a confortable level.

* SQUELCH CONTROL

The squelch control is used to mute the receiver in the absence of incoming signals, and removes the annoying rushing sound that would otherwise be present.
It is normally rotated clockwise until the background noise just disappears without an incoming signal. To advance the control beyond this point could mean missing a weak signal.

* CHANNEL SELECTOR

This 40 channel rotary switch, selects any of the 25KHz steps between "000KHz" to 975KHz. Selects position for desired operating channel frequency (See also below on "MHz" switch and +12.5KHz switch).

* POWER CONTROL

This knob is an R.F output power control continuously variable from 1 watt minimum up to 25 watts maximum. As general indication, 12:00 approx. 2–3 watts, and 3:00 approx. 10 watts.

* MIC CONNECTOR

The unit is supplied with a correct Push-To-Talk hand type microphone. As an alternative, any dynamic type of 500/600 ohms impedance microphone will be suitable, but consult schematic diagram for further details, and wiring.

* SELECTOR SWITCH

Provides two programmable DIODE-MATRIX channels and two priority AUXILIARY CRYSTAL (option) channels selectable to give instant change between SYNTHE channel and four desired priority channels (see SCAN CHANNEL PROGRAMMING page).

* OFFSET SELECTOR

For normal simplex operation the switch is in the released position. Thus the transmit and receive frequency is the same.

When using repeater offset, normal or reverse, push the bottom side switch, then LED shown on the –(minus) position, if use +(plus) offset, push an upper side switch.

Should be change for display frequency if in the "SYN" position of the selector switch. This offset frequency can be changed to +1.6MHz offset for UHF transverter (option) use. (see detail 1.6MHz OFFSET OPEATION)

* MHz SWITCH

Change the megahertz from 144MHz to 145MHz independently of the main rotary switch.

* +12.5KHz SWITCH

This switch, shifts the frequency 12.5KHz above each 25KHz step on the synthesizer for both transmit and receive and is indicated on the right hand edge of LED display.

* SCAN SWITCH

This provides scanning between two desired channels. Scan should be stop, when there is an incoming signal or desired channel transmission is required release the scan switch. This selects right position of the selector switch (see SCAN CHANNEL-PROGRAM).

* TONE SWITCH

If the switch is pushed, this gives automatic operation of the Tone-Burst on transmit (see detail TONE BURST FUNCTION). Programmed scan channel shows on the LED display.

* ACCESSORY SOCKET

This is for use with extension controls – see schematic diagram for connections.

* EXT, SPEAKER JACK

○ Internal speaker disconnected.

○○ Both internal and external speakers in operation.

* ANTENNA CONNECTOR

This SO-239 coaxial connector is for connection to a suitable resonated 2 meter antenna. If the antenna or cable is open or shorted the automatic transmitter power protection circuit will operates. Do not continue to operate under these conditions.

* DC 13.8V PWR CONNECTOR

Battery voltage should be checked on transmit load as if this falls much below 12 volts, output power, stability and quality will suffer. Ensure correct battery polarity connection with supply BLACK/RED twin cable.
(Chassis is negative or earth).

When using mains power supply unit, it must be of a regulated type and capable of more than 6 amps at 13.8Volts, for the full 25 watts output to be obtained.

ACCESSORY

Supplied with this transceiver are the following accessories.

Macrophone unit with plug	1
Black/Red power cord with plug	1
Mobile mounting bracket	1
Spare fuse (10 Amps)	1
Desk top angled stand	1
Ext. Speaker plug	1
Microphone hanger with screws	1
Jumper wire with pins	1
Instruction manual	1

GENERAL OPERATION

Connect D.C power cable to power source, antenna connector to antenna and plug in the microphone before operation.

RECEIVER OPERATION:

The receiver becomes operative when the audio volume control is rotated clockwise. The power supply switch is a part of the volume control and power is "ON" unless turned fully counter-clockwise. Adjust audio volume control to required level.

The squelch control should be set either just below noise level, or at a setting that will open the receiver at a desired level of incoming signal.

The CHANNEL SELECTOR rotary switch, MHz-switch, SCAN switch, SELECTOR switch at "SYN" position and OFFSET switches must be set in appropriate positions.
Operation of the "+12.5KHz" push botton switch will give this facility if required.

TRANSMITTER OPERATION:

It is good operating practice to use the minimum RF power output to secure good communications, according to distance and band conditions. Output level is controlled by the "PWR" knob setting.

The transmitter becomes operative with the microphone connected and Push-To-Talk switch depressed. In the OFFSET mode the TONE-BURST is automatic and after 1 second speak clearly and distictly into the microphone. Close speaking is recommended for maximum talk power and minimum back ground noise.

REMOVAL OF TOP/BOTTOM COVERS AND FRONT/CHASSIS PANEL:

TOP COVER:

When removed, this will give access to;

1) Channel switching selector board, DIODE-MATRIX programming, Sacn-CHANNEL programming, OFFSET frequency programming and TONE-BURST circuit.
2) Transmitter board.
3) Part of the transmitter POWER board and accessory connector.

Remove the four black screws. Slide back and lift to clear. Always use correct size of screw-driver.

BOTTOM COVER:

When removed, this will give access to;

1) Main PLL board, with PLL local crystal and Auxiliary channel crystal socket/trimmers, and Main receiver board, with Helical-Resonator.
2) Power protection diode, Noise eliminator for power board.

Remove the four black screws, slide way back to rear panel, and slightly lift. It may also be necssary to remove speaker conncetor leads from the receiver board.

FRONT/CHASSIS PANEL:

It is necessary to remove both TOP/BOTTOM covers (see above) before removal of the front panel and front chassis mount.

Removal of FRONT/CHASSIS panel gives access to;

1) VOL/SQ, ROTARY SELECTOR, CHANNEL-SELECTOR, MIC CONNECTOR and FUNCTION SWITCH controls.

If further access to chassis is required, first remove the two Philips (metalized) top and bottom screws and the two black screws at mid-panel height.

Remove slowly with great care and it may also be necessary to disconnect the ribbon wires from their channel switching board connectors. (Streight slow pull from connectors. DO NOT bend or fold these wires).

WARNING:

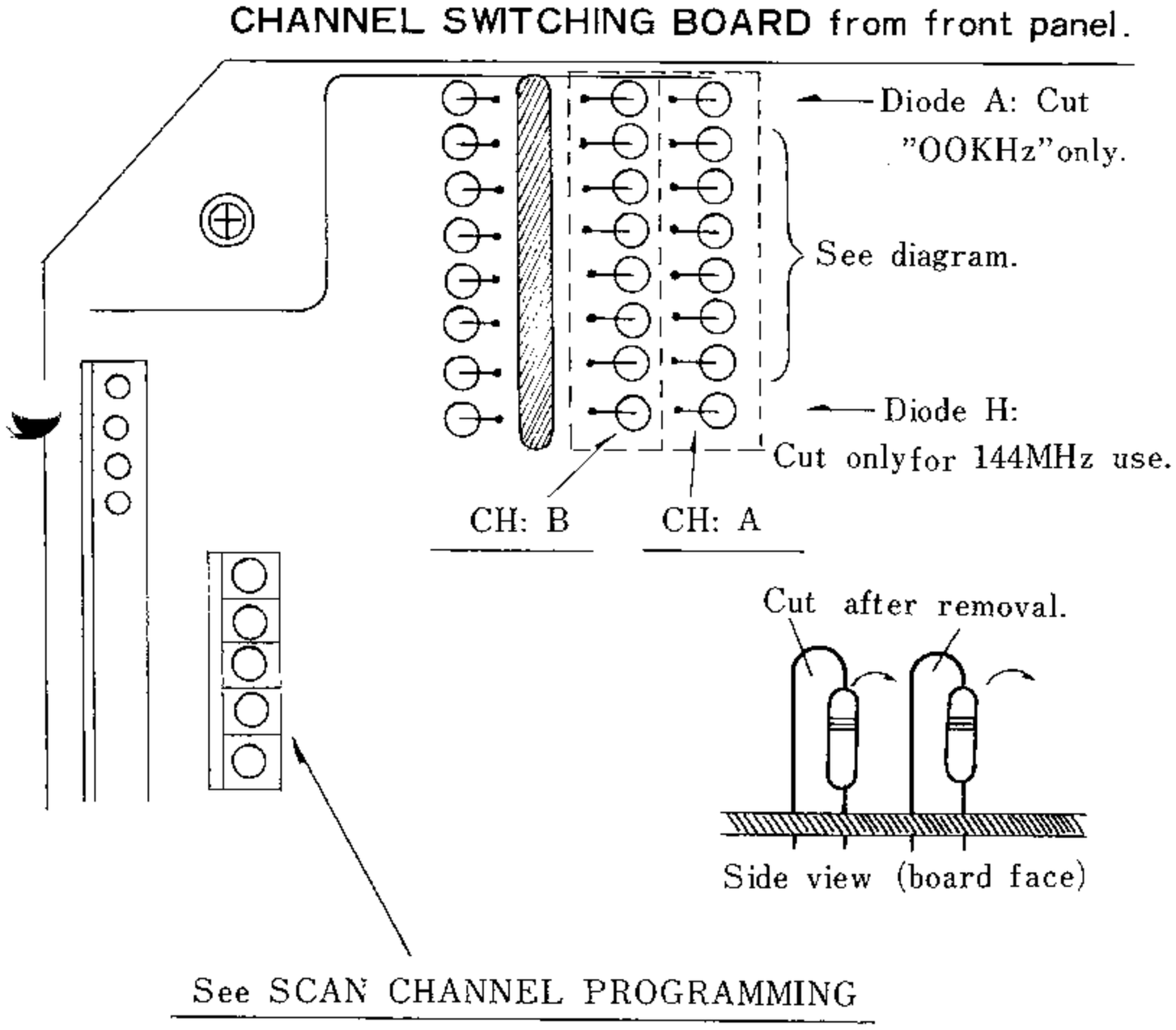
THE ABOVE PANELS AND COVERS SHOULD BE REMOVED ONLY IF THE OWNER HAS THE NECESSARY TECHNICAL ABILITY TO CARRY OUT THE REQUIRED ADJUSTMENT ONLY. SUITABLE TEST EQUIPMENT AND TOOLS MUST BE AVAILABLE. OTHERWISE REFER TO DEALER FOR SERVICE OR MAINTENANCE.

MATRIX CHANNEL "A & B" PROGRAM

1) Remove the top cover, see from front side. Matrix is located upper left side of switching board.
2) Program DIODE-MATRIX channel "A & B" as follows;

Diode A : Cut , if last two digit is "00KHz" (Do not cut, if +12.5KHz).
Diode B-G : See diagram.
Diode H : Cut, for 144MHz only.

CHANNEL SWITCHING BOARD from front panel.



See SCAN CHANNEL PROGRAMMING

MATRIX PROGRAMMING DIAGRAM

Note: Non mark means cut the diode.

NO.	B	C	D	E	F	G	DIODE	NOTE
							FREQ	
1							000	
2	○						025	
3		○					050	
4	○	○					075	
5			○				100	
6	○		○				125	
7		○	○				150	
8	○	○	○				175	
9				○			200	
10	○			○			225	
11		○		○			250	
12	○	○		○			275	
13			○	○			300	
14	○		○	○			325	
15		○	○	○			350	
16	○	○	○	○			375	
17					○		400	
18	○				○		425	
19		○			○		450	
20	○	○	⊗		○		475	
21			○		○		500	
22	○		○		○		525	
23		○	○		○		550	
24	○	○	○		○		575	
25				○	○		600	
26	○			○	○		625	
27		○		○	○		650	
28	○	○		○	○		675	
29			○	○	○		700	
30	○		○	○	○		725	
31		○	○	○	○		750	
32	○	○	○	○	○		775	
33						○	800	
34	○					○	825	
35		○				○	850	
36	○	○				○	875	
37			○			○	900	
38	○		○			○	925	
39		○	○			○	950	
40	○	○	○			○	975	

AUXILIARY CHANNEL/CRYSTAL INSTALLATION

CRYSTAL SPECIFICATION:

The AUXILIARY channel crystal (on the PLL board) are provided with a recognized number engraved which classifies the frequency characteristics (temperature range of $-20°C$ to $+60°C$).
Compensating circuits with selected components are utilized to maintain stability within specified limits. The following section describes the various PLL local crystal board (crystal array in the PLL unit) assemblies, and identifies value of specification.

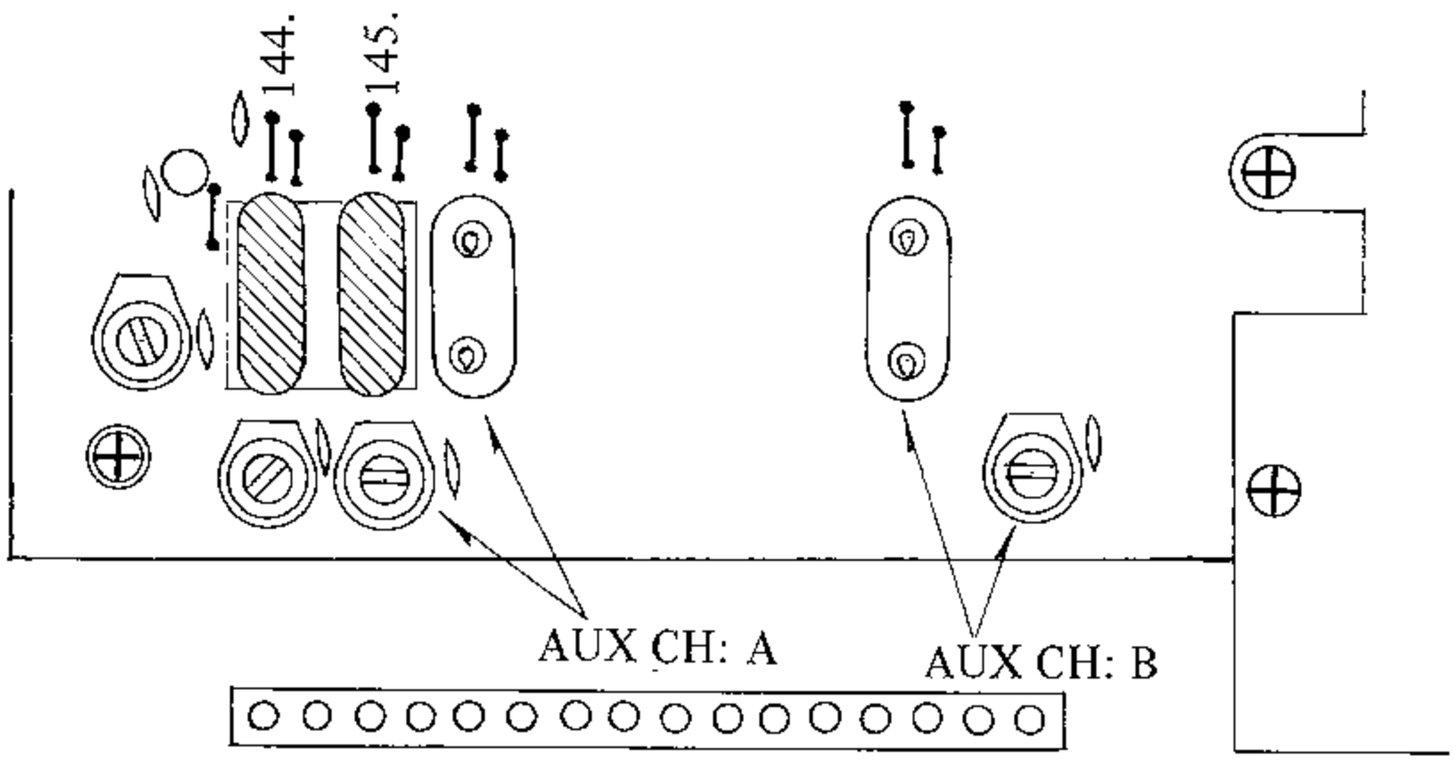
Case	HC−25/U (can type)
Frequency range	41.6333 ~42.300MHz 3rd overtone type.
Load capacitance	35pF +/−2pF
Eqv, series resistance	Less than 40 ohms
Frequency tolerance	0.005% at 25°C
Frequency stability	+/−20 ppm at 25°C.

$$\text{OSC. Frequency} = \frac{(\text{CH. Frequency} - 19.10\text{MHz})}{3}$$

NOTE: Frequency range should be within 144 – 146MHz.

AUXILIARY CHANNEL INSTALLATION:

When fitting auxiliary crystal, place into the crystal socket (located on PLL unit, beside local crystals) channel "A & B" as desired. Adjust crystal frequency at SIMPLEX position on TRANSMIT using frequency counter.



NOTE: PLL board, bottom side, viewed from front.

SCAN CHANNEL POSITION PROGRAM

This unit provides SCAN function operation using the SCAN push botton switch on the front panel. Although factory programmed before ship, if required to move to other channel position, pull-out a pin from plug (just push the pin trigger) and move to desired position shown below.

Scanner gives two desired channels between porgrammed scan position and main channel function knob position. Either DIODE-MATRIX channel or AUX CRYSTAL channel, and SYNTHESIZER dial channel is scanned.

PROGRAMMABLE CHANNEL METHOD

Pin No, 1 . . . . . AUX CH: B
Pin No, 2 . . . . . AUX CH: A
Pin No, 3 . . . . . MATRIX CH: A
Pin No, 4 . . . . . MATRIX CH: B
Pin No, 5 . . . . . COMMON (not remove).

AUX CH: B AUX CH: A MATRIX CH: A MATRIX CH: B

(Top view from FRONT panel)

NOTE: Not recommended transmission while this switch is "ON" may alter to other channel when unlatched logic circuit.

TONE BURST FUNCTION

The factory provided TONE BURST circuit is located at the upper right hand edge of the channel switching board.

EXTENSION DURATION:

The tone is of approximately one second duration. This duration can be altered between approx. 0.5 seconds and 4 seconds by replacing 1uF 16V blue or dip tantalum capacitor, located just right side "106" crystal on the switching board from front view.

0.5uF 16V . . . . . 0.5 second
1.0uF 16V . . . . . 1.0 second (fitted).
2.0uF 16V . . . . . 2.0 second
3.0uF 16V . . . . . 3.0 second
4.0uF 16V . . . . . 4.0 second

TONE OUTPUT LEVEL CONTROL:

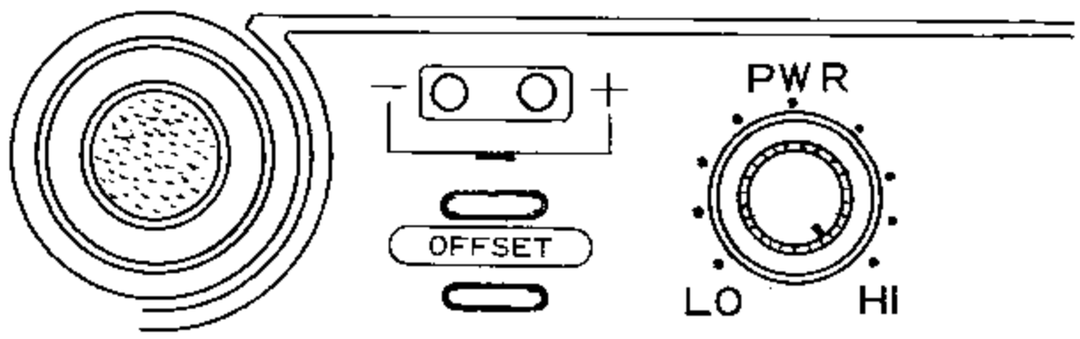
The factory pre-adjusted tone output deviation level is approx. 3.5KHz 70% modulation, however when alternative repeater access level is required, the output can be adjusted at the 50K ohms potentiometer (located upper left side from CD-4060 I.C). If tone duration is changed the deviation level remains unchanged.

CHANGE 1.6MHz OFFSET OPERATION

This unit has specially provided +1.6MHz shift available for UHF band transverter operation. The optional unit Model MUV-430A UHF (430 –440MHz) linear transverter provides UHF transceive operation. (NOTE : Operable frequency range each "OOOKHz to "400KHz„ only).

PROGRAM FREQUENCY:

–OFFSET is –600KHz
+OFFSET is +1,600KHz

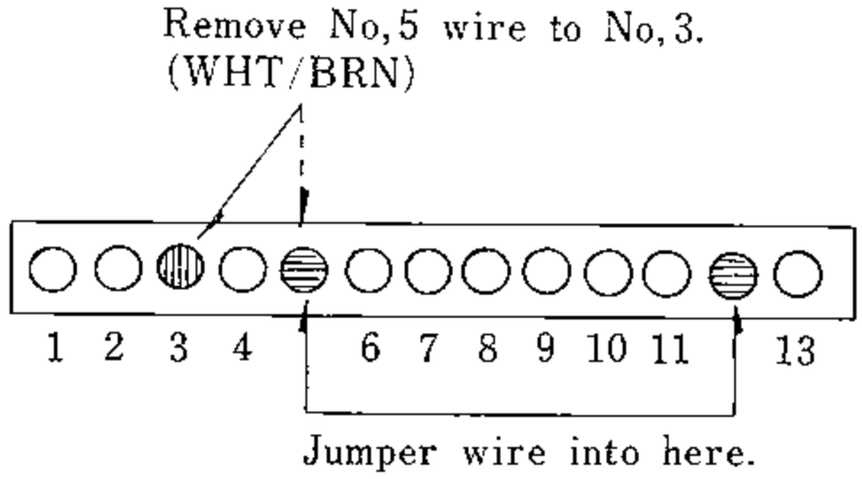


NOTE: The useable frequency range is still in-band only as logic circuit prevents out of band operation.

MODIFICATION METHOD:

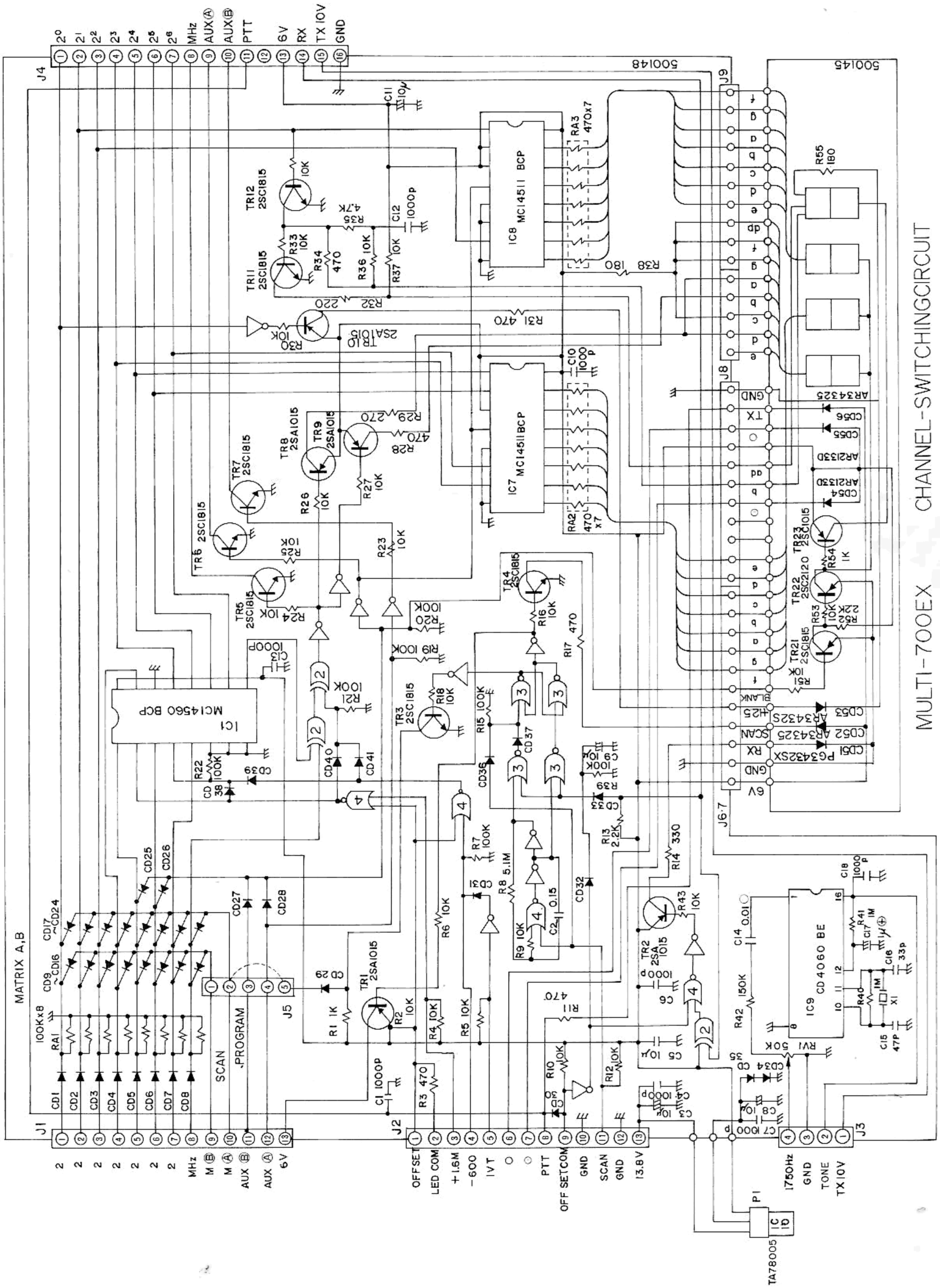
Continued from matrix program and scan position modification and above same switching board. Removal method is same as scan program connector plug. Location is just behind of meter, white 13 pin connector plug.

1) Remove the connector plug from the board.
2) Remove a No, 5 (WHT/BRN) wire pin (push the pin trigger) from connector, then into the No, 3 position.
3) Fit jumper wire with pins (in the Acc's bag) into the No, 5 hole and No, 12 (open position) short.
4) Fit the connector plug back into the board properly, double check above changed connection and position once again.

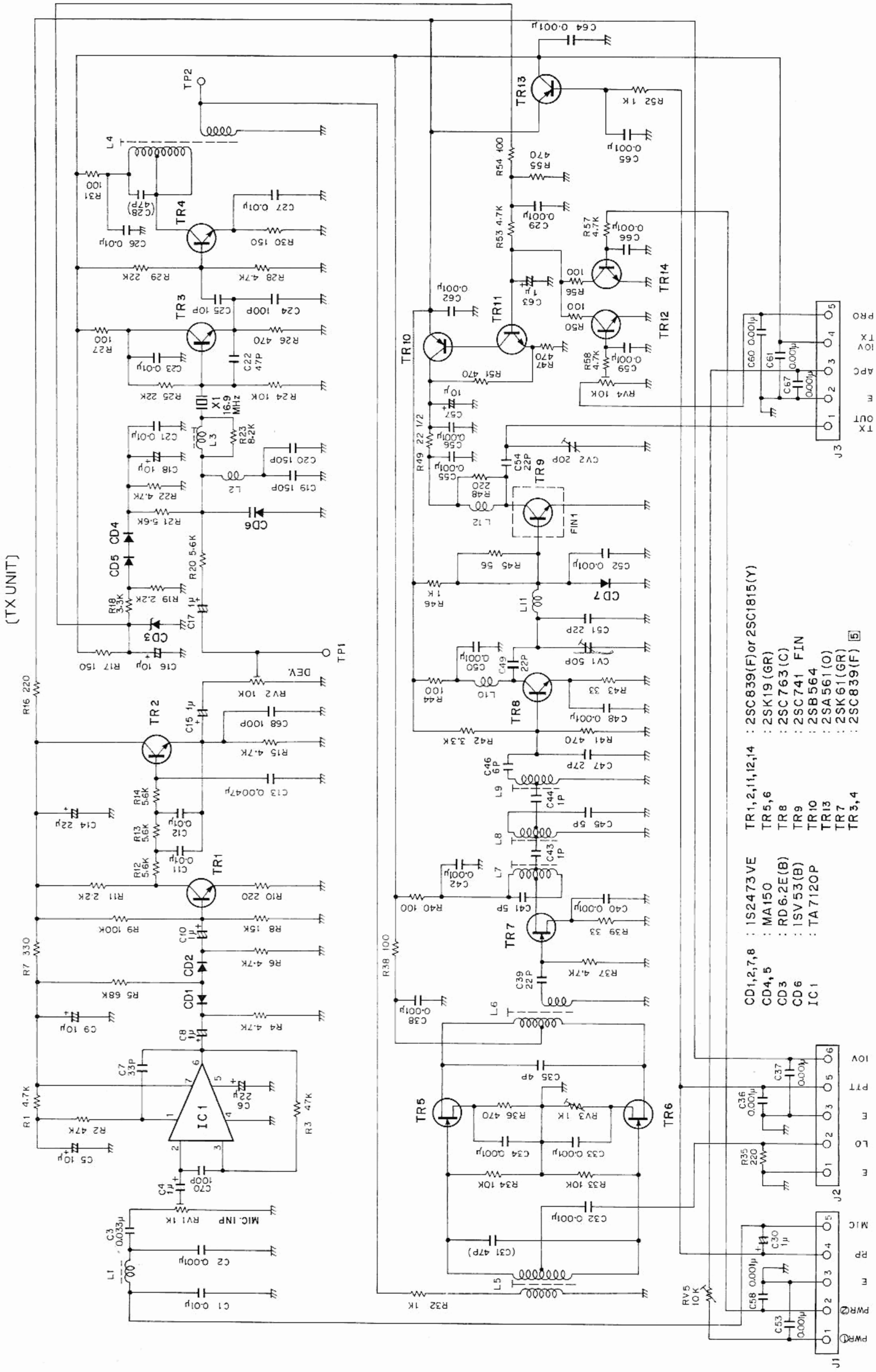


TOP VIEW FROM FRONT PANEL

CH, SW UNIT


MULTI-700EX CHANNEL-SWITCHINGCIRCUIT
MATRIX A,B
J1
J2
J3
J4
J5
J6·7
J8
J9
IC1 MC14560 BCP
IC7 MC14511BCP
IC8 MC14511 BCP
IC9 CD4060 BE
P1
TA78005
TR1 2SA1015
TR2 2SA1015
TR3 2SC1815
TR4 2SC1815
TR5 2SC1815
TR6 2SC1815
TR7 2SC1815
TR8 2SA1015
TR9 2SA1015
TR10 2SA1015
TR11 2SC1815
TR12 2SC1815
TR21 2SC1815
TR22 2SC2120
TR23 2SC1015
RA1 100K×8
RA2 470L x7
RA3 470×7
AR34325
AR2133D
CD1~CD8
CD9~CD16
CD17~CD24
CD25
CD26
CD27
CD28
CD29
CD30
CD31
CD32
CD33
CD34
CD35
CD36
CD37
CD38
CD39
CD40
CD41
CD51 PG3432SX RX
CD52 AR34325 SCAN
CD53 AR34325 H25
CD54 AR2133D
CD55 AR2133D
CD56 AR34325
BLANK
GND
6V
TX
SCAN
OFFSET
LED COM
+1.6M
-600
1VT
PTT
OFF SETCOM
GND
SCAN
GND
13.8V
1750Hz
GND
TONE
TX 10V
MHz
M Ⓑ
M Ⓐ
AUX Ⓑ
AUX Ⓐ
6V
PTT
RX
TX 10V
GND
5001A8
5001A5

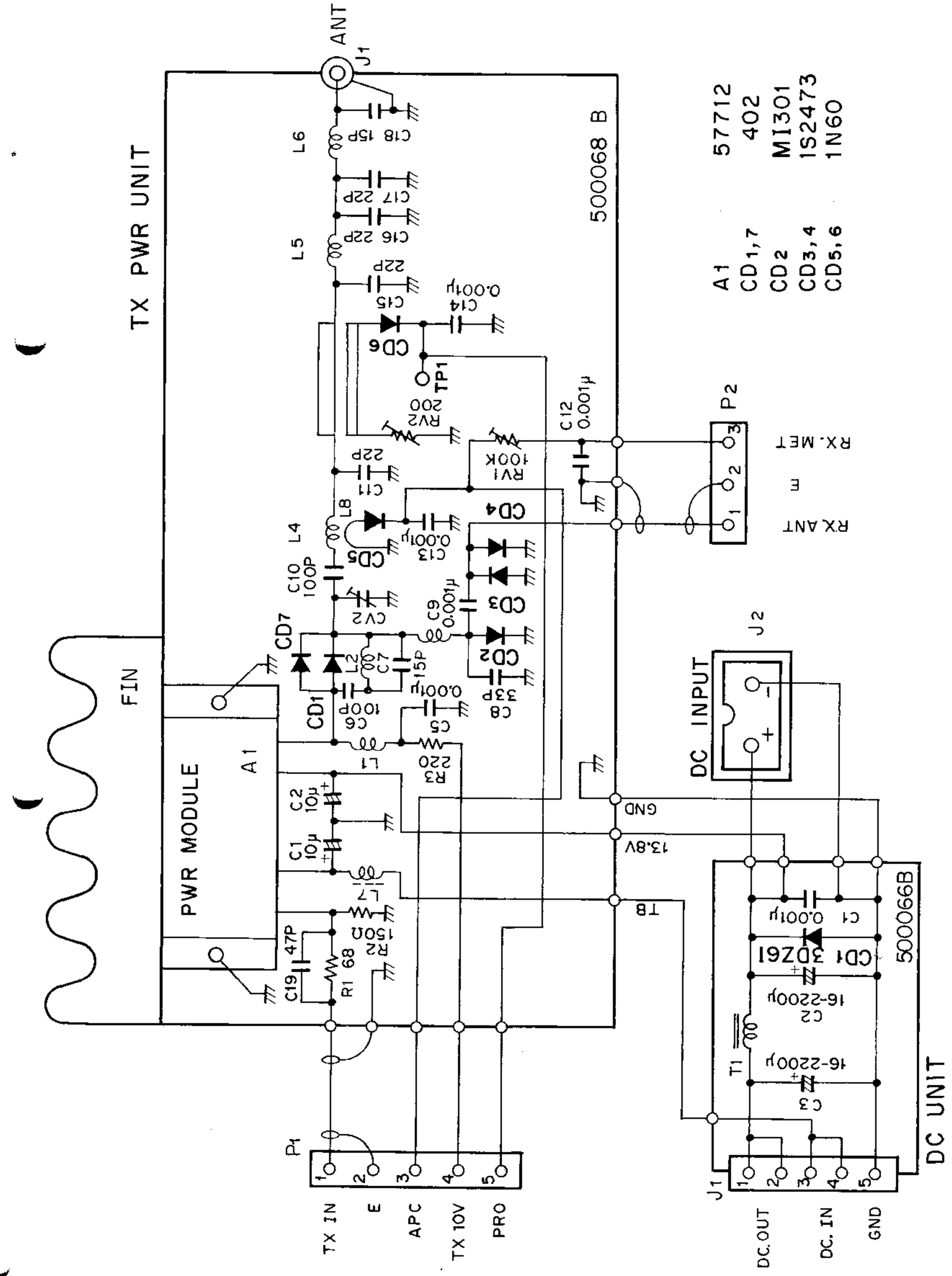
TX UNIT



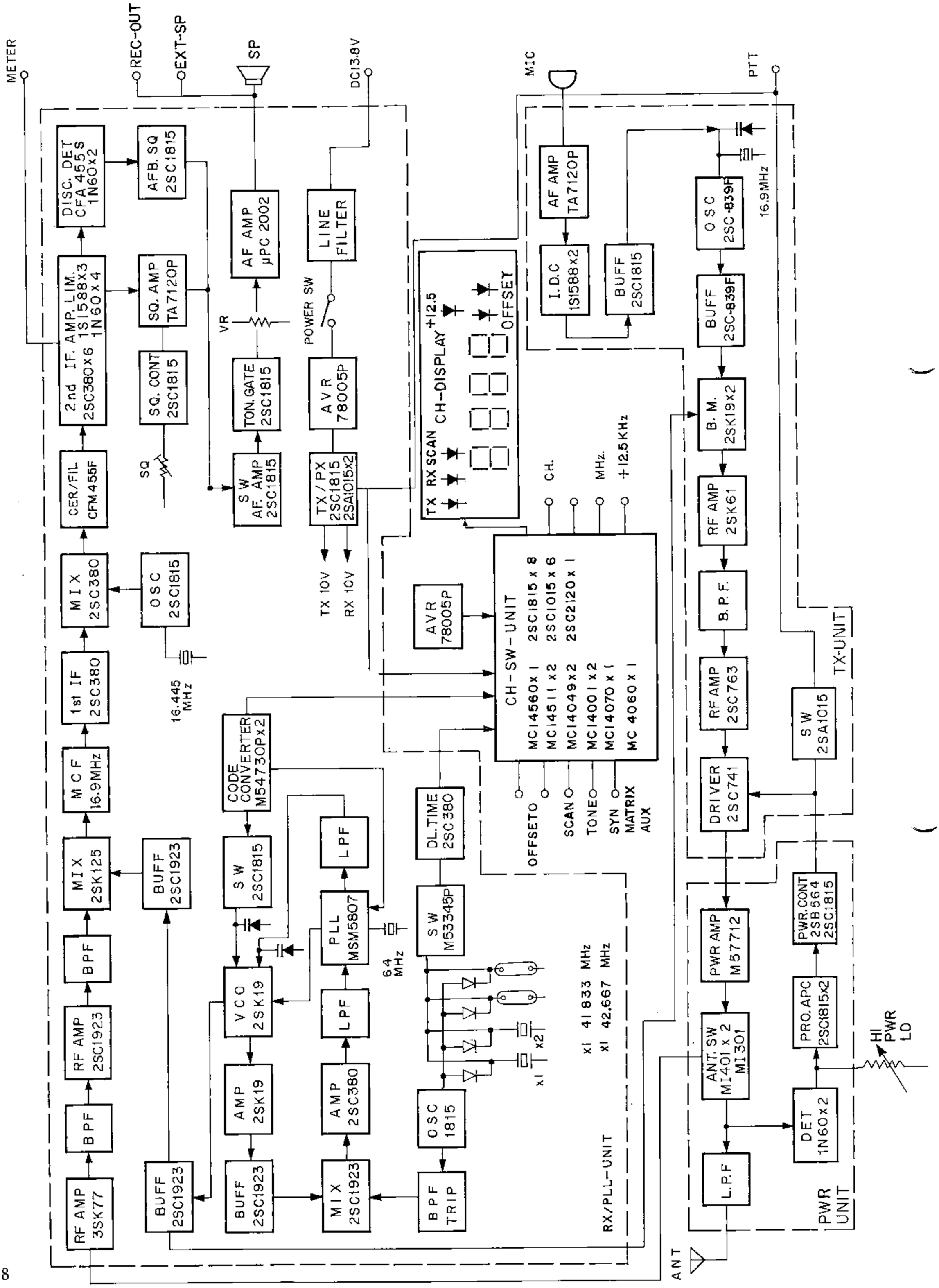
CD1,2,7,8 : 1S2473VE
CD4,5 : MA150
CD3 : RD6.2E(B)
CD6 : 1SV53(B)
IC1 : TA7120P

TR1,2,11,12,14 : 2SC839(F)or 2SC1815(Y)
TR5,6 : 2SK19(GR)
TR8 : 2SC763(C)
TR9 : 2SC741 FIN
TR10 : 2SB564
TR13 : 2SA561(O)
TR7 : 2SK61(GR)
TR3,4 : 2SC839(F) [5]

TX PWR UNIT


TX PWR UNIT
FIN
PWR MODULE
A1
ANT
J1
L6
C18 15P
L5
C17 22P
C16 22P
22P
C15
0.001μ
C14
CD6
TP1
RV2 200
C12 0.001μ
P2
RX. MET
E
RX ANT
22P
C11
RV1 100K
L8
L4
CD4
CD5
C10 100P
0.001μ
C13
CV2
CD7
CD1
CD3
CD2
C9 0.001μ
L2
C7 15P
C6 100P
0.001μ
C5
C8 33P
L1
R3 220
C2 10μ
C1 10μ
L7
R2 150Ω
C19 47P
R1 68
TB
GND
13.8V
P1
TX IN
E
APC
TX 10V
PRO
DC INPUT
J2
CD1 3DZ61
C1 0.001μ
C2 16-220Oμ
T1
C3 16-220Oμ
J1
DC. OUT
DC. IN
GND
DC UNIT
5000668 B
57712
402
MI301
1S2473
1N60
A1
CD1,7
CD2
CD3,4
CD5,6

BLOCK DIAGRAM



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