

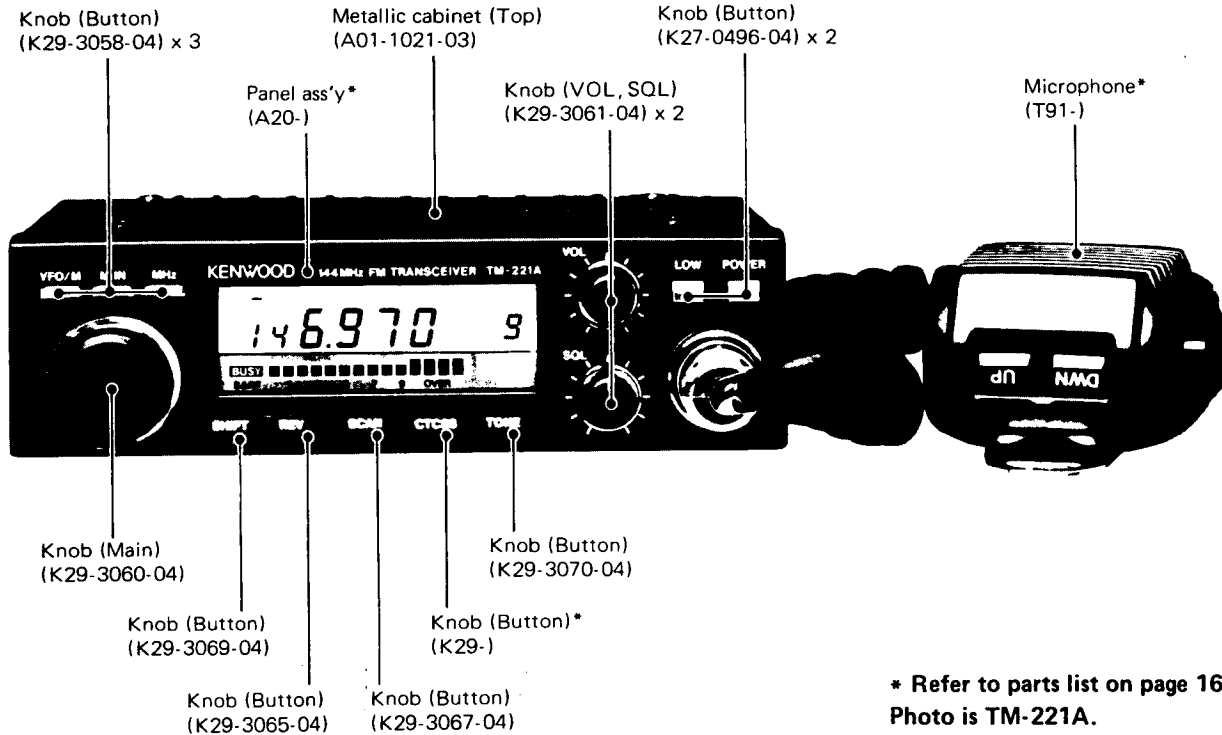
144MHz FM TRANSCEIVER

# TM-221A/E/ES

## SERVICE MANUAL

# KENWOOD

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## CIRCUIT DESCRIPTION

| MODEL        | TM-221A (45W) |             |             | TM-221E (10W) |             | TM-221ES (45W) |             |
|--------------|---------------|-------------|-------------|---------------|-------------|----------------|-------------|
| UNIT         | K             | M1          | M2          | T1            | W1          | T2             | W2          |
| Final unit   | X45-1360-02   |             |             | X45-1330-03   |             | X45-1360-02    |             |
| Control unit | X53-3040-11   | X53-3040-21 | X53-3040-22 | X53-3040-51   | X53-3040-61 | X53-3040-51    | X53-3040-61 |
| TX-RX unit   | X57-3060-11   |             |             | X57-3060-51   |             | X57-3060-52    |             |

Table 1 Comparison of TM-221A, TM-221E and TM-221ES

### Frequency configuration

The TM-221A/E/ES utilize a PLL synthesizer system incorporating a digital VFO. (See Fig. 1.) The channel step can be selected as 5, 10, 12.5 (T,W), 15, 20, or 25kHz.

The receiver operates as a double conversion system. Received signals are mixed with the first local oscillator (133.305~137.300MHz (K,M), 133.300~135.295MHz (T,W)) to produce the first intermediate frequency of 10.695MHz (K,M), 10.7MHz (T,W). The first intermediate frequency is mixed with the second local oscillator (10.24 MHz (K,M), 10.245MHz (T,W)) to produce the second intermediate frequency of 455kHz.

The transmitter system consists of a PLL circuit incorporating a direct oscillator and direct divider. The output is amplified by a linear amplifier prior to being transmission.

### Receiver system

#### • General

Incoming signals from the antenna pass through a low-pass filter in the Transmitter Final unit and a diode transmit/receive switch, then enter the receiver front end.

After passing through two antenna coils the signals are amplified by a GaAs (galium arsenide) FET (Q1 : 3SK184(S). Undesired signals are removed by 3 tuning coils (L19~L21 : K,M) or a 3-pole helical resonator (L3 : T,W). The resulting signal is applied to the first mixer Q2 : 3SK131(V12), which employs an N channel MOS FET to obtain good 2-signal characteristics. In the first mixer (Q2) the signal is mixed with the first local oscillator from the PLL system to produce the first IF signal of 10.695MHz (K,M), 10.7MHz (T,W). Interfering Adjacent channel interference is removed from the first IF signal by a two-stage monolithic crystal filter (MCF) (L6).

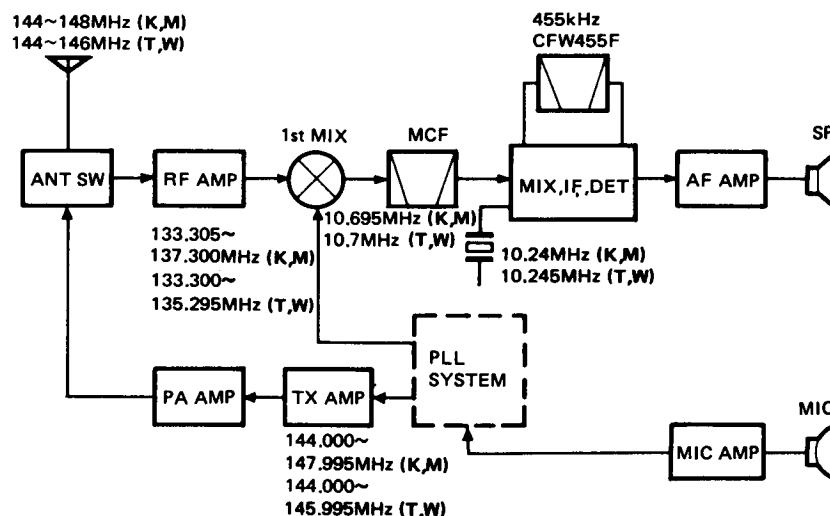


Fig. 1 Frequency configuration

# CIRCUIT DESCRIPTION

The first IF signal is amplified by Q3 : 2SC2714(Y) and fed to a special narrow-FM IC (TA7761F). Here the signal is mixed with the 10.24MHz (K,M), 10.245MHz (T,W) frequency from the second local oscillator to produce the 455kHz second IF signal. This signal is sharpened by passing it through a six-element ceramic filter (CFW455F). The signal is then amplified by a five-stage limiting amplifier contained in IC1. This is followed by quadrature detection which is also performed by IC1. Undesirable high-frequency components are removed from the detected signal by an active low-pass filter. The signal then passes through the audio volume control, then is amplified by the audio power amplifier (IC4), and applied to the speaker. The circuit configuration from detection onward is shown in Fig. 2.

● **Squelch circuit**

The noise component extracted from the detector output is filtered to remove the second intermediate frequency component (455kHz), amplified twice, and is then fed to the rectifier. After rectification, the signal passes through the squelch control to the audio limiter circuit.

● **S-meter circuit**

The S-meter output voltage of the special narrow-FM IC (TA7761F) is amplified by an inverting amplifier, then fed to the Control unit. The microprocessor converts the analog voltage to a digital signal that is used to control the LCD bar meter.

| Item                          | Rating  |
|-------------------------------|---|
| Nominal center frequency (fo) | 10.695MHz   |
| Pass bandwidth                | ±7.5kHz or more at 3dB  |
| Attenuation bandwidth         | ±25kHz or less at 40dB<br>±45kHz or less at 60dB  |
| Guaranteed attenuation        | 70dB or more within ±1MHz<br>40dB or more spurious at fo~fo + 500kHz<br>80dB or more spurious at fo-(910±10kHz) |
| Ripple                        | 1.0dB or less   |
| Insertion loss                | 1.5dB or less   |
| Terminating impedance         | 3kΩ/0pF   |

**Table 2-1 MCF (L71-0216-05) characteristics (TX-RX unit L6 : K,M type)**

| Item                          | Rating  |
|-------------------------------|---|
| Nominal center frequency (fo) | 10.7MHz   |
| Pass bandwidth                | ±7.5kHz or more at 3dB  |
| Attenuation bandwidth         | ±25kHz or less at 40dB<br>±45kHz or less at 60dB  |
| Guaranteed attenuation        | 70dB or more within ±1MHz,<br>(Spurious response 40dB or more at fo~fo + 500kHz)<br>80dB or more at fo-(900~920kHz) |
| Ripple                        | 1.0dB or less   |
| Insertion loss                | 1.5dB or less   |
| Terminal impedance            | 3kΩ/0pF   |

**Table 2-2 MCF (L71-0228-05) characteristics (TX-RX unit L6 : T,W type)**

| Item                                       | Rating                         |
|--|--------------------------------|
| Nominal center frequency                   | 455kHz±1kHz                    |
| 6dB bandwidth                              | ±6kHz or more (from 455kHz)    |
| 50dB bandwidth                             | ±12.5kHz or less (from 455kHz) |
| Ripple (within 455±4kHz)                   | 3dB or less                    |
| Insertion loss                             | 6dB or less                    |
| Guaranteed attenuation (within 455±100kHz) | 35dB or less                   |
| I/O impedance                              | 2.0kΩ                          |

**Table 3 Ceramic filter CFW455F (L72-0315-05) characteristics (TX-RX unit L10)**

# CIRCUIT DESCRIPTION

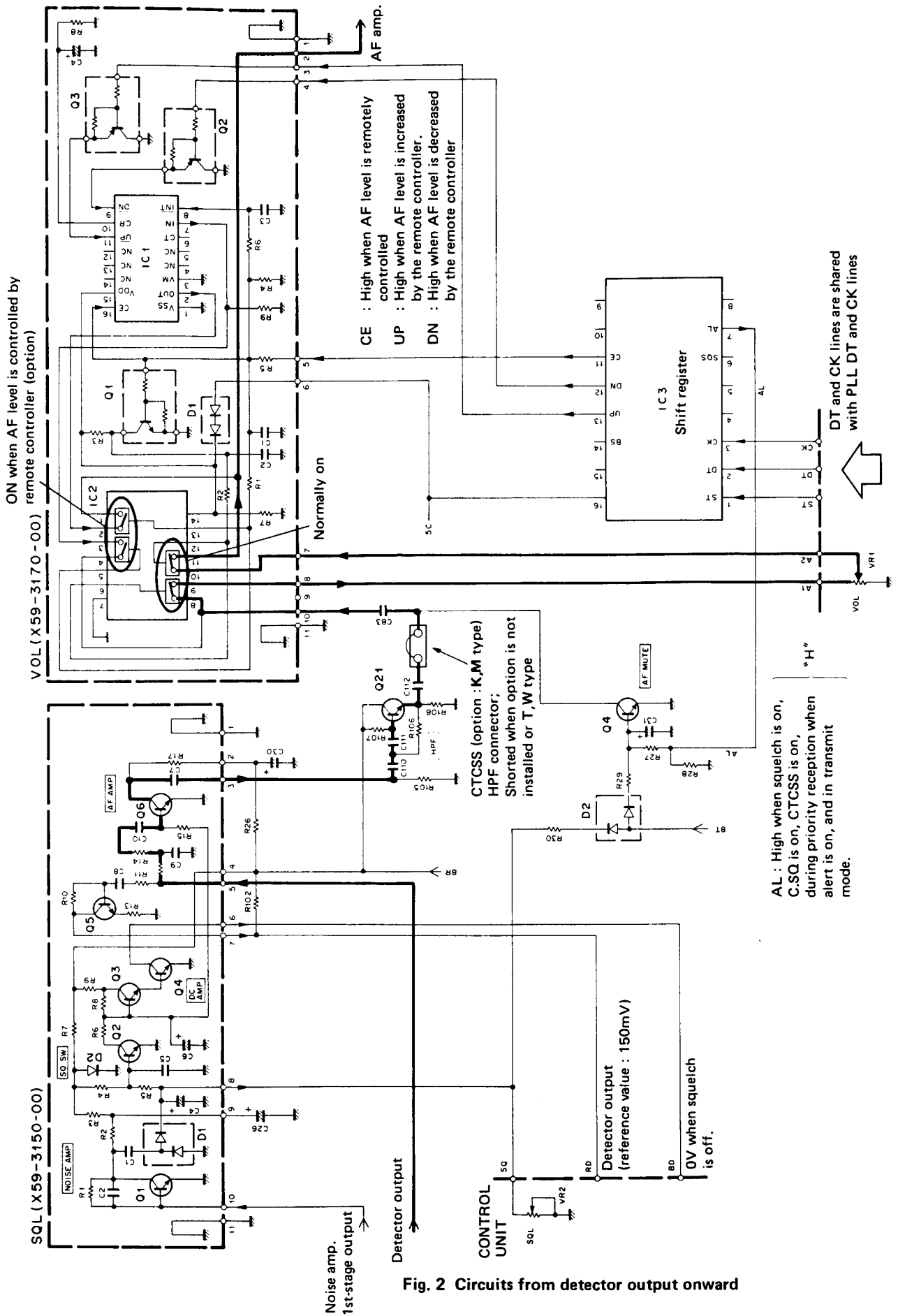


Fig. 2 Circuits from detector output onward

CONTROL UNIT (X53-3040-XX)

## CIRCUIT DESCRIPTION

### Transmitter system

#### • General

In the transmitter system the desired frequency is produced directly by an oscillator. Frequency modulation is obtained directly thru the use of a varactor diode.

#### • Modulation circuit

Audio signals from the microphone are applied to a three-stage operational amplifier which adds preemphasis, performs amplification and limiting, and includes a splatter filter to remove undesired high-frequency components. After amplification by the operational amplifier, part of the audio signal is applied to the microphone check circuit used in the low-power mode.

In the FM modulation circuit, the frequency of the VCO is directly modulated by a varactor diode.

#### • Preampifier stage circuit

The output from the VCO enters the linear amplifier, which is capable of high-quality signal amplification because it operates entirely in linear mode. APC, (Automatic Power Control) is performed by controlling the collector voltage of the 3 stage final preamplifier stage.

#### • Power amplifier circuit

The drive signal is applied to the power module and amplified to the required level. In the model TM-221A/ES heat is dissipated efficiently by a large mechanically strong heatsink.

#### • APC and SWR protection circuits

Fig. 3 shows the basic ALC (Automatic Level Control) and SWR (Standing Wave Ratio) protection circuits. The SWR protection circuit incorporates a CM coupler that detects any reflected power caused by mismatching of the antenna. After detection and amplification, this circuit acts to lower the output control voltage, which protects the power module by reducing the gain. The automatic power control (APC) circuit incorporates a diode that is used to detect a portion of the output from the power module. The detected signal is amplified and is then used to control the power control voltage. The control voltage is inversely proportional to the output, so a constant output level is maintained.

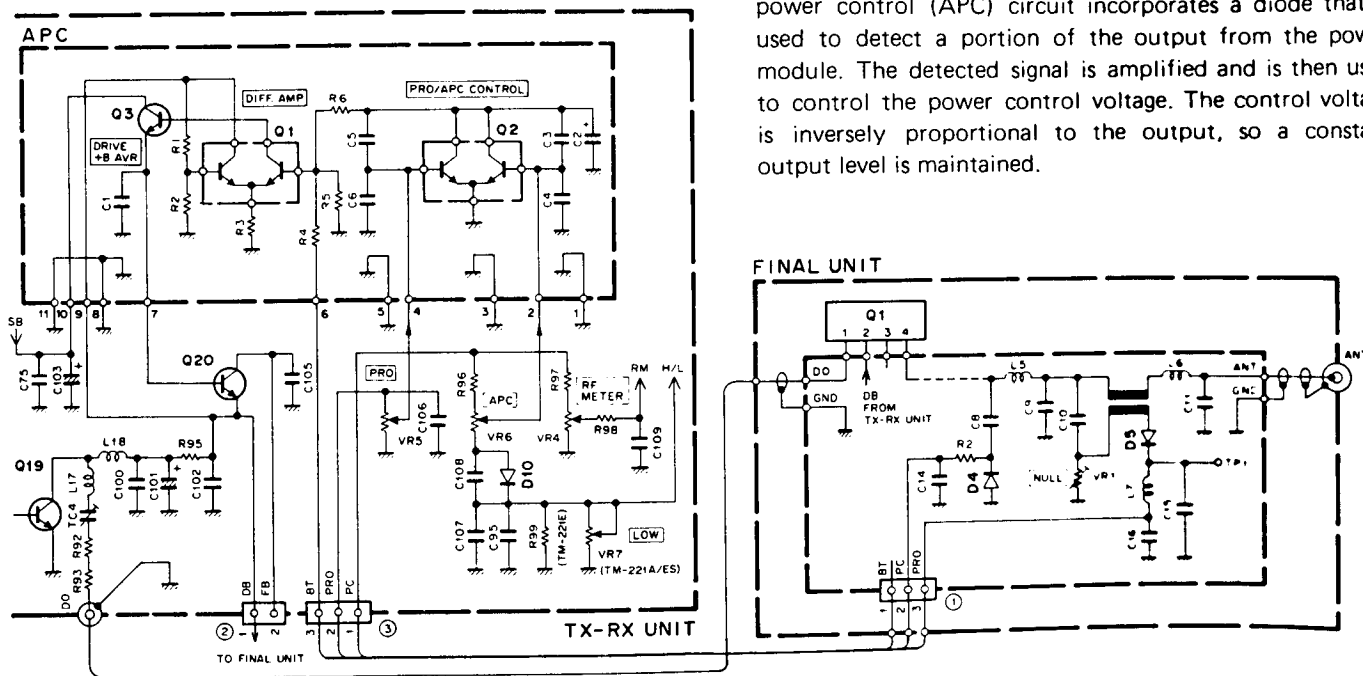


Fig. 3 APC and SWR protection circuits

| Item                         | Symbol | TC<br>(°C) | Unit | Condition                           | Specifications   |            |
|------------------------------|--------|------------|------|-------------------------------------|------------------|------------|
|                              |        |            |      |                                     | M57747           | M57726     |
| Operating voltage            | Vcc    | 25         | V    |                                     | 17               | 17         |
| Current consumption          | Icc    | 25         | A    |                                     | 5                | 14         |
| Input power                  | pin    | 25         | W    | Z <sub>G</sub> =Z <sub>L</sub> =50Ω | 0.4 (VCC1≤12.5V) | 0.6        |
| Output power                 | Po     | 25         | W    | Z <sub>G</sub> =Z <sub>L</sub> =50Ω | 20               | 55         |
| Case temperature (operating) | Tc(op) |            | °C   |                                     | -30 ~ +110       | -30 ~ +110 |
| Storage temperature          | Tstg   |            | °C   |                                     | -40 ~ +110       | -40 ~ +110 |

Table 4 Power module M57747 (TM-221E), M57726 (TM-221A/ES)  
absolute maximum ratings (Final unit Q1)

# CIRCUIT DESCRIPTION

## PLL synthesizer

Fig. 4 is the PLL system block diagram. The transmitter and receiver systems of the TM-221A/E/ES have independent VCOs and PLLs, but share a common low-pass filter.

The VCOs are configured as subunits. This construction minimizes outside influence and improves frequency stability.

To provide 5, 10, 12.5 (T,W), 15, 20, and 25kHz steps, a comparison frequency of 5kHz or 6.25kHz (T,W) is obtained by dividing the 10.24MHz (K,M), 12.8MHz (T,W) frequency of the reference oscillator by 2048 or 2560 (T,W). In both the transmitter and receiver systems the target frequency is produced directly by the VCO, passed through one amplifier stage, then applied to a pulse-swallow PLL IC that divides the frequency, performs phase comparison, and locks the frequency.

The reference frequency division ratios (four values) and comparison frequency division ratio are supplied to the PLL IC (M54959P) as external serial data. An internal dual-modulus (1/128 and 1/129) prescaler enables the entire pulse-swallow PLL circuit to be implemented on a single chip. (See Fig. 5.) The switching functions (SW1 and SW2) of the PLL IC are used to switch between the 8R (receive) and 8T (transmit) operating voltages in the transmit and receive modes.

The switch controls are applied together with frequency division ratio data from the Control unit.

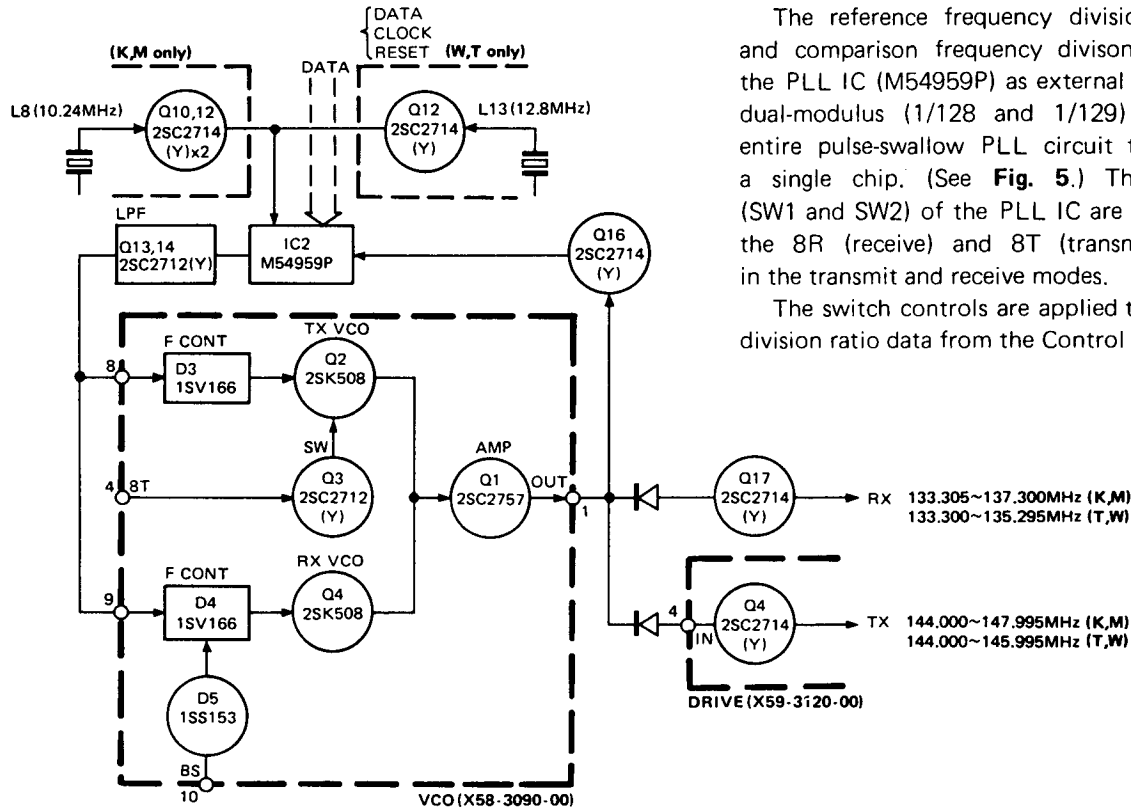


Fig. 4 PLL system block diagram

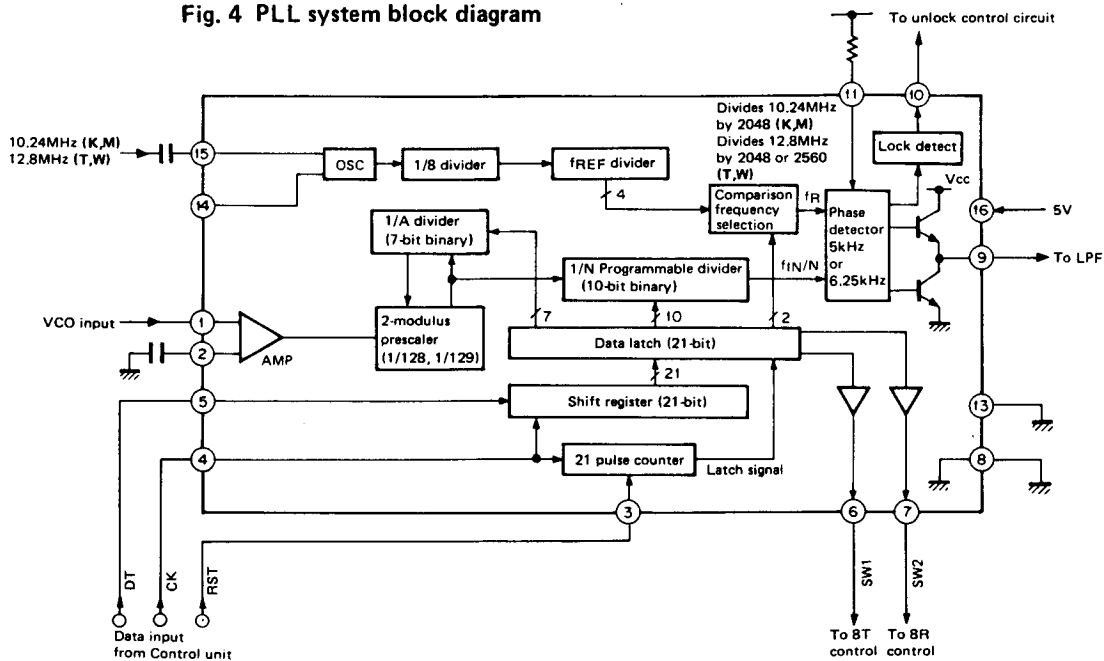


Fig. 5 PLL IC ; M54959P block diagram

# CIRCUIT DESCRIPTION

At 144MHz (K,M), fVCO (RX) has the following relationship to the various frequency division ratios :

$$fVCO = (144 - 10.695) = [(n \times 128) + A] \times fosc / R$$

where, fVCO : Frequency output by the VCO

n : 10-bit binary programmable counter setting

A : 7-bit binary programmable counter setting

fosc : 10.24MHz reference oscillator

R : 14-bit binary programmable counter setting

(2048)

If n=208 and A=37, then;

$$fVCO = [(208 \times 128) + 37] \times 10240 / 2048$$

$$= [26624 + 37] \times 5$$

$$= 133305\text{kHz} = 133.305\text{MHz}$$

### ● Unlock detector circuit

Whenever the PLL is unlocked, pin 10 of the PLL IC goes high ("H") (5.5V), turning off Q15 so that Q1 and Q2 in the module unit (drive unit) turn OFF. The result is that during receive Q17 is OFF, and during transmit Q4 and Q5 in the module unit are OFF. This halts transmit, preventing unwanted radiation from the antenna. (See Fig. 6.)

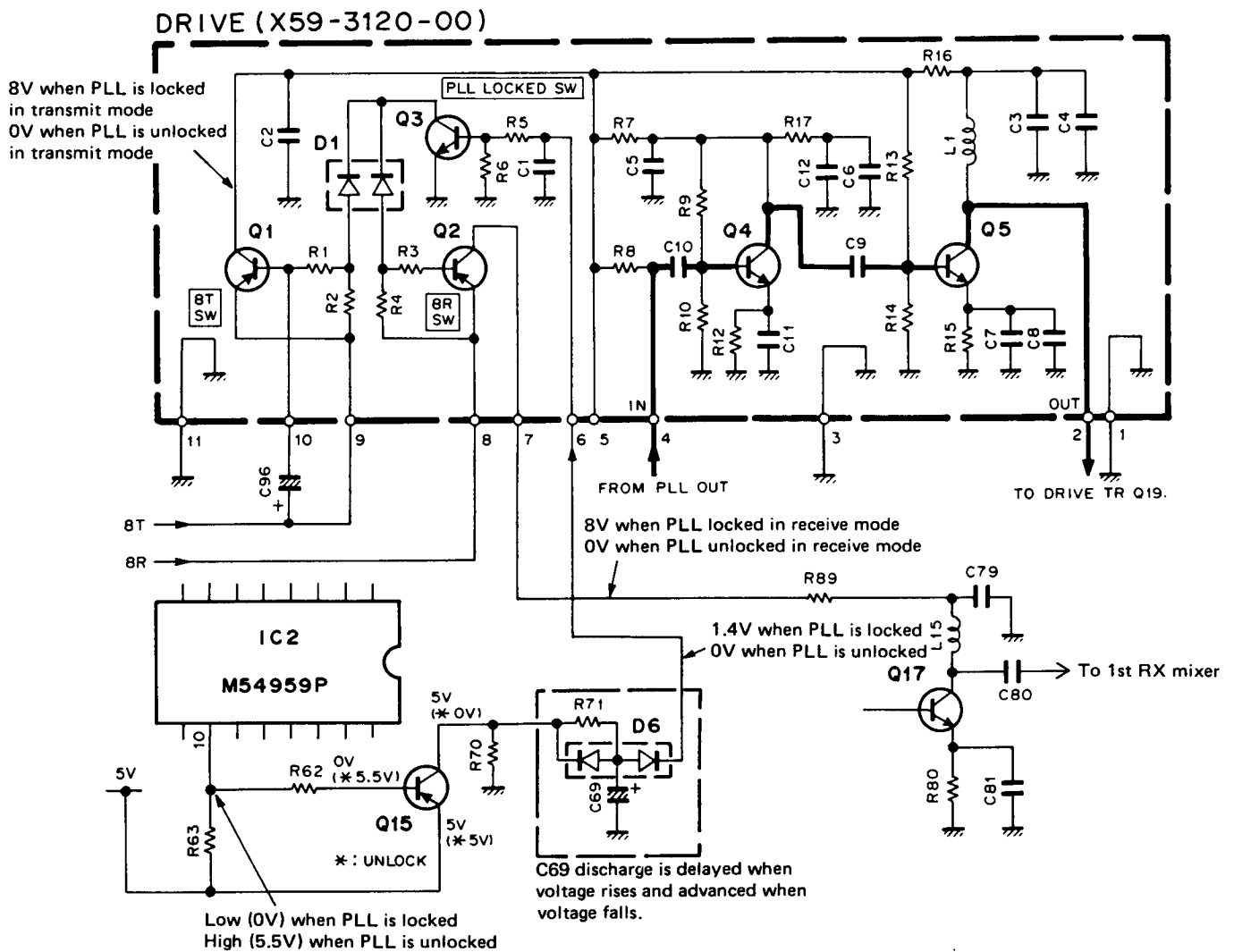


Fig. 6 PLL unlock detector circuit

## CIRCUIT DESCRIPTION

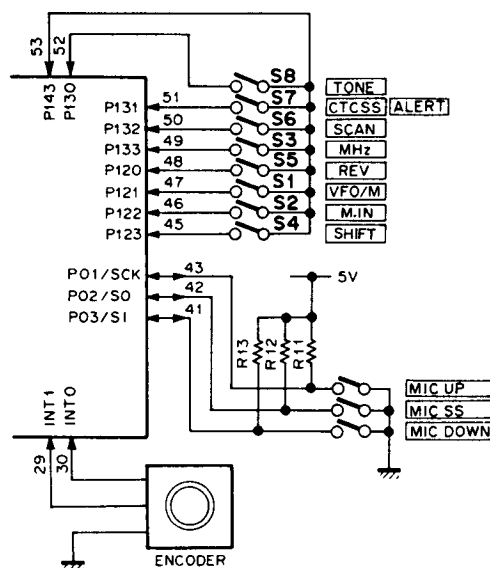
### Digital control unit

#### ● General

The control unit consists of a microprocessor, input keys, peripheral circuits, and a display. The single microprocessor (IC3) controls all transceiver functions. The pin assignments of the microprocessor are listed on the **Table 6**.

#### ● Keys and rotary encoder input circuits

**Fig. 7** shows the input circuit for the keys and rotary encoder. Data from the front panel keys, microphone keys, and rotary encoder are applied directly to the microprocessor.



**Fig. 7** Key and rotary encoder input circuits

| Terminal No. | Name  | I/O | Logic        | Function   | Terminal No.       | Name    | I/O  | Logic      | Function   |
|--------------|-------|-----|--------------|--|--------------------|---------|------|------------|--|
| 1            | P41   | O   | -            | Digital output of D-A conv.                            | 35                 | T11     | -    | -          | Not used.  |
| 2            | P40   | O   | -            |  | 36                 | T10     | -    | -          |  |
| 3            | P53   | O   | -            |  | 37                 | P23     | O    | -          |  |
| 4            | P52   | O   | -            |  | 38                 | P22     | O    | H          | Squelch control during remote control.                 |
| 5            | P51   | O   | -            |  | 39                 | P21     | O    | H          | Shift register strobe.                                 |
| 6            | P50   | O   | -            |  | 40                 | PT00    | O    | -          | Beep oscillator output.                                |
| 7            | RESET | I   | L            | Reset input.   | 41                 | P03/SI  | I/I  | L/-        | Microphone DOWN switch input/serial data input.        |
| 8            | X2    | -   | -            | 4.194304MHz crystal oscillator.                        | 42                 | P02/SO  | I/O  | L/-        | Microphone PTT switch input/serial data input.         |
| 9            | X1    | -   | -            |  | 43                 | P01/SCK | I/-  | L/-        | Microphone UP switch input/serial data input.          |
| 10           | P63   | -   | -            | Not used.  | 44                 | INT4    | I    | -          | Backup detect input.                                   |
| 11           | P62   | -   | -            |  | 45                 | P123    | I    | L          | SHIFT switch input.                                    |
| 12           | P61   | O   | $\uparrow$   | CTCSS shift register reset (K,M)                       | 46                 | P122    | I    | L          | M.IN switch input.                                     |
| 13           | P60   | I   | L            | Model setting : "L" for 144MHz<br>"H" for 430MHz band. | 47                 | P121    | I    | L          | VFO/M select switch input.                             |
| 14           | P73   | O   | -            | LCD driver data.                                       | 48                 | P120    | I    | L          | REV switch input.                                      |
| 15           | P72   | O   | $\uparrow$   | LCD driver clock.                                      | 49                 | P133    | I    | L          | Frequency step select switch input.                    |
| 16           | P71   | O   | H            | LCD driver enable.                                     | 50                 | P132    | I    | L          | SCAN switch input.                                     |
| 17           | P70   | -   | -            | Not used.  | 51                 | P131    | I    | L          | CTCSS switch input (K,M).<br>Alert switch input (T,W). |
| 18           | P83   | I   | L            |  | Directional input. | 52      | P130 | I          | L  |
| 19           | P82   | I   | L            | 53   |                    | P143    | O    | -          | Pull-down pin.   |
| 20           | P81   | I   | L            | Not used.  |                    | 54      | P142 | O          | -  |
| 21           | P80   | I   | L            |  | 55                 | P141    | O    | -          |  |
| 22           | P93   | O   | -            |  | 56                 | P140    | O    | -          |  |
| 23           | P92   | O   | $\downarrow$ | PLL and shift register clock.                          | 57                 | NC      | -    | -          | Power supply pin (5V).                                 |
| 24           | P91   | O   | -            | PLL and shift register data.                           | 58                 | VDD     | -    | -          |  |
| 25           | P90   | O   | L            | PLL enable.  | 59                 | P33     | -    | -          | GND terminal (0V).                                     |
| 26           | Vss   | -   | -            | GND terminal (0V).                                     | 60                 | P32     | I    | H          | Tone detect input (when CTCSS is on (K,M)).            |
| 27           | P13   | I   | L            | BUSY input.  | 61                 | P31     | O    | -          | CTCSS IC data (K,M).                                   |
| 28           | INT2  | I   | -            | Encoder input.   | 62                 | P30     | O    | $\uparrow$ | CTCSS IC clock.  |
| 29           | INT1  | I   | -            |  | 63                 | P43     | O    | -          | DAC digital data output.                               |
| 30           | INT0  | I   | H            | Remote connection detect input (only when connected).  | 64                 | P42     | O    | -          |  |
| 31           | PTH03 | I   | -            | Not used.  |                    |         |      |            |  |
| 32           | PTH02 | I   | -            |  |                    |         |      |            |  |
| 33           | PTH01 | I   | -            |  |                    |         |      |            |  |
| 34           | PTH00 | I   | -            |  |                    |         |      |            |  |

**Table 5**  $\mu$ PD75106G-508-1B pin assignments (Control unit IC3)



# CIRCUIT DESCRIPTION

• **Display circuit**

Located in the LCD assembly (Fig. 8), the display circuit consists of the LCD driver, its peripheral circuits, and the LCD. The LCD is driven with a 50% duty cycle

according to serial data sent from pins P71 to P73 of the microprocessor to the LCD driver. Fig. 9 shows the common output and segment output signals of the LCD driver.

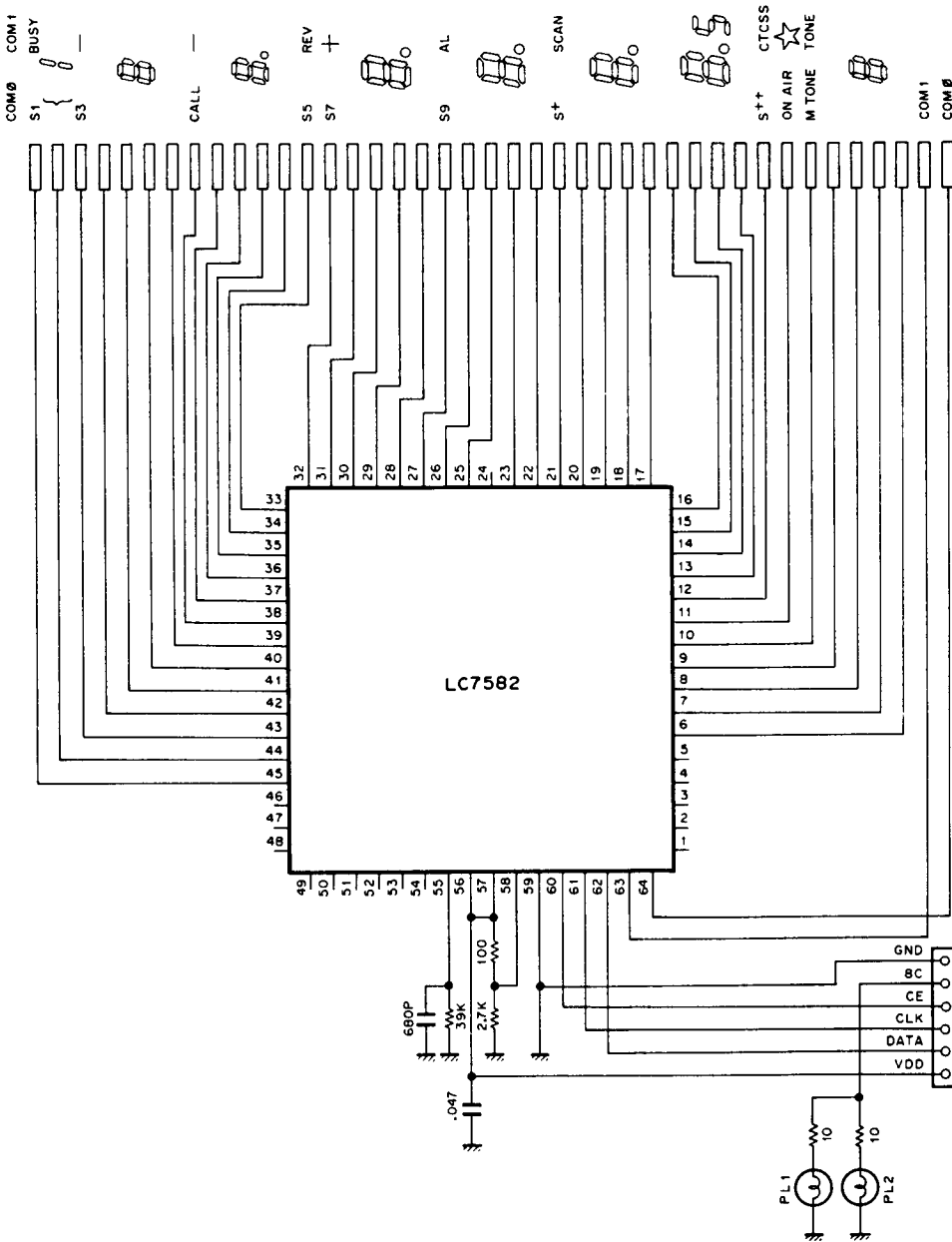


Fig. 8 LCD ass'y (B38-0303-05)

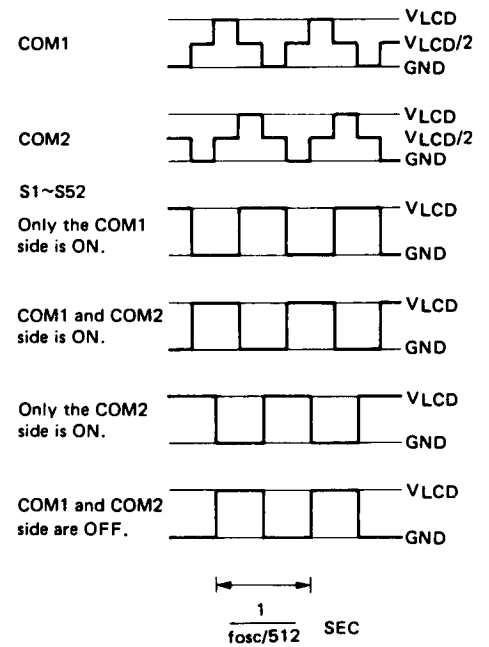
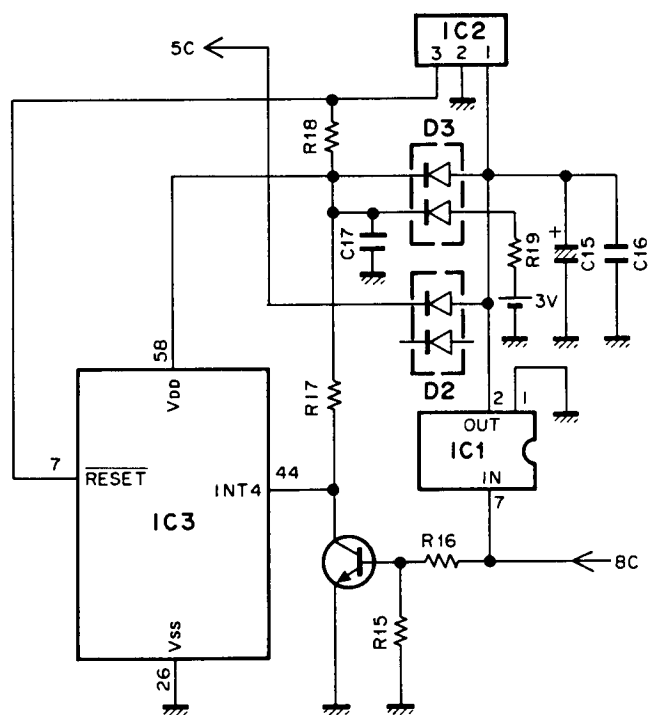


Fig. 9 LCD driver common and segment output signals

## CIRCUIT DESCRIPTION

### Reset backup circuit

Fig. 10 shows the reset backup circuit. When the transceiver is turned ON, 3.0V is applied at the INT4 pin causing IC3 to enter the backup mode.



IC2 timing chart

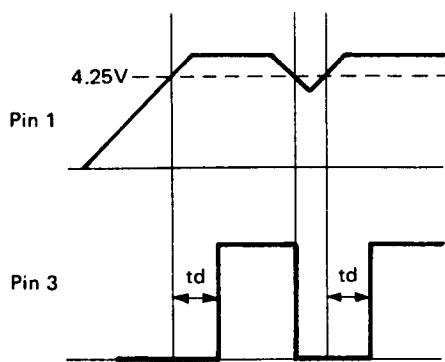


Fig. 10 Reset and backup circuit

### PLL data output

PLL data is supplied from pins P92 (CK), P91 (DT), and P90 (RST) of the microprocessor. Fig. 11 shows the data transfer format. Fig. 12 shows the data configuration.

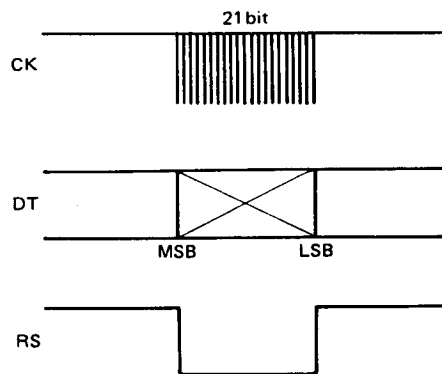
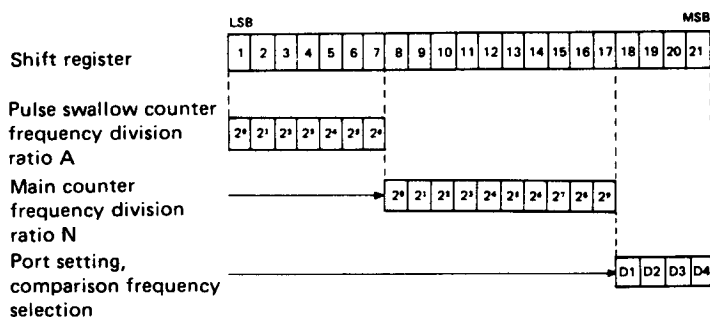


Fig. 11 PLL data transfer format



The 21-bit data is converted by the procedure below.

#### 1. Frequency division ratio data A, N (17 bits)

$$F (\text{RX display} - 10.695\text{MHz}) = [(N \times 128) + A] \times 10.24\text{MHz}/\text{ref} (\text{K, M})$$

$$F (\text{RX display} - 10.7\text{MHz}) = [(N \times 128) + A] \times 12.8\text{MHz}/\text{ref} (\text{T, W})$$

N : Frequency division ratio of main 10-bit counter

A : Frequency division ratio of 7-bit pulse swallow counter

#### 2. Comparison frequency (ref) selection (2 bits)

| Data |    | Phase comparison frequency |                              |
|------|----|----------------------------|------------------------------|
| D1   | D2 |                            |                              |
| L    | L  | 5kHz                       | 5, 10, 15, 20 or 25kHz steps |
| H    | L  | 6.25kHz                    | 12.5kHz step                 |

#### 3. Switch selection (2 bits)

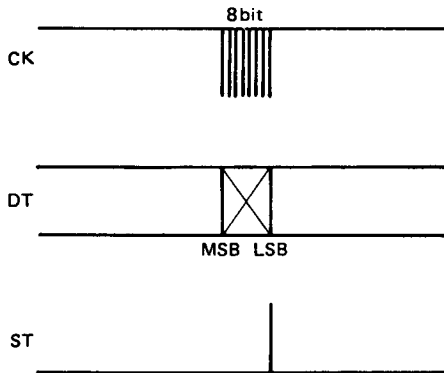
| Data |    | Output port |     |         |
|------|----|-------------|-----|---------|
| D3   | D4 | SW1         | SW2 |         |
| H    | L  | H           | L   | RX mode |
| L    | H  | L           | H   | TX mode |

Fig. 12 PLL data configuration

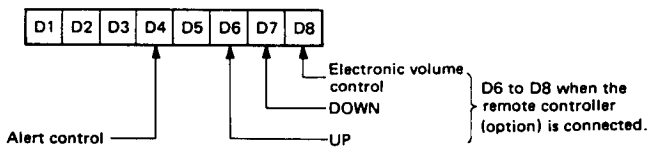
# CIRCUIT DESCRIPTION

● **Alert and electronic volume control output (when optional remote controller is connected)**

The alert and electronic volume control outputs are provided by pins P92 (CK), P91 (DT), and P21 (ST) of the microprocessor to the 8-bit shift register (IC3) in the TX-RX unit. P92 (CK) and P91 (DT) are also used for the PLL data. **Fig. 13** shows the data transfer format. **Fig. 14** shows the data configuration.



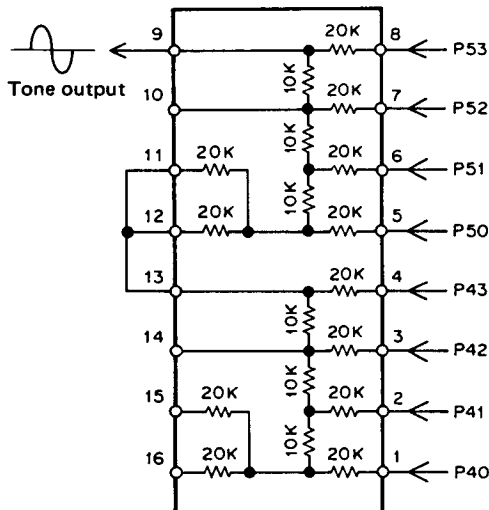
**Fig. 13** Data transfer format for alert and electronic volume control



**Fig. 14** Data configuration for alert and electronic volume control

● **Tone output**

The outputs from pins P40 to P43 and P50 to P53 of the microprocessor are applied to a ladder resistance network (IC4) which converts these signals into an analog waveform with 38 possible tone frequencies combinations 67.0 to 250.3Hz. **Fig. 15** shows the internal configuration of IC4.



**Fig. 15** Internal configuration of KRR-C001 ladder resistance network (Control unit IC4)

● **S-meter and RF meter input**

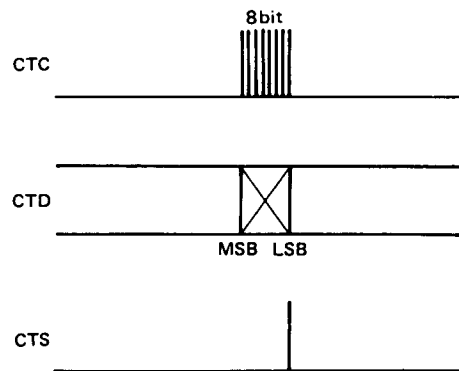
The analog voltage of the S-meter is applied to pin PTH00 of the microprocessor, and the analog voltage of the RF meter to pin PTH01. After 4-bit (16-step) analog-to-digital conversion, the resulting signal is sent to the display.

● **Busy input**

When squelch is ON and an input signal is present, a low input lights the busy indicator.

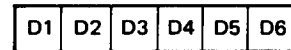
● **CTCSS unit (option : TM-221A only) input and output**

The microprocessor sends data from pins P30, P31, and P61 to the CTCSS unit. **Fig. 16** shows the data transfer format. **Fig. 17** shows the data configuration. When a tone is detected from the CTCSS unit, a "H" is applied to pin P32 of the microprocessor to open the squelch.



**Fig. 16** CTCSS data transfer format

CTCSS unit MN6520 tone frequency select data



Ex. 88.5Hz L H L H H H

**Fig. 17** CTCSS data configuration

● **Remote control (RC-10) (option) input and output**

When the RC-10 remote control unit is connected a "H" is applied to pin INTO of the microprocessor, switching the following pins to the functions indicated:

- P03 → SI : Serial data input pin
- P02 → SO : Serial data output pin
- P01 →  $\overline{\text{SCK}}$  : Serial clock input/output pin

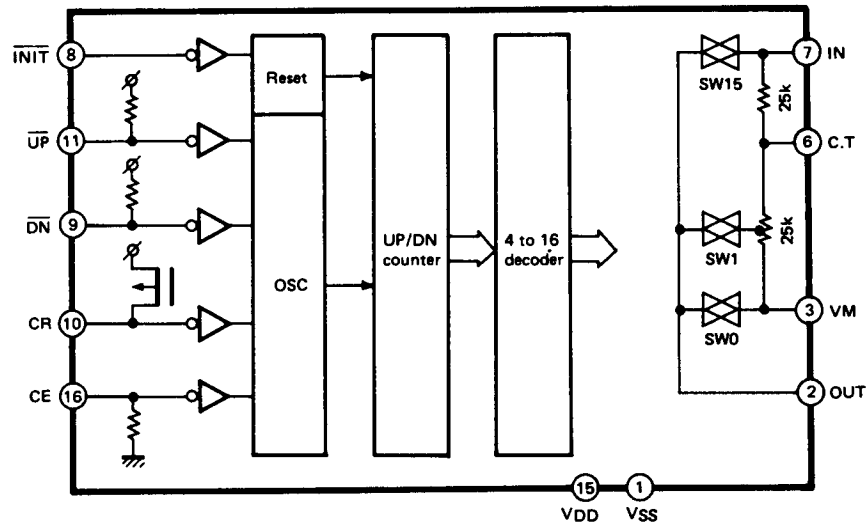
## SEMICONDUCTOR DATA

Electronic volume LC7532M (VOL IC1)

● Electric characteristics

| Item                      | Symbol  | Conditions  | Specifications |       |      | Unit |
|---------------------------|---------|---|----------------|-------|------|------|
|                           |         |   | Min.           | Typ.  | Max. |      |
| High-frequency distortion | THD1    | VDD=3V, RL=50kΩ,<br>f=1kHz, VR MAX,<br>VIN=-20dBV   |                | 0.1   | 0.5  | %    |
|                           | THD2    | VDD=2.1V, RL=50kΩ,<br>f=1kHz, VR MAX,<br>VIN=-20dBV |                | 0.3   | 1.0  | %    |
| Output in low-power mode  | X OUT   | At 0dBm input : f=1kHz, RL=51kΩ                     |                | -95   | -60  | dB   |
| Input impedance           | R IN    | UP, DN, CE  | 100            |       | 400  | kΩ   |
| Current consumption       | IDD (1) | VDD=3V when operating                               |                | 0.035 | 1    | mA   |
|                           | IDD (2) | VDD=3V, CE="L"                                      |                | 4     |      | μA   |

● Block diagram



## DESCRIPTION OF ELEMENTS

### FINAL UNIT (X45-1330-03) : TM-221E, (X45-1360-02) : TM-221A/ES

| Element | Function                                    | Description  |
|---------|---|--|
| Q1      | Power amplifier                             | Boosts power to the required level. M57747 in TM-221E, M57726 in TM-221A/ES. |
| D1      | Protection against reverse power connection |  |
| D2,D3   | Transmit/receive select                     | ON during transmit.  |
| D4      | High-frequency output voltage level detect  | Detects high-frequency output level and controls output in the APC circuit.  |
| D5      | Reflected power detector                    | Adjustable with VR1.   |

### CONTROL UNIT (X53-3040-XX)

| Element | Function                   | Description  |
|---------|----------------------------|--|
| IC1     | 6V AVR                     |  |
| IC2     | Reset IC                   | Outputs Reset signal and detects low voltage.  |
| IC3     | Microprocessor             | Controls frequencies and general set functions.                                      |
| IC4     | Tone DAC                   | Converts digital data from IC3 (P40 to P43, P50 to P53) to an analog tone frequency. |
| Q1      | Squelch switching          | Switches squelch on/off when remote controller is connected.                         |
| Q2      | Switching                  | Controls the microprocessor's backup detect input.                                   |
| D1      | Reverse current protection | Protects against external voltage applied to pin 5 of the microprocessor.            |
| D2(1/2) | Microprocessor protection  | Protects against static surge.   |
| D2(2/2) | Voltage drop               |  |
| D3(1/2) | Reverse current protection | Prevents current from flowing to the backup battery.                                 |
| D3(2/2) | Reverse current protection | Prevents backup battery current from flowing to inappropriate circuits.              |
| D4      | Microprocessor protection  | Protects against static surge.   |

### TX-RX UNIT (X57-3060-XX)

| Element | Function                          | Description  |
|---------|-----------------------------------|--|
| IC1     | 8V AVR                            |  |
| IC2     | PLL                               | Pulse-swallow type phase-locked loop.  |
| IC3     | Shift register                    | Controls alert <b>(T,W)</b> , band switching, and electronic volume functions.   |
| IC4     | AF amplifier                      | Speaker output.  |
| Q1      | High-frequency amplifier          | Operates in receive mode (144MHz).   |
| Q2      | First mixer                       | Converts the 2 meter-band received frequency into the 10.695MHz <b>(K,M)</b> 10.7MHz <b>(T,W)</b> .  |
| Q3      | High-frequency amplifier          | First intermediate frequency amplifies.  |
| Q4      | AF muting                         | Operates when CTCSS is ON <b>(K,M)</b> , during priority reception when alert is ON <b>(T,W)</b> , when SQS is high, and in transmit mode. |
| Q5      | 8R switching                      | ON in receive mode.  |
| Q6      | 8T switching                      | ON in transmit mode.   |
| Q7      | 8T switching control              | ON in transmit mode.   |
| Q8      | 8R switching control              | ON in receive mode.  |
| Q9      | Constant-voltage control          | 5V power supply for PLL.   |
| Q10     | Buffer amplifier                  | Buffer amplifier for Q12, which amplifies the 10.24MHz crystal oscillator <b>(K,M)</b> .   |
| Q11     | High-frequency amplifier          | Amplifies 12.8MHz to the level required for the PLL <b>(T,W)</b> .   |
| Q12     | High-frequency amplifier          | Amplifies 10.24MHz to the level required for the PLL <b>(K,M)</b> .  |
| Q13,Q14 | PLL low-pass filter               |  |
| Q15     | PLL unlock control                | ON when the PLL is locked.   |
| Q16     | High-frequency amplifier          | Amplifies the VCO output to the level required for the PLL.  |
| Q17     | High-frequency amplifier          | Amplifies the VCO output to the level required for input to the 1st IF mixer (Q2).   |
| Q18     | Inverting amplifier               | Inverts the output from the BS port of the shift register (HI/LO → LO (0V)/HI (8V)).   |
| Q19     | Transmit driver (power amplifier) | Amplifies to the level required for input to the final unit power module.  |
| Q20     | + B (DB) AVR of Q19               | Operates in transmit mode.   |

## DESCRIPTION OF ELEMENTS

| Element | Function                    | Description  |
|---------|-----------------------------|--|
| Q21     | High-pass filter            | Improves AF frequency characteristics in the receive mode.   |
| D1      | Limiting                    | Limits the first IF signal.  |
| D2      | Reversal current protection | Turns on the SQ circuit and Q4 for AL, in transmit mode for muting of the AF line.                           |
| D3      | Reversal current protection | Prevents flow of RF meter current to the microphone check circuit and rectifies the microphone check output. |
| D4      | Discharge                   | For discharging any residual charge on the 8T line.  |
| D5      | AVR                         | Zener diode for setting the AVR circuit reference voltage.   |
| D6      | Switching characteristic    | Diode to provide rise and fall hysteresis on the LD line.  |
| D7      | VCO output switch           | Reduces the drive circuit load in receive mode.  |
| D8      | VCO output switch           | Reduces the oscillator load in transmit mode.  |
| D9      | Temperature compensation    | Temperature compensation for Q19 (driver).   |
| D10     | Temperature compensation    | Temperature compensation for APC circuit.  |
| D11~D13 | Wideband RF amplifier       | Varicap-diode of the RF tuning circuit.  |
| D14,15  | S-meter circuit protection  | Protect for S-meter circuit when TX to RX mode.  |

### VCO (X58-3090-00)

| Element | Function                            | Description   |
|---------|-------------------------------------|---|
| Q1      | Amplifier                           | Operates in all modes to amplify the VCO output to the required level.                                  |
| Q2      | Transmit VCO                        | Operates in transmit mode as the PLL VCO (144MHz band).   |
| Q3      | Transmit VCO switch                 | Turns on the transmit VCO.  |
| Q4      | Receive VCO                         | Operates in receive mode as the PLL VCO.  |
| D1      | OR circuit                          | ORs 8T and 8R to operate Q1 at normal temperature.  |
| D2      | Transmit modulation varactor        | Adds FM modulation to TX VCO.   |
| D3      | Transmit frequency control varactor |   |
| D4      | Receive frequency control varactor  |   |
| D5      | Band switch                         | Expands the receive band by switching for 138 to 152.995MHz (low) and 153 to 173.995MHz (high) signals. |

### DRIVE (X59-3120-00)

| Element | Function                    | Description  |
|---------|-----------------------------|--|
| Q1      | Switching                   | Supplies 8V to the drive circuit; switched by Q3.  |
| Q2      | Switching                   | Supplies 8V to the local oscillator amplifier; switched by Q3.   |
| Q3      | Switching                   | ON when the PLL is locked.   |
| Q4,Q5   | High-frequency amplifier    | Operates in transmit mode. When checking levels near these transistors, be careful of the probe ground points. |
| D1      | Reversal current protection | Separates Q1 and Q2.   |

### APC (X59-3130-00)

| Element | Function               | Description          |
|---------|------------------------|----------------------|
| Q1      | Differential amplifier |                      |
| Q2(1/2) | Protection control     | Adjustable with VR5. |
| Q2(2/2) | APC control            | Adjustable with VR6. |
| Q3      | Drive stage + B AVR    |                      |

### IF (X59-3140-00)

| Element | Function   | Description   |
|---------|--|---|
| IC1     | Second local oscillator, mixer, IF amplifier, quadrature detector, noise amplifier | ⑦ S-meter output.      ⑪ Noise amplifier output (first stage).<br>⑨ Detector output      ⑫ First IF signal input. |

# DESCRIPTION OF ELEMENTS

## SQL (X59-3150-00)

| Element | Function                | Description             |
|---------|-------------------------|-------------------------|
| Q1      | Noise amplifier         |                         |
| Q2      | Squelch switching       | ON when squelch is on.  |
| Q3,Q4   | DC amplifier            | OFF when squelch is on. |
| Q5      | Low-frequency amplifier | For RD terminal.        |
| Q6      | Low-frequency amplifier | OFF when squelch is on. |
| D1      | Squelch noise rectifier |                         |
| D2      | Base bias setting       |                         |

## MIC (X59-3160-00)

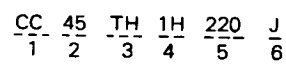
| Element  | Function                | Description                             |
|----------|-------------------------|---|
| IC1(1/2) | Low-frequency amplifier | ① Output, ② Input.                      |
| IC1(2/2) | Low-frequency amplifier | For microphone check. ⑥ Input ⑦ Output. |
| IC2(1/2) | Limiting amplifier      | ① Output ② Input.                       |
| IC2(2/2) | LPF                     | ⑥ , ⑦ Output.                           |

## VOL (X59-3170-00)

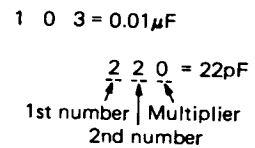
| Element | Function   | Description   |
|---------|--|---|
| IC1     | Electronic volume control<br>(16 steps, initialized to the<br>6th step from the<br>bottom) | ② Output.<br>⑦ Input.<br>⑧ Initialize input : "L" → step 6.<br>⑨ Increase ("L" input raises the volume 1 step).<br>⑩ Decrease ("L" input lowers the volume 1 step).<br>⑬ "H" while operating. |
| IC2     | Bidirectional switch (4 circuits)  | ① - ② controlled by ⑬ .<br>③ - ④ controlled by ⑤ .<br>⑧ - ⑨ controlled by ⑥ .<br>⑩ - ⑪ controlled by ⑫ .  |
| Q1      | Bidirectional switch enable  | ON to enable electronic volume control.   |
| Q2      | Switching  | ON to decrease by 1 step.   |
| Q3      | Switching  | ON to increase by 1 step.   |
| D1      | Voltage drop   |   |

## PARTS LIST

### CAPACITORS



- Capacitor value
- 0 1 0 = 1pF
- 1 0 0 = 10pF
- 1 0 1 = 100pF
- 1 0 2 = 1000pF = 0.001μF



- 1 = Type ..... ceramic, electrolytic, etc.
- 2 = Shape ..... round, square, etc.
- 3 = Temp. coefficient
- 4 = Voltage rating
- 5 = Value
- 6 = Tolerance

#### • Temperature Coefficient

| 1st Word | C     | L   | P      | R      | S     | T    | U      |
|----------|-------|-----|--------|--------|-------|------|--------|
| Color*   | Black | Red | Orange | Yellow | Green | Blue | Violet |
| ppm/°C   | 0     | -80 | -150   | -220   | -330  | -470 | -750   |

| 2nd Word | G    | H    | J     | K     | L     |
|----------|------|------|-------|-------|-------|
| ppm/°C   | ± 30 | ± 60 | ± 120 | ± 250 | ± 500 |

Example CC45TH = -470±60 ppm/°C

#### • Tolerance

| Code | C      | D     | G   | J   | K    | M    | X            | Z            | P            | No code   |
|------|--------|-------|-----|-----|------|------|--------------|--------------|--------------|---|
| (%)  | ± 0.25 | ± 0.5 | ± 2 | ± 5 | ± 10 | ± 20 | + 40<br>- 20 | + 80<br>- 20 | + 100<br>- 0 | More than<br>Less than<br>10μF-10~+50<br>4.7μF-10~+75 |

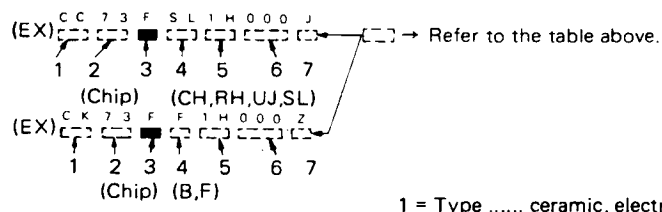
| Code | B     | C      | D     | F   | G   |
|------|-------|--------|-------|-----|-----|
| (pF) | ± 0.1 | ± 0.25 | ± 0.5 | ± 1 | ± 2 |

Less than 10 pF

#### • Rating voltage

| 2nd word | A    | B    | C    | D    | E    | F    | G    | H    | J    | K    | V  |
|----------|------|------|------|------|------|------|------|------|------|------|----|
| 1st word | 0    | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10 |
| 0        | 1.0  | 1.25 | 1.6  | 2.0  | 2.5  | 3.15 | 4.0  | 5.0  | 6.3  | 8.0  | -  |
| 1        | 10   | 12.5 | 16   | 20   | 25   | 31.5 | 40   | 50   | 63   | 80   | 35 |
| 2        | 100  | 125  | 160  | 200  | 250  | 315  | 400  | 500  | 630  | 800  | -  |
| 3        | 1000 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 5000 | 6300 | 8000 | -  |

#### • Chip capacitors



#### Dimension

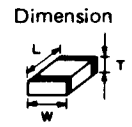
| Dimension code | L         | W          | T              |
|----------------|-----------|------------|----------------|
| Empty          | 5.6 ± 0.5 | 5.0 ± 0.5  | Less than 2.0  |
| E              | 3.2 ± 0.2 | 1.6 ± 0.2  | Less than 1.25 |
| F              | 2.0 ± 0.3 | 1.25 ± 0.2 | Less than 1.25 |

#### Dimension

| Dimension code | L         | W          | T    | Wattage |
|----------------|-----------|------------|------|---------|
| E              | 3.2 ± 0.2 | 1.6 ± 0.2  | 0.57 | 2B      |
| F              | 2.0 ± 0.3 | 1.25 ± 0.2 | 0.45 | 2A      |

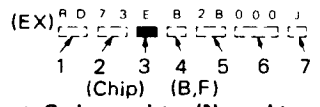
#### Rating wattage

| Cord | Wattage | Cord | Wattage | Cord | Wattage |
|------|---------|------|---------|------|---------|
| 2A   | 1/10W   | 2E   | 1/4W    | 3A   | 1W      |
| 2B   | 1/8W    | 2H   | 1/2W    | 3D   | 2W      |
| 2C   | 1/6W    |      |         |      |         |



### RESISTORS

#### • Chip resistor (Carbon)



- 1 = Type ..... ceramic, electrolytic, etc.
- 2 = Shape ..... round, square, etc.
- 3 = Dimension
- 4 = Temp. coefficient
- 5 = Voltage rating
- 6 = Value
- 7 = Tolerance.

#### • Carbon resistor (Normal type)





## PARTS LIST

\* New Parts

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Teile ohne Parts No. werden nicht geliefert.

| Ref. No.<br>参照番号    | Address<br>位置 | New<br>Parts<br>新 | Parts No.<br>部品番号 | Description<br>部品名 / 規格       | Desti-<br>nation<br>仕向 | Re-<br>marks<br>備考 |
|---------------------|---------------|-------------------|-------------------|-------------------------------|------------------------|--------------------|
| <b>TM-221A/E/ES</b> |               |                   |                   |                               |                        |                    |
| 1                   | 1B            | *                 | A01-1021-03       | METALLIC CABINET(TOP)         |                        |                    |
| 2                   | 2B            | *                 | A01-1022-03       | METALLIC CABINET(BOTTOM)      |                        |                    |
| 4                   | 1A            | *                 | A20-2578-02       | PANEL ASSY                    | K1M1M2                 |                    |
| 4                   | 1A            | *                 | A20-2600-02       | PANEL ASSY                    | T1W1                   |                    |
| 4                   | 1A            | *                 | A20-2600-02       | PANEL ASSY                    | T2W2                   |                    |
| -                   |               | *                 | A20-2574-03       | PANEL                         |                        |                    |
|                     |               | *                 | B10-0688-03       | FRONT GLASS                   | T1W1                   |                    |
|                     |               | *                 | B10-0688-03       | FRONT GLASS                   | T2W2                   |                    |
| 9                   | 2A            | *                 | B11-0442-04       | REFRACTOR                     |                        |                    |
| 11                  | 2A            | *                 | B38-0303-05 *     | LCD ASSY                      |                        |                    |
| 14                  | 1B            | *                 | B42-2455-04       | LABEL (M4X8 MAX)              |                        |                    |
| 15                  | 1E            |                   | B46-0410-10       | WARRANTY CARD                 | K1                     |                    |
| 16                  | 1D            | *                 | B50-8148-00       | INSTRUCTION MANUAL            | K1M1M2                 |                    |
| 16                  | 1D            | *                 | B50-8148-00       | INSTRUCTION MANUAL            | W1W2                   |                    |
| 16                  | 1D            | *                 | B50-8149-00       | INSTRUCTION MANUAL            | T1T2                   |                    |
| -                   |               | *                 | B10-0686-03       | FRONT GLASS                   | K1M1M2                 |                    |
| -                   |               | *                 | B11-0446-04       | REFRACTOR                     |                        |                    |
| 22                  | 3D            | *                 | E31-3224-05       | FLAT CABLE (LCD-CONTROL)      |                        |                    |
| -                   |               | *                 | E30-2053-05       | DC CORD ASSY (ACSY)           |                        |                    |
| -                   |               | *                 | E31-3239-15       | LEAD WITH CONNECTOR(SP)       |                        |                    |
| 27                  | 3D            |                   | F05-2036-05       | FUSE(20A) FOR DC CORD         | K1M1M2                 |                    |
| 27                  | 3D            |                   | F05-1031-05       | FUSE(10A)                     | T2W2                   |                    |
| 27                  | 3D            |                   | F05-1031-05       | FUSE(10A)                     | T1W1                   |                    |
| 30                  | 2B            |                   | F05-4022-05       | FUSE(4A)                      |                        |                    |
| 30                  | 2B            |                   | F20-0520-04       | INSULATING SHEET(LITHUM BATT) |                        |                    |
| 31                  | 2A            |                   | F20-0521-04       | INSULATING SHEET(LITHUM BATT) |                        |                    |
| 32                  | 2A            |                   | F29-0431-05       | INSULATOR (VOL. SOL)          |                        |                    |
| 35                  | 1C            |                   | G10-0607-04       | FELT (HEAT SINK)              |                        |                    |
| 36                  | 1A            |                   | G09-0405-05       | SPRING (KNOB)                 |                        |                    |
| 37                  | 1B, 2B        |                   | G10-0604-04       | FELT                          |                        |                    |
| 38                  | 1B            | *                 | G10-0651-04       | FELT (SP)                     |                        |                    |
| 40                  | 2A            | *                 | G13-0839-04       | CUSHION (KNOB)                |                        |                    |
| 42                  | 1B            | *                 | G13-0845-04       | CUSHION (SP)                  |                        |                    |
| 43                  | 2A            |                   | G53-0508-04       | FELT                          |                        |                    |
| -                   |               | *                 | G13-0838-04       | CUSHION                       |                        |                    |
| -                   |               | *                 | G13-0842-04       | CUSHION                       | M1M2T1                 |                    |
| -                   |               | *                 | G13-0842-04       | CUSHION                       | T2W1W2                 |                    |
| -                   |               |                   | G13-0853-04       | FELT (SUB PANEL)              |                        |                    |
| 48                  | 3E            | *                 | H01-8079-04       | ITEM CARTON BOX               | K1                     |                    |
| 48                  | 3E            | *                 | H01-8080-04       | ITEM CARTON BOX               | M1M2                   |                    |
| 48                  | 3E            | *                 | H01-8081-04       | ITEM CARTON BOX               | T1                     |                    |
| 48                  | 3E            | *                 | H01-8082-04       | ITEM CARTON BOX               | T2                     |                    |
| 48                  | 3E            | *                 | H01-8083-04       | ITEM CARTON BOX               | W1                     |                    |
| 48                  | 3E            | *                 | H01-8084-04       | ITEM CARTON BOX               | W2                     |                    |
| 49                  | 3D            | *                 | H10-2626-02       | POLYSTYRENE FOAMED FIXTURE    | T1W1                   |                    |
| 49                  | 3D            | *                 | H10-2627-02       | POLYSTYRENE FOAMED FIXTURE    | K1M1M2                 |                    |
| 49                  | 3D            | *                 | H10-2627-02       | POLYSTYRENE FOAMED FIXTURE    | T2W2                   |                    |
| 51                  | 1D            | *                 | H13-0812-04       | POLYSTYRENE FORMED PLATE      |                        |                    |
| 52                  | 2D            | *                 | H13-0814-04       | BUFFER (MOUNT BRACKET)        |                        |                    |
| 53                  | 3D            |                   | H25-0049-03       | PROTECTION BAG (DC CORD)      |                        |                    |

E: Scandinavia & Europe K: USA P: Canada W: Europe

U: PX(Far East, Hawaii) T: England M: Other Areas

UE: AAFES(Europe) X: Australia

TM-221A : K1, M1, M2

TM-221E : T1, W1

TM-221ES : T2, W2

△ indicates safety critical components.

\* New LCD For W721 E 38-0337-05

## PARTS LIST

× New Parts

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|---|---------------|-------------------|-------------------|----------------------------------|------------------------|--------------------|
| 54  | 2D            | *                 | H25-0720-04       | PROTECTION BAG                   | K1                     |                    |
| 55  | 3D            |                   | H25-0029-04       | PROTECTION BAG (MIC HOOK, SCREW) |                        |                    |
| 57  | 3D            |                   | J20-0319-24       | MIC HOOK (ACSY)                  | K1                     |                    |
| 59  | 2D            | *                 | J29-0416-03       | MOUNTING BRACKET (ACSY)          |                        |                    |
| 60  | 2A            |                   | J31-0141-04       | SPACER RING (MIC)                |                        |                    |
| 61  | 1B            | *                 | J19-1422-04       | HOLDER                           |                        |                    |
| -   |               |                   | J61-0307-05       | WIRE BAND                        |                        |                    |
| 64  | 1A            | *                 | K27-0496-04       | KNØB (BUTTON) POWER, LOW         |                        |                    |
| 66  | 2A            | *                 | K29-3058-04       | KNØB (BUTTON) MHZ, VFO/M, M. IN  |                        |                    |
| 67  | 1A            | *                 | K29-3060-04       | KNØB MAIN                        |                        |                    |
| 68  | 1A            | *                 | K29-3061-04       | KNØB VOL, SQL                    |                        |                    |
| 69  | 1A            | *                 | K29-3069-04       | KNØB (BUTTON) SHIFT              |                        |                    |
| 70  | 1A            | *                 | K29-3065-04       | KNØB (BUTTON) REV                |                        |                    |
| 71  | 1A            | *                 | K29-3067-04       | KNØB (BUTTON) SCAN               |                        |                    |
| 72  | 1A            | *                 | K29-3066-04       | KNØB (BUTTON) ALERT              | T1W1<br>T2W2<br>K1M1M2 |                    |
| 72  | 1A            | *                 | K29-3066-04       | KNØB (BUTTON) ALERT              |                        |                    |
| 72  | 1A            | *                 | K29-3068-04       | KNØB (BUTTON) CTCSS              |                        |                    |
| 73  | 1A            | *                 | K29-3070-04       | KNØB (BUTTON) TONE               |                        |                    |
| -   |               | *                 | K29-3057-04       | KNØB RING                        |                        |                    |
| 77  | 3D            | *                 | N99-0318-05       | SCREW SET (ACSY)                 |                        |                    |
| 78  | 3D            |                   | N46-3010-46       | PAN HEAD TAPPING SCREW (MIC)     | K1                     |                    |
| A   | 1B, 1C        |                   | N32-2606-46       | FLAT HEAD MACHINE SCREW          |                        |                    |
| B   | 2A            |                   | N87-2606-46       | BRAZIER HEAD TAPTITE SCREW       |                        |                    |
| C   | 2A, 2B        |                   | N89-2606-46       | BINDING HEAD TAPTITE SCREW       |                        |                    |
| D   | 1B, 2B        |                   | N35-2606-45       | BINDING HEAD MACHINE SCREW       |                        |                    |
| -   |               |                   | S50-1406-05       | TACT SWITCH                      | T2W1W2<br>M1M2T1       |                    |
| -   |               |                   | S50-1406-05       | TACT SWITCH                      |                        |                    |
| 85  | 1B            | *                 | T07-0246-05       | LOUDSPEAKER (FULL RANGE)         |                        |                    |
| 86  | 2D            |                   | T91-0359-05       | MICROPHONE                       | K1                     |                    |
| 86  | 2D            |                   | T91-0365-15       | MICROPHONE                       |                        |                    |
| 86  | 2D            | *                 | T91-0365-15       | MICROPHONE                       | T2W1W2<br>M1M2T1       |                    |
| -   |               |                   | LC7582            | IC (LCD DRIVER)                  |                        |                    |
| 94  | 2A            |                   | W09-0326-05       | LITHIUM BATTERY                  |                        |                    |
| 99  | 1B, 1C        | *                 | X45-1330-03       | FINAL UNIT                       | T1W1<br>K1M1M2         |                    |
| 99  | 1B, 1C        | *                 | X45-1360-02       | FINAL UNIT                       |                        |                    |
| 99  | 1B, 1C        | *                 | X45-1360-02       | FINAL UNIT                       | T2W2                   |                    |
| 100                                       | 2A            | *                 | X53-3040-11       | CONTROL UNIT                     | K1                     |                    |
| 100                                       | 2A            | *                 | X53-3040-21       | CONTROL UNIT                     | M1                     |                    |
| 100                                       | 2A            | *                 | X53-3040-22       | CONTROL UNIT                     | M2                     |                    |
| 100                                       | 2A            | *                 | X53-3040-51       | CONTROL UNIT                     | T1T2                   |                    |
| 100                                       | 2A            | *                 | X53-3040-61       | CONTROL UNIT                     | W1W2                   |                    |
| 101                                       | 2B            | *                 | X57-3060-11       | TX-RX UNIT                       | K1M1M2<br>T1W1         |                    |
| 101                                       | 2B            | *                 | X57-3060-51       | TX-RX UNIT                       |                        |                    |
| 101                                       | 2B            | *                 | X57-3060-52       | TX-RX UNIT                       | T2W2                   |                    |
| <b>FINAL UNIT (X45-1330-03) : TM-221E</b> |               |                   |                   |                                  |                        |                    |
| C1  | +2            |                   | C90-0868-05       | ELECTRO                          | 10UF                   | 16WV               |
| C3  |               |                   | CC45SL2H030C      | CERAMIC                          | 3.0PF                  | C                  |
| C4  |               |                   | CC45SL2H150J      | CERAMIC                          | 15PF                   | J                  |
| C5  |               |                   | CC45SL2H101J      | CERAMIC                          | 100PF                  | J                  |
| C6  |               |                   | CC45SL2H150J      | CERAMIC                          | 15PF                   | J                  |

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TM-221E : T1, W1

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|--|---------------|-------------------|-------------------|------------------------------|-------------------------|--------------------|
| C7   |               |                   | CC45SL2H390J      | CERAMIC 39PF J               |                         |                    |
| C8   |               |                   | CC45CH1H020C      | CERAMIC 2.0PF C              |                         |                    |
| C9   |               |                   | CC45SL2H330J      | CERAMIC 33PF J               |                         |                    |
| C10  |               |                   | CC45CH1H010C      | CERAMIC 1.0PF C              |                         |                    |
| C11  |               |                   | CM73F2H220J       | CHIP C 22PF J                |                         |                    |
| C12 -18                                      |               |                   | CK45B1H102K       | CERAMIC 1000PF K             |                         |                    |
|  |               |                   | E31-2066-05       | COAX. CABLE (DB)             |                         |                    |
|  |               |                   | E31-2090-05       | COAX. CABLE (RA)             |                         |                    |
| 110  | 1C            |                   | E30-2021-35       | DC CORD                      |                         |                    |
| 111  | 1C            |                   | E30-2074-05       | ANT. CABLE WITH CONNECTOR    |                         |                    |
| -  |               |                   | E11-0401-05       | EAR PHONE JACK               |                         |                    |
| TP1  |               |                   | E23-0512-05       | TERMINAL (1P)                |                         |                    |
|  |               |                   | F05-4022-05       | FUSE (4A)                    |                         |                    |
| 115  | 1C            |                   | F01-0949-05       | HEAT SINK                    |                         |                    |
| 120  | 1B            |                   | J19-1375-04       | COAX. CABLE FITTING HARDWARE |                         |                    |
| 121  | 1C            |                   | J41-0033-05       | BUSHING (DC CORD)            |                         |                    |
| 122  | 1C            |                   | J42-0425-05       | BUSHING (ANT CABLE)          |                         |                    |
| -  |               |                   | J61-0307-05       | WIRE BAND                    |                         |                    |
| L1   |               |                   | L34-0908-05       | COIL (3,9.5T)                |                         |                    |
| L2   |               |                   | L34-0895-05       | COIL (3,6T)                  |                         |                    |
| L3   |               |                   | L34-0742-05       | COIL (3,5T)                  |                         |                    |
| L4   |               |                   | L34-0908-05       | COIL (3,9.5T)                |                         |                    |
| L5 ,6  |               |                   | L34-0499-05       | VHF COIL (3,4T)              |                         |                    |
| L7   |               |                   | L40-1091-03       | SMALL FIXED INDUCTOR(1UH)    |                         |                    |
| E  | 1B            |                   | N09-0626-04       | SEMUSE SCREW                 |                         |                    |
| F  | 1B            |                   | N87-2606-41       | BRAZIER HEAD TAPTITE SCREW   |                         |                    |
| R1   |               |                   | RD14DB2H181J      | SMALL-RD 180 J 1/2W          |                         |                    |
| R2   |               |                   | RD14BB2C103J      | RD 10K J 1/6W                |                         |                    |
| VR1  |               |                   | R12-0541-05       | TRIMMING PBT. (100)          |                         |                    |
| D1   |               |                   | DSA3A1            | DIODE                        |                         |                    |
| D2 ,3  |               |                   | MI308             | DIODE                        |                         |                    |
| D4 ,5  |               |                   | 1S1587            | DIODE                        |                         |                    |
| Q1   |               |                   | M57747            | IC(POWER MODULE)             |                         |                    |
| <b>FINAL UNIT (X45-1360-02) : TM-221A/ES</b> |               |                   |                   |                              |                         |                    |
| C1 ,2  |               |                   | CE04CW1C100M      | ELECTRO 10UF 16WV            |                         |                    |
| C3   |               |                   | CC45SL2H100D      | CERAMIC 10PF D               |                         |                    |
| C4   |               |                   | CC45SL2H180J      | CERAMIC 18PF J               |                         |                    |
| C5   |               |                   | CK45B2H102K       | CERAMIC 1000PF K             |                         |                    |
| C6   |               |                   | CC45SL2H180J      | CERAMIC 18PF J               |                         |                    |
| C7   |               |                   | CC45SL2H390J      | CERAMIC 39PF J               |                         |                    |
| C8   |               |                   | CC45CH1H010C      | CERAMIC 1.0PF C              |                         |                    |
| C9   |               |                   | CC45SL2H330J      | CERAMIC 33PF J               |                         |                    |
| C10  |               |                   | CC45CH1H010C      | CERAMIC 1.0PF C              |                         |                    |
| C11  |               |                   | CM73F2H220J       | CHIP C 22PF J                |                         |                    |
| C12 -17                                      |               |                   | CK45B1H102K       | CERAMIC 1000PF K             |                         |                    |
|  |               |                   | E11-0401-05       | EAR PHONE JACK               |                         |                    |
|  |               |                   | E23-0512-05       | TERMINAL                     |                         |                    |
|  |               |                   | E31-2066-05       | COAX CABLE (DB)              |                         |                    |
|  |               |                   | E31-2090-05       | COAX CABLE (RA)              |                         |                    |
| 110  | 1C            |                   | E30-2021-35       | DC CORD                      |                         |                    |

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|---|---------------|-------------------|----------------------------|--------------------------------|-------------------------|--------------------|
| 111   | 1C            |                   | E30-2074-05                | ANT. CABLE WITH CONNECTOR      |                         |                    |
| 115   | 1C            |                   | F05-1031-05<br>F01-0950-05 | FUSE (10A)<br>HEAT SINK        |                         |                    |
| 120   | 1B            |                   | J31-0503-05                | BEAD                           |                         |                    |
| 121   | 1C            |                   | J19-1375-04                | COAX CABLE FITTING HARDWARE    |                         |                    |
| 122   | 1C            |                   | J41-0033-05                | BUSHING (DC CORD)              |                         |                    |
| -   |               |                   | J42-0448-05                | BUSHING (ANT CABLE)            |                         |                    |
|   |               |                   | J61-0307-05                | WIRE BAND                      |                         |                    |
| L1  |               |                   | L34-0908-05                | COIL (3,9.5T)                  |                         |                    |
| L2  |               |                   | L34-0895-05                | COIL (3,6T)                    |                         |                    |
| L3  |               |                   | L34-0499-05                | VHF COIL (3,4T)                |                         |                    |
| L4  |               |                   | L34-0908-05                | COIL (3,9.5T)                  |                         |                    |
| L5 ,6   |               |                   | L34-0499-05                | VHF COIL (3,4T)                |                         |                    |
| L7  |               |                   | L40-1091-03                | SMALL FIXED INDUCTOR(1UH)      |                         |                    |
| E   | 1B            |                   | N09-0626-04                | SEMUS SCREW                    |                         |                    |
| F   | 1B            |                   | N87-2606-41                | BRAZIER HEAD TAPTITE SCREW     |                         |                    |
| R1  |               |                   | RD14DB2H151J               | SMALL-RD 150 J 1/2W            |                         |                    |
| R2  |               |                   | RD14BB2C153J               | RD 15K J 1/6W                  |                         |                    |
| VR1   |               |                   | R12-0541-05                | TRIMMING POT. (100)            |                         |                    |
| D1  |               |                   | DSA3A1                     | DIODE                          |                         |                    |
| D2  |               |                   | UM9401                     | DIODE                          |                         |                    |
| D3  |               |                   | M1308                      | DIODE                          |                         |                    |
| D4 ,5   |               |                   | 1S1587                     | DIODE                          |                         |                    |
| Q1  |               |                   | M57726                     | IC(POWER MODULE)               |                         |                    |
| <b>CONTROL UNIT (X53-3040-XX) -11 : K -21 : M1 -22 : M2 -51 : T1,T2 -61 : W1,W2</b> |               |                   |                            |                                |                         |                    |
| C1 ,2   |               |                   | CK73FB1H103K               | CHIP C 0.010UF K               |                         |                    |
| C3 ,4   |               |                   | CC73FCH1H330J              | CHIP C 33PF J                  |                         |                    |
| C5 -14  |               |                   | CK73FB1H102K               | CHIP C 1000PF K                |                         |                    |
| C15   |               |                   | CE04CW1C100M               | ELECTRO 10UF 16WV              |                         |                    |
| C16   |               |                   | CK73FB1H103K               | CHIP C 0.010UF K               |                         |                    |
| C17   |               |                   | CK73EF1C105Z               | CHIP C 1.0UF Z                 |                         |                    |
|   |               |                   | E06-0858-05                | MIC JACK                       |                         |                    |
|   |               |                   | E40-1878-05                | PIN CONNECTOR                  |                         |                    |
| L1  |               |                   | L77-1313-05                | CRYSTAL RESONATOR(4.194304MHZ) |                         |                    |
| R1  |               |                   | RD41FB2B563J               | CYLND CHIP R 56K J 1/8W        |                         |                    |
| R2 -5   |               |                   | RD41FB2B105J               | CYLND CHIP R 1.0M J 1/8W       |                         |                    |
| R6  |               |                   | RD41FB2B104J               | CYLND CHIP R 100K J 1/8W       |                         |                    |
| R7  |               |                   | RD41FB2B105J               | CYLND CHIP R 1.0M J 1/8W       |                         |                    |
| R8 ,9   |               |                   | RD41FB2B104J               | CYLND CHIP R 100K J 1/8W       |                         |                    |
| R10 -13   |               |                   | RD41FB2B473J               | CYLND CHIP R 47K J 1/8W        |                         |                    |
| R14   |               |                   | RD41FB2B2R2J               | CYLND CHIP R 2.2 J 1/8W        |                         |                    |
| R15   |               |                   | RD41FB2B103J               | CYLND CHIP R 10K J 1/8W        |                         |                    |
| R16   |               |                   | RD41FB2B473J               | CYLND CHIP R 47K J 1/8W        |                         |                    |
| R17 ,18   |               |                   | RD41FB2B474J               | CYLND CHIP R 470K J 1/8W       |                         |                    |
| R19   |               |                   | RD41FB2B472J               | CYLND CHIP R 4.7K J 1/8W       |                         |                    |
| R21   |               |                   | R92-0687-05                | CHIP R 0 OHM                   |                         |                    |
| R22   |               |                   | R92-0687-05                | CHIP R 0 OHM                   |                         | K1M1M2             |
| R23   |               |                   | R92-0687-05                | CHIP R 0 OHM                   |                         | M2W1W2             |
| R24   |               |                   | R92-0687-05                | CHIP R 0 OHM                   |                         | M1T1T2             |
| R25   |               |                   | R92-0687-05                | CHIP R 0 OHM                   |                         | K1M1               |

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|---|---------------|-------------------|---|---|-------------------------|----------------------------------|
| R26<br>VR1<br>VR2   |               |                   | RD41FB2B102J<br>R05-3441-05<br>R05-4420-05  | CYLND CHIP R 1.0K J 1/BW<br>POTENTIOMETER(10KA)V8L<br>POTENTIOMETER(50KB)SQL                              |                         |                                  |
| S1 -8<br>S9 ,10   |               |                   | S40-1086-05<br>S40-2458-05  | TACT SWITCH<br>PUSH SWITCH  |                         |                                  |
| D1 -4<br>IC1<br>IC2<br>IC3<br>IC4                                     |               | *                 | 1S5184<br>LA5006M<br>MS1951BML<br>75106G-508-1B<br>KRR-C001                       | CHIP DIODE<br>IC(LOW SATURATION REGULATOR)<br>IC(SYSTEM RESET)<br>IC(MICROPROCESSOR)<br>IC(TONE A-D CONV) |                         |                                  |
| Q1<br>Q2  |               |                   | DTC124EK<br>2SC2712(Y)  | DIGITAL TRANSISTOR<br>CHIP TRANSISTOR   |                         |                                  |
|   |               | *                 | W02-0388-05   | ROTARY ENCODER  |                         |                                  |
| <b>TX-RX UNIT (X57-3060-XX) -11 : K,M1,M2 -51 : T1,W1 -52 : T2,W2</b> |               |                   |   |   |                         |                                  |
| 166   | 1B            |                   | A13-0675-01   | FRAME   |                         |                                  |
| C1<br>C2<br>C3<br>C4<br>C5  |               |                   | CC73FCH1H330J<br>CC41FRH1H120J<br>CC41FCH1H080D<br>CC41FRH1H150J<br>CC73FCH1H240J | CHIP C 33PF J<br>CYLND CHIP C 12PF J<br>CYLND CHIP C 8.0PF D<br>CYLND CHIP C 15PF J<br>CHIP C 24PF J      |                         |                                  |
| C6<br>C7<br>C8 ,9<br>C10<br>C11                                       |               |                   | CK73FB1H102K<br>CK73FB1H103K<br>CK73FB1H102K<br>CK73FB1H103K<br>* CC41FCH1H020C   | CHIP C 1000PF K<br>CHIP C 0.010UF K<br>CHIP C 1000PF K<br>CHIP C 0.010UF K<br>CYLND CHIP C 2.0PF C        |                         |                                  |
| C12<br>C13<br>C14<br>C15<br>C16                                       |               | *                 | CC41FCH1H150J<br>CK73FB1H102K<br>CK73FB1H103K<br>* CC41FCH1H050C<br>CC73FCH1H101J | CYLND CHIP C 15PF J<br>CHIP C 1000PF K<br>CHIP C 0.010UF K<br>CYLND CHIP C 5.0PF C<br>CHIP C 100PF J      |                         |                                  |
| C17 -19<br>C20<br>C21<br>C22<br>C22                                   |               |                   | CK73FB1H103K<br>CK73FB1H102K<br>CE04EW1A470M<br>CC73FSL1H151J<br>CC73FSL1H151J    | CHIP C 0.010UF K<br>CHIP C 1000PF K<br>ELECTRO 47UF 10WV<br>CHIP C 150PF J<br>CHIP C 150PF J              |                         | T1W1<br>W1W2                     |
| C22<br>C23<br>C24<br>C25<br>C25                                       |               |                   | CC73FSL1H331J<br>CK73FB1H103K<br>CC41FCH1H100D<br>CC73FCH1H330J<br>CC73FCH1H330J  | CHIP C 330PF J<br>CHIP C 0.010UF K<br>CYLND CHIP C 10PF D<br>CHIP C 33PF J<br>CHIP C 33PF J               |                         | K1M1M2<br>K1M1M2<br>T1W1<br>T2W2 |
| C25<br>C26<br>C27<br>C28<br>C29                                       |               |                   | CC73FSL1H181J<br>CE04EW1C100M<br>CK73FB1H102K<br>CK73EF1C105Z<br>CK73FB1H103K     | CHIP C 180PF J<br>ELECTRO 10UF 16WV<br>CHIP C 1000PF K<br>CHIP C 1.0UF Z<br>CHIP C 0.010UF K              |                         | K1M1M2                           |
| C30 ,31<br>C32 ,33<br>C34<br>C35 ,36<br>C37                           |               |                   | CE04EW1A470M<br>CK73EB1H104K<br>CK73FB1H103K<br>CK73FB1H102K<br>CE04EW1A470M      | ELECTRO 47UF 10WV<br>CHIP C 0.10UF K<br>CHIP C 0.010UF K<br>CHIP C 1000PF K<br>ELECTRO 47UF 10WV          |                         |                                  |
| C38<br>C39  |               |                   | CK73EB1H333K<br>CE04EW1A470M  | CHIP C 0.033UF K<br>ELECTRO 47UF 10WV   |                         |                                  |

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|------------------|---------------|-------------------|-------------------|-------------------------|-------------------------|--------------------|
| C40              |               |                   | CK73EF1C105Z      | CHIP C 1.0UF Z          |                         |                    |
| C41              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        | K1M1M2                  |                    |
| C42              |               |                   | CE04EW1A470M      | ELECTRØ 47UF 10WV       |                         |                    |
| C43              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C44              |               |                   | CE04EW1C100M      | ELECTRØ 10UF 16WV       |                         |                    |
| C45              |               | *                 | C92-0004-05       | CHIP TAN 1UF 16WV       |                         |                    |
| C46              |               |                   | CE04EW1A470M      | ELECTRØ 47UF 10WV       |                         |                    |
| C47              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C48              |               | *                 | CC41FCH1H030C     | CYLND CHIP C 3.0PF C    | K1M1M2                  |                    |
| C49 ,50          |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        | K1M1M2                  |                    |
| C51              |               |                   | CC73FCH1H330J     | CHIP C 33PF J           | K1M1M2                  |                    |
| C52              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        | K1M1M2                  |                    |
| C53              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        | T1W1                    |                    |
| C53              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        | T2W2                    |                    |
| C54              |               |                   | CC41FCH1H150J     | CYLND CHIP C 0.010UF J  | T1W1                    |                    |
| C54              |               |                   | CC41FCH1H150J     | CYLND CHIP C 0.010UF J  | T2W2                    |                    |
| C55              |               |                   | CC73FSL1H221J     | CHIP C 220PF J          | T1W1                    |                    |
| C55              |               |                   | CC73FSL1H221J     | CHIP C 220PF J          | T2W2                    |                    |
| C56 ,57          |               |                   | CC73FCH1H101J     | CHIP C 100PF J          | T1W1                    |                    |
| C56 ,57          |               |                   | CC73FCH1H101J     | CHIP C 100PF J          | T2W2                    |                    |
| C58              |               |                   | CC73FCH1H101J     | CHIP C 100PF J          | K1M1M2                  |                    |
| C59              |               |                   | CK73EB1H473K      | CHIP C 0.047UF K        |                         |                    |
| C60              |               |                   | CC73FCH1H101J     | CHIP C 100PF J          |                         |                    |
| C61              |               |                   | CK41FB1H471K      | CYLND CHIP C 470PF K    |                         |                    |
| C62              |               |                   | CK73FB1H182K      | CHIP C 1800PF K         |                         |                    |
| C63              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C64              |               | *                 | C92-0004-05       | CHIP TAN 1UF 16WV       |                         |                    |
| C65              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C66              |               | *                 | C92-0003-05       | CHIP TAN 0.47UF 25WV    |                         |                    |
| C67              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C68              |               |                   | CK73EB1H683K      | CHIP C 0.068UF K        |                         |                    |
| C69              |               | *                 | C92-0004-05       | CHIP TAN 1UF 16WV       |                         |                    |
| C70 ,71          |               |                   | CE04EW1A101M      | ELECTRØ 100UF 10WV      |                         |                    |
| C72              |               |                   | CC73FCH1H330J     | CHIP C 33PF J           |                         |                    |
| C73              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C74              |               |                   | CC73FCH1H330J     | CHIP C 33PF J           |                         |                    |
| C75              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C76              |               |                   | CC41FCH1H100D     | CYLND CHIP C 10PF D     |                         |                    |
| C77              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C78              |               |                   | CC41FCH1H100D     | CYLND CHIP C 10PF D     |                         |                    |
| C79              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C80              |               |                   | CK41FB1H471K      | CYLND CHIP C 470PF K    |                         |                    |
| C81              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C82              |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C83              |               |                   | CK73EF1C105Z      | CHIP C 1.0UF Z          |                         |                    |
| C84 ,85          |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                         |                    |
| C86              |               |                   | CK73EF1C105Z      | CHIP C 1.0UF Z          |                         |                    |
| C87              |               |                   | CK73EB1H333K      | CHIP C 0.033UF K        |                         |                    |
| C88 -90          |               |                   | CE04EW1A470M      | ELECTRØ 47UF 10WV       |                         |                    |
| C91              |               |                   | CE04EW1A471M      | ELECTRØ 470UF 10WV      |                         |                    |
| C92              |               |                   | CK73EB1H104K      | CHIP C 0.10UF K         |                         |                    |
| C93              |               |                   | C90-2033-05       | ELECTRØ 1000UF 16WV     |                         |                    |
| C94              |               |                   | CC73FCH1H101J     | CHIP C 100PF J          |                         |                    |
| C95              |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                         |                    |
| C96              |               |                   | CE04EW1E4R7M      | ELECTRØ 4.7UF 25WV      |                         |                    |

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|--|---------------|-------------------|--|--|--------------------------------------|--------------------|
| C97<br>C98<br>C100<br>C101<br>C102           |               |                   | CE04EW1C100M<br>CK73FB1H102K<br>CK73FB1H102K<br>CE04EW1C100M<br>CK73FB1H102K       | ELECTRØ 10UF 16WV<br>CHIP C 1000PF K<br>CHIP C 1000PF K<br>ELECTRØ 10UF 16WV<br>CHIP C 1000PF K                                      |                                      |                    |
| C103<br>C104<br>C105-109<br>C110,111<br>C112 |               |                   | CE04EW1C101M<br>CK73FB1H103K<br>CK73FB1H102K<br>CK73FB1H562K<br>CK73EB1H104K       | ELECTRØ 100UF 16WV<br>CHIP C 0.010UF K<br>CHIP C 1000PF K<br>CHIP C 5600PF K<br>CHIP C 0.10UF K                                      |                                      |                    |
| C113<br>C114<br>C115<br>C116<br>C117         |               | *                 | CK73FB1H103K<br>CC41FCH1H030C<br>CC41FCH1H150J<br>* CC41FCH1H010C<br>CC41FCH1H150J | CHIP C 0.010UF K<br>CYLND CHIP C 3.0PF C<br>CYLND CHIP C 15PF J<br>CYLND CHIP C 1.0PF C<br>CYLND CHIP C 15PF J                       | K1M1M2<br>K1M1M2<br>K1M1M2<br>K1M1M2 |                    |
| C118<br>C119<br>TC1<br>TC2<br>TC2            |               |                   | CC41FCH1H220J<br>CK73FB1H103K<br>* C05-0348-05<br>C05-0308-05<br>C05-0308-05       | CYLND CHIP C 22PF J<br>CHIP C 0.010UF K<br>TRIMMING CAP (6PF)<br>TRIMMING CAP (4PF)<br>TRIMMING CAP (4PF)                            | K1M1M2<br>K1M1M2<br>T1W1<br>T2W2     |                    |
| TC3 ,4                                       |               | *                 | C05-0350-05  | TRIMMING CAP (20PF)  |                                      |                    |
| -<br>J1<br>J2<br>J3                          |               |                   | E04-0154-05<br>E31-3237-05<br>E40-5016-05<br>E40-3237-05<br>E40-3238-05            | RF COAXIAL CONNECTOR<br>LEAD WITH CONNECTOR<br>PIN CONNECTOR (2P)<br>PIN CONNECTOR (2P)<br>PIN CONNECTOR (3P)                        | K1M1M2<br>K1M1M2                     |                    |
| J4<br>J5<br>J6<br>J7 ,8<br>TP1               |               |                   | E40-3237-05<br>E40-3238-05<br>E40-3237-05<br>E40-5079-05<br>E40-0211-05            | PIN CONNECTOR (2P)<br>PIN CONNECTOR (3P)<br>PIN CONNECTOR (2P)<br>PIN CONNECTOR (SSQ-9)<br>PIN CONNECTOR (2P)                        |                                      |                    |
| TP2 ,3                                       |               |                   | E23-0465-05  | TERMINAL   |                                      |                    |
| -  |               | *                 | F11-1064-05  | SHIELDING CASE   | K1M1M2                               |                    |
| L1 ,2<br>L3<br>L3<br>L4<br>L5                |               | *                 | L34-4039-15<br>L79-0498-15<br>L79-0498-15<br>L34-0683-05<br>L30-0005-05            | COIL<br>HELICAL<br>HELICAL<br>TUNING COIL<br>TUNING COIL   | T1W1<br>T2W2                         |                    |
| L6<br>L6<br>L6<br>L7<br>L8                   |               |                   | L71-0216-05<br>L71-0228-05<br>L71-0228-05<br>L30-0005-05<br>L77-0720-05            | MCF (10.695MHZ)<br>MCF (10.70MHZ)<br>MCF (10.70MHZ)<br>TUNING COIL<br>CRYSTAL RESONATOR(10.24MHZ)                                    | K1M1M2<br>T1W1<br>T2W2<br>K1M1M2     |                    |
| L8<br>L8<br>L9<br>L10<br>L11                 |               |                   | L77-0946-05<br>L77-0946-05<br>L30-0531-05<br>L72-0315-05<br>L30-0503-05            | CRYSTAL RESONATOR(10.245MHZ)<br>CRYSTAL RESONATOR(10.245MHZ)<br>TUNING COIL<br>CERAMIC FILTER (CFW455F)<br>TUNING COIL               | T1W1<br>T2W2                         |                    |
| L12<br>L13<br>L13<br>L14<br>L15              |               |                   | L40-3392-81<br>L77-1311-05<br>L77-1311-05<br>L40-3392-81<br>L40-3982-81            | CHIP INDUCTOR (3.3UH)<br>CRYSTAL RESONATOR(12.8MHZ)<br>CRYSTAL RESONATOR(12.8MHZ)<br>CHIP INDUCTOR (3.3UH)<br>CHIP INDUCTOR (0.39UH) | T1W1<br>T2W2                         |                    |

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|------------------|---------------|----------------|-------------------|----------------------------|------------------------|--------------------|
| L16              |               |                | L15-0308-05       | LOW-FREQUENCY CHOKE COIL   |                        |                    |
| L17              |               |                | L34-0893-05       | COIL (3,4T)                |                        |                    |
| L18              |               |                | L34-0894-05       | COIL (3,5T)                |                        |                    |
| L19              |               | *              | L34-2302-05       | COIL                       | K1M1M2                 |                    |
| L20              |               | *              | L34-2303-05       | COIL                       | K1M1M2                 |                    |
| L21              |               | *              | L34-2302-05       | COIL                       | K1M1M2                 |                    |
| B                | 1B,2B         |                | NB7-2606-46       | BRAZIER HEAD TAPTITE SCREW |                        |                    |
| R1               |               |                | RD41FB2B562J      | CYLND CHIP R 5.6K J 1/8W   |                        |                    |
| R2               |               |                | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W   |                        |                    |
| R3               |               |                | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W    |                        |                    |
| R4               |               |                | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W    |                        |                    |
| R5               |               |                | RD41FB2B470J      | CYLND CHIP R 47 J 1/8W     |                        |                    |
| R6               |               |                | RD41FB2B331J      | CYLND CHIP R 330 J 1/8W    |                        |                    |
| R7               |               |                | RD41FB2B470J      | CYLND CHIP R 47 J 1/8W     |                        |                    |
| R8               |               |                | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W   | K1M1M2                 |                    |
| R8               |               |                | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W   | T1W1                   |                    |
| R8               |               |                | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W   | T2W2                   |                    |
| R9               |               |                | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W    |                        |                    |
| R10              |               |                | RD41FB2B470J      | CYLND CHIP R 47 J 1/8W     |                        |                    |
| R11              |               |                | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W    |                        |                    |
| R12              |               |                | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W   |                        |                    |
| R13              |               |                | RD41FB2B100J      | CYLND CHIP R 10 J 1/8W     |                        |                    |
| R14              |               |                | RD41FB2B274J      | CYLND CHIP R 270K J 1/8W   |                        |                    |
| R15              |               |                | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W    |                        |                    |
| R16              |               |                | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W   |                        |                    |
| R17              |               |                | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W    |                        |                    |
| R18              |               |                | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W    |                        |                    |
| R19              |               |                | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W    |                        |                    |
| R20              |               |                | RD41FB2B471J      | CYLND CHIP R 470 J 1/8W    |                        |                    |
| R21              |               |                | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W    |                        |                    |
| R22              |               |                | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W    |                        |                    |
| R23              |               |                | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W   |                        |                    |
| R24              |               |                | R92-0687-05       | CHIP R 0 0HM               | T1W1                   |                    |
| R24              |               |                | R92-0687-05       | CHIP R 0 0HM               | T2W2                   |                    |
| R25              |               |                | RD41FB2B333J      | CYLND CHIP R 33K J 1/8W    |                        |                    |
| R26              |               |                | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W   |                        |                    |
| R27              |               |                | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W   |                        |                    |
| R28              |               |                | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W    |                        |                    |
| R29              |               |                | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W    |                        |                    |
| R30              |               |                | RD41FB2B273J      | CYLND CHIP R 27K J 1/8W    |                        |                    |
| R31              |               |                | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W   |                        |                    |
| R32              |               |                | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W    | T2W2                   |                    |
| R33              |               |                | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W   | K1M1M2                 |                    |
| R33              |               |                | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W    | T1W1                   |                    |
| R33              |               |                | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W    | T2W2                   |                    |
| R34              |               |                | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W   |                        |                    |
| R35              |               |                | R92-0687-05       | CHIP R 0 0HM               | T1W1                   |                    |
| R35              |               |                | R92-0687-05       | CHIP R 0 0HM               | T2W2                   |                    |
| R36              |               |                | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W   |                        |                    |
| R37              |               |                | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W    |                        |                    |
| R38              |               |                | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W   |                        |                    |
| R39              |               |                | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W   |                        |                    |
| R40              |               |                | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W    |                        |                    |

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|------------------|---------------|-------------------|-------------------|--------------------------|------------------------|--------------------|
| R41              |               |                   | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W |                        |                    |
| R42              |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W |                        |                    |
| R43              |               |                   | RD41FB2B100J      | CYLND CHIP R 10 J 1/8W   |                        |                    |
| R44              |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W |                        |                    |
| R45 -49          |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W  |                        |                    |
| R50              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  | K1M1M2                 |                    |
| R51              |               |                   | RD41FB2B274J      | CYLND CHIP R 270K J 1/8W | K1M1M2                 |                    |
| R52              |               |                   | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W | K1M1M2                 |                    |
| R53              |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W | K1M1M2                 |                    |
| R54              |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W  |                        |                    |
| R55              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  | K1M1M2                 |                    |
| R56              |               |                   | RD41FB2B331J      | CYLND CHIP R 330 J 1/8W  | K1M1M2                 |                    |
| R57              |               |                   | RD41FB2B470J      | CYLND CHIP R 47 J 1/8W   | K1M1M2                 |                    |
| R58              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  | T1W1                   |                    |
| R58              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  | T2W2                   |                    |
| R59              |               |                   | RD41FB2B273J      | CYLND CHIP R 27K J 1/8W  | T1W1                   |                    |
| R59              |               |                   | RD41FB2B273J      | CYLND CHIP R 27K J 1/8W  | T2W2                   |                    |
| R60              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  | T1W1                   |                    |
| R60              |               |                   | RD41FB2B183J      | CYLND CHIP R 18K J 1/8W  | T2W2                   |                    |
| R61              |               |                   | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W | T1W1                   |                    |
| R61              |               |                   | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W | T2W2                   |                    |
| R62              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  |                        |                    |
| R63              |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W  |                        |                    |
| R64 ,65          |               |                   | RD41FB2B272J      | CYLND CHIP R 2.7K J 1/8W |                        |                    |
| R66              |               |                   | RD41FB2B822J      | CYLND CHIP R 8.2K J 1/8W |                        |                    |
| R67              |               |                   | RD41FB2B183J      | CYLND CHIP R 18K J 1/8W  |                        |                    |
| R68 ,69          |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  |                        |                    |
| R70              |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W |                        |                    |
| R71              |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W  |                        |                    |
| R72              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  |                        |                    |
| R73              |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W  |                        |                    |
| R74              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  |                        |                    |
| R75              |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W |                        |                    |
| R76              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  |                        |                    |
| R77              |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W |                        |                    |
| R78              |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W  |                        |                    |
| R79              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  |                        |                    |
| R80              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  |                        |                    |
| R81 ,82          |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W  |                        |                    |
| R83              |               |                   | RD41FB2B681J      | CYLND CHIP R 680 J 1/8W  |                        |                    |
| R84              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  |                        |                    |
| R85              |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W  |                        |                    |
| R86              |               |                   | RD41FB2B2R2J      | CYLND CHIP R 2.2 J 1/8W  |                        |                    |
| R87              |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W  |                        |                    |
| R88              |               |                   | RD41FB2B273J      | CYLND CHIP R 27K J 1/8W  |                        |                    |
| R89              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W  |                        |                    |
| R90              |               |                   | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/8W |                        |                    |
| R91              |               |                   | RD41FB2B151J      | CYLND CHIP R 150 J 1/8W  |                        |                    |
| R92 ,93          |               |                   | R92-0687-05       | CHIP R 0 8HM             |                        |                    |
| R94              |               |                   | R92-0687-05       | CHIP R 0 8HM             | T1W1                   |                    |
| R94              |               |                   | R92-0687-05       | CHIP R 0 8HM             |                        | T2W2               |
| R95              |               | *                 | R92-0685-05       | RD 22 J 1/2W             | K1M1M2                 |                    |
| R95              |               | *                 | R92-0685-05       | RD 22 J 1/2W             | T2W2                   |                    |
| R95              |               | *                 | R92-0686-05       | RD 33 J 1/2W             | T1W1                   |                    |
| R96              |               |                   | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W | K1M1M2                 |                    |

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| R96              |               |                   | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W       | T2W2                   |                    |
| R96              |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W        | T1W1                   |                    |
| R97              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W        | T2W2                   |                    |
| R97              |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W        | K1M1M2                 |                    |
| R97              |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W       | T1W1                   |                    |
| R98              |               |                   | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W       |                        |                    |
| R99              |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/8W        | T1W1                   |                    |
| R100             |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W       |                        |                    |
| R101             |               |                   | RD41FB2B564J      | CYLND CHIP R 560K J 1/8W       |                        |                    |
| R102             |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/8W       |                        |                    |
| R103             |               |                   | RD41FB2B183J      | CYLND CHIP R 18K J 1/8W        | K1M1M2                 |                    |
| R104             |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W        | K1M1M2                 |                    |
| R105             |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/8W        |                        |                    |
| R106             |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W        |                        |                    |
| R107             |               |                   | RD41FB2B564J      | CYLND CHIP R 560K J 1/8W       |                        |                    |
| R108             |               |                   | RD41FB2B222J      | CYLND CHIP R 2.2K J 1/8W       |                        |                    |
| R109             |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W       |                        |                    |
| R110-112         |               |                   | RD41FB2B104J      | CYLND CHIP R 100K J 1/8W       | K1M1M2                 |                    |
| R113             |               |                   | RD41FB2B473J      | CYLND CHIP R 47K J 1/8W        |                        |                    |
| R114-116         |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/8W       |                        |                    |
| R117             |               |                   | R92-0687-05       | CHIP R 0 0HM                   | T1W1                   |                    |
| R117             |               |                   | R92-0687-05       | CHIP R 0 0HM                   | T2W2                   |                    |
| R118,119         |               |                   | R92-0687-05       | CHIP R 0 0HM                   |                        |                    |
| R120             |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/8W        | K1M1M2                 |                    |
| R121-123         |               |                   | R92-0687-05       | CHIP R 0 0HM                   |                        |                    |
| R124             |               |                   | R92-0670-05       | CHIP R 0 0HM                   |                        |                    |
| R125,126         |               |                   | RD14BB2C223J      | RD 22K J 1/6W                  |                        |                    |
| VR1              |               |                   | R12-5047-05       | TRIMMING P0T. (220K)           |                        |                    |
| VR2              |               |                   | R12-3096-05       | TRIMMING P0T. (10K)            | K1M1M2                 |                    |
| VR3              |               |                   | R12-3096-05       | TRIMMING P0T. (10K)            |                        |                    |
| VR4,5            |               |                   | R12-3099-05       | TRIMMING P0T. (47K)            |                        |                    |
| VR6              |               |                   | R12-3096-05       | TRIMMING P0T. (10K)            |                        |                    |
| VR7              |               |                   | R12-3098-05       | TRIMMING P0T. (33K)            | K1M1M2                 |                    |
| VR7              |               |                   | R12-3098-05       | TRIMMING P0T. (33K)            | T2W2                   |                    |
| D1               |               |                   | 1S5226            | CHIP DI0DE                     |                        |                    |
| D2               |               |                   | 1S5181            | CHIP DI0DE                     |                        |                    |
| D3,4             |               |                   | 1S5184            | CHIP DI0DE                     |                        |                    |
| D5               |               |                   | 02CZ6.2(Y,Z)      | CHIP ZENER DI0DE               |                        |                    |
| D6               |               |                   | 1S5181            | CHIP DI0DE                     |                        |                    |
| D7,8             |               |                   | BA2B2             | DI0DE                          |                        |                    |
| D9,10            |               |                   | 1S5181            | CHIP DI0DE                     |                        |                    |
| D11-13           |               |                   | 1SV164            | CHIP VARI-CAP DI0DE            | K1M1M2                 |                    |
| D14,15           |               |                   | 1S1555            | DI0DE                          |                        |                    |
| IC1              |               | *                 | MC7808C           | IC(V0LTAGE REGULATOR/ +14V)    |                        |                    |
| IC2              |               |                   | M54959P           | IC(FREQ SYNTHESIZER PLL)       |                        |                    |
| IC3              |               |                   | TC4094BP          | IC(8-STAGE SHIFT/STORE BUS REG |                        |                    |
| IC4              |               |                   | UPC1241H          | IC                             |                        |                    |
| Q1               |               |                   | 3SK184(S)         | CHIP FET                       |                        |                    |
| Q2               |               | *                 | 3SK131(V12)       | CHIP FET                       |                        |                    |
| Q3               |               |                   | 2SC2714(Y)        | CHIP TRANSIST0R                |                        |                    |
| Q4               |               |                   | 2SC3326(A)        | CHIP TRANSIST0R                |                        |                    |
| Q5,6             |               |                   | 2SB1119S          | CHIP TRANSIST0R                |                        |                    |
| Q7,8             |               |                   | DTC124EK          | DIGITAL TRANSIST0R             |                        |                    |
| Q9               |               |                   | 2SC2712(Y)        | CHIP TRANSIST0R                |                        |                    |

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|--------------------------|---------------|-------------------|-------------------|-------------------------|------------------------|--------------------|
| Q10                      |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR         | K1M1M2                 |                    |
| Q11                      |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR         | T1W1                   |                    |
| Q11                      |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR         | T2W2                   |                    |
| Q12                      |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR         | K1M1M2                 |                    |
| Q13 ,14                  |               |                   | 2SC2712(Y)        | CHIP TRANSISTOR         |                        |                    |
| Q15                      |               |                   | 2SA1162(Y)        | CHIP TRANSISTOR         |                        |                    |
| Q16 ,17                  |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR         |                        |                    |
| Q18                      |               |                   | 2SC2712(Y)        | CHIP TRANSISTOR         |                        |                    |
| Q19                      |               |                   | 2SC2538-22-A      | TRANSISTOR              | T1W1                   |                    |
| Q19                      |               | *                 | 2SC3369           | TRANSISTOR              | K1M1M2                 |                    |
| Q19                      |               | *                 | 2SC3369           | TRANSISTOR              |                        |                    |
| Q20                      |               |                   | 2SD1406(Y)        | TRANSISTOR              | T2W2                   |                    |
| Q21                      |               |                   | 2SC2712(Y)        | CHIP TRANSISTOR         |                        |                    |
| TH1                      |               |                   | 112-502-2         | THERMISTER (5K)         |                        |                    |
|                          |               | *                 | X58-3090-00       | SUB UNIT (VCO)          |                        |                    |
|                          |               | *                 | X59-3120-00       | MODULE UNIT (DRIVE)     |                        |                    |
|                          |               | *                 | X59-3130-00       | MODULE UNIT (APC)       |                        |                    |
|                          |               | *                 | X59-3140-00       | MODULE UNIT (IF)        |                        |                    |
|                          |               | *                 | X59-3150-00       | MODULE UNIT (SQL)       |                        |                    |
|                          |               | *                 | X59-3160-00       | MODULE UNIT (MIC)       |                        |                    |
|                          |               | *                 | X59-3170-00       | MODULE UNIT (VOL)       |                        |                    |
| <b>VCO (X58-3090-00)</b> |               |                   |                   |                         |                        |                    |
| C1 ,2                    |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                        |                    |
| C3                       |               |                   | CC41FCH1H030C     | CYLND CHIP C 3.0PF C    |                        |                    |
| C4                       |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                        |                    |
| C5                       |               |                   | CC41FCH1H030C     | CYLND CHIP C 3.0PF C    |                        |                    |
| C6                       |               |                   | CC41FCH1H100D     | CYLND CHIP C 10PF D     |                        |                    |
| C7                       |               |                   | CC41FCH1H080D     | CYLND CHIP C 8.0PF D    |                        |                    |
| C8                       |               |                   | CC41FCH1H220J     | CYLND CHIP C 22PF J     |                        |                    |
| C9                       |               |                   | CC41FCH1H0R5C     | CYLND CHIP C 0.5PF C    |                        |                    |
| C10                      |               |                   | CC73FCH1H270J     | CHIP C 27PF J           |                        |                    |
| C11                      |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                        |                    |
| C12                      |               |                   | CC41FCH1H030C     | CYLND CHIP C 3.0PF C    |                        |                    |
| C13                      |               |                   | CK73FB1H103K      | CHIP C 0.010UF K        |                        |                    |
| C14                      |               |                   | CC41FCH1H030C     | CYLND CHIP C 3.0PF C    |                        |                    |
| C15                      |               |                   | CC41FCH1H120J     | CYLND CHIP C 12PF J     |                        |                    |
| C16                      |               |                   | CC73FCH1H330J     | CHIP C 33PF J           |                        |                    |
| C17                      |               |                   | CC41FCH1H150J     | CYLND CHIP C 15PF J     |                        |                    |
| C18                      |               |                   | CC41FCH1H110J     | CYLND CHIP C 11PF J     |                        |                    |
| C19                      |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                        |                    |
| C20                      |               |                   | CC73FCH1H470J     | CHIP C 47PF J           |                        |                    |
| C21                      |               |                   | CK73FB1H102K      | CHIP C 1000PF K         |                        |                    |
| TC1 ,2                   |               |                   | C05-0345-05       | CHIP TRIMMING CAP(10PF) |                        |                    |
|                          |               |                   | E40-5095-05       | PIN ASSY (10P)          |                        |                    |
| L1                       |               |                   | L40-3392-81       | CHIP INDUCTOR (3.3UH)   |                        |                    |
| L2                       |               | *                 | L34-1192-05       | COIL (3.5T)             |                        |                    |
| L3 ,4                    |               |                   | L40-3392-81       | CHIP INDUCTOR (3.3UH)   |                        |                    |
| L5                       |               | *                 | L34-1193-05       | COIL (3.4T)             |                        |                    |
| L6                       |               |                   | L40-1092-81       | CHIP INDUCTOR (1UH)     |                        |                    |
| R1                       |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/BW |                        |                    |
| R2                       |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/BW |                        |                    |
| R3                       |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/BW |                        |                    |
| R4                       |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/BW |                        |                    |

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| R5                         |               |                   | RD41FB2B470J      | CYLND CHIP R 47 J 1/BW   |                        |                    |
| R6                         |               |                   | RD41FB2B391J      | CYLND CHIP R 390 J 1/BW  |                        |                    |
| R7                         |               |                   | RD41FB2B104J      | CYLND CHIP R 100K J 1/BW |                        |                    |
| R8                         |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/BW  |                        |                    |
| R9                         |               |                   | RD41FB2B152J      | CYLND CHIP R 1.5K J 1/BW |                        |                    |
| R10                        |               |                   | RD41FB2B823J      | CYLND CHIP R 82K J 1/BW  |                        |                    |
| R11                        |               |                   | RD41FB2B224J      | CYLND CHIP R 220K J 1/BW |                        |                    |
| R12                        |               |                   | RD41FB2B470J      | CYLND CHIP R 47 J 1/BW   |                        |                    |
| R13                        |               |                   | RD41FB2B181J      | CYLND CHIP R 180 J 1/BW  |                        |                    |
| R14                        |               |                   | RD41FB2B682J      | CYLND CHIP R 6.8K J 1/BW |                        |                    |
| R15 ,16                    |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/BW  |                        |                    |
| R17                        |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/BW |                        |                    |
| D1                         |               |                   | 1SS184            | CHIP DIODE               |                        |                    |
| D2                         |               | *                 | 1SV164            | CHIP VARI-CAP DIODE      |                        |                    |
| D3 ,4                      |               | *                 | 1SV166            | CHIP VARI-CAP DIODE      |                        |                    |
| D5                         |               | *                 | 1SS153            | CHIP DIODE               |                        |                    |
| Q1                         |               |                   | 2SC2757(T33)      | CHIP TRANSISTOR          |                        |                    |
| Q2                         |               | *                 | 2SK508(K52)       | CHIP FET                 |                        |                    |
| Q3                         |               |                   | 2SC2712(Y)        | CHIP TRANSISTOR          |                        |                    |
| Q4                         |               | *                 | 2SK508(K51)       | CHIP FET                 |                        |                    |
| <b>DRIVE (X59-3120-00)</b> |               |                   |                   |                          |                        |                    |
| C1 -7                      |               |                   | CK73FB1H102K      | CHIP C 1000PF K          |                        |                    |
| C8                         |               |                   | CK73FB1H103K      | CHIP C 0.010UF K         |                        |                    |
| C9                         |               |                   | CC73FCH1H330J     | CHIP C 33PF J            |                        |                    |
| C10                        |               |                   | CC41FCH1H020C     | CYLND CHIP C 2.0PF C     |                        |                    |
| C11                        |               |                   | CK73FB1H103K      | CHIP C 0.010UF K         |                        |                    |
| C12                        |               |                   | CK73EF1C105Z      | CHIP C 1.0UF Z           |                        |                    |
|                            |               |                   | E23-0471-05       | TERMINAL                 |                        |                    |
| L1                         |               |                   | L40-5672-80       | CHIP INDUCTOR (56NH)     |                        |                    |
| R1 -5                      |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/BW |                        |                    |
| R6                         |               |                   | RD41FB2B103J      | CYLND CHIP R 10K J 1/BW  |                        |                    |
| R7                         |               |                   | RD41FB2B101J      | CYLND CHIP R 100 J 1/BW  |                        |                    |
| R8                         |               |                   | RD41FB2B102J      | CYLND CHIP R 1.0K J 1/BW |                        |                    |
| R9                         |               |                   | RD41FB2B223J      | CYLND CHIP R 22K J 1/BW  |                        |                    |
| R10                        |               |                   | RD41FB2B472J      | CYLND CHIP R 4.7K J 1/BW |                        |                    |
| R11                        |               |                   | RD41DB2B331J      | CYLND CHIP R 330 J 1/BW  |                        |                    |
| R12                        |               |                   | RD41FB2B680J      | CYLND CHIP R 68 J 1/BW   |                        |                    |
| R13                        |               |                   | RD41FB2B182J      | CYLND CHIP R 1.8K J 1/BW |                        |                    |
| R14                        |               |                   | RD41FB2B471J      | CYLND CHIP R 470 J 1/BW  |                        |                    |
| R15                        |               |                   | RD41FB2B390J      | CYLND CHIP R 39 J 1/BW   |                        |                    |
| R16                        |               |                   | RD41FB2B220J      | CYLND CHIP R 22 J 1/BW   |                        |                    |
| R17                        |               |                   | R92-0687-05       | CHIP R 0 OHM             |                        |                    |
| R18                        |               |                   | R92-0338-05       | CYLND CHIP R 0 OHM       |                        |                    |
| D1                         |               |                   | 1SS184            | CHIP DIODE               |                        |                    |
| Q1 ,2                      |               |                   | 2SA1162(Y)        | CHIP TRANSISTOR          |                        |                    |
| Q3                         |               |                   | 2SC2712(Y)        | CHIP TRANSISTOR          |                        |                    |
| Q4                         |               |                   | 2SC2714(Y)        | CHIP TRANSISTOR          |                        |                    |
| Q5                         |               | *                 | 2SC3837K(N)       | CHIP TRANSISTOR          |                        |                    |
| <b>APC (X59-3130-00)</b>   |               |                   |                   |                          |                        |                    |
| C1                         |               |                   | CK73FB1H102K      | CHIP C 1000PF K          |                        |                    |
| C2                         |               |                   | C92-0501-05       | CHIP TAN 1.5UF 10WV      |                        |                    |
| C3                         |               |                   | CK73FB1H472K      | CHIP C 4700PF K          |                        |                    |

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| C4<br>C5<br>C6              |               |                   | CK73FB1H102K<br>CK73FB1H472K<br>CK73FB1H102K                                   | CHIP C 1000PF K<br>CHIP C 4700PF K<br>CHIP C 1000PF K   |                         |                    |
|                             |               |                   | E23-0471-05  | TERMINAL  |                         |                    |
| R1<br>R2<br>R3<br>R4<br>R6  | .5            |                   | RD41FB2B222J<br>RD41FB2B102J<br>RD41FB2B152J<br>RD41FB2B103J<br>RD41FB2B122J   | CYLND CHIP R 2.2K J 1/8W<br>CYLND CHIP R 1.0K J 1/8W<br>CYLND CHIP R 1.5K J 1/8W<br>CYLND CHIP R 10K J 1/8W<br>CYLND CHIP R 1.2K J 1/8W |                         |                    |
| Q1<br>Q3                    | .2            |                   | FMW1<br>2SA1162(Y)   | DIGITAL TRANSISTOR<br>CHIP TRANSISTOR   |                         |                    |
| <b>IF (X59-3140-00)</b>     |               |                   |  |   |                         |                    |
| C1<br>C2<br>C3<br>C4<br>C5  |               |                   | CK73FB1H102K<br>CK73FB1H472K<br>CC73FCH1H330J<br>CK73FB1H472K<br>CC73FSL1H561J | CHIP C 1000PF K<br>CHIP C 4700PF K<br>CHIP C 33PF J<br>CHIP C 4700PF K<br>CHIP C 560PF J  |                         |                    |
| C6<br>C7<br>C8              | -10           |                   | CK73FB1H472K<br>CK73FB1H103K<br>CK73EB1H104K                                   | CHIP C 4700PF K<br>CHIP C 0.010UF K<br>CHIP C 0.10UF K  |                         |                    |
|                             |               |                   | E23-0471-05  | TERMINAL  |                         |                    |
| L1<br>L2                    |               | *                 | L40-2211-81<br>L33-0695-05   | SMALL FIXED INDUCTOR(220UH)<br>CHOKE COIL (1MH)   |                         |                    |
| R1<br>R4<br>R5              | .2            |                   | RD41FB2B104J<br>RD41FB2B332J<br>RD41FB2B182J                                   | CYLND CHIP R 100K J 1/8W<br>CYLND CHIP R 3.3K J 1/8W<br>CYLND CHIP R 1.8K J 1/8W  |                         |                    |
| IC1                         |               | *                 | TA7761F  | IC  |                         |                    |
| <b>SQL (X59-3150-00)</b>    |               |                   |  |   |                         |                    |
| C1<br>C2<br>C4<br>C5<br>C6  |               | *                 | CK73FB1H102K<br>CC73FCH1H330J<br>C92-0005-05<br>CK73EF1C105Z<br>C92-0504-05    | CHIP C 1000PF K<br>CHIP C 33PF J<br>CHIP-TAN 2.2UF 6.3WV<br>CHIP C 1.0UF Z<br>CHIP-TAN 0.68UF 20WV                                      |                         |                    |
| C7<br>C9<br>C10             | .8            |                   | CK73FB1E393K<br>CK73FB1H153K<br>CK73FB1H333K                                   | CHIP C 0.039UF K<br>CHIP C 0.015UF K<br>CHIP C 0.033UF K  |                         |                    |
|                             |               |                   | E23-0471-05  | TERMINAL  |                         |                    |
| R1<br>R2<br>R3<br>R4<br>R5  |               |                   | RD41FB2B104J<br>RD41FB2B272J<br>RD41FB2B222J<br>RD41FB2B223J<br>RD41FB2B332J   | CYLND CHIP R 100K J 1/8W<br>CYLND CHIP R 2.7K J 1/8W<br>CYLND CHIP R 2.2K J 1/8W<br>CYLND CHIP R 22K J 1/8W<br>CYLND CHIP R 3.3K J 1/8W |                         |                    |
| R6<br>R7<br>R8<br>R9<br>R10 |               |                   | RD41FB2B682J<br>RD41FB2B103J<br>RD41FB2B474J<br>RD41FB2B472J<br>RD41FB2B474J   | CYLND CHIP R 6.8K J 1/8W<br>CYLND CHIP R 10K J 1/8W<br>CYLND CHIP R 470K J 1/8W<br>CYLND CHIP R 4.7K J 1/8W<br>CYLND CHIP R 470K J 1/8W |                         |                    |
| R11<br>R12<br>R13           |               |                   | RD41FB2B273J<br>RD41FB2B223J<br>RD41FB2B222J                                   | CYLND CHIP R 27K J 1/8W<br>CYLND CHIP R 22K J 1/8W<br>CYLND CHIP R 2.2K J 1/8W  |                         |                    |

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| Ref. No.<br>参照番号                    | Address<br>位置 | New<br>Parts<br>新 | Parts No.<br>部品番号  | Description<br>部品名 / 規格   | Desti-<br>nation<br>仕向 | Re-<br>marks<br>備考 |
|-------------------------------------|---------------|-------------------|--|---|------------------------|--------------------|
| R14<br>R15<br>R16<br>R17            |               |                   | RD41FB2B393J<br>RD41FB2B273J<br>RD41FB2B331J<br>RD41FB2B222J                   | CYLND CHIP R 39K J 1/8W<br>CYLND CHIP R 27K J 1/8W<br>CYLND CHIP R 330 J 1/8W<br>CYLND CHIP R 2.2K J 1/8W                             |                        |                    |
| D1<br>D2<br>Q1 ,2<br>Q3 ,4<br>Q5 ,6 |               |                   | 1SS226<br>1SS181<br>2SC2712(Y)<br>2SC3295(B)<br>2SC2712(Y)                     | CHIP DIODE<br>CHIP DIODE<br>CHIP TRANSISTOR<br>CHIP TRANSISTOR<br>CHIP TRANSISTOR   |                        |                    |
| <b>MIC (X59-3160-00)</b>            |               |                   |  |   |                        |                    |
| C1<br>C2<br>C3<br>C4 ,5<br>C6       |               |                   | CK73FB1H223K<br>CK73EF1C105Z<br>CK73FB1H333K<br>CK73FB1H223K<br>CK73EF1C105Z   | CHIP C 0.022UF K<br>CHIP C 1.0UF Z<br>CHIP C 0.033UF K<br>CHIP C 0.022UF K<br>CHIP C 1.0UF Z  |                        |                    |
| C7<br>C8<br>C9<br>C10<br>C11        |               |                   | CC73FSL1H101J<br>CK73FB1H272K<br>CK73EF1C105Z<br>CC73FSL1H101J<br>CK73FB1H821K | CHIP C 100PF J<br>CHIP C 2700PF K<br>CHIP C 1.0UF Z<br>CHIP C 100PF J<br>CHIP C 820PF K   |                        |                    |
|                                     |               |                   | E23-0471-05  | TERMINAL  |                        |                    |
| R1<br>R2<br>R3<br>R4<br>R5          |               |                   | RD41FB2B123J<br>RD41FB2B473J<br>RD41FB2B563J<br>RD41FB2B101J<br>RD41FB2B154J   | CYLND CHIP R 12K J 1/8W<br>CYLND CHIP R 47K J 1/8W<br>CYLND CHIP R 56K J 1/8W<br>CYLND CHIP R 100 J 1/8W<br>CYLND CHIP R 150K J 1/8W  |                        |                    |
| R6<br>R7<br>R8<br>R9<br>R10         |               |                   | RD41FB2B104J<br>RD41FB2B101J<br>RD41FB2B153J<br>RD41FB2B473J<br>RD41FB2B561J   | CYLND CHIP R 100K J 1/8W<br>CYLND CHIP R 100 J 1/8W<br>CYLND CHIP R 15K J 1/8W<br>CYLND CHIP R 47K J 1/8W<br>CYLND CHIP R 560 J 1/8W  |                        |                    |
| R11<br>R12<br>R13<br>R14 -16<br>R17 |               |                   | RD41FB2B274J<br>RD41FB2B563J<br>RD41FB2B224J<br>RD41FB2B823J<br>RD41FB2B103J   | CYLND CHIP R 270K J 1/8W<br>CYLND CHIP R 56K J 1/8W<br>CYLND CHIP R 220K J 1/8W<br>CYLND CHIP R 82K J 1/8W<br>CYLND CHIP R 10K J 1/8W |                        |                    |
| R19 ,20                             |               |                   | R92-0687-05  | CHIP R 0 OHM  |                        |                    |
| IC1 ,2                              |               |                   | NJM4558M   | IC(OP AMP X2)   |                        |                    |
| <b>VOL (X59-3170-00)</b>            |               |                   |  |   |                        |                    |
| C1 ,2<br>C3<br>C4                   |               |                   | CK73EB1E104K<br>CK73FF1E104Z<br>C92-0004-05                                    | CHIP C 0.10UF K<br>CHIP C 0.10UF Z<br>CHIP TAN 1UF 16WV   |                        |                    |
|                                     |               |                   | E23-0471-05  | TERMINAL  |                        |                    |
| R1 --3<br>R4<br>R5<br>R6<br>R7      |               |                   | RD41FB2B473J<br>RD41FB2B823J<br>RD41FB2B103J<br>RD41FB2B104J<br>RD41FB2B272J   | CYLND CHIP R 47K J 1/8W<br>CYLND CHIP R 82K J 1/8W<br>CYLND CHIP R 10K J 1/8W<br>CYLND CHIP R 100K J 1/8W<br>CYLND CHIP R 2.7K J 1/8W |                        |                    |
| R8<br>R9                            |               |                   | RD41FB2B104J<br>RD41FB2B272J   | CYLND CHIP R 100K J 1/8W<br>CYLND CHIP R 2.7K J 1/8W  |                        |                    |
| D1                                  |               |                   | 1SS226   | CHIP DIODE  |                        |                    |

E: Scandinavia & Europe K: USA P: Canada W: Europe

U: PX(Far East, Hawaii) T: England M: Other Areas

UE: AAFES(Europe) X: Australia

TM-221A : K1,M1,M2

TM-221E : T1,W1

TM-221ES : T2,W2

⚠ indicates safety critical components.

# PARTS LIST

× New Parts

Parts without Parts No. are not supplied.

Les articles non mentionnés dans le Parts No. ne sont pas fournis.

Telle ohne Parts No. werden nicht geliefert.

| Ref. No.<br>参照番号          | Address<br>位置 | New Parts<br>新 | Parts No.<br>部品番号 | Description<br>部品名 / 規格 | Desti-<br>nation<br>仕 向 | Re-<br>marks<br>備考 |
|---------------------------|---------------|----------------|-------------------|-------------------------|-------------------------|--------------------|
| IC1<br>IC2<br>Q1<br>Q2 ,3 |               | *              | LC7532M           | IC(BILATERAL SWITCH)    |                         |                    |
|                           |               | *              | MN4066BS          | IC(QUAD ANALOG SWITCH)  |                         |                    |
|                           |               |                | DTC144EK          | DIGITAL TRANSISTOR      |                         |                    |
|                           |               |                | DTA114EK          | DIGITAL TRANSISTOR      |                         |                    |

E: Scandinavia & Europe K: USA P: Canada W: Europe  
 U: PX(Far East, Hawaii) T: England M: Other Areas  
 UE: AAFES(Europe) X: Australia

TM-221A : K1,M1,M2  
 TM-221E : T1,W1  
 TM-221ES : T2,W2

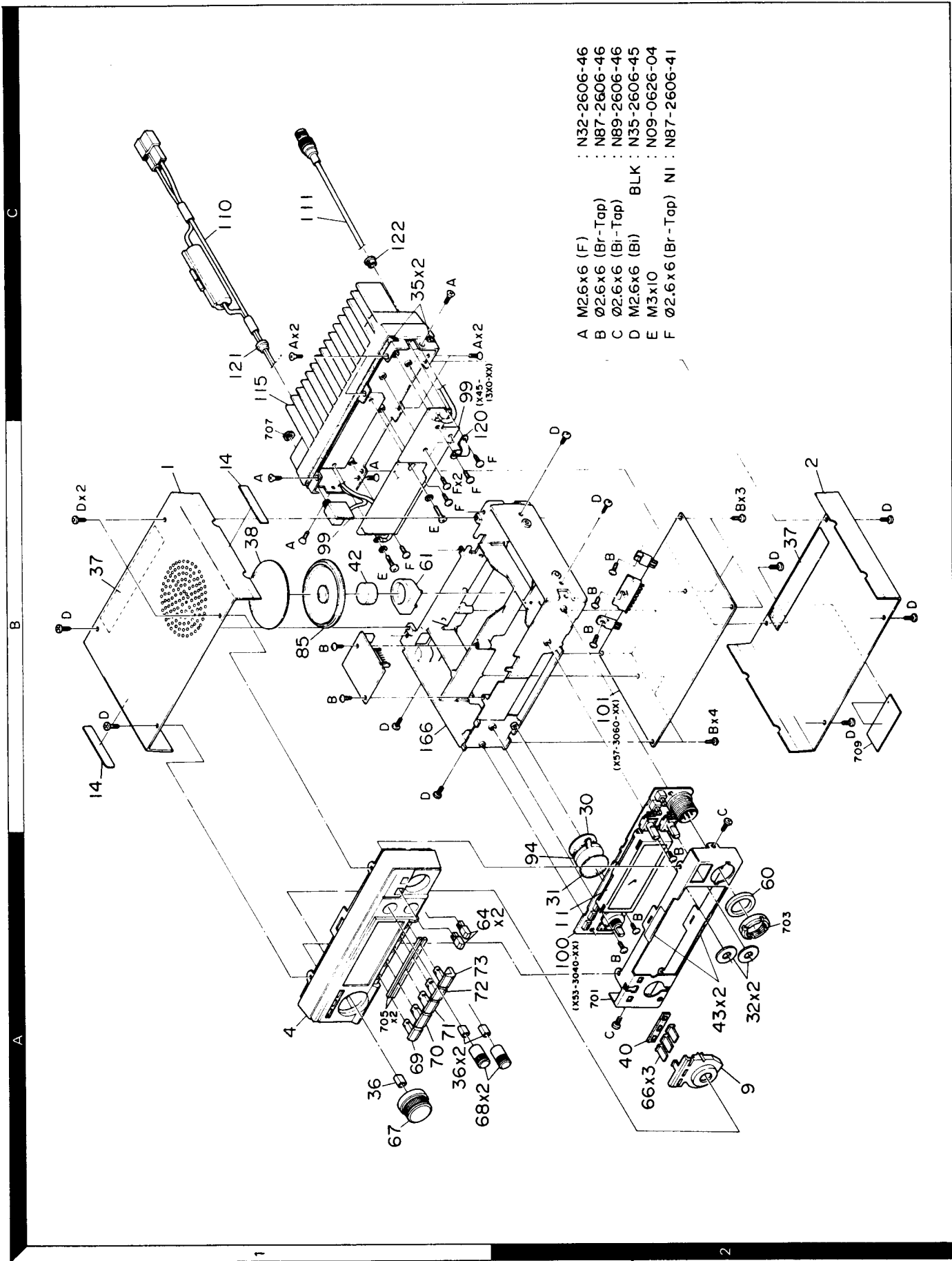
⚠ indicates safety critical components.

## SEMICONDUCTOR

N : New parts

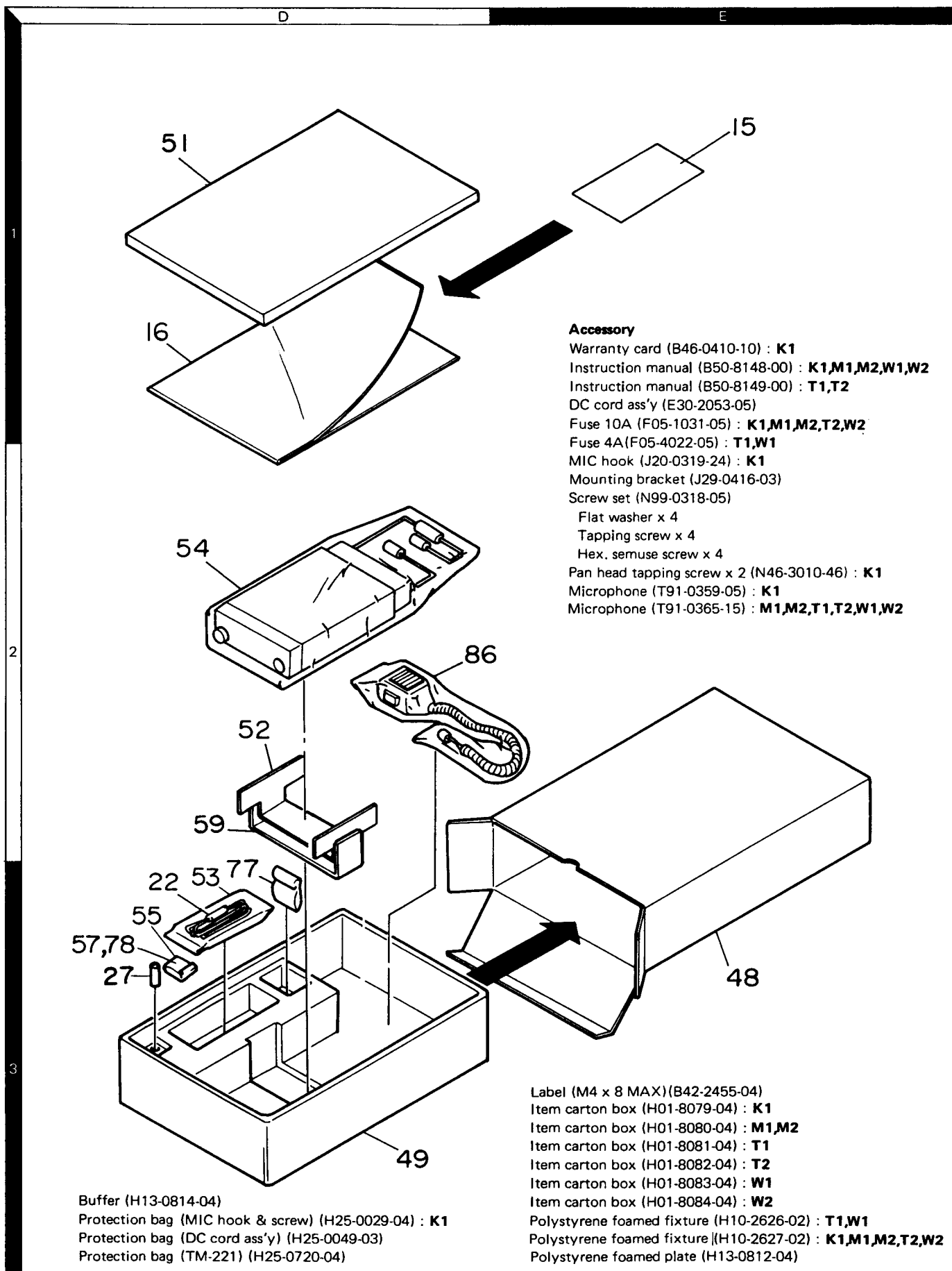
| Item                    | Re-<br>marks               | Parts No.    | Item                | Re-<br>marks     | Parts No.   |
|-------------------------|----------------------------|--------------|---------------------|------------------|-------------|
| <b>Diode</b>            |                            | 1S1555       | <b>Digital TR</b>   |                  | DTA114EK    |
|                         |                            | 1S1587       |                     |                  | DTC124EK    |
|                         |                            | BA282        |                     |                  | DTC144EK    |
|                         |                            | DSA3A1       |                     |                  | FMW-1       |
|                         |                            | MI308        | <b>Chip FET</b>     | N                | 2SK508(K51) |
|                         |                            | UM9401       |                     | N                | 2SK508(K52) |
| <b>Chip diode</b>       | N                          | 1SS153       | N                   | 3SK131(V12)      |             |
|                         |                            | 1SS181       |                     | 3SK184(S)        |             |
|                         |                            | 1SS184       | <b>Power module</b> |                  | M57726      |
|                         |                            | 1SS226       |                     |                  | M57747      |
| <b>Chip zener diode</b> |                            | 02CZ6.2(Y,Z) | <b>IC</b>           | N                | KRR-C001    |
|                         | <b>Chip vari-cap diode</b> | N            |                     | 1SV164           | N           |
|                         |                            | N            | 1SV166              | N                | LC7532M     |
| <b>Thermister</b>       |                            | 112-502-2    |                     | LC7582           |             |
|                         | <b>TR</b>                  | N            | 2SC2538-22-A        | N                | M51951BML   |
| 2SC3369                 |                            |              | N                   | M54959P          |             |
| 2SD1406(Y)              |                            |              | N                   | MC7808C          |             |
| <b>Chip TR</b>          | N                          | 2SA1162(Y)   | N                   | MN4066BS         |             |
|                         |                            | 2SB1119S     |                     | NJM4558M         |             |
|                         |                            | 2SC2712(Y)   | N                   | TA7761F          |             |
|                         |                            | 2SC2714(Y)   |                     | TC4094BP         |             |
|                         |                            | 2SC2757(T33) |                     | μPC1241H         |             |
|                         |                            | 2SC3295(B)   | N                   | μPD75106G-508-1B |             |
|                         |                            | 2SC3326(A)   |                     |                  |             |
| 2SC3837K(IN)            |                            |              |                     |                  |             |

## EXPLODED VIEW





## PACKING



**Accessory**

- Warranty card (B46-0410-10) : **K1**
- Instruction manual (B50-8148-00) : **K1,M1,M2,W1,W2**
- Instruction manual (B50-8149-00) : **T1,T2**
- DC cord ass'y (E30-2053-05)
- Fuse 10A (F05-1031-05) : **K1,M1,M2,T2,W2**
- Fuse 4A(F05-4022-05) : **T1,W1**
- MIC hook (J20-0319-24) : **K1**
- Mounting bracket (J29-0416-03)
- Screw set (N99-0318-05)
- Flat washer x 4
- Tapping screw x 4
- Hex. semuse screw x 4
- Pan head tapping screw x 2 (N46-3010-46) : **K1**
- Microphone (T91-0359-05) : **K1**
- Microphone (T91-0365-15) : **M1,M2,T1,T2,W1,W2**

- Buffer (H13-0814-04)
- Protection bag (MIC hook & screw) (H25-0029-04) : **K1**
- Protection bag (DC cord ass'y) (H25-0049-03)
- Protection bag (TM-221) (H25-0720-04)

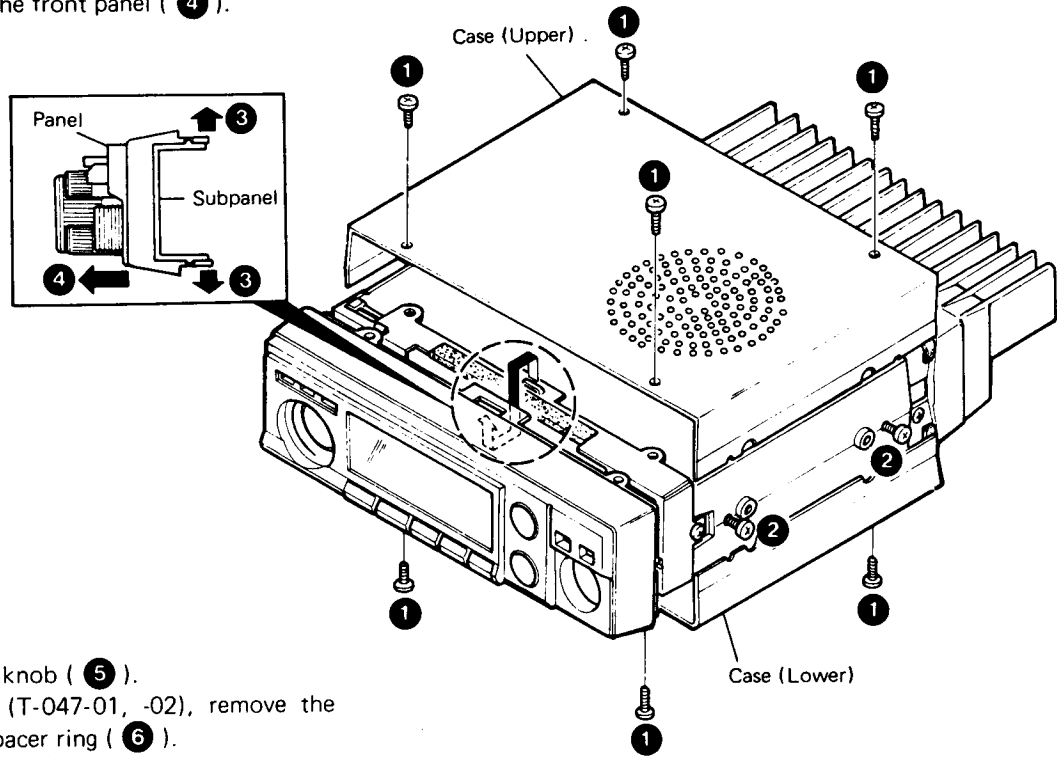
- Label (M4 x 8 MAX)(B42-2455-04)
- Item carton box (H01-8079-04) : **K1**
- Item carton box (H01-8080-04) : **M1,M2**
- Item carton box (H01-8081-04) : **T1**
- Item carton box (H01-8082-04) : **T2**
- Item carton box (H01-8083-04) : **W1**
- Item carton box (H01-8084-04) : **W2**
- Polystyrene foamed fixture (H10-2626-02) : **T1,W1**
- Polystyrene foamed fixture (H10-2627-02) : **K1,M1,M2,T2,W2**
- Polystyrene foamed plate (H13-0812-04)

Parts with the exploded numbers larger than 700 are not supplied.

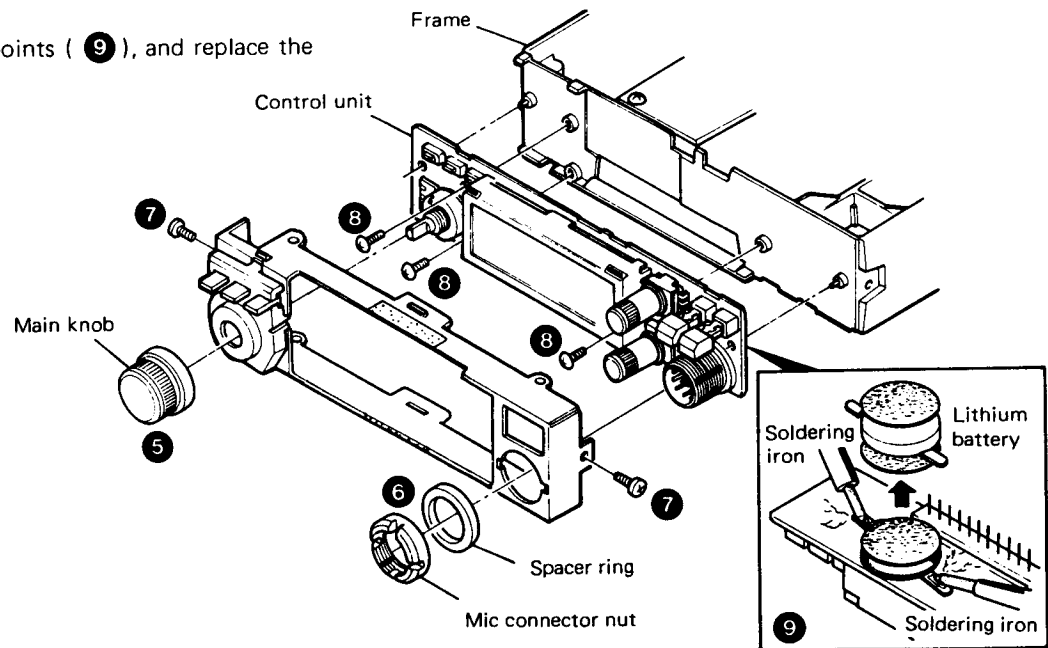
## DISSASSEMBLY

### Replacement of Lithium Battery

1. Remove the eight screws from the upper and lower case ( ① ). Loosen the four screws on the left and right panel ( ② ), and remove the upper and lower case.
2. Release the stoppers fixing the front panel and sub-panel ( ③ ), and remove the front panel ( ④ ).



3. Pull out the main control knob ( ⑤ ).
4. Using the special tools (T-047-01, -02), remove the MIC connector nut and spacer ring ( ⑥ ).
5. Remove the two screws ( ⑦ ), and remove the sub-panel.
6. Remove three screw ( ⑧ ), and remove the Control unit. As it is connected to the TX-RX unit at the rear of it via a connector pin, disconnect it gently when removing.
7. Remove solder from two points ( ⑨ ), and replace the lithium battery.



## ADJUSTMENT

### REQUIRED TEST EQUIPMENT

1. **DC V.M**
  - 1) High input impedance
2. **RF VTVM (RF V.M)**
  - 1) Input impedance :  $1M\Omega$  min.,  $2pF$  max.
  - 2) Voltage range : F.S =  $10mV \sim 300V$
  - 3) Frequency range : Up to  $450MHz$
3. **Frequency Counter (f. counter)**
  - 1) Input sensitivity : Approx.  $50mV$
  - 2) Frequency range : Up to  $450MHz$
4. **DC Power Supply**
  - 1) Voltage :  $10V \sim 17V$ , variable
  - 2) Current :  $6A$  min.
5. **Power Meter**
  - 1) Measurement range Approx. :  $30W, 3W, 1W$
  - 2) Input impedance :  $50\Omega$
  - 3) Frequency range :  $450MHz$
6. **AF VTVM (AF V.M)**
  - 1) Input impedance :  $1M\Omega$  min.
  - 2) Voltage range : F.S =  $1mV \sim 30V$
  - 3) Frequency range :  $50Hz \sim 10kHz$
7. **AF Generator (AG)**
  - 1) Output frequency :  $100Hz \sim 10kHz$
  - 2) Output voltage :  $0.5mV \sim 1V$
8. **Linear Detector**
  - 1) Frequency range :  $450MHz$
9. **Field Strength Meter**
  - 1) Frequency range :  $450MHz$
10. **Directional Coupler**
11. **Oscilloscope**
  - 1) High sensitivity oscilloscope with horizontal input terminal
12. **SSG**
  - 1) Frequency range :  $144MHz$ .
  - 2) Modulation : AM and FM MOD.
  - 3) Output level :  $-20dB$  to  $100dB$
13. **Dummy Load**
  - 1)  $8\Omega$ ,  $50W$  (approx.)
14. **Noise Generator**
  - 1) Must generate ignition-like noise containing harmonics beyond  $450MHz$ .

### 15. Sweep Generator

- 1) Sweep range :  $1440MHz$  and  $430MHz$  bands

### 16. Tracking generator

### PREPARATION

- 1) Unless otherwise specified, knobs and switches should be set as follows **Table 7**.

|            |     |                |     |
|------------|-----|----------------|-----|
| POWER SW   | ON  | SHIFT SW       | OFF |
| AF VOL VR  | MIN | REV SW         | OFF |
| SQL VOL VR | MIN | SCAN SW        | OFF |
| LOW SW     | OFF | CTCSS SW (K,M) | OFF |
| VFO/M SW   | VFO | ALERT SW (T,W) | OFF |
|            |     | TONE SW        | OFF |

Table 7

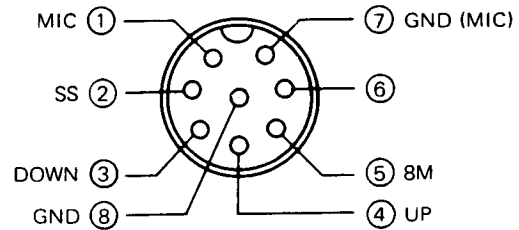


Fig. 18 MIC terminals (view from front panel side)

- 2) Use an insulated adjusting rod to adjust trimmers and coils.
- 3) To prevent damaging SSG, never connect the microphone to mic jack while adjusting the receiver section.
- 4) Be sure to turn the power switch OFF, before connecting the power cable to a power source.
- 5) SSG output levels are those at the time the output terminal is open.
- 6) Meter and display section should be set as follows **Fig. 19**.

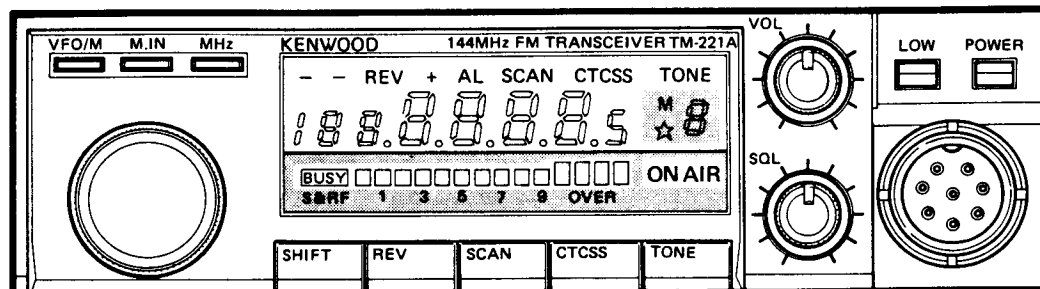




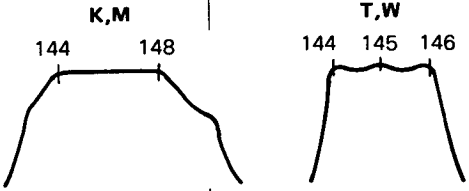
Fig. 19

## CIRCUIT DESCRIPTION

### COMMON ADJUSTMENT

| Item             | Condition   | Measurement              |            |          | Adjustment |  |                                      | Specification/Remarks   |
|------------------|---|--------------------------|------------|----------|------------|--|--------------------------------------|---|
|                  |   | Test equipment           | Unit       | Terminal | Unit       | Part                                   | Method                               |   |
| 1. Setting       | 1) Power supply : 13.8V DC<br>Power SW : OFF<br>VOL VR : Fully counter clockwise (CCW)<br>SQL VR : Fully counter clockwise (CCW)<br>VR6 on TX-RX unit : Fully counter clockwise (CCW) |                          |            |          |            |  |                                      |   |
| 2. Reset         | 1) Turn the power SW ON, holding the VFO/M and M.IN SW down.<br>2) Release the VFO/M and M.IN SW.   |                          |            |          |            |  |                                      | Display 145.000<br> appeared during 5 sec.<br>then,  disappeared. |
| 3. PLL           | 1) RX VCO<br>FREQ. : 145.020<br>Receive.  | Digital volt-meter       | TX-RX      | TP3 (4C) | VCO        | TC2 (4B)                               | 3.3V                                 | ±0.1V   |
|                  | 2) TX VCO<br>FREQ. : 145.020<br>Transmit.   |                          |            |          |            | TC1 (4B)                               | 4.5V                                 | ±0.1V   |
| 4. TX FREQ. ADJ. | 1) FREQ. : 146.000 (K,M)<br>145.020 (T,W)<br>Transmit.  | f.counter<br>Power meter | Rear panel | ANT (1E) | TX-RX      | TC1 (4D)<br>(K,M)<br>TC2 (4C)<br>(T,W) | 146.000MHz (K,M)<br>145.020MHz (T,W) | ±100Hz  |

### RECEIVER SYSTEM ADJUSTMENT

| Item             | Condition   | Measurement                            |            |          | Adjustment |   |   | Specification/Remarks  |
|------------------|---|--|------------|----------|------------|---|---|--|
|                  |   | Test equipment                         | Unit       | Terminal | Unit       | Part  | Method  |  |
| 1. Helical       | 1) FREQ. : 146.020 (K,M)<br>145.040 (T,W)<br>Connect the sweep gen. to the ANT terminal and the Oscilloscope to the detector output.<br>2) Connect the spectrum analyzer to the TP1 terminal from the TX-RX unit.<br>3) Connect the TP3 terminal to GND terminal. | Oscilloscope                           | TX-RX      | TP1 (4E) | TX-RX      | L1(3E)<br>L2(2E)<br>L19 (3F)<br>(K,M)<br>L21 (4F)<br>(K,M)<br>L3(3E)<br>(T,W) | Adjust for the waveform perform shown on right.                 |  |
| 2. IF trap (K,M) | 1) FREQ. : 147.500MHz<br>SSG output : 126.110MHz<br>MOD : OFF<br>Output : 60dBμ   | Digital multi-meter                    | TX-RX      | TP2 (4D) | TX-RX      | L20 (3F)  | MAX.  |  |
| 3. GAIN          | 1) FREQ. : 146.020 (K,M)<br>145.040 (T,W)<br>SSG output : 5dBμ<br>MOD : OFF   | Digital multi-meter                    | TX-RX      | TP2 (4D) | TX-RX      | L4(4E)<br>L5(4E)<br>L7(4E)<br>L9(4E)  | Repeat for MIN.<br>Repeat the adjustment in order of L5 and L7. | Check : Accurate SSG's freq.   |
| 4. Discri        | 1) FREQ. : 146.020 (K,M)<br>145.040 (T,W)<br>SSG output : 20dBμ<br>MOD : 1kHz<br>DEV : ±5kHz  | AF VM<br>Oscilloscope<br>8Ω dummy load | Rear panel | SP (1B)  | TX-RX      | L11 (4D)  | AF MAX.   |  |

## ADJUSTMENT




| Item           | Condition  | Measurement                            |            |          | Adjustment |          |                                      | Specification/Remarks |
|----------------|--|--|------------|----------|------------|----------|--------------------------------------|-----------------------|
|                |  | Test equipment                         | Unit       | Terminal | Unit       | Part     | Method                               |                       |
| 5. Sensitivity | 1) FREQ. : 146.020 (K,M)<br>145.040 (T,W)<br>SSG output : -9dBμ              | AF VM Oscilloscope<br>8Ω<br>dummy load | Rear panel | SP (1B)  |            |          | Check                                | SINAD 12dB or more.   |
|                | 2) FREQ. : 144.020   |  |            |          |            |          |                                      |                       |
|                | 3) FREQ. : 147.980 (K,M)<br>145.960 (T,W)                                    |  |            |          |            |          |                                      |                       |
| 6. S-meter     | 1) FREQ. : 146.020 (K,M)<br>145.040 (T,W)<br>SSG output : -6dBμ<br>MOD : OFF | LCD (S-meter)                          |            |          | TX-RX      | VR1 (4D) | Set the RF scale to reads "2 digit". | S-meter lights OFF.   |
|                | 2) SSG output : 16dBμ  |  |            |          |            |          | All digits light.                    |                       |
|                | 3) SSG : OFF   |  |            |          |            |          |                                      |                       |

### TRANSMITTER SYSTEM ADJUSTMENT

| Item           | Condition  | Measurement                                     |            |          | Adjustment |                      |                                       | Specification/Remarks                          |  |                   |
|----------------|--|---|------------|----------|------------|----------------------|---------------------------------------|--|--|-------------------|
|                |  | Test equipment                                  | Unit       | Terminal | Unit       | Part                 | Method                                |  |  |                   |
| 1-1. RF output | 1) FREQ. : 146.000 (K,M)<br>145.020 (T,W)<br>VR6 (TX-RX unit) : Fully clockwise (CW)<br>VR1 (Final unit) : Center Transmit.                  | Power meter (DC power supply galvo meter)       | Rear panel | ANT (1E) | TX-RX      | TC3 (3A)<br>TC4 (2B) | MAX                                   | 50W or more (K,M,T2,W2)<br>13W or more (T1,W1) |  |                   |
|                | 2) FREQ. : 147.995 (K,M)<br>145.020 (T1,W1)<br>145.980 (T2,W2)<br>Transmit.  |   |            |          |            |                      | VR6 (3B)                              | 47W (K,M,T2,W2)<br>12W (T1,W1)                 | ±4W, less than 9.5A (K,M,T2,W2)<br>±2W, less than 2.8A (T1,W1)                 |                   |
|                | 3) FREQ. : 144.000<br>Transmit.  |   |            |          |            |                      |                                       | Check  | 43W or more, less than 9.5A (K,M,T2,W2)<br>10W or more, less than 2.8A (T1,W1) |                   |
|                | 4) FREQ. : 146.000 (K,M)<br>145.980 (T1,W1)<br>145.000 (T2,W2)<br>Transmit.  |   |            |          |            |                      |                                       |  |  |                   |
| 1-2. LOW Power | 1) FREQ. : 146.000 (K,M)<br>145.020 (T,W)<br>LOW SW : ON<br>Transmit.  |   |            |          |            |                      | Check                                 | 0.5~2W, less than 1.5A (T1,W1)                 |  |                   |
|                |  |   |            |          | TX-RX      | VR7 (3B)             | 5W (K,M,T2,W2)                        | ±2W, less than 4A. (K,M,T2,W2)                 |  |                   |
| 2. RF meter    | 1) FREQ. : 146.000 (K,M)<br>145.020 (T,W)<br>Transmit.   | LCD (RF meter)                                  |            |          | TX-RX      | VR4 (3B)             | Set to the RF scale reads "6 digits". |  |  |                   |
|                | 2) LOW SW : OFF<br>Transmit.   |   |            |          |            |                      |                                       | All digits light.                              |  |                   |
| 3. DEV.        | 1) FREQ. : 146.000 (K,M)<br>145.020 (T,W)<br>AG : 1kHz, 50mV (K,M)<br>1kHz, 30mV (T,W)<br>• MS-57A/61A (Anritsu)<br>HPS : OFF<br>LPF : 20kHz | Linear detector Modulation analyzer Power meter | Rear panel | ANT (1E) | TX-RX      | VR3 (3C)             | ±4.4kHz                               | ±200Hz   |  |                   |
|                | 2) AG : 1kHz, 5mV (K,M)  |   |            |          |            |                      | TX-RX                                 | VR2 (3C)                                       | ±3kHz (K,M)  | ±200Hz (K,M)      |
|                | 1kHz, 3mV (T,W)  |   |            |          |            |                      |                                       |  | Check  | ±2.2~3.6kHz (T,W) |

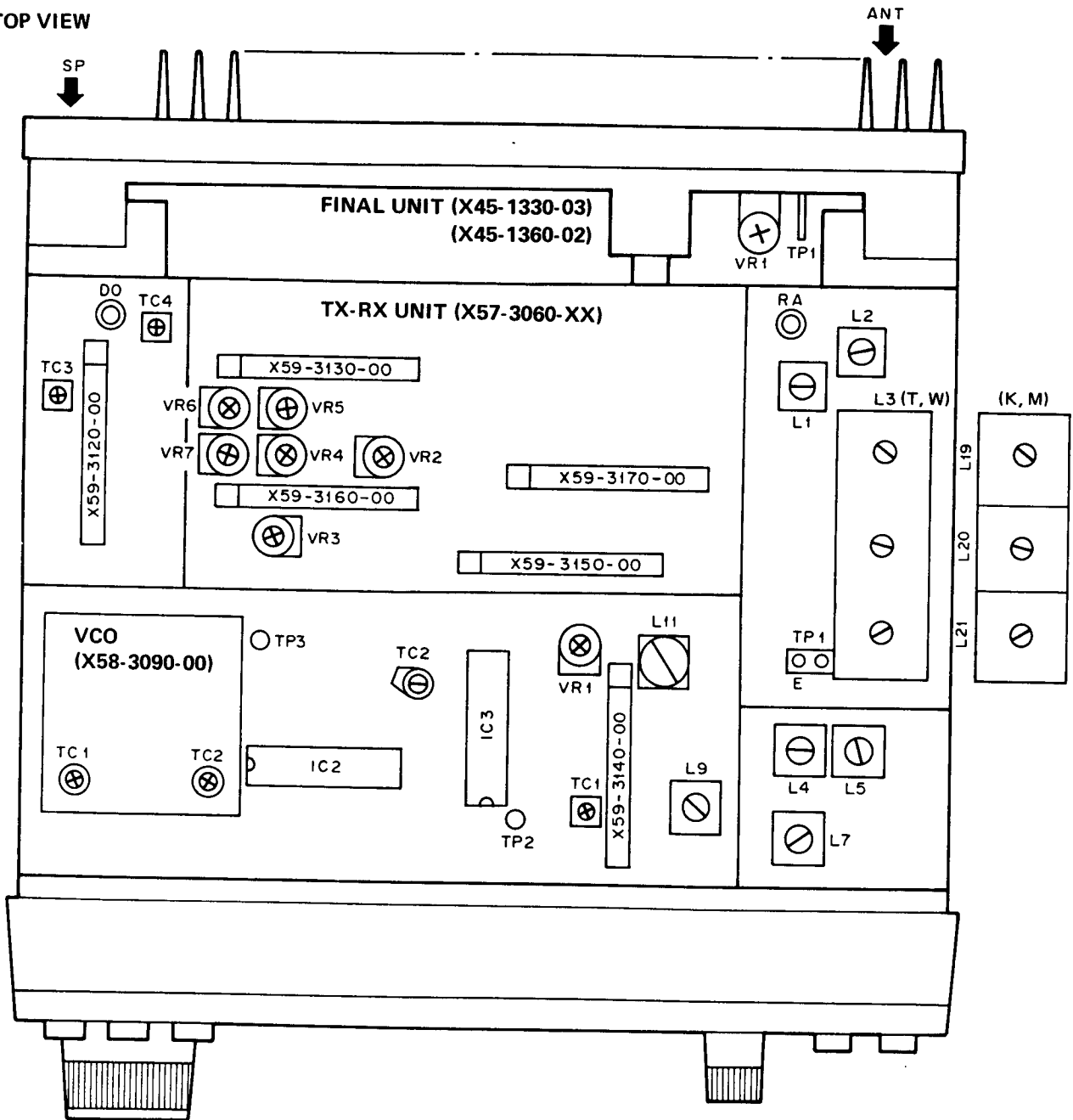


## ADJUSTMENT

| Item                                    | Condition  | Operation check   | Item  | Condition  | Operation check   |
|---|--|---|---|--|---|
| 4-2.<br>Odd split<br>memory<br>channels | 2) Press the M.IN switch   | The beeper sound changes.<br> indicator lights.<br>The memory channel number display is not light. | 5. TONE<br>FREQ.  | 3) Press any switch except the LOW and the Power switches to return to the normal VFO FREQ.  | Receive FREQ. lights.   |
|   | The receive FREQ. memory entry is completed, then changes to the waiting mode of the transmit FREQ. memory entry.          |   | 6. Memory<br>channel<br>lockout<br>selec-<br>tion   | 1) Press the VFO/M switch to select the memory channel mode.   |  indicator lights. |
|   | 4) Select the desired transmit FREQ. using the Tuning control or the Microphone UP/DOWN switch.                            |   |   | 2) Select the desired memory channel to skip using the Tuning control or the Microphone UP/DOWN switch.  |   |
| 5) Press the M.IN switch.               | Memory entry is completed.   |   | 3) Press the M.IN switch and the SCAN switch. When the M.IN switch is pressed, the M indicator lights. The SCAN switch should be pressed within 5 sec. after the M.IN switch is pressed, or the M indicator goes off. |  indicator lights.<br>The asterisk (*) lights in the left of the memory channel number display.<br>The indicated memory channel is skipped during SCAN operation. |   |
| 5. TONE<br>FREQ.                        | 1) Press the M.IN switch and then TONE switch. (within 5 sec. after pressing the M.IN switch.)                             | TONE FREQ. lights.  |   |  |   |
|   | 2) Select the desired TONE FREQ. using the Tuning control or the Microphone UP/DOWN switch. (a value in the 67.0 to 250.3) |   |   |  |   |

# TM-221A/E/ES ADJUSTMENT

TOP VIEW



## TX-RX UNIT (X57-3060-XX)

- VR1 : S-1
- VR2 : DEV. 1kHz, 5mV,  $\pm 3$ kHz (K, M)
- VR3 : DEV. 1kHz, 50mV (K, M), 30mV (T, W),  $\pm 4.4$ kHz
- VR4 : RF meter
- VR5 : PRO.
- VR6 : RF output
- VR7 : Low power (K, M, T2, W2)
- L1,2 : Helical
- L3 : Helical (T, W)
- L4,5,7,9 : IF GAIN
- L11 : Discr.
- L19,21 : Helical (K, M)
- L20 : IF trap (K, M)
- TC1 : TX frequency (K, M)
- TC2 : TX frequency (T, W)
- TC3,4 : TX power

## FINAL UNIT (X45-1330-03) : TM-221E (X45-1360-02) : TM-221A/ES

VR1 : PRO. (NULL)

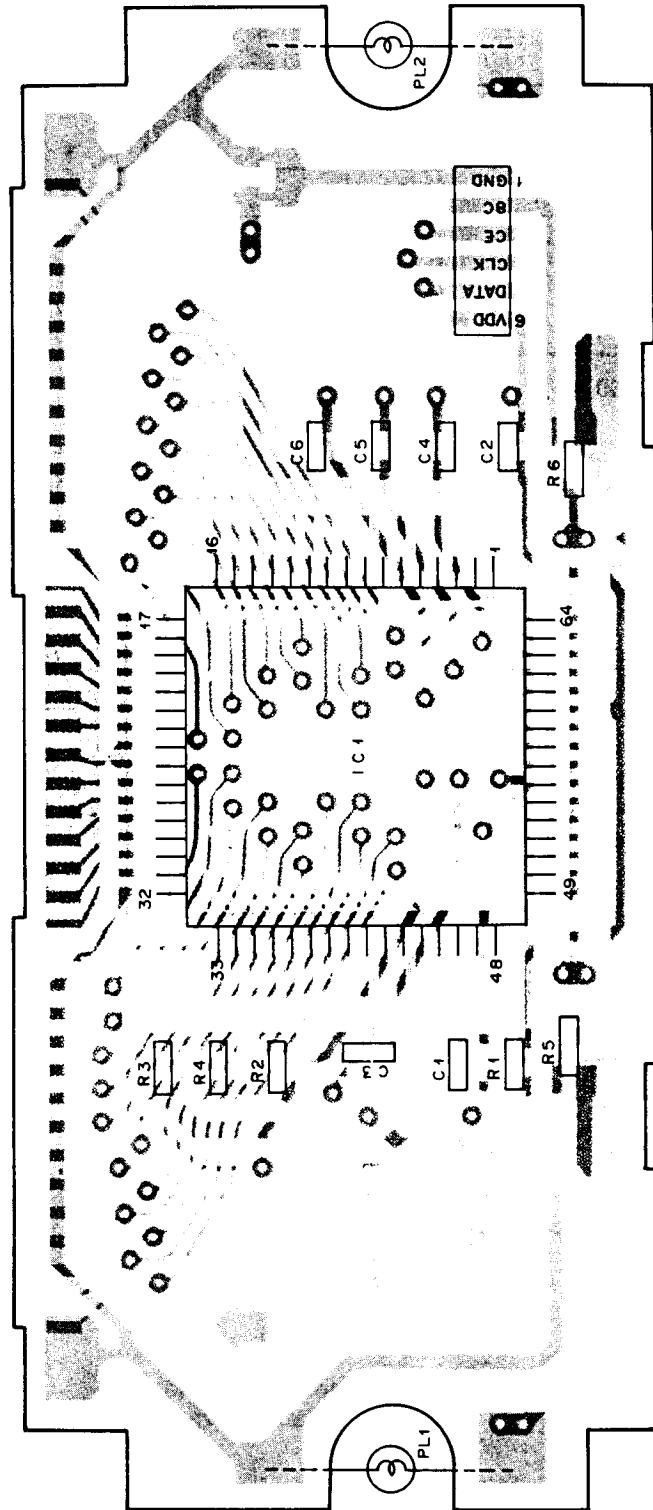
## VCO (X58-3090-00)

- TC1 : TX VCO
- TC2 : RX VCO



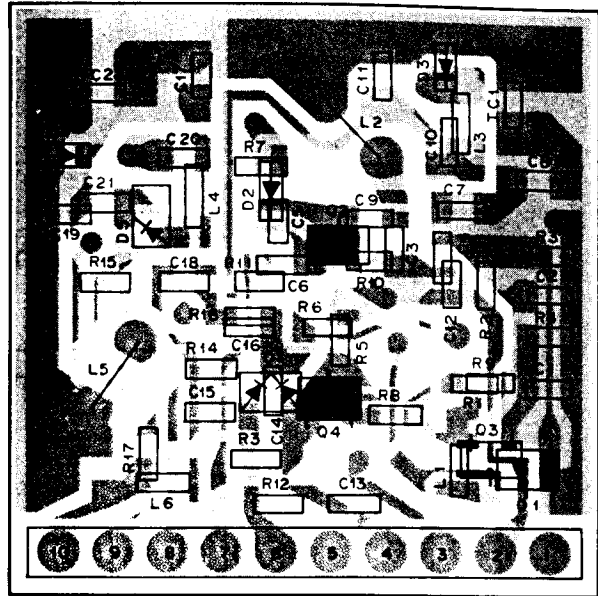
# TM-221A/E/ES PC BOARD VIEWS

LCD ASS'Y (B38-0303-05) Component side view



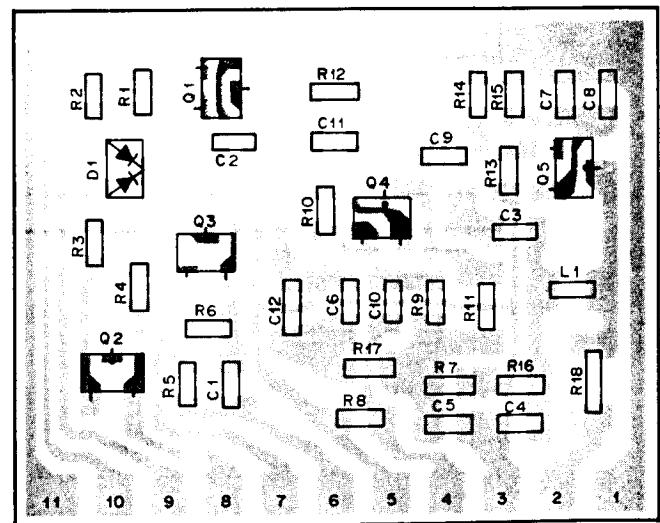
IC1 : LC7582

VCO (X58-3090-00) Component side view



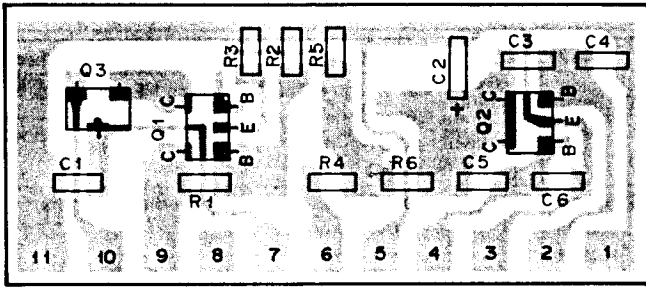
Q1 : 2SC2757(T33) Q2 : 2SK508(K52)  
 Q3 : 2SC2712(Y) Q4 : 2SK508(K51)  
 D1 : 1SS184 D2 : 1SV164  
 D3,4 : 1SV166 D5 : 1SS153

DRIVE (X59-3120-00) Component side view



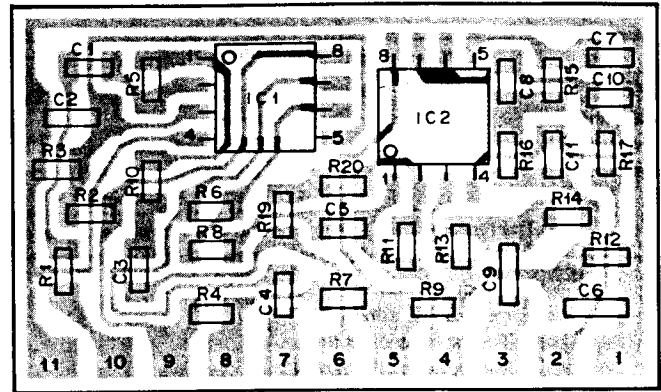
Q1,2 : 2SA1162(Y) Q3 : 2SC2712(Y)  
 Q4 : 2SC2714(Y) Q5 : 2SC3837K(N)  
 D1 : 1SS184

APC (X59-3130-00) Component side view



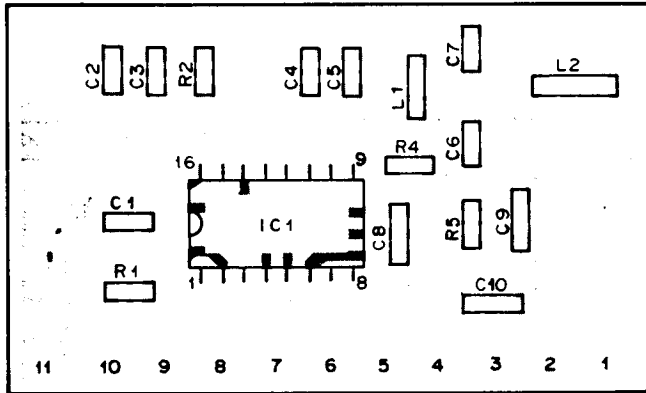
Q1,2 : FMW-1 Q3 : 2SA1162(Y)

MIC (X59-3160-00) Component side view



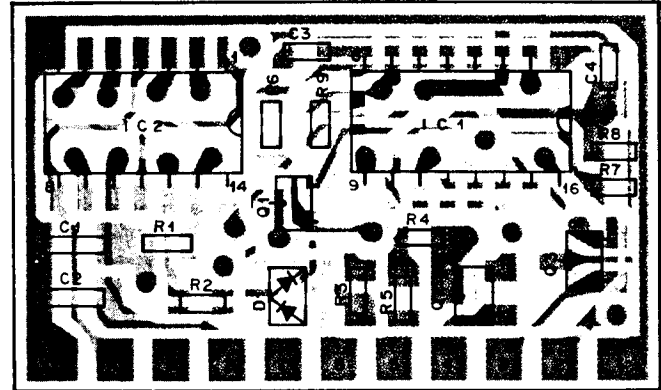
IC1,2 : NJM4558M

IF (X59-3140-00) Component side view



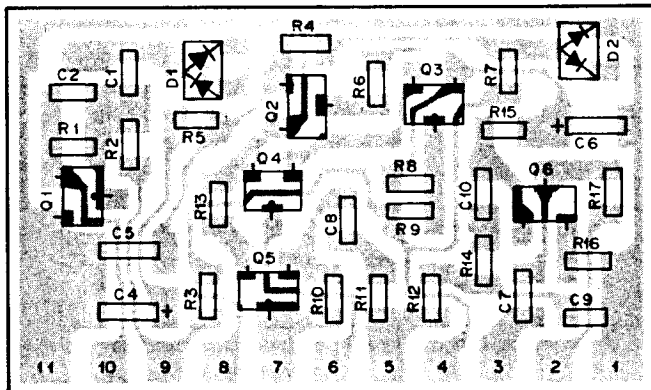
IC1 : TA7761F

VOL (X59-3170-00) Component side view



Q1 : DTC144EK Q2,3 : DTA114EK  
 IC1 : LC7532M IC2 : MN4066BS  
 D1 : 1SS226

SQL (X59-3150-00) Component side view



Q1,2,5,6 : 2SC2712(Y) Q3,4 : 2SC3295(B)  
 D1 : 1SS226 D2 : 1SS181

2SA1162 2SC2757  
 2SC2712 2SC3295  
 2SC2714 2SC3837K

2SK508

FMW-1



DTC144EK

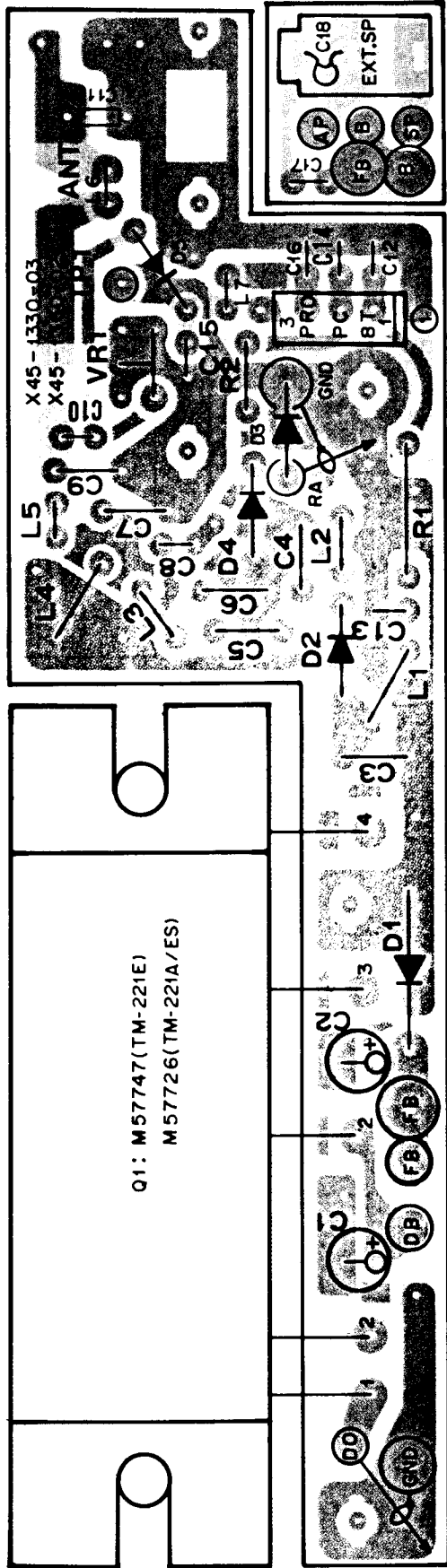
DTA114EK



# PC BOARD VIEWS TM-221A/E/ES

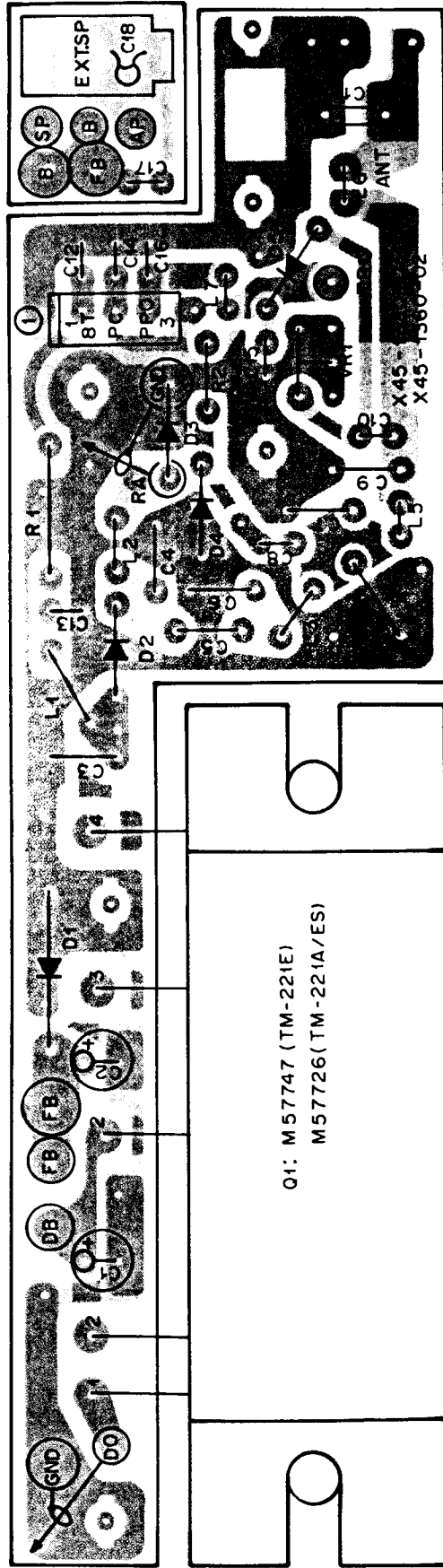
FINAL UNIT (X45-1330-03) : TM-221E  
 (X45-1360-02) : TM-221A/ES

Component side view



FINAL UNIT (X45-1330-03) : TM-221E  
 (X45-1360-02) : TM-221A/ES

Foil side view



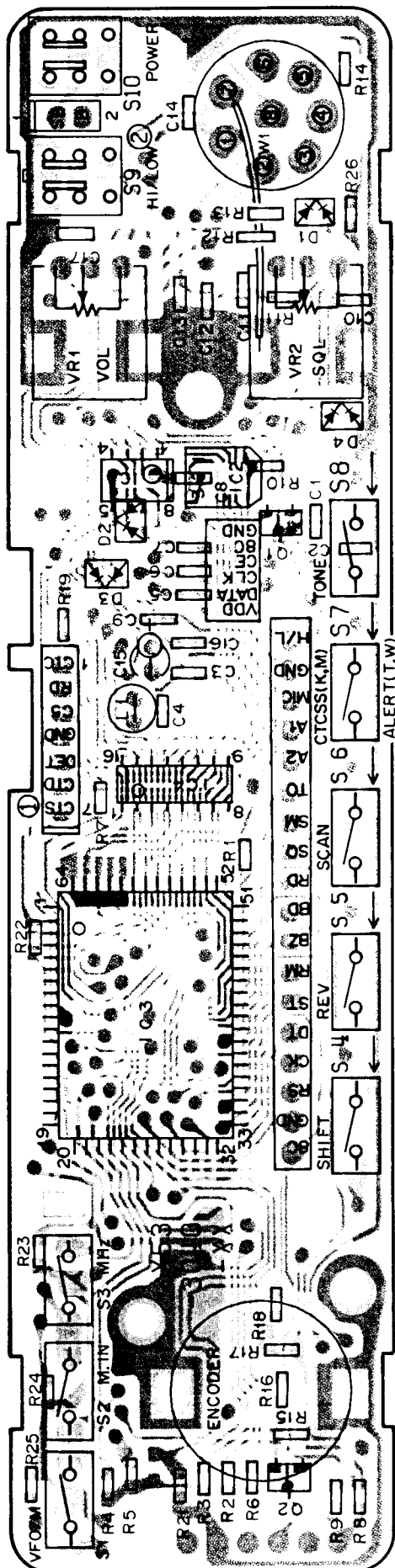
C18 : TM-221E ONLY

Q1 : M57747 (TM-221E) , M57726 (TM-221A, TM-221ES)  
 D1 : DSA3A1 D2 : MI308 (TM-221E) , UM9401 (TM-221A, TM-221ES) D3 : MI308 D4,5 : 1S1587

# TM-221A/E/ES PC BOARD VIEWS

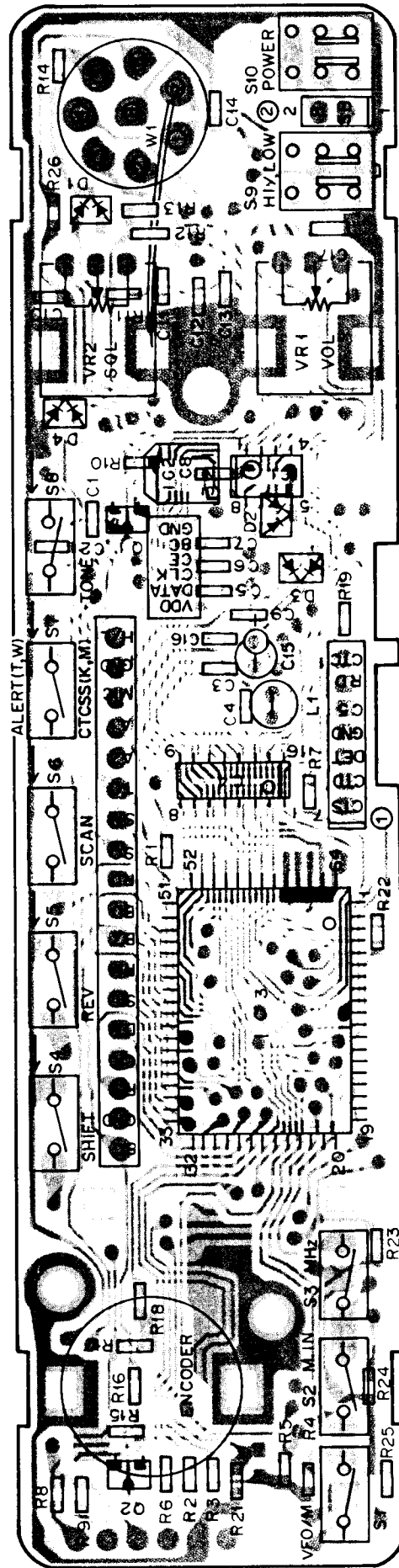
CONTROL UNIT (X53-3040-XX)

Component side view



CONTROL UNIT (X53-3040-XX)

Foil side view

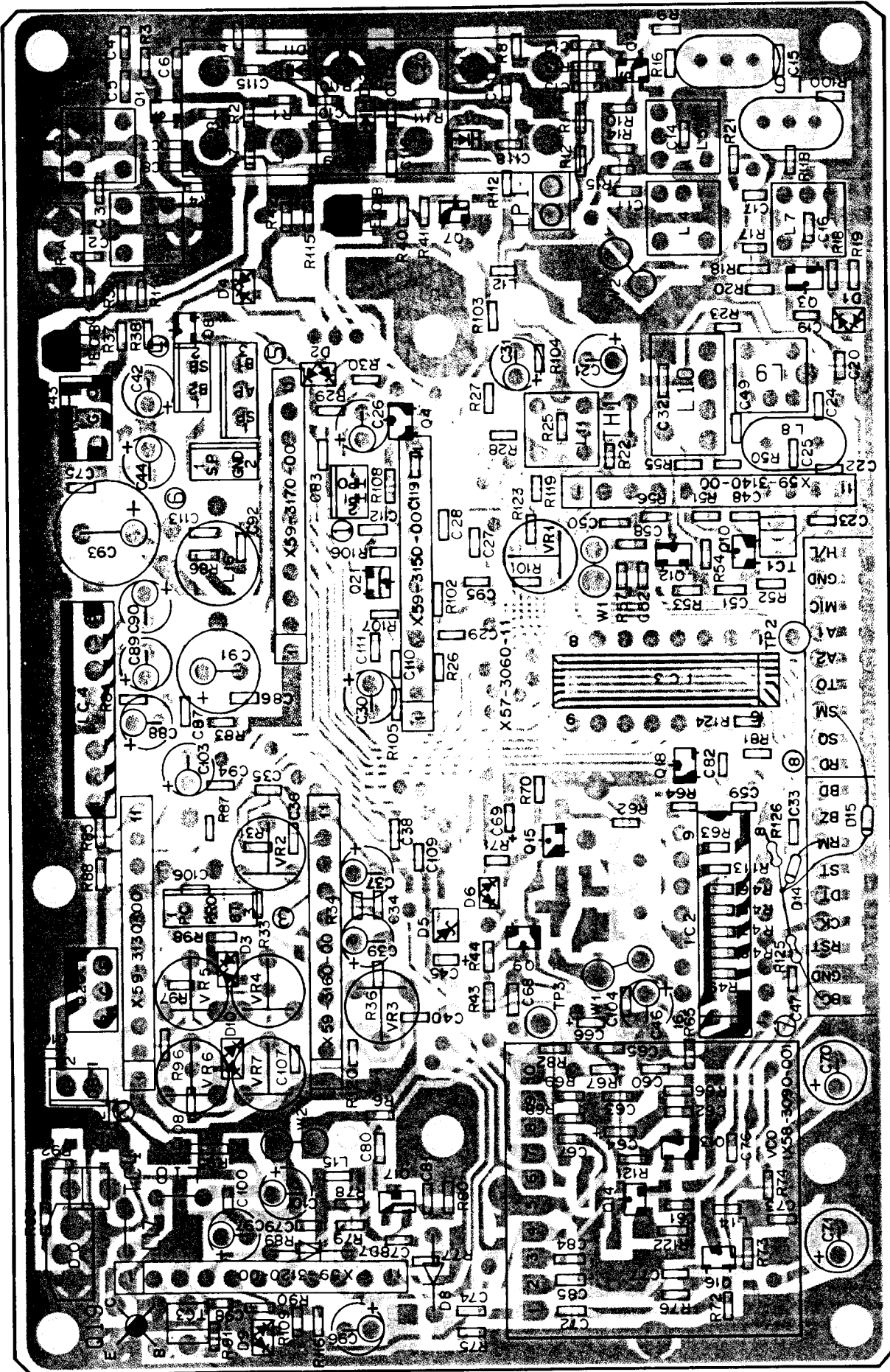


|              | R22 | R23 | R24 | R25 |
|--------------|-----|-----|-----|-----|
| .11 (K)      | O   | X   | X   | O   |
| -21 (M1)     | O   | X   | O   | O   |
| -22 (M2)     | X   | O   | X   | X   |
| -51 (T1, T2) | X   | X   | O   | X   |
| -61 (W1, W2) | X   | O   | X   | X   |

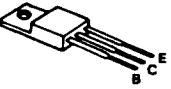
O : Used, X : Not used

Q1 : DTC124EK Q2 : 2SC2712(Y)  
 IC1 : LA5006M IC2 : M51951BML IC3 : μPD75106G-508-1B IC4 : KRR-C001  
 D1-4 : 1SS184

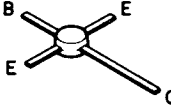
TX-RX UNIT (X57-3060-11) : K,M1,M2 Component side view



2SD1406



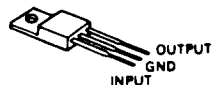
2SC3369



2SB1119S



MC7808C



2SA1162

2SC2712

2SC2714

2SC3326



DTC124EK

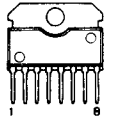


3SK131

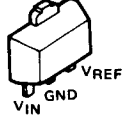
3SK184



μPC1241H

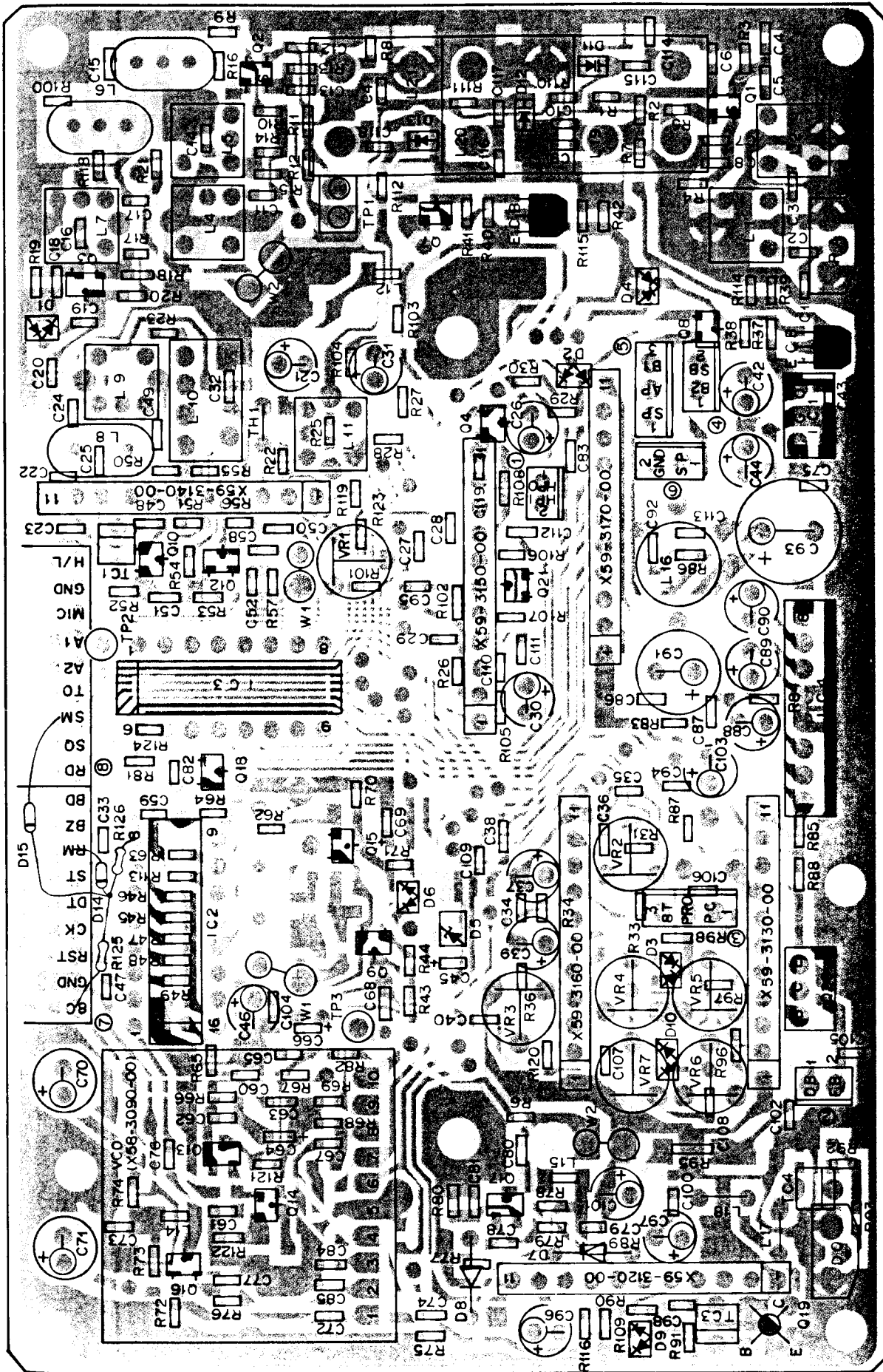


M51951BML



# PC BOARD VIEWS TM-221A/E/ES

TX-RX UNIT (X57-3060-11) : K,M1,M2 Foil side view

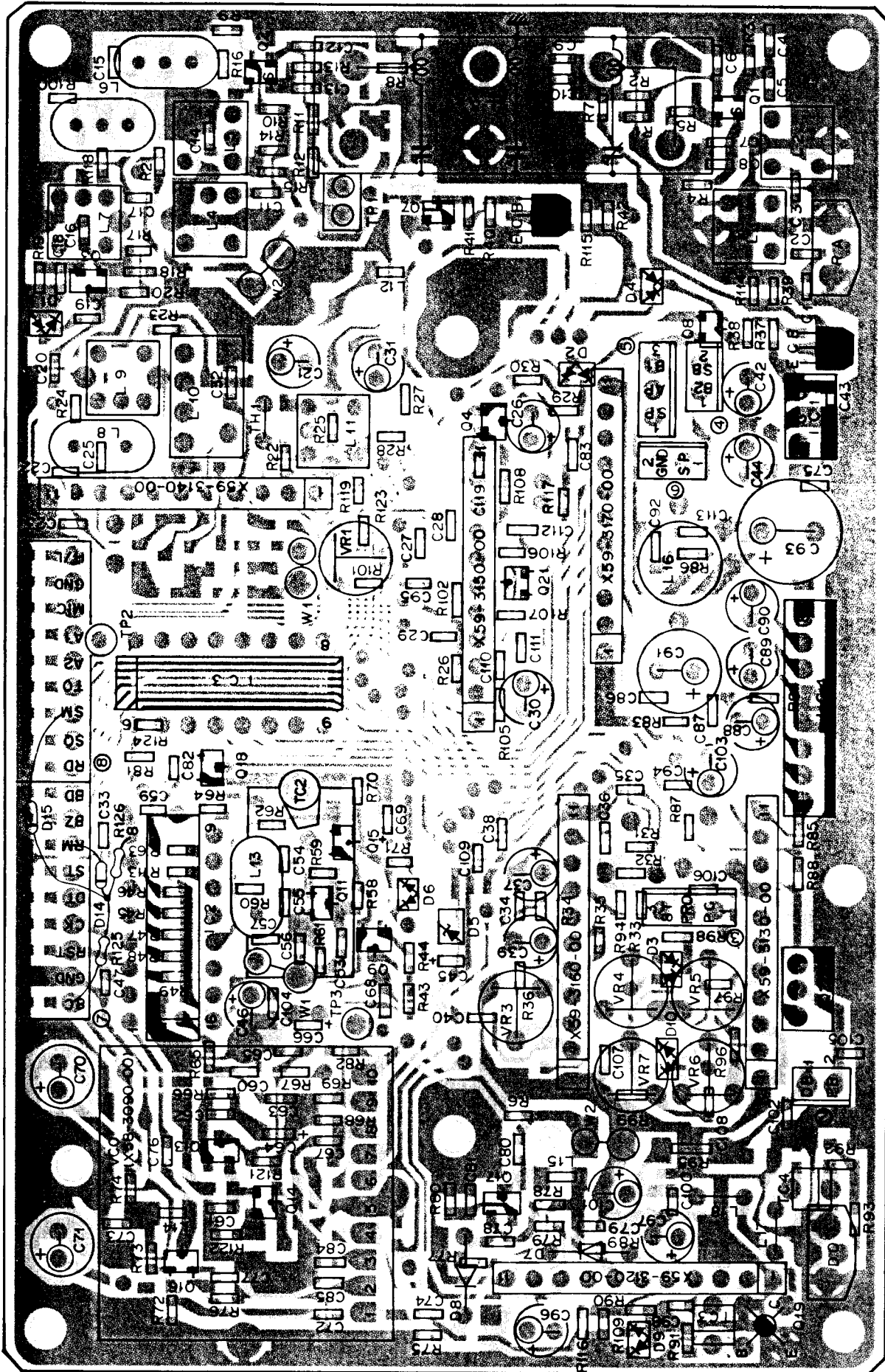


- Q1 : 3SK184(S) Q2 : 3SK131(V12) Q3,10,12,16,17 : 2SC2714(Y) Q4 : 2SC3326(A) Q5,6 : 2SB1119S Q7,8 : DTC124EK
- Q9,13,14,18,21 : 2SC2712(Y) Q15 : 2SA1162(Y) Q19 : 2SC3369 Q20 : 2SD1406(Y)
- IC1 : MC7808C IC2 : M54959P IC3 : TC4094BP IC4 : μPC1241H
- D1 : 1SS226 D2,6,9,10 : 1SS181 D3,4 : 1SS184 D5 : 02CZ6.2(Y,Z) D7,8 : BA282 D11-13 : 1SV164 D14,15 : 1S1555

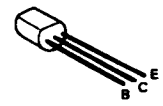




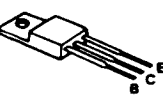
TX-RX UNIT (X57-3060-XX) -51 : T1,W1 -52 : T2,W2 Foil side view



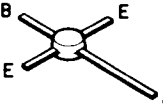
2SC2538-22-A



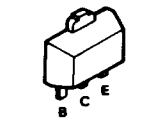
2SD1406



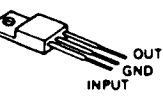
2SC3369



2SB1119S



MC7808C



2SA1162

2SC2712

2SC2714

2SC3326

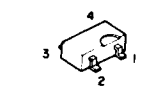


DTC124EK

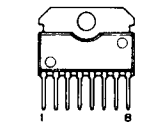


3SK131

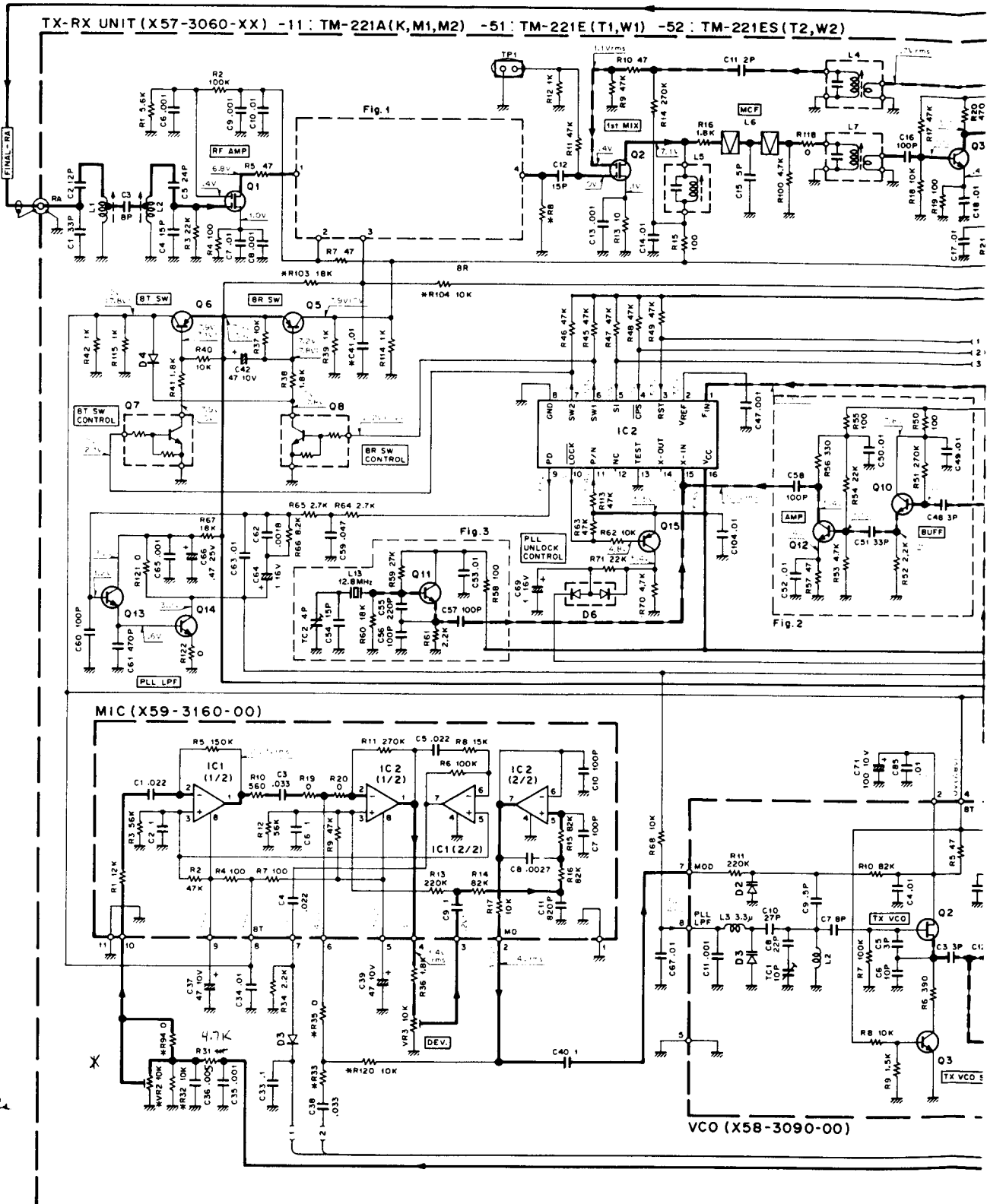
3SK184



μPC1241H



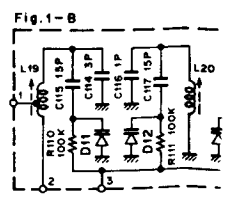
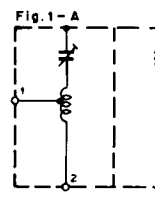




X Note: change  
wound do  
w.c input  
R31, C36

- Q1 : 3SK184 (S)
- Q2 : 3SK131 (V12)
- Q3,10~12,16,17 : 2SC2714 (Y)
- Q4 : 2SC3326 (A)
- Q5,6 : 2SB1119S
- Q7,8 : DTC124EK
- Q9,13,14,18,21 : 2SC2712 (Y)
- Q15 : 2SA1162 (Y)
- Q20 : 2SD1406 (Y)
- TH1 : 112-502-2

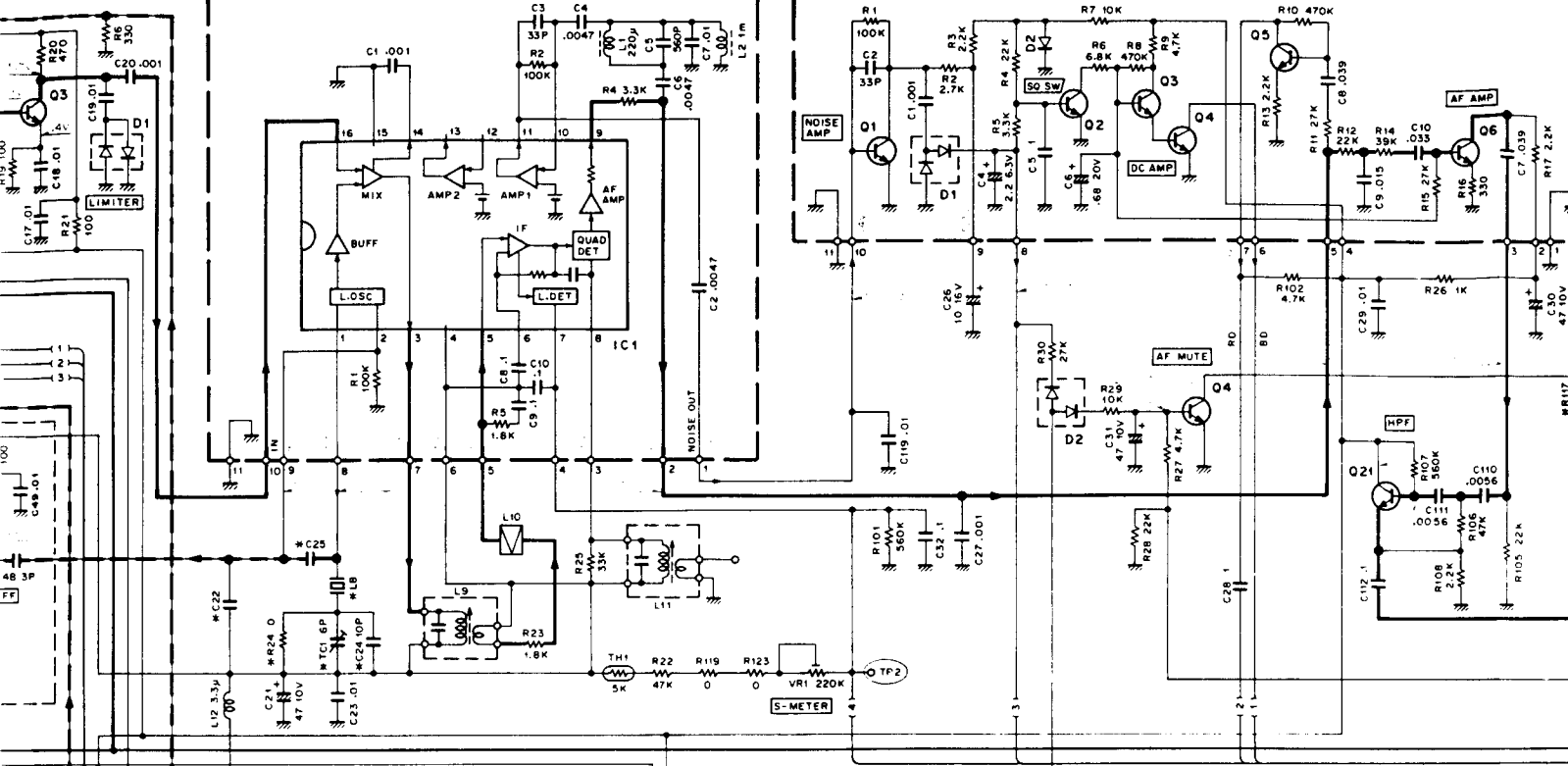
- IC1 : MC780BC
- IC2 : M54959P
- IC3 : TC4094BP
- IC4 :  $\mu$ PC1241H
- D1 : 1SS226
- D2,6,9,10 : 1SS181
- D3,4 : 1SS184
- D5 : O2C26.2 (Y,Z)
- D7,8 : BA282
- D11~13 : 1SV164
- D14,15 : 1S1555



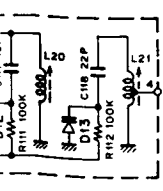
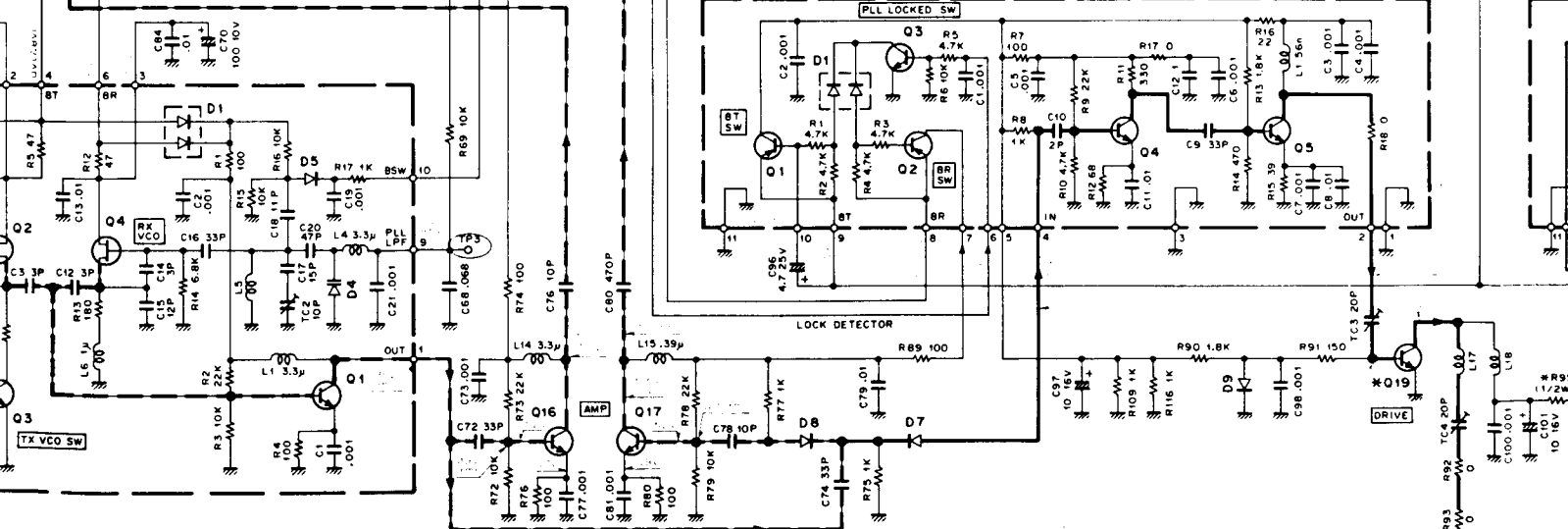
|                    | Q19          | VR2 | VR7 | LB        | TC1 | R8   | R24 | R32 | R33  | R35 | R94 | R95 | R96  | R97  | R99 | R103 | R104 | R117 | R120 | C22  | C24 | C25 | C41 | Fig.1 | Fig.2 | Fig.3 |
|--------------------|--------------|-----|-----|-----------|-----|------|-----|-----|------|-----|-----|-----|------|------|-----|------|------|------|------|------|-----|-----|-----|-------|-------|-------|
| TM-221A (45W) -11  | 25C3369      | O   | O   | 10.24MHz  | O   | 1.8K | X   | X   | 100K | X   | X   | 22  | 100K | 10K  | X   | O    | X    | O    | X    | 150P | X   | 33P | X   | A     | X     | O     |
| TM-221E (10W) -51  | 25C2538-22-A | X   | X   | 10.245MHz | X   | 2.2K | O   | O   | 22K  | O   | O   | 33  | 47K  | 4.7K | O   | X    | X    | O    | X    | 150P | X   | 33P | X   | A     | X     | O     |
| TM-221ES (45W) -52 | 25C3369      | X   | O   | 10.245MHz | X   | 2.2K | O   | O   | 22K  | O   | O   | 22  | 100K | 10K  | X   | X    | X    | O    | X    | 150P | X   | 33P | X   | A     | X     | O     |

## IF (X59-3140-00)

## SQL (X59-3150-00)



## DRIVE (X59-3120-00)

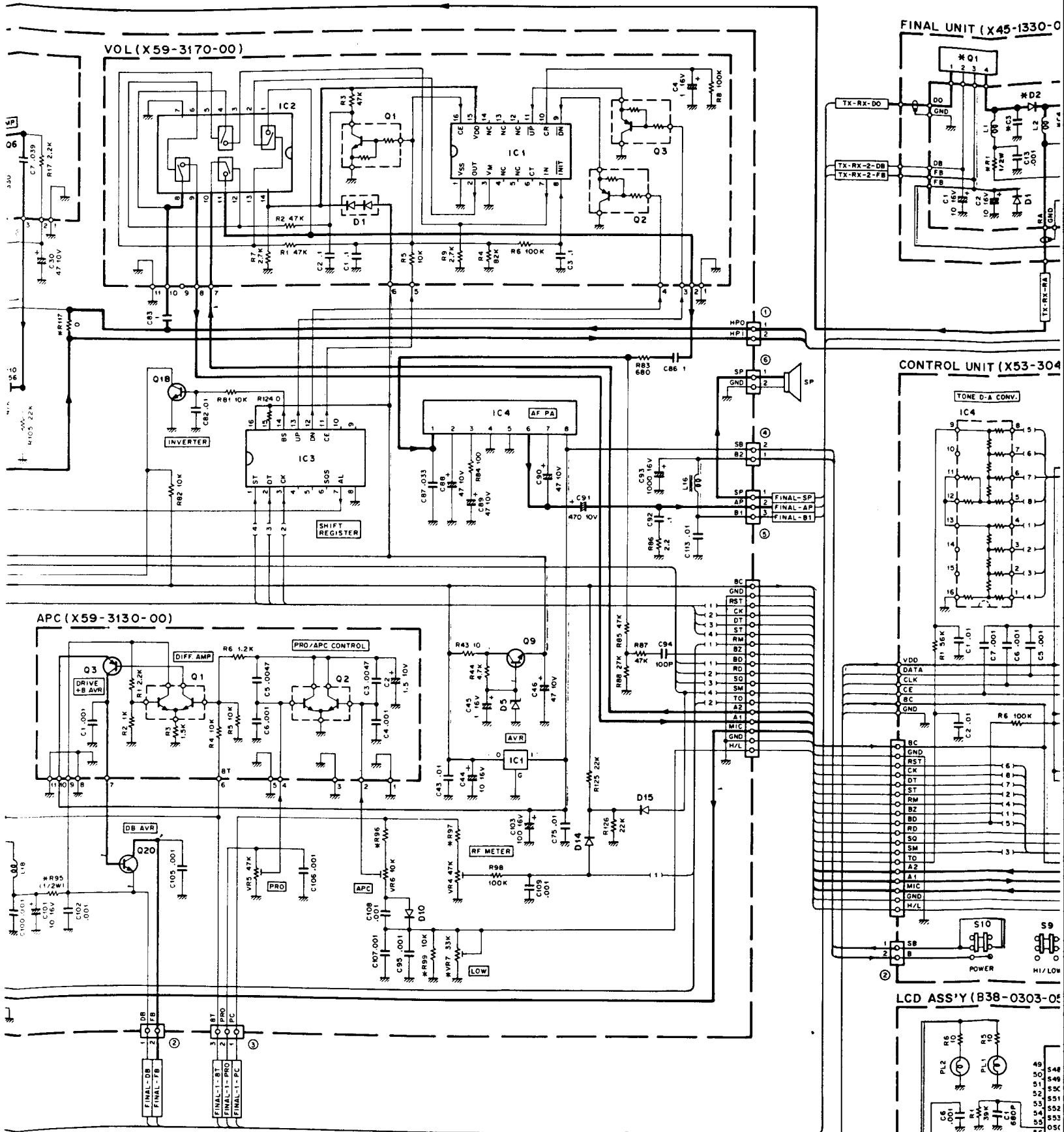


- |                    |                     |                           |                   |
|--------------------|---------------------|---------------------------|-------------------|
| (X58-3090-00)      | (X59-3120-00)       | (X59-3140-00)             | (X59-3160-00)     |
| Q1 : 2SC2757 (T33) | Q1, 2 : 2SA1162 (Y) | IC1 : TA7761F             | IC1, 2 : NJM4558M |
| Q2 : 2SK508 (K52)  | Q3 : 2SC2712 (Y)    | (X59-3150-00)             | (X59-3170-00)     |
| Q3 : 2SC2712 (Y)   | Q4 : 2SC2714 (Y)    | Q1, 2, 5, 6 : 2SC2712 (Y) | Q1 : DTC144EK     |
| Q4 : 2SK508 (K51)  | Q5 : 2SC3837K (N)   | Q3, 4 : 2SC3295 (B)       | Q2, 3 : DTA114EK  |
| D1 : 1SS184        | D1 : 1SS184         | D1 : 1SS226               | IC1 : LC7532M     |
| D2 : 1SV164        | (X59-3130-00)       | D2 : 1SS181               | IC2 : MN4066BS    |
| D3, 4 : 1SV166     | Q1, 2 : FMW-1       |                           |                   |
| D5 : 1SS153        | Q3 : 2SA1162 (Y)    |                           | D1 : 1SS226       |

O USED  
X NOT USED

|        |           |
|--------|-----------|
| Fig. 3 | Connector |
| X      | O         |
| O      | X         |
| O      | X         |

# IC DIAGRAM

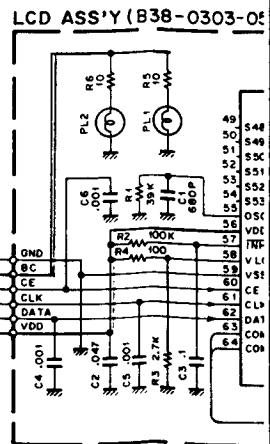


|            | (K)  | -11 | R22 | R23 | R24 | R25 |
|------------|------|-----|-----|-----|-----|-----|
| TM-221A    | IM11 | -21 | O   | X   | X   | O   |
|            | IM21 | -22 | O   | O   | X   | X   |
| TM-221E/ES | 1T1  | -51 | X   | X   | O   | X   |
|            | 1W1  | -61 | X   | O   | X   | X   |

O : USED  
X : NOT USED

- (X53-3040-XX)  
 Q1 : DTC124EK  
 Q2 : 2SC2742(Y)  
 IC1 : LA5006M  
 IC2 : M51951BML  
 IC3 : μPD75106G-508-B  
 IC4 : KRR-C001

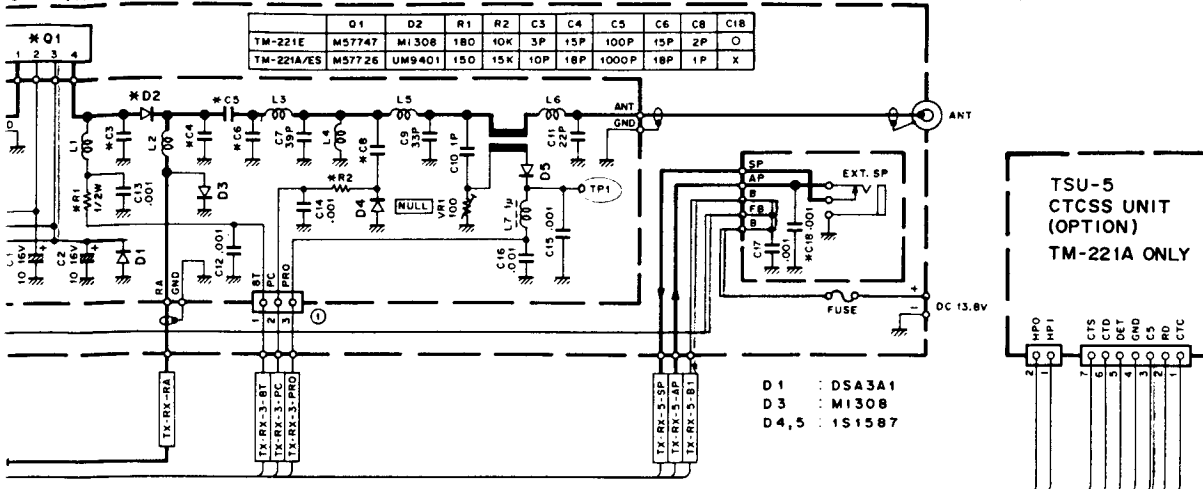
D1~4 : 1SS184



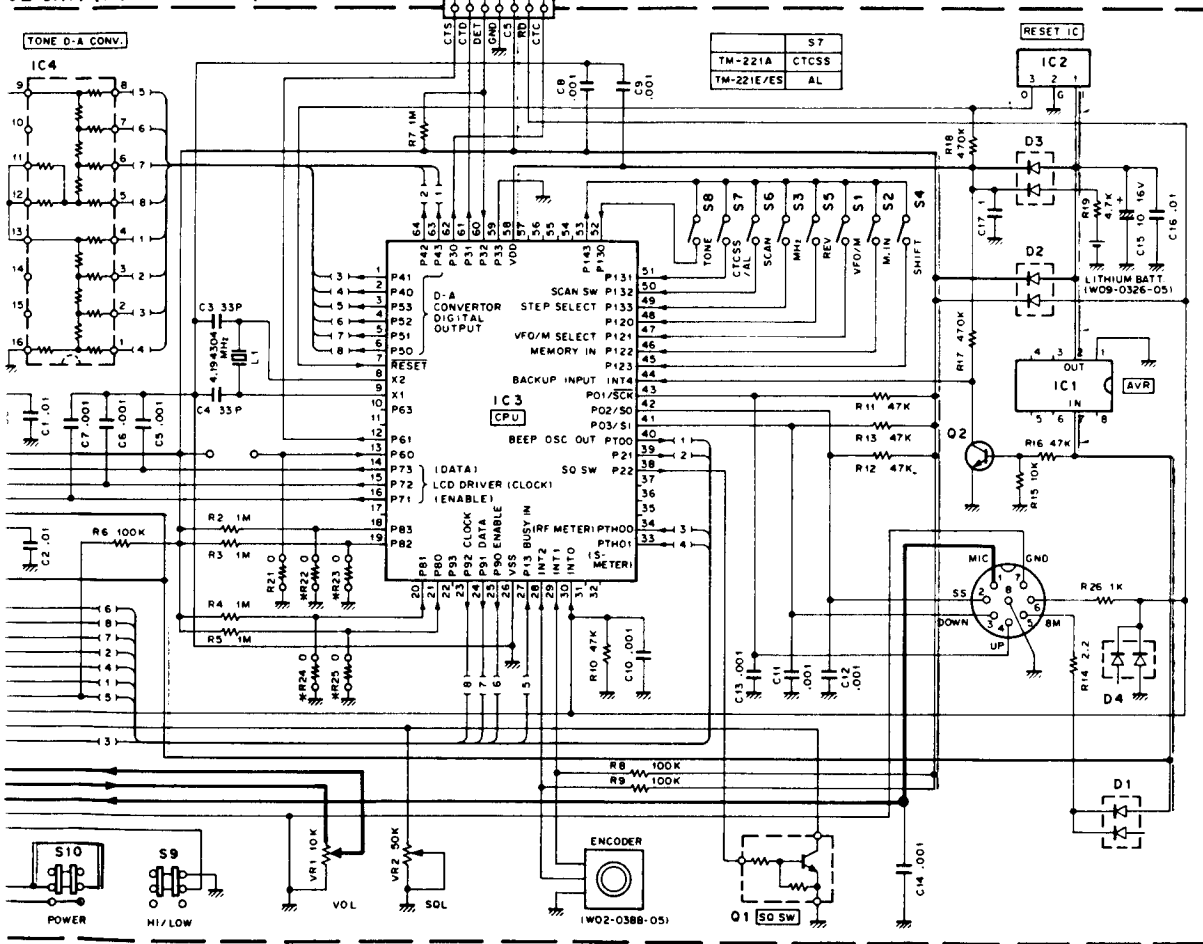
Voltage measurement conditions  $f = 144.00\text{MHz}$ , RX no signal, ( ) : TX.

# TM-221A/E/ES

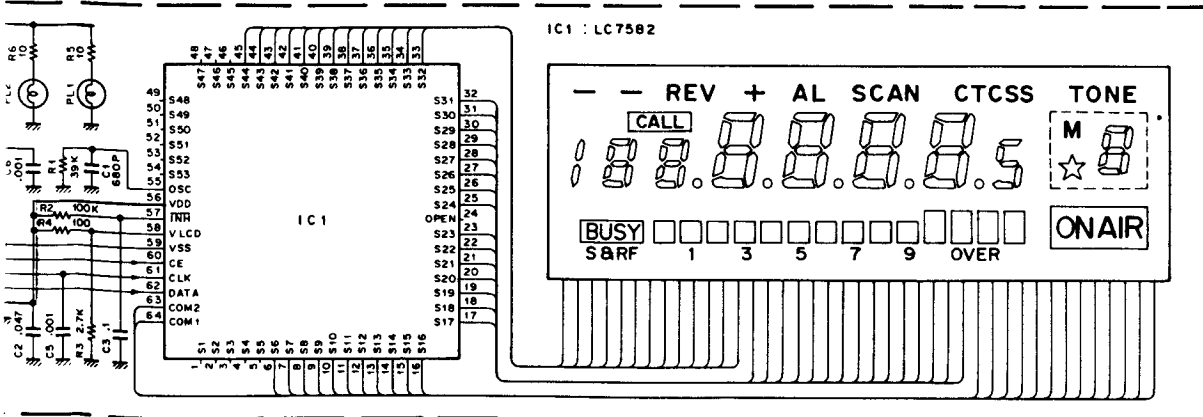
UNIT (X45-1330-03) : TM-221E (10W) (X45-1360-02) : TM-221A/ES (45W)



OL UNIT (X53-3040-XX)

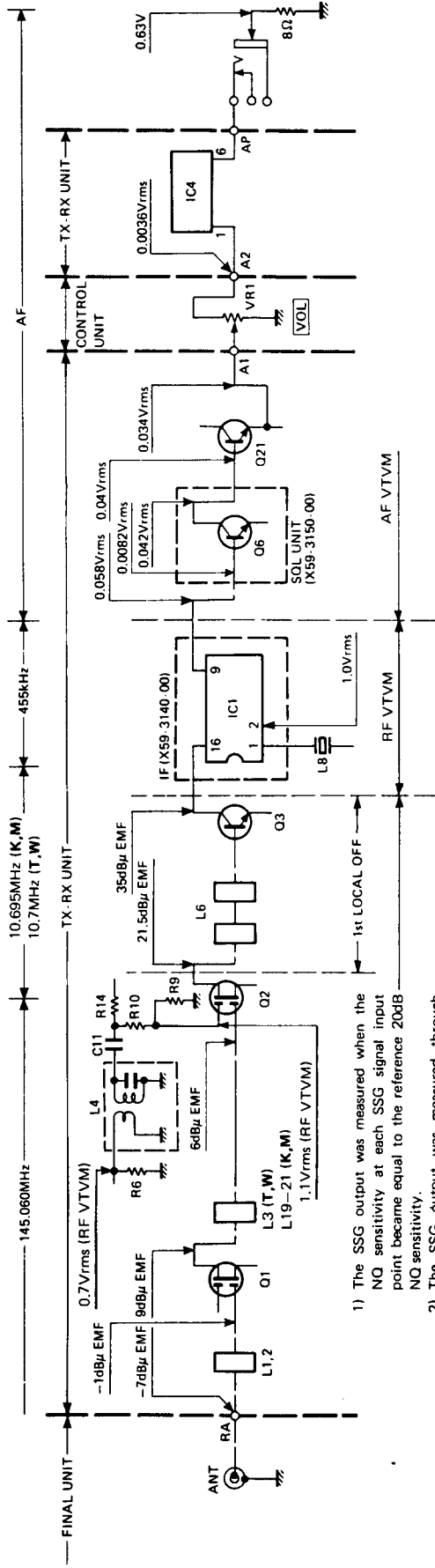


S'Y (B38-0303-05)



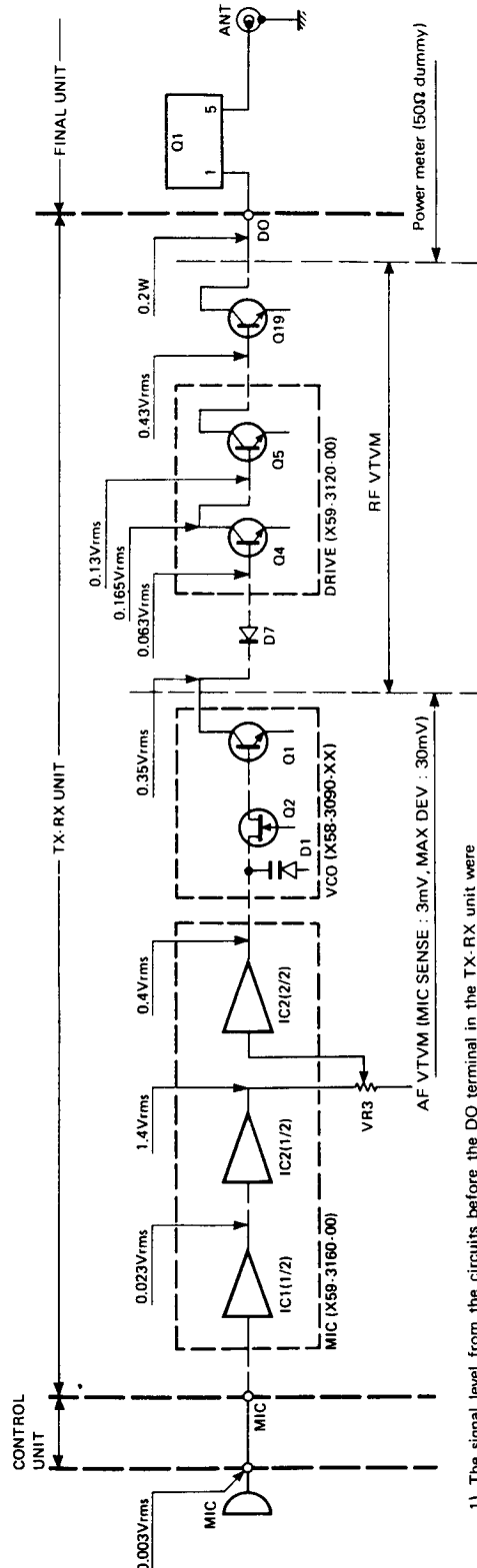
## LEVEL DIAGRAM

### RX SECTION



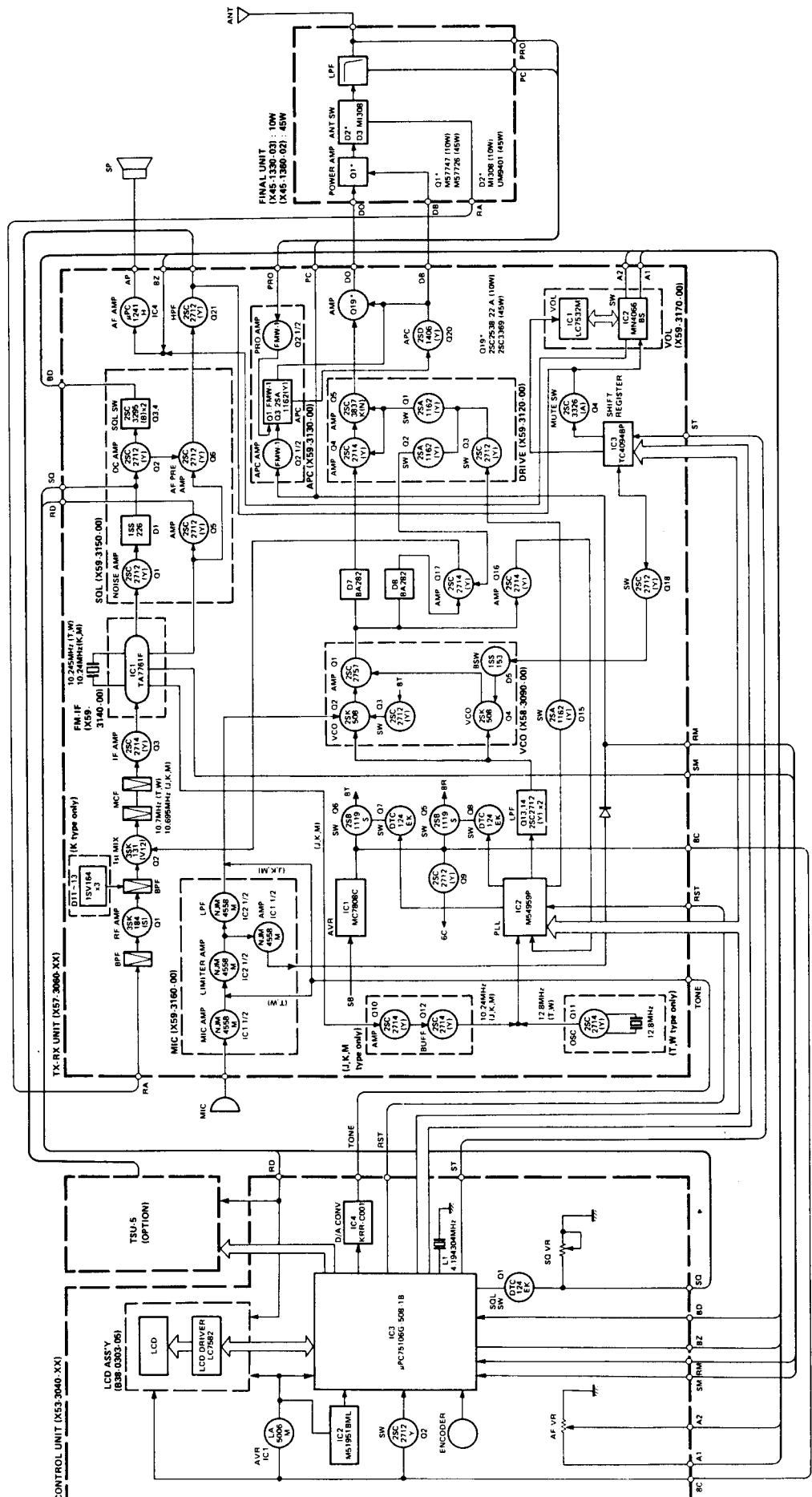
- 1) The SSG output was measured when the NO sensitivity at each SSG signal input point became equal to the reference 20dB NO sensitivity.
- 2) The SSG output was measured through a  $0.01\mu F$  capacitor.

### TX SECTION



- 1) The signal level from the circuits before the DO terminal in the TX-RX unit were measured with the DO coaxial cable disconnected.
- 2) The circuits were measured with a RF probe.
- 3) FREQ. : 145.060MHz

## BLOCK DIAGRAM



## TERMINAL FUNCTIONS

| Connector No.  | Terminal No. | Terminal Name | Terminal Function             |
|--|--------------|---------------|-------------------------------|
| <b>FINAL UNIT (X45-1330-03) : TM-221E<br/>(X45-1360-02) : TM-221A/ES</b> |              |               |                               |
| ①  | 1            | 8T            | TX + 8T                       |
|  | 2            | PC            | Auto power control Protection |
|  | 3            | PRO           |                               |
|  |              | RA            | RX ANT                        |
|  |              | DO            | Drive output                  |
|  |              | AP            | Audio power                   |
|  |              | B             | + B                           |
|  |              | SP            | Speaker                       |
|  |              | FB            | Final + B                     |
|  | DB           | Drive +B      |                               |
| <b>CONTROL UNIT (X53-3040-XX)</b>  |              |               |                               |
| ①  | 1            | CTC           | CTCSS IC clock                |
|  | 2            | RD            | Remote data                   |
|  | 3            | 5C            | + 5V                          |
|  | 4            | GND           | GND                           |
|  | 5            | DET           | Tone detector output          |
|  | 6            | CTD           | CTCSS IC data                 |
|  | 7            | CTS           | CTCSS shift register reset    |
| ②  | 1            | SB            | Switched + B (13.8V)          |
|  | 2            | B             | + B2                          |
| ③  |              | 8C            | + 8V                          |
|  |              | GND           | GND                           |
|  |              | RS            | PLL enable                    |
|  |              | CK            | PLL & shift register clock    |
|  |              | DT            | PLL & shift register data     |
|  |              | ST            | Shift register strobe         |
|  |              | RM            | RF meter                      |
|  |              | BZ            | Beep output                   |
|  |              | BD            | Busy display                  |
|  |              | RD            | Remote data                   |
|  |              | SQ            | Squelch                       |
|  |              | SM            | S meter                       |
|  |              | TO            | Tone output                   |
|  |              | A2            | AF output                     |
|  |              | A1            | AF input                      |
|  |              | MIC           | Mic AF input                  |
|  | GND          | GND           |                               |
|  | H/L          | Hi/low switch |                               |
| ④  |              | VDD           | Backup voltage                |
|  |              | DATA          | LCD driver data               |
|  |              | CLK           | LCD driver clock              |
|  |              | CE            | LCD driver enable             |
|  |              | 8C            | + 8V                          |
|  | GND          | GND           |                               |

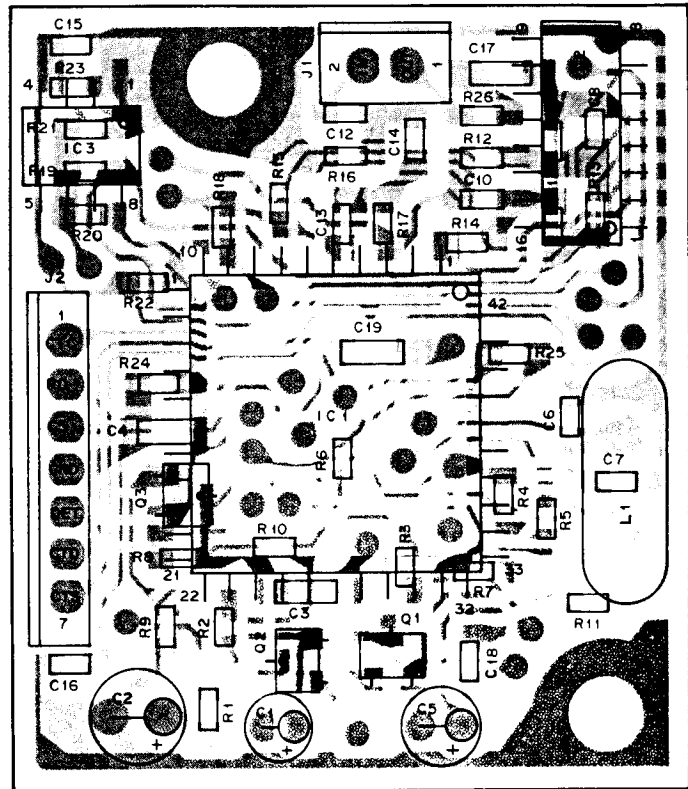
| Connector No.                   | Terminal No. | Terminal Name | Terminal Function          |
|---------------------------------|--------------|---------------|----------------------------|
| <b>TX-RX UNIT (X57-3060-XX)</b> |              |               |                            |
| ①                               | 1            | HPO           |                            |
|                                 | 2            | HPI           |                            |
| ②                               | 1            | DB            | Drive +B                   |
|                                 | 2            | FB            | Final +B                   |
| ③                               | 1            | PC            | Auto power control         |
|                                 | 2            | PRO           | Protection                 |
|                                 | 3            | 8T            | TX + 8V                    |
| ④                               | 1            | B2            | + B2                       |
|                                 | 2            | SB            | Switched + B (13.8V)       |
| ⑤                               | 1            | SP            | Speaker                    |
|                                 | 2            | AP            | Audio power                |
|                                 | 3            | B1            | + B1                       |
| ⑥                               | 1            | SP            | Speaker                    |
|                                 | 2            | GND           | GND                        |
| ⑦                               |              | 8C            | + 8V                       |
|                                 |              | GND           | GND                        |
|                                 |              | RST           | PLL enable                 |
|                                 |              | CK            | PLL & shift register clock |
|                                 |              | DT            | PLL & shift register data  |
|                                 |              | ST            | Shift register strobe      |
|                                 |              | RM            | RF meter                   |
|                                 |              | BZ            | Beep output                |
|                                 | BD           | Busy display  |                            |
| ⑧                               |              | RD            | Remote data                |
|                                 |              | SQ            | Squelch                    |
|                                 |              | SM            | S meter                    |
|                                 |              | TO            | Tone output                |
|                                 |              | A2            | AF output                  |
|                                 |              | A1            | AF input                   |
|                                 |              | MIC           | Mic AF input               |
|                                 |              | GND           | GND                        |
|                                 | H/L          | Hi/low switch |                            |
|                                 |              | RA            | RX ANT                     |
|                                 |              | DO            | Drive output               |

## TSU-5 (CTCSS UNIT)

### TSU-5 PARTS LIST

| Parts No.                       | New Parts | Description                    | Ref. No.    |
|---------------------------------|-----------|--------------------------------|-------------|
| <b>TSU-5</b>                    |           |                                |             |
| E31-3248-05                     | *         | Lead with connector            |             |
| N87-2606-46                     |           | Brazier head taptite screw x 2 |             |
| X52-3060-00                     | *         | CTCSS unit                     |             |
| <b>CTCSS UNIT (X52-3060-00)</b> |           |                                |             |
| CC41FCH1H150J                   |           | Chip C 15pF J                  | C6,7        |
| CC73FSL1H681J                   |           | Chip C 680pF J                 | C15         |
| CE04CW1A100M                    |           | Electro 10μF 10WV              | C1          |
| CE04CW1A101M                    |           | Electro 100μF 10WV             | C2          |
| CE04CW1A220M                    |           | Electro 22μF 10WV              | C5          |
| CK73EF1C104Z                    |           | Chip C 0.1μF Z                 | C3,4        |
| CK73EF1C105Z                    |           | Chip C 1μF Z                   | C17,19      |
| CK73FB1H103K                    |           | Chip C 0.01μF K                | C16,18      |
| CK73FB1H222K                    |           | Chip C 2200pF K                | C13,14      |
| CK73FB1H272K                    |           | Chip C 2700pF K                | C12         |
| C93-0501-05                     | *         | Chip C 680pF                   | C8-11       |
| E31-3248-05                     | *         | Lead with connector            | -           |
| E40-5016-05                     |           | Pin ass'y 2P                   | J1          |
| E40-5021-05                     |           | Pin ass'y 7P                   | J2          |
| L77-1333-05                     |           | X'tal 4.194304MHz              | L1          |
| RD41FB2B103J                    |           | Chip R 10k J 1/8W              | R4,10,11    |
| RD41FB2B104J                    |           | Chip R 100k J 1/8W             | R1          |
| RD41FB2B105J                    |           | Chip R 1M J 1/8W               | R8,22,23    |
| RD41FB2B122J                    |           | Chip R 1.2k J 1/8W             | R26         |
| RD41FB2B124J                    |           | Chip R 120k J 1/8W             | R16         |
| RD41FB2B153J                    |           | Chip R 15k J 1/8W              | R5          |
| RD41FB2B154J                    |           | Chip R 150k J 1/8W             | R25         |
| RD41FB2B183J                    |           | Chip R 18k J 1/8W              | R3          |
| RD41FB2B222J                    |           | Chip R 2.2k J 1/8W             | R6          |
| RD41FB2B273J                    |           | Chip R 27k J 1/8W              | R19         |
| RD41FB2B392J                    |           | Chip R 3.9k J 1/8W             | R9          |
| RD41FB2B473J                    |           | Chip R 47k J 1/8W              | R2,20,21,24 |
| RD41FB2B683J                    |           | Chip R 68k J 1/8W              | R17         |
| RD41FB2B823J                    |           | Chip R 82k J 1/8W              | R7          |
| RD41FB2B824J                    |           | Chip R 820k J 1/8W             | R15,18      |
| R92-0688-05                     | *         | Chip R 470k                    | R14         |
| R92-0689-05                     | *         | Chip R 910k                    | R12,13      |
| MN6520                          |           | IC                             | IC1         |
| MN4094BS                        | *         | IC                             | IC2         |
| NJM4558M                        |           | IC                             | IC3         |
| DTC114YK                        |           | Digital transistor             | Q1,2        |
| 2SC2712(GR)                     |           | Chip transistor                | Q3          |

### TSU-5 PC BOARD VIEW



2SC2712



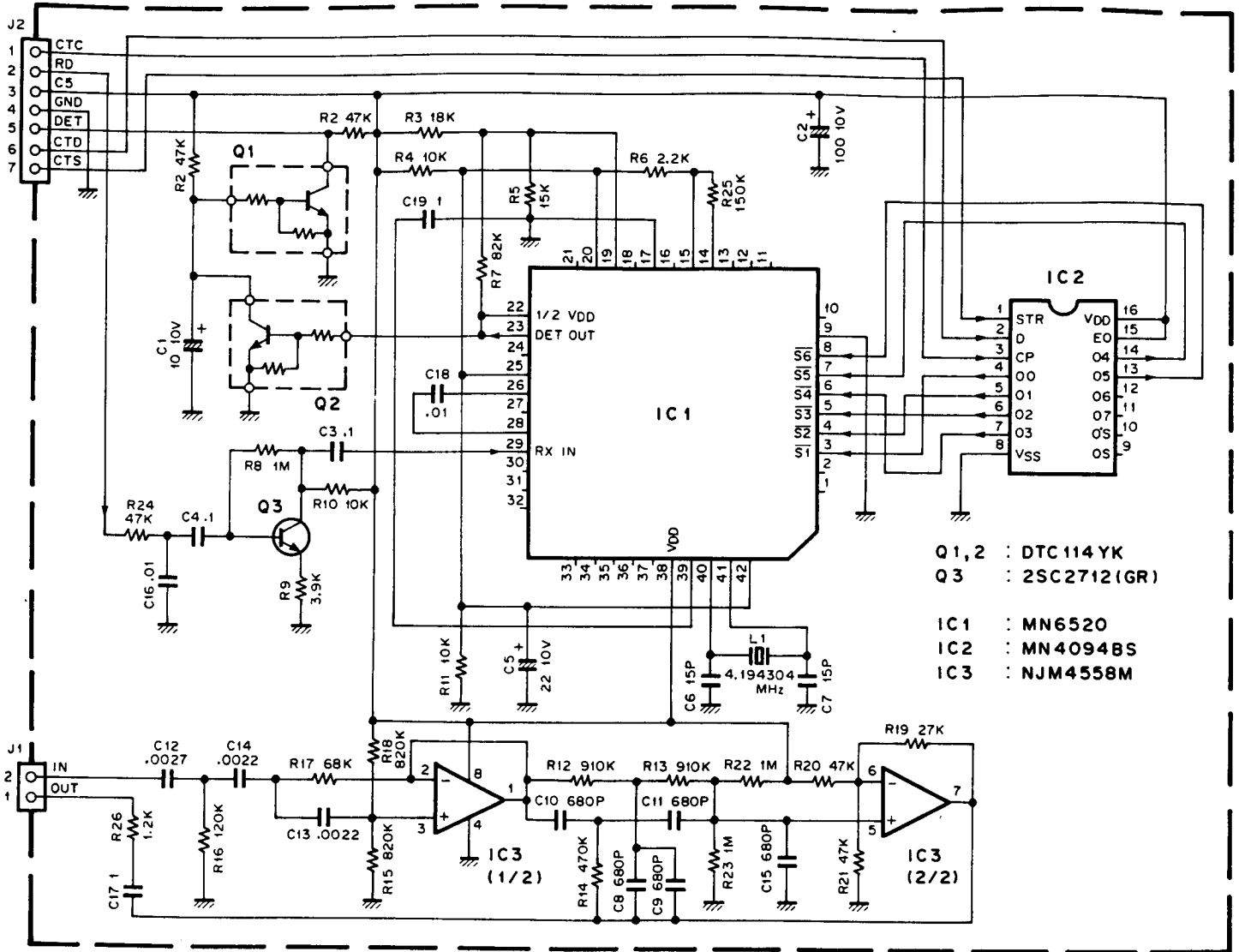
DTC114YK





## TSU-5 (CTCSS UNIT)

### TSU-5 SCHEMATIC DIAGRAM



## SPECIFICATIONS

| Specifications       |  | Model                             | TM-221A   | TM-221ES       | TM-221E        |  |
|----------------------|--|-----------------------------------|---|----------------|----------------|--|
|                      |  |                                   |   |                |                |  |
| General              | Frequency range                                    |                                   | 144 to 148MHz                                   | 144 to 146MHz  |                |  |
|                      | Mode   |                                   | F3E (FM)  |                |                |  |
|                      | Antenna impedance                                  |                                   | 50 ohms   |                |                |  |
|                      | Operating temperature                              |                                   | -20°C to +60°C (-4°F to +140°F)                 |                |                |  |
|                      | Power requirements                                 |                                   | 13.8V DC ± 15%                                  |                |                |  |
|                      | Ground   |                                   | Negative  |                |                |  |
|                      | Current drain                                      | Transmit mode (Max.)              |   | 9.5A           | 2.6A           |  |
|                      |  | Receive mode with no input signal |   | 0.4A           |                |  |
|                      | Frequency stability                                |                                   | Better than $\pm 10 \times 10^{-6}$             |                |                |  |
|                      | Dimensions<br>(Projections included, W x H x D mm) |                                   |   | 141 x 42 x 193 | 141 x 42 x 154 |  |
| Weight               |  |                                   | 1.2kg   | 1.0kg          |                |  |
| Transmitter          | Output power*                                      | HI                                | 45W   |                | 10W            |  |
|                      |  | LOW                               | Approx. 5W<br>Adjustable up to out 30W          |                | Approx. 1W     |  |
|                      | Modulation   |                                   | Reactance modulation                            |                |                |  |
|                      | Spurious radiation                                 |                                   | Less than -60dB                                 |                |                |  |
|                      | Max. frequency deviation                           |                                   | $\pm 5$ kHz                                     |                |                |  |
|                      | Audio distortion (at 60% modulation)               |                                   | Less than 3%                                    |                |                |  |
| Microphone impedance |  | 500 to 600 ohms                   |   |                |                |  |
| Receiver             | Circuitry  |                                   | Double conversion superheterodyne               |                |                |  |
|                      | Intermediate frequency                             |                                   | 10.695MHz/455kHz                                | 10.7MHz/455kHz |                |  |
|                      | Sensitivity (12dB SINAD)                           |                                   | Less than 0.16 $\mu$ V                          |                |                |  |
|                      | Selectivity  |                                   | -6dB : More than 12kHz, -60dB : Less than 26kHz |                |                |  |
|                      | Spurious response                                  |                                   | Better than 70dB                                |                |                |  |
|                      | Squelch sensitivity                                |                                   | Less than 0.1 $\mu$ V                           |                |                |  |
|                      | Output (5% distortion)                             |                                   | More than 2W across 8 ohms load                 |                |                |  |
|                      | External speaker impedance                         |                                   | 8 ohms  |                |                |  |

### Notes :

1. Circuit and ratings are subject to change without notice due to advancement in technology.
2. \* : Recommended duty cycle :
  - 1 minute : Transmission
  - 3 minutes : Reception

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