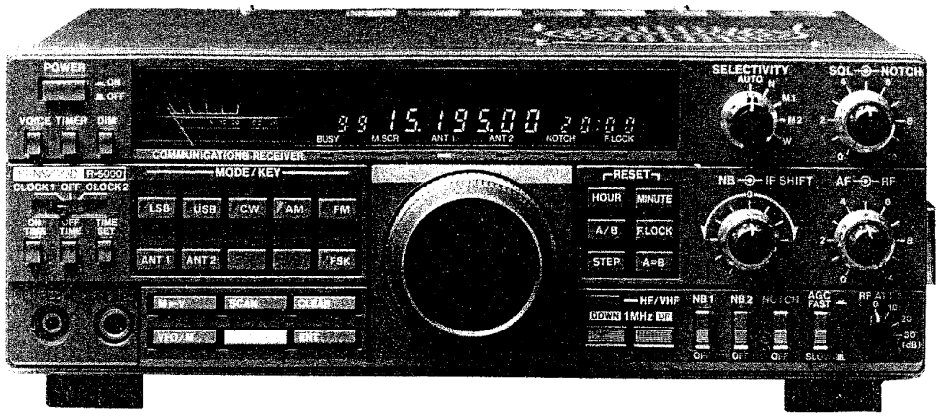
COMMUNICATIONS RECEIVER

R-5000

SERVICE MANUAL

KENWOOD

B51-3073-00 (O) 150



CONTENTS

Caution :
Optional accessory installation — The user should not attempt to install the optional accessory beyond that described in the operating instructions. All installations should be referred to qualified service personnel.

CIRCUIT DESCRIPTION

OVERVIEW

The R-5000 is a double-conversion general-coverage receiver with a first IF (intermediate frequency) of 58.1125 MHz and second IF of 8.83MHz. (In the FM mode triple conversion is used with a third IF of 455kHz.) It can receive AM, LSB, USB, CW, FM, and RTTY signals from 30kHz to 30MHz, with performance specifications guaranteed from 100kHz up. The VC-20 VHF converter option extends the receiving range to 108MHz to 174MHz.

Interference is removed by an IF filter switching circuit and 0-to-30dB RF attenuator. The receiver also has an IF shift feature, AF notch filter (not used in the CW mode), and AF peak filter (CW mode only).

The receiver's phase-locked loops operate under microprocessor control. High frequency stability and accuracy are achieved by a single-crystal system that provides digital frequency control in 10Hz steps. This includes the frequencies of the VHF converter.

Other major features of the R-5000 receiver are

1. Reduction of many types of impulse noise controlled by two noise blanker switches and a noise-blanker level control.
2. Two digital VFOs (Variable-Frequency Oscillators).
3. Direct entry of frequencies thru the use of numeric keypad.
4. A memory that stores band, mode, and antenna (1 or 2) information for 100 channels.
5. Memory scanning and ten types of programmed scanning.
6. A built-in timer and dual-time clock.
7. Display dimmer.
8. The VS-1 voice synthesizer option internal installation.
9. Possible interfacing to a personal computer.
10. A rechargeable lithium backup battery for the microprocessor.
11. A built-in AC power supply (the receiver can also operate on an external DC power supply).

Frequency Configulation

The R-5000 operates as a triple-conversion receiver in the FM mode and as a double-conversion receiver in other modes. **Fig. 1** shows the principal frequencies used in its signal circuits. Consider an HF-band signal received in the SSB mode. Let f_{IN} be the frequency input from the antenna, f_{VCO} the local oscillator frequency input by the first mixer (MIX1), f_{HET} the local oscillator frequency input by the second mixer (MIX2), and f_{BFO} the beat-frequency oscillator input from the detector. When f_{IN} is at zero-beat — that is, when the SSB signal is zeroed in with f_{IN} as the carrier point — the following relationship holds true :

(1) First IF at the MCF input

$$f_{VCO} - f_{IN} = \text{1 st IF (58.1125MHz)} \quad \cdots\cdots ①$$

(2) Second IF at the XF input

$$\text{1 st IF} - f_{HET} = \text{2nd IF (8.83MHz)} \quad \cdots\cdots ②$$

(3) At the detector input

$$\text{2nd IF} - f_{BFO} = 0 \text{ (AF signal)} \quad \cdots\cdots ③$$

(4) Substituting the left side of Eq. (2) into (3) and the left side of Eq. (1) into (2) gives

$$f_{VCO} - f_{IN} - f_{HET} - f_{BFO} = 0 \quad \cdots\cdots ④$$

(5) Which can be rewritten as

$$f_{IN} = f_{VCO} - f_{HET} - f_{BFO} \quad \cdots\cdots ⑤$$

Equation ⑤ describes the frequency relationship of the signal circuits.

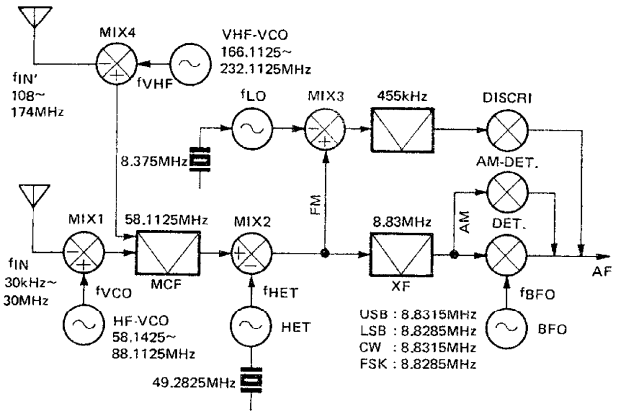


Fig. 1 Signal frequency configurations

Consider next the f_{VCO} frequencies from the PLL circuits.

(1) In PLL1

At *1,

$$f_{VCO1} = \frac{1}{4500} \cdot \frac{1}{2} f_{STD} \cdot N1 \quad \cdots\cdots ⑥$$

At *2,

$$f_{VCO1}' = \frac{1}{200} \cdot f_{VCO1} \quad \cdots\cdots ⑦$$

At *3,

$$f_{VCO1}'' = f_{VCO1}' + f_{BFO} + f_{HET} \quad \cdots\cdots ⑧$$

(2) In PLL2

$$f_{VCO2} - f_{VCO1}'' = \text{PLL2 IF}$$

$$\therefore f_{VCO2} = f_{VCO1}'' + \text{PLL2 IF} \quad \cdots\cdots ⑨$$

where the intermediate frequency PLL2 IF is:

$$\text{PLL2 IF} = \frac{1}{180} \cdot \frac{1}{2} f_{STD} \cdot N2 \quad \cdots\cdots ⑩$$

(3) In PLL3

$$f_{VCO2} - f_{VCO} = \text{PLL3 IF}$$

$$\therefore f_{VCO} = f_{VCO2} - \text{PLL3 IF} \quad \cdots\cdots ⑪$$

where the intermediate frequency PLL3 IF is:

$$\text{PLL3 IF} = \frac{1}{18} \cdot \frac{1}{2} f_{STD} \cdot N3 \quad \cdots\cdots ⑫$$

(4) These equations can be combined by substituting ⑥ and ⑦ into ⑧ to obtain

$$f_{VCO1}'' = \frac{1}{200} \cdot \frac{1}{4500} \cdot \frac{1}{2} f_{STD} \cdot N1 + f_{BFO} + f_{HET}$$

$$= \frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} \quad \cdots\cdots ⑬$$

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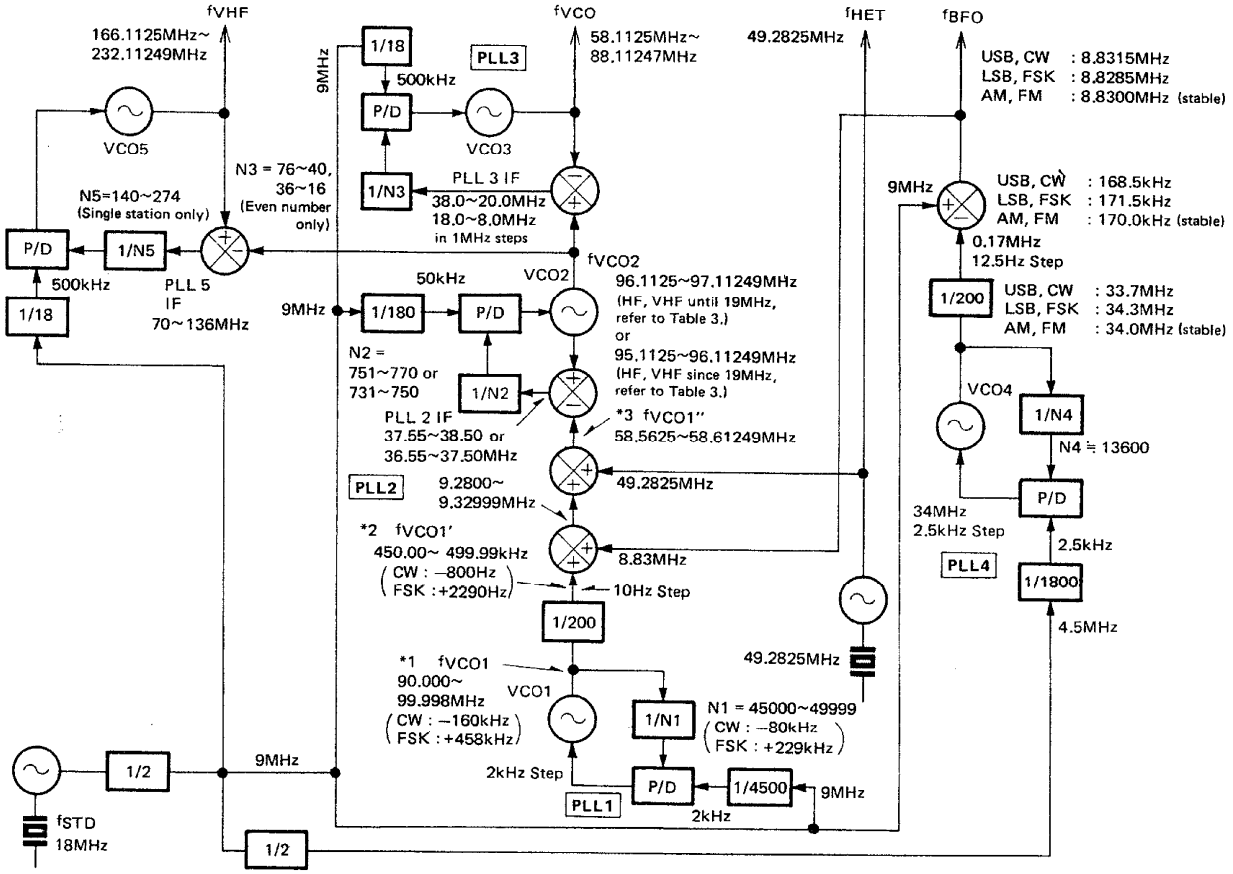

Fig. 2 PLL frequency configurations

(5) and substituting ⑩ and ⑬ into ⑨ to obtain

$$f_{VCO2} = \frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} + \frac{N2}{360} f_{STD} \cdots\cdots ⑭$$

(6) Substitution of ⑫ and ⑭ into ⑪ then gives

$$f_{VCO} = \frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} + \frac{N2}{360} f_{STD} - \frac{N3}{36} f_{STD} \cdots\cdots ⑮$$

This derivation of fVCO from the PLL system implies the following relation between the PLL and signal circuits.

(1) Substituting ⑮ into ⑤, we get

$$f_{IN} = f_{VCO} - f_{HET} - f_{BFO}$$

$$= \underbrace{\frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} + \frac{N2}{360} f_{STD} - \frac{N3}{36} f_{STD}}_{f_{VCO}} - f_{HET} - f_{BFO}$$

$$= \frac{N1}{1800000} f_{STD} + \frac{N2}{360} f_{STD} - \frac{N3}{36} f_{STD}$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N3}{36} \right) f_{STD} \cdots\cdots ⑯$$

(1) If the same relations are considered in the VHF band, at the fourth mixer (MIX4) in the signal system

$$f_{VHF} - f_{IN}' = 1\text{st IF}$$

The rest follows the same development as in the HF band. From Eqs. (2) and (3) above.

$$f_{VHF} - f_{IN}' - f_{HET} - f_{BFO} = 0$$

$$\therefore f_{IN}' = f_{VHF} - f_{HET} - f_{BFO} \cdots\cdots ⑰$$

(2) In the PLL system, the decades from PLL2 on down follow the same path as in the HF band, so the same calculations can be performed.

(3) At PLL5

$$f_{VHF} - f_{VCO2} = \text{PLL5 IF}$$

$$\therefore f_{VHF} = f_{VCO2} + \text{PLL5 IF} \cdots\cdots ⑱$$

where PLL5 IF is given by

$$\text{PLL5 IF} = \frac{1}{18} \cdot \frac{1}{2} f_{STD} \cdot N5 \cdots\cdots ⑲$$

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(4) Substitution of ⑭ and ⑲ into ⑱ gives

$$f_{VHF} = \frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} + \frac{N2}{360} f_{STD} + \frac{N5}{36} f_{STD} \quad \cdots\cdots ⑳$$

(5) Substitution of ⑳ into ⑰ gives

$$f_{IN}' = \underbrace{\frac{N1}{1800000} f_{STD} + f_{BFO} + f_{HET} + \frac{N2}{360} f_{STD} + \frac{N5}{36} f_{STD}}_{f_{VHF}} - f_{HET} - f_{BFO}$$

$$= \frac{N1}{1800000} f_{STD} + \frac{N2}{360} f_{STD} + \frac{N5}{36} f_{STD}$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} + \frac{N5}{36} \right) f_{STD} \quad \cdots\cdots ㉑$$

From Eqs. ⑯ and ㉑ it can be seen that in both the HF and VHF bands the fBFO and fHET terms drop out, leading to the conclusion that **the receiving frequency is determined by the standard reference frequency and the division rations N1, N2, N3 and N5.**

Further analysis indicates the following:

i) Since the values of N1, N2, N3, and N5 are determined by the microprocessor according to the operating frequency, they are not subject to error or drift.

ii) Since the expression is linear in fSTD the accuracy of the operating frequency equals the accuracy of the standard reference frequency.

iii) Since there are no terms involving fBFO and fHET, the operating frequency is unaffected by variations in fBFO and fHET.

The crystal oscillator that produces the reference frequency fSTD of the R-5000 is accurate to within 10ppm (at −10°C to 50°C). From i) and ii), it follows that the overall accuracy is that same at any point in the range of 30kHz to 30MHz and 108MHz to 174MHz. Additionally iii) implies that the variable-band functions of IF-shift etc. can be realized easily by controlling fBFO (the division ratio of PLL4).

The discussion above has dealt with the SSB mode, but a similar argument applies to all modes except the FM mode to show that the receiving frequency is determined by the standard reference frequency fSTD and N1, N2, N3, and N5 alone.

To generate 800Hz receiver beats in the CW mode, the frequency of PLL1 is shifted 800Hz down.

To match the receiver frequency to the space frequency in the FSK mode, the frequency of PLL1 is shifted 2290 Hz lower.

Mode	Displayed frequency
USB, LSB	Carrier point frequency
CW	BFO frequency + 800Hz
AM, FM	IF filter nominal center frequency
FSK	BFO frequency + 2290Hz

Table 1 Displayed frequencies

Circuit Configuration

From the antenna terminals on the rear panel, the signal enters the RF unit, in which relay switch (RL1) selects the signal from the desired antenna: ANT1 or ANT2. The signal is routed through a low-pass filter with a cutoff frequency of 30MHz, a 20dB attenuator (RL2), and a 10dB attenuator (RL3), to a ten-element bandpass filter. (The two bands below 1.6MHz are defined by low-pass filters.) Each bandpass filter element has the same configuration as in the TS-940, but in bands where there is ample bandwidth, a fixed inductance is used. There is no need to adjust the impedance at the output of the bandpass filter because automatic gain control is not accomplished using a PIN diode. The signal is therefore taken from the bandpass filter through a high impedance and matched directly to the RF amplifier (Q1). In the 0.5 MHz to 1.6MHz band, the signal passes through a three-stage trap filter that removes interference from broadcast-band transmission.

Note: Trap 1 L12 (0.39μH) x C35 (0.033μF) = 1403kHz
Trap 2 L13 (1μH) x C36 (0.033μF) = 876kHz
Trap 3 L14 (2.2μH) x C37 (0.033μF) = 591kHz

In locations subject to interference, such as near high-power broadcasting stations, interference can be reduced or eliminated changing by the L or C constants of the traps to tune them to the interfering frequencies. The attenuation of the trap can be enhanced by increasing the L/C ratio (making L large and C small) without changing the trap frequency, but this has a gradually increasing effect on low bands in the 2MHz to 3MHz range.

The signal from the RF amplifier (consisting of Q1 and Q2 cascaded) passes through an IF trap (around L44) then converted to the first IF of 58.1125MHz by mixing with the VCO signal in the first mixer (Q3 and Q4). To assure a high intercept point, the output of the mixer passes through a grounded-gate push-pull amplifier (Q5 and Q6), and is then applied to the IF unit after correction for the loss generated in the MCF.

The configuration so far is basically the same as in the TS-940, except for the higher 58.1125MHz first IF.

Upon entering the IF unit, the signal passes through HF/VHF switch (D1 and D2), then through the 58.1125 MHz MCF (XF1) which narrows the bandwidth by approximately 20kHz/−6dB, and is then amplified by the first IF amplifier (Q1). Q1 acts with delayed automatic gain control: it operates with full gain up to antenna input voltages of 100μV to 150μV but reduces gain for higher inputs. The use of AGC in this stage keeps the input level of the second mixer, the one that saturates the fastest

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(causing clipping), at an appropriate level so that even large input signals such as S9 + 60dB are undistorted. The AGC delay results in quick suppression of internal noise in the small and medium input ranges, thereby improving the audible signal-to-noise ratio.

In the second mixer (Q4 and Q5), the signal from Q1 is mixed with the HET signal (49.2825kHz) from Q2 and Q3, which converts it to the second IF (8.83MHz). The HET signal is generated by a third-overtone crystal oscillator, X1. To cancel any drift in this signal by frequency control in the set as a whole, the signal is also sent to the main phase-locked loop in the PLL unit.

After the signal is converted to 8.83MHz, it is applied in parallel to the noise blanker gate (Q10) and to the third mixer (Q9). In the third mixer, the third local oscillator frequency (8.375MHz) generated by Q8 is injected to convert the 8.83MHz signal to 455kHz. The 455kHz signal is sent in parallel to the noise blanking circuit and to the FM IF section.

In modes other than FM, the signal leaving the noise blanking gate (Q10) is routed through a series of filters: first an approximately 6kHz/–6dB W filter (XF2), then an filter M2 (XF3), an filter M1 (optional), and filter N (optional), with amplifier (Q18, Q19, and Q20) between adjacent filter stages. After being narrowed to the required bandwidth by these filters, the signal is amplified by Q21 and Q22 and is detected by a link detector (D24 to D27) or AM detector (Q26).

In the FM mode, the output of the third mixer (Q9) passes through a ceramic filter (CF1) and is amplified by limiters IC5 and IC6, then is detected by a ceramic discriminator (L26).

After detection, the level and frequency characteristics of the signal are corrected by a separate preamplifier for each mode, and the output is selected by an analog CMOS switch (IC9). The selected signal passes through a notch circuit that functions automatically as a peak filter in the CW mode, then through (X59-3030-00), a squelch gate (X59-3040-00), a tone balance amplifier IC12, and the AF gain trimmer. It is then amplified by the AF power amplifier IC13.

Series Connection of IF Filters

A major feature of the R-5000 is that the IF filters that determine the receiving bandwidth are not switched in parallel as in previous receivers but are arranged in series (or cascade).

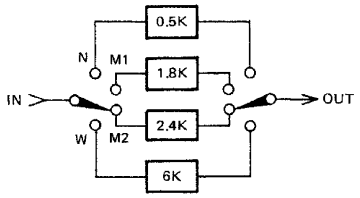

Fig. 3–1 IF filter connection in the conventional models

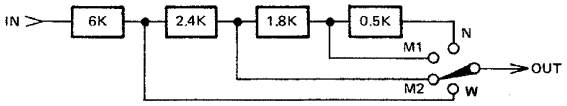

Fig. 3–2. IF filter connection in R-5000 (conceptual diagram)

Filters with passbands wider than the desired receiving bandwidth all pass the signal without attenuating it; the width of the passband is determined by the narrowest filter used; the other filters do not cause any changes or undesirable effects. At offsets of greater than a few kilohertz, however, the attenuation of each filter is added in. This and the careful circuit layout have resulted in a major improvement in guaranteed attenuation.

Passage through a number of narrow-band filters adds a group delay, but in practice the narrowest filter exerts the controlling influence, so there is no major change. The advantage of this type of layout was demonstrated, although in a different way, by the dual filter system of the TS-830 and TS-940.

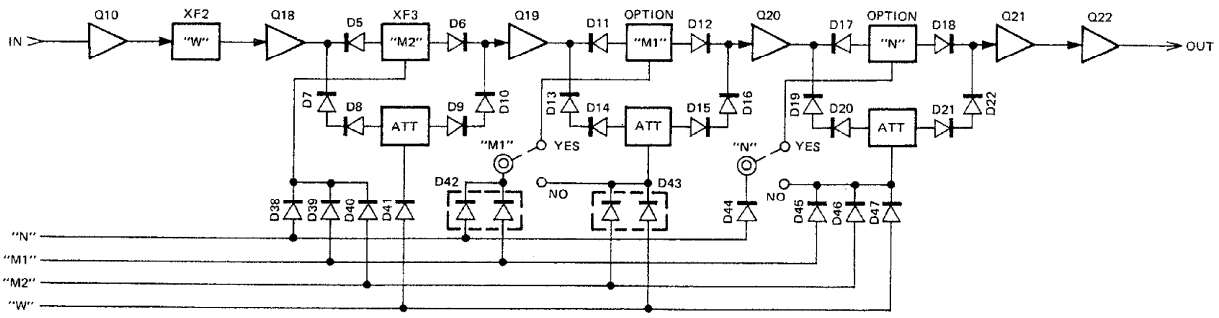

Fig. 4 IF filter connection

CIRCUIT DESCRIPTION

The SELECTIVITY switch offers a choice of four receiving bandwidths: N, M1, M2, and W. In the AUTO position, these are selected automatically according to the signal mode as follows:

MODE	SELECTIVITY
USB, LSB	M2
CW	N
AM	W
FSK	N

Table 2 SELECTIVITY responds each auto mode

The SELECTIVITY switch does not function in the FM mode, so the set operates with a fixed FM bandwidth.

The M1 and N filters are optional. YES/NO jumpers in the IF unit must be reset when these filters are installed. If an optional filter selected by the SELECTIVITY switch is not installed, the set automatically operates at the bandwidth of the next-wider installed filter. **Fig. 5** shows the circuits associated with the SELECTIVITY switch.

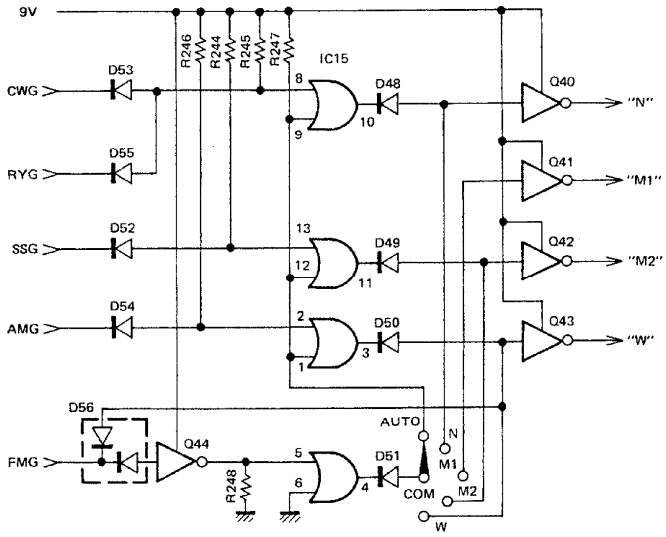

Fig. 5 SELECTIVITY switch peripheral circuit

Noise Blanking (NB)

The noise blanker is basically the same as the one used in previous models. A particular feature is the NB2 position that stresses "woodpecker" blanking. The noise blanking level can be controlled from the front panel for maximum effectiveness.

Noise blanking is performed at the second IF (8.83 MHz) of the SSB signal system, but the NB noise amplifier operates at 455kHz, the third IF of the FM mode. If two 8.83MHz high-gain amplifiers were mounted on the same board, inadequate isolation between them would have the same result as inadequate filtering by the SSB IF filters, and the selectivity characteristic would be impaired. For this reason, the frequency of the NB noise amplifier is different from the frequency of the main SSB signal system.

The NB noise amplifier uses MOS-FET element that provide a wide AGC dynamic range and suppress intermodulation distortion and unwanted noise blanking triggered by strong adjacent-channel signals.

Other models used diode switching for the noise blanking gate, but the R-5000 switches a MOS-FET amplifier (Q10) on and off to gate noise to blanking—this matches impedances of the preceding and following filters and other circuits to obtain a better overall gain distribution. When on, the gate itself has gain. Gating is fast enought to pose no problems for noise blanking, and an on/off transconductance ratio of 70dB or above is guaranteed.

The circuit in **Fig. 6** generates the noise blanking gate control pulse.

Due to the effect of automatic gain control in the NB noise amplifier, application of an unmodulated carrier generates a signal voltage of approximately 0.6V at point A ,input of an AM voice signal gives a maximum of about 1.3V, and SSB input gives a maximum of 2V. When fast impulse noise is applied, however, the AGC tracking delay allows a momentary voltage of 3V to 5V. The emitter of Q15 is connected to a circuit consisting of R67, R68, Q25, R69, the NB LEVEL potentiometer control, and the NB switch. When the NB switch is OFF, a voltage of approximately 6.1V is added; when the NB switch is ON, a voltage of 0.3V to 2.6V is added, depending on the position of the NB LEVEL control. When the voltage at point A rises 0.6V above the voltage of the Q15 emitter, Q15 switches ON. Since point B is coupled to ground, Q16 switches ON, Q17 switches on, and NB gate Q10 switches OFF.

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Discrimination between signal and noise by observation of the voltage at point A depends on the mode as described above and on the strength of the signal, the presence of interference, and the type of noise. The NB LEVEL control provides an extremely effective means of keeping the optimum noise separation and switching threshold voltage set, but if NB LEVEL is turned up too high, noise blanking will be triggered by peaks in the voice signal, so this control must be used with care.

When NB2 is OFF, Q15, Q16, and Q17 all switch ON and OFF simultaneously; but when NB2 is ON, the NB2 end of resistor R71 becomes open so that C56 extends the blanking state by about 7ms. This makes the noise blanker effective against almost any type of "woodpecker" noise. For other types of woodpecker noise and for certain propagation conditions, however, the effectiveness is somewhat reduced.

Q25 is a protection switch that minimizes the break in the received signal when NB2 is switched ON by mistake for non-woodpecker noise. In the TS-930 and TS-940, a circuit counted the period of the blanking pulse and blanking was automatically inhibited in the case of operator error, but the R-5000 has a simplified circuit that detects operator errors from abnormalities in the receiver output tone.

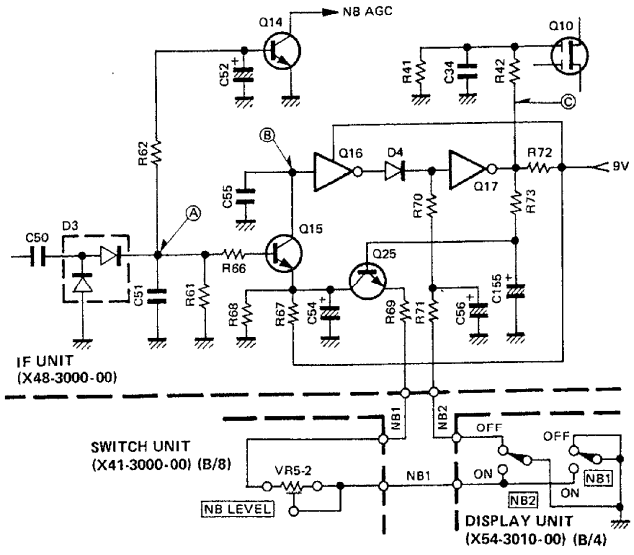

Fig. 6 NB gate control pulse performing circuit

Notch Circuit

The R-5000 has an audio notch filter. In the CW mode this is automatically switched over to a peak filter that mainly blocks the high audio frequencies for CW reception with a good signal-to-noise ratio. The notch/peak frequency can be varied continuously from 450Hz to 3kHz by the NOTCH control.

A notch filter with a sharp cut-off may represent a high level of audio filter engineering, but in practice it can be difficult to use because the notch point is too hard to locate. Accordingly, this notch filter has a comparatively broad characteristic.

The circuit is basically a bridge-T active filter acting as a variable bandpass filter (peak filter). The notch characteristic is synthesized according to the input and output signal sum. Using a modular configuration with chip components improves stability. As a result, the effective notch attenuation is 30dB to 40dB throughout the variable range.

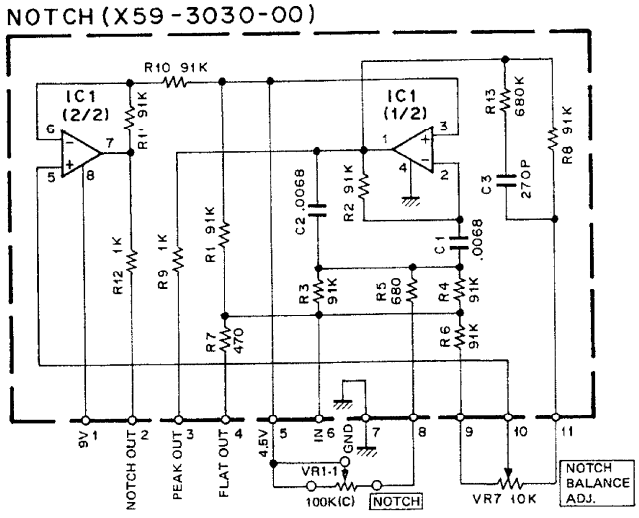

Fig. 7 NOTCH circuit

CIRCUIT DESCRIPTION

AGC and S Meter Circuits

In the R-5000, automatic gain control is implemented in four MOS-FET stages located in the first IF amplifier (58.1124MHz, IF unit, Q1) and second IF amplifier (8.83 MHz, IF unit, Q19, Q21, Q22). In the first IF amplifier, the automatic gain control is delayed. This guarantees an AGC range of at least 90dB for an antenna input voltage of 1μV to 20mV and up. There are four AGC time constants: an independent slow and fast in both the SSB and AM systems, providing stable, undistorted reception.

Fig. 8 shows the R-5000's AGC circuit. The signal taken from Q22 in the last IF amplifier at 8.83MHz is buffered by Q24 then detected by the AGC detector D28; its DC component drives AGC amplifier (Q27). The time-constant circuit has four time constants, as explained above, which are selected by an analog C-MOS switch according to the current mode and the position of the AGC switch. (SLOW or FAST). In the FM mode, the SSB-fast time constant is used regardless of the position of the AGC switch. This is done not because automatic gain control operates in the FM mode but to adjust the response of the S meter.

The voltage from the time-constant circuit is applied to the S meter module unit and drives the AGC line through a voltage buffer (Q5) and the AGC drivers (Q3 and Q4). The reason for the Q5 voltage buffer is to provide a high-impedance input to the time-constant circuit and for temperature compensation of S meter driver Q2 (to prevent zero-point temperature drift of the S meter). The AGC drivers (Q3 and Q4) have the same complementary Darlington configuration as used in the TS-930 and TS-940, which reduces the impedance of AGC line, improve the transient tracking characteristic, and enables the emitter current of Q3 to be controlled by an external muting signal, so that muting can be created by block-biasing the IF amplifier via the AGC line. This method of block biasing using the AGC line was also used in the TS-930 and TS-940 as part of the full-breaking circuit. It enables muting to be switched ON and OFF quickly and smoothly, with no abnormal gain increase during transient switchover.

On the controlled side, fast AGC is fed back to Q21 and Q22 with no attack delay, but the feedback to Q19 is somewhat slowed, in consideration of loop stability, to provide for narrow-band filtering (filter options N and M1) in the loop.

The source voltage of voltage buffer Q5 is detected and applied to comparator (IC4) which generates the delayed AGC voltage for Q1 in the first IF amplifier. If the AGC dynamic range is ignored, the best signal-to-noise ratio results from having automatic gain control act on the latest possible stage, for rapid suppression of the internal noise generated as the antenna input voltage increases. To prevent saturation (clipping distortion) due to large input and to obtain a wide AGC dynamic range, level control must be performed at as early a stage as possible. To satisfy both these requirements at once, the R-5000 uses delayed automatic gain control. Specifically, the first IF amplifier (Q1) operates at full gain at antenna input voltages from 100μV to 150μV, but at diminishing gain at higher voltages. Due to the large number of narrow-band filters in the loop, however, the AGC attack speed is set to a low value; since the recovery speed is also slow, no block bias is added to Q1 from the external muting signal.

As indicated by the fact that the S meter can be read in microvolts, the S meter of the R-5000 is superior in accuracy and linearity to previous models in the 1.8MHz to 30MHz range. The same S meter circuit is used in all modes, so the meter deflects by the same amount in response to the same incoming signal level in any receiving mode. Even in the FM mode, the S meter deflects according to the AGC voltage, just as in the SSB system.

The SSB IF circuit always generates an AGC signal which drives the S meter. For that reason, the first IF amplifier (Q1), shared by the FM and SSB systems, is under automatic gain control even in the FM mode but, since the automatic gain control is delayed and applies only to large antenna input, it has no actual effect on the FM signal.

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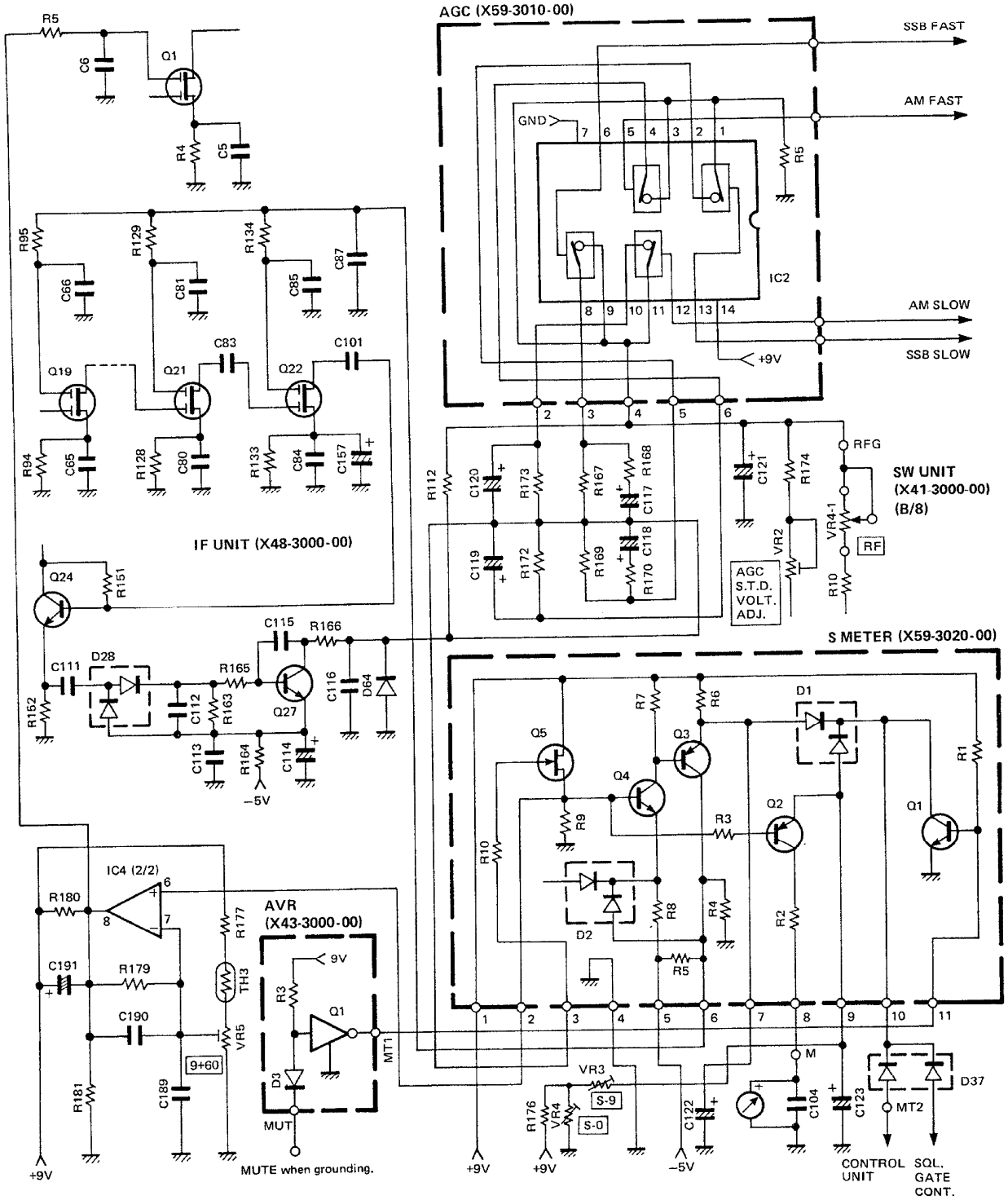


Fig. 8 AGC circuit

CIRCUIT DESCIRPTION

Muting Circuit

The R-5000 is designed to be used in combination with a separate transmitter, so it has been provided with an external muting control connector that can be used to halt reception during transmission. When the REMOTE connector pin on the rear panel is connected to chassis ground, the R-5000 is muted.

1. The second mixer (Q4, Q5 in the IF unit) is block-biased over the BLK line from the microprocessor.
2. The second IF amplifier (IF units, Q19, Q21, Q22) is block-biased through the AGC line.
3. The S meter drive circuit is switched OFF. The S meter does not deflect when the RF GAIN control is turned counterclockwise.
4. The squelch gate is switched OFF, the audio is muted, and the BUSY lamp lights.
5. ENT, SCAN, SCROLL, and other operations are halted and cleared.

The electrical states of the muting connector on the rear panel are as follows

Voltage : about + 4.8V when open

Current : about 0.4mA when grounded

Accordingly, if the residual voltage is roughly 0.2V or less when muting is switched ON, a transistor switch can be used to control the muting input.

Analog switch

The R-5000 uses analog C-MOS switches to select the AGC time constant, the detected audio signal, the filter characteristic (notch, peak, or flat), and for squelch gating. These switches have the following advantages:

1. High duty factor
2. Low ON state resistance
3. Little generated distortion and noise
4. Only slight clipping the control input
5. Very low control power

They also simplify the Control circuits and reduce the length of the signal lines.

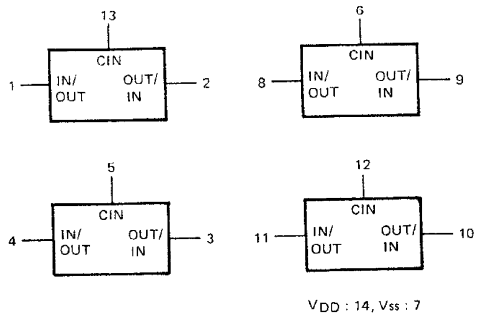


Fig. 9 Analog switch TC4066BP block diagram

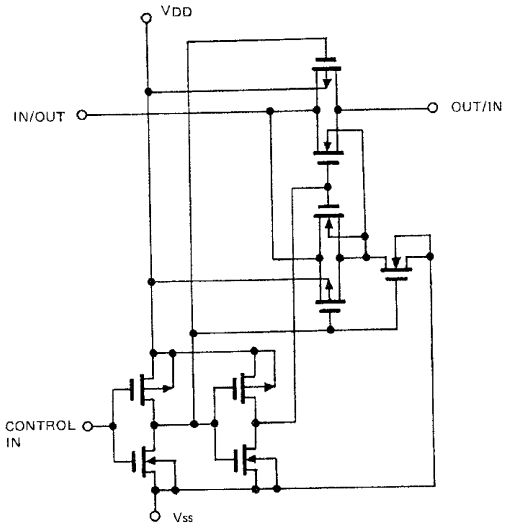


Fig. 10 Analog switch TC4066BP equivalent circuit

PLL Circuit

The PLL circuit of the R-5000 consists of five phase-locked loops that provide tuning in 10Hz steps from 30kHz to 30MHz in the HF band with a base frequency of 18MHz (from 108MHz to 174MHz if the VHF converter option is installed).

The BFO and HET frequencies are applied to the phase-locked loops to perform an IF shift. The division ratio data sent to the phase-locked loops is controlled by the microprocessor. Except in the FM mode, one-crystal frequency control is performed, the signal phase being compared with a reference frequency generated by an oscillator.

Fig. 11 is a block diagram of the PLL circuit.

CIRCUIT DESCRIPTION

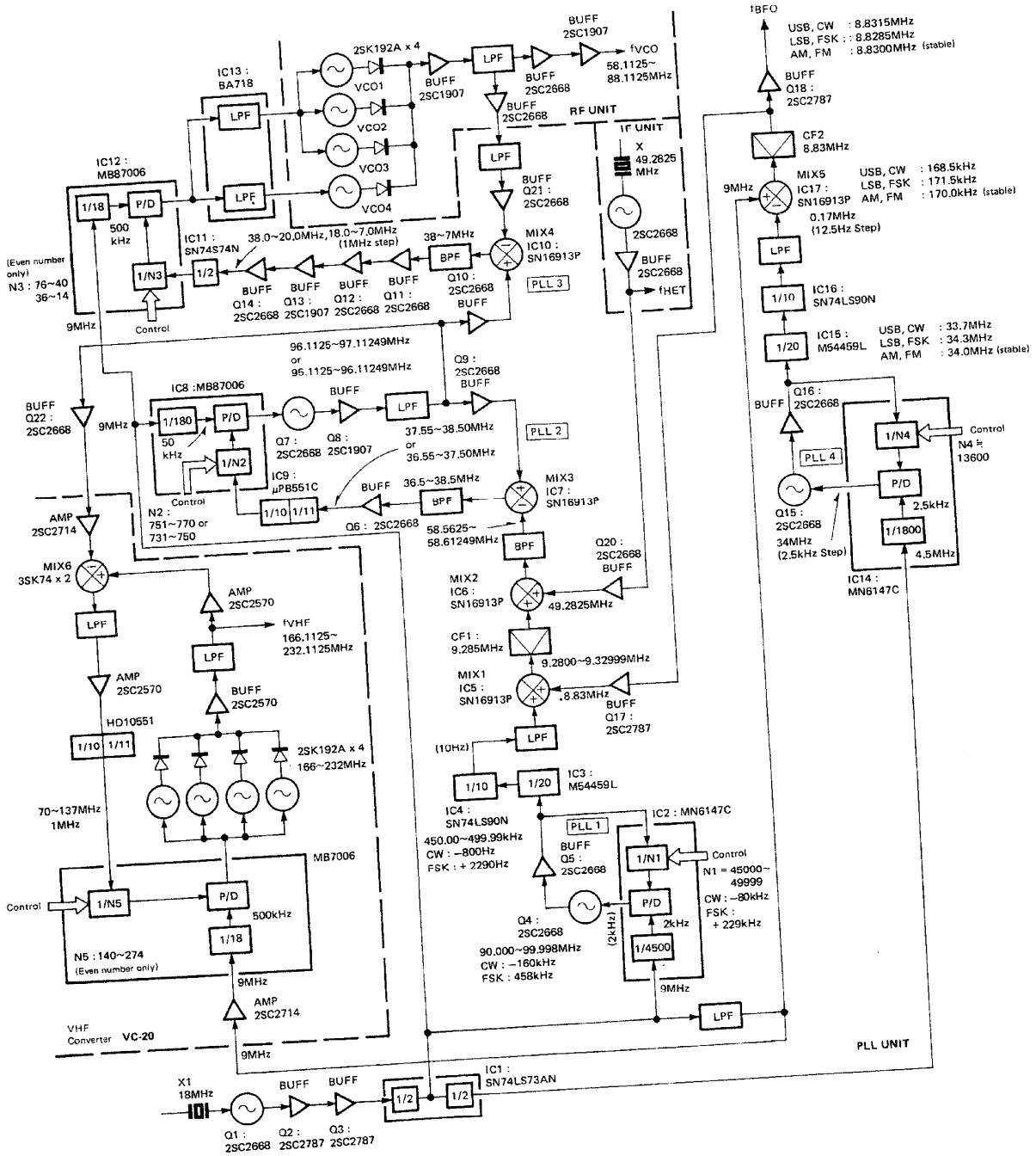


Fig. 11 PLL circuit block diagram

CIRCUIT DESCRIPTION

• Reference oscillator circuit

The basic standard signal used in the R-5000 (fSTD) is generated by an 18MHz crystal oscillator X1 and Q1 : 2SC2668. It is buffered by Q2 and Q3 : 2SC2787, then divided by IC1 : SN74LS73AN to produce the basic reference frequencies of 1/2 fSTD and 1/4 fSTD used by the phase-locked loops.

• PLL4

PLL4 operates on the BFO signal, and its main component is IC14 : MN6147C. PLL4 also performs fine frequency adjustments such as IF shifting of the detected signal and carrier point correction.

The basic reference frequency 1/4 fSTD is divided by 1800 in the reference frequency prescaler (IC14) to generate form the 2.5kHz reference frequency. The signal generated by VCO4 at Q15 : 2SC2668 is buffered by Q16 : 2SC2668 and returned to IC14, which divides it by according to the ratio sent from the Control unit (DA0 to DA3, CL4), and compares its phase with the comparison reference described above. The phase difference is returned to VCO4 forming the BFO phase-locked loop. When PLL4 is locked, the VCO4 frequency is approximately 34MHz, but varies depending on the mode, IF shift, and carrier point correction.

The output from PLL4 is divided by 20 at IC15 : M54459L, then by 10 in IC16 : SN74LS90N. After filtering by a low-pass filter, it is mixed with the 1/2 fSTD signal of 9MHz, passed through CF2 (8.83MHz), and buffered by Q18 : 2SC2787, then supplied to the IF unit as the BFO signal.

The second BFO signal is buffered by Q17 : 2SC2787 and enters the mixer in the main loop, where it drives the digital variable-frequency oscillator (VFO). As a result, even if the BFO frequency is varied, the operating frequency does not change. Mode switching (USB, LSB, etc.), IF shiting, and carrier point fine adjustment are performed. The IF shift is a shift of ±1kHz during SSB, CW, and FSK reception. The carrier point frequency can be adjusted by about ±300Hz.

The frequency relationships of PLL4 are given below:

$$f_{VCO4} = \frac{1}{1800} \cdot \frac{1}{4} f_{STD} \cdot N4$$

$$f_{BFO} = \frac{1}{2} f_{STD} - \frac{1}{200} f_{VCO4} = \left(\frac{1}{2} - \frac{N4}{1440000}\right) f_{STD}$$

• PLL1

PLL1 forms the lowest-order decade of the digital VFO, corresponding to a bandwidth of 50kHz.

Its main component is IC2 : MN4617C. The VCO at Q4 : 2SC2668 locks in the range from 90.000MHz to 99.998MHz (89.840MHz to 99.838MHz in the CW mode, 90.458MHz to 100.456MHz in the FSK mode). The 9MHz 1/2 fSTD signal is applied at pin 3 of IC2, and is divided by 4500 internally to form the 2kHz reference signal.

The output of the VCO passes through the buffer amplifier Q5 : 2SC2668 and is applied at pin 16 of IC2, which divides it internally by a factor of N1. A phase comparator compares it with the 2kHz reference signal, the VCO frequency is then locked in 2kHz steps. The division ratio N1 is sent as division data (DA0 to DA3, CL1) from the microprocessor in 5000 steps (45000 to 49999) corresponding to frequencies from 0.00kHz to 49.99kHz. The division ratio N1 is corrected according to the mode.

During CW reception, to obtain 800Hz beats at the operating frequency reading, N1 is shifted by 80 (44920 to 49919). During FSK reception, to equalize the space frequency and displayed frequency, N1 is shifted by 229 (45229 to 50228).

The PLL1 output is divided by 20 at IC3 : M54459L, then by 10 in IC4 : SN74LS90N and passes through a low-pass filter to pin 5 of IC5 : SN16913P in the first mixer (MIX1), where it is mixed with the signal produced by PLL4. After passing through CF1, it emerges in 10Hz steps from 9.2800MHz to 9.32999MHz, and is applied to pin 5 of IC6 : SN16913P of the second mixer (MIX2).

The frequency relationships of PLL1 are given by the following equation:

$$f_{VCO1} = \frac{1}{4500} \cdot \frac{1}{2} f_{STD} \cdot N1 = \frac{N1}{9000} f_{STD}$$

• PLL2

PLL2 is also one of the digital VFO phase-locked loops, corresponding to the 1MHz bandwidth. It has a pulse-swallow configuration and consists of IC8 : MB87006 and IC9 : μPB551C.

The division ratio data are arranged to shift the frequency range covered by PLL2 and PLL3, and by PLL2 and PLL5 (in the VHF converter), so that the frequency ranges of the VCOs in the PLL unit are not received as internal beats. PLL2 therefore has two frequency ranges, and VCO2 is variable within a range of 2MHz.

CIRCUIT DESCRIPTION

The oscillation frequency of VCO2 in the locked state is in one of the two ranes 96.1125MHz to 97.11249MHz or 95.1125MHz to 96.11249MHz. The basic reference signal 1/2 fSTD is applied to pin 1 of IC8 and divided by 180 by the reference divider in IC8 to produce the 50kHz reference signal. The signal produced at Q7 : 2SC2668 in VCO2 passes through a buffer amplifier consisting of Q8 : 2SC1907 and Q9 : 2SC2668 and a low-pass filter, then is mixed with the low-order decade signal in the third mixer (MIX3). The resulting signal is filtered by a bandpass filter and buffered by Q6 : 2SC2668, then fed back to the pulse-swallow prescaler IC9 where it is divided by an amount depending on the division ratio data N2 from the Control unit (SO, SCK, CL2).

Next its phase is compared with that of the 50kHz reference signal. In forming the low-order decade signal, the VCO1 signal is divided by 200, and to cancel the drift of the BFO and HET signals, fHET and fBFO are fed into the main loop early.

Considerations involving the prescaler and mixer on the signal path result is the frequency relationships in PLL2 as follows:

$$f_{VCO2} = \text{PLL2 IF} + f_{HET} + f_{BFO} + \frac{1}{200} f_{VCO1}$$

$$= \frac{1}{180} \cdot \frac{1}{2} f_{STD} \cdot N2 + f_{HET} + \left(\frac{1}{2} - \frac{N4}{1440000}\right) f_{STD} + \frac{1}{200} \cdot \frac{N1}{9000} f_{STD}$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N4}{1440000} + \frac{1}{2}\right) f_{STD} + f_{HET}$$

• PLL3

PLL3 is the last phase-locked loop in the HF band. Its principal component is IC12 : MB87006. VCO3, which is located in the RF unit, is divided into four bands, one for each frequency range, one of which is selected by a signal that depends on the band data (RB0 to RB3) from the Control unit.

The basic reference signal 1/2 fSTD is applied to pin 1 of IC12 and divided by 18 to create a 500kHz reference signal. The VCO3 output selected according to the received frequency is buffered by Q12 : 2SC1907 and Q15 : 2SC2668 in the RF unit, then returned as the VFO signal to the PLL unit. After buffering by Q21 : 2SC2668 in the PLL unit, it is mixed with low-order decade signal VCO2 and passed through a bandpass filter and buffer amplifier consisting of Q11, Q12 and Q14 : 2SC2668 and Q13 : 2SC1907, then divided by 2 in IC11 : SN74S74N and returned to IC12.

Here it is divided according to division ratio data N3 from the Control unit (SO, SCK, and LE1) and its phase is compared with that of the 500kHz comparison reference. VCO3 is controlled according to the error voltage to complete the PLL3 loop.

The frequencies in PLL3 are as follows:

$$f_{VCO3} = f_{VCO} = f_{VCO2} - \text{PLL3 IF}$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N4}{1440000} + \frac{1}{2}\right) f_{STD} + f_{HET} - \frac{1}{18} \cdot \frac{1}{2} f_{STD} \cdot N3$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N3}{36} - \frac{N4}{1440000} + \frac{1}{2}\right) f_{STD} + f_{HET}$$

• PLL5

This phase-locked loop covers the VHF band and is part of the VHF converter option. VCO5 is also divided according to the received frequency into four bands, one of which is selected according to the band data (RB0 to RB3) from the Control unit.

The IC package of this phase-locked loop, IC101 : MB87006 on the VHF converter board, receives 1/2 fSTD at pin 1, which is divided by 18 to create the 500kHz comparison reference signal.

The output signal from VCO5 passes through a low-pass filter, buffer, and amplifier (Q111 and Q100 : 2SC2570) then is mixed with low-order PLL signal VCO2. Then it is filtered by another low-pass filter and buffered by Q104 : 2SC2570, then applied to the pulse-swallow prescaler IC100 : HD10551. IC101 receives division ratio data N5 from the Control unit (SO, SCK, and LE2), according to which it divides the input signal while switching the swallow prescaler through the modulus control pin, and performs a phase comparison with the 500kHz comparison signal. Low-order decade signal VCO2 covers the received-frequency range from 108MHz to 174MHz in 10Hz steps, the same as in the HF band.

The frequencies in PLL5 are given as follows:

$$f_{VCO5} = f_{VHF} = f_{VCO2} + \text{PLL5 IF}$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N4}{1440000} + \frac{1}{2}\right) f_{STD} + f_{HET} + \frac{1}{18} \cdot \frac{1}{2} f_{STD} \cdot N5$$

$$= \left(\frac{N1}{1800000} + \frac{N2}{360} - \frac{N4}{1440000} + \frac{N5}{36} + \frac{1}{2}\right) f_{STD} + f_{HET}$$

CIRCUIT DESCRIPTION

• Unlocked signals

If even one of the phase-locked loops becomes unlocked, the displayed frequency would not agree with the received frequency. In unlocked operation, a signal is sent to the Control unit, which blanks the display to warn the user of the unlock condition.

From PLL2 on down the HF and VHF bands share the same phase-locked loops, so three analog signals are output, corresponding to PLL3 (HF), PLL5 (VHF), and PLL1 + PLL2 + PLL4 (low-order decades). If the PLL3 unlock signal (HUL) and low-order unlocked signal (ULK) are simultaneously active in the HF band or if the PLL5 unlock signal (VUL) and low-order unlock signal (ULK) are simultaneously active in the VHF band, the Control unit concludes that the PLL system is correctly locked.

The VUL signal is used to detect the presence or absence of the converter option. When the converter is not installed or is malfunctioning, VUL does not become active, so operation is unconditionally shifted to the HF band.

• MKR signal

The 500kHz comparison reference signal is always sent output from pin 13 of IC12, so this signal is used as the marker signal for 500kHz calibration.

Name	Use	IC components	Reference signal	Comparison frequency	R, Range of N	VCO frequency range	Test point	Unlock signal
PLL1	Digital VFO least significant digit	IC2 : MN6147C	1/2 fSTD	2kHz	45000~49999 (CW : 44920~49919) (FSK : 45229~50228)	90.0~99.998MHz (CW : 89.83~99.838MHz) (FSK : 90.458~100.456MHz)	Pin 3 : Reference signal 1/2 fSTD Pin 16 : VCO1 return signal, approx. 90~100MHz when locked.	Pin 2 : "H" when locked.
PLL2	Digital VCO middle digit	IC8 : MB87006 IC9 : μPB551C (Pulse swallow)	1/2 fSTD	50kHz	751~770 or 731~750	96.1125~97.11249MHz or 95.1125~96.11249MHz PLL2 IF 37.55~38.50MHz or 36.55~37.50MHz (In 50kHz steps)	Pin 1 : Reference signal 1/2 fSTD Pin 13 : Comparison signal 50kHz IC9, pin 2 : PLL2 IF signal	Pin 7 : "H" when locked.
PLL3	Digital VCO VHF band most significant digit	IC12 : MB87006	1/2 fSTD	500kHz	76~40 and 36~14 (Even number only)	58.1425~88.11245MHz PLL3 IF 38.0~20.0MHz 18.0~7.0MHz (In 1MHz steps)	Pin 1 : Reference signal 1/2 fSTD Pin 13 : Comparison signal 500kHz Pin 8 : PLL3 IF signal	Pin 7 : "H" when locked. PLL unit connector 5 , HUL terminal : "L" when locked.
PLL4	BFO signal	IC14 : MN6147C	1/4 fSTD	2.5kHz	Logical IF shift center value USB, CW : 13480 LSB, FSK : 13720 AF, FM : 13600 Varied by IF shift and carrier point compensation. 13209~13990	Logical IF shift center value USB, CW : 33.7MHz LSB, FSK : 34.3MHz AM, FM : 34.0MHz 33.0225~34.975MHz	Pin 3 : Reference signal 1/4 fSTD Pin 16 : VCO4 return signal, approx. 34MHz	Pin 2 : "H" when locked.
PLL5	Digital VFO VHF band most significant digit	VHF converter IC101 : MB87006 IC100 : HD10551 (Pulse swallow)	1/2 fSTD	500kHz	140~274 (Even number only)	166.1125~232.1125MHz PLL5 IF 70.0~137.0MHz (In 1MHz steps)	Pin 1 : Reference signal 1/2 fSTD Pin 13 : Comparison signal 500kHz Pin 8 : PLL5 IF signal	Pin 7 : "H" when locked. VHF converter connector 3 , VUL terminal : "L" when locked.

Table 3 PLLs summary

CIRCUIT DESCRIPTION

Digital Control

The digital section of the R-5000 has a multichip configuration consisting of a μPD7800G 8-bit microprocessor CPU, 16K-byte x 8-bit read-only memory (ROM), 2K-byte x 8-bit random-access memory (RAM), and two M5M82C55AP-5 universal C-MOS input-output ports. It also has an optional 8251 serial I/O port for interfacing with a personal computer. These components are connected via a common data bus.

Fig. 12 is a block diagram of the control system. The integrated circuits are interfaced by an address bus, data bus, and control bus. Data flow is controlled by the microprocessor.

The digital control section consists of the Control unit (X53-3020-XX) and Display unit (X54-3010-00).

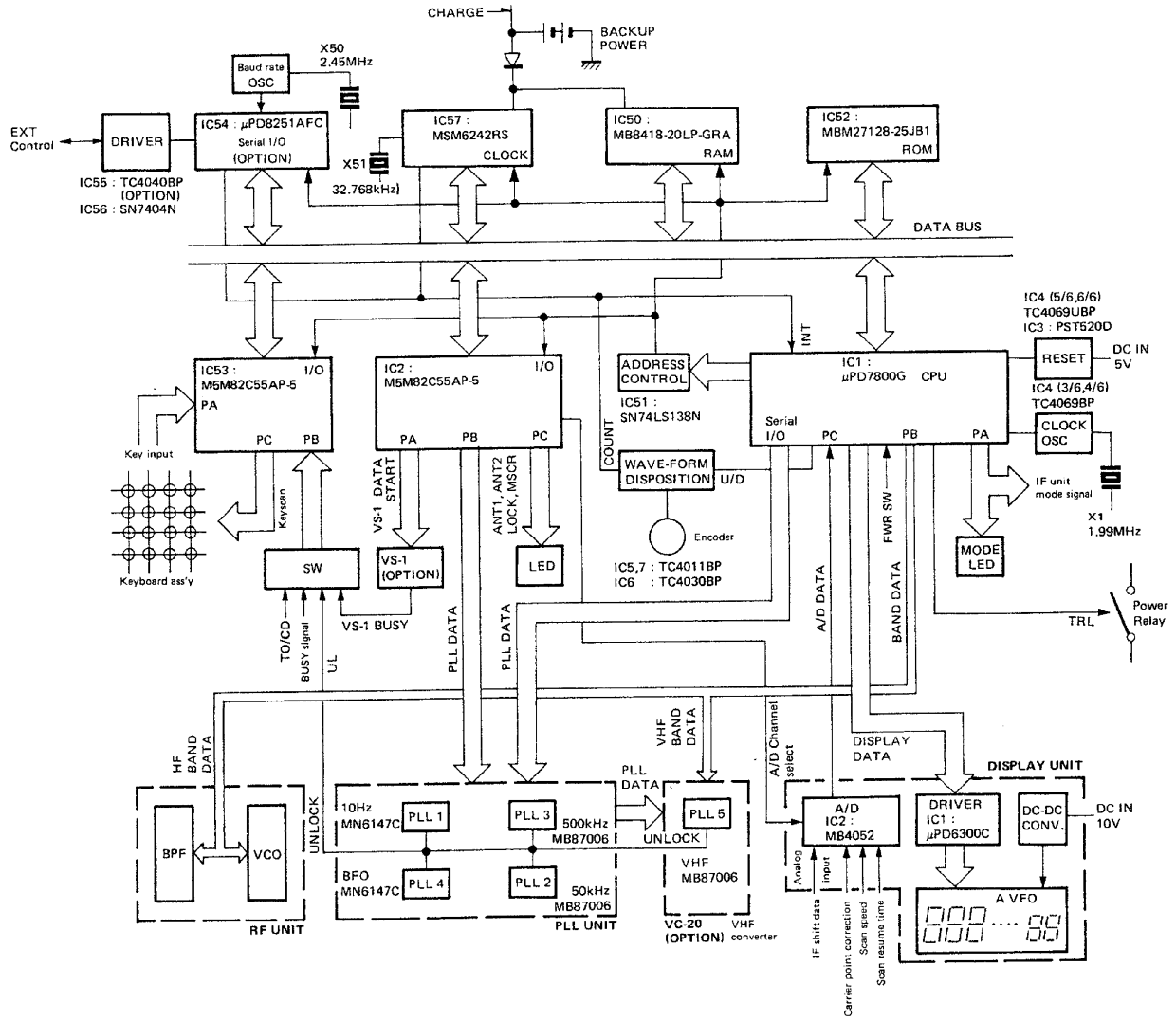


Fig. 12 Control circuit block diagram

CIRCUIT DESCRIPTION

• Details of the Units

The control unit is a microcomputer incorporating a CPU, ROM, RAM, parallel I/O, serial I/O (optional), encoder waveform-shaping circuit, system reset circuit, system clock, and real-time clock.

The Display unit consists of a display data interface, A/D converter, fluorescent indicator tubes, an indicator driver, and a DC-DC converter.

The microcomputer section operates continuously as long as the set is plugged in, regardless of whether the power switch is ON or OFF. It also controls the display of time and runs the timer.

• Encoder Circuit

The encoder is an optical deivce that provides two count pulses 90° out of phase. In the Control unit, this two-phase signal is resolved into an up/down directional signal and count pulses that notify the microprocessor of the rotation of the encoder. The encoder has 250 slits, each slit giving rise to four count pulses so that one rotation of the encoder generates 1000 pulses.

Fig. 13 shows the encoder circuit, and **Fig. 14** gives the timing chart.

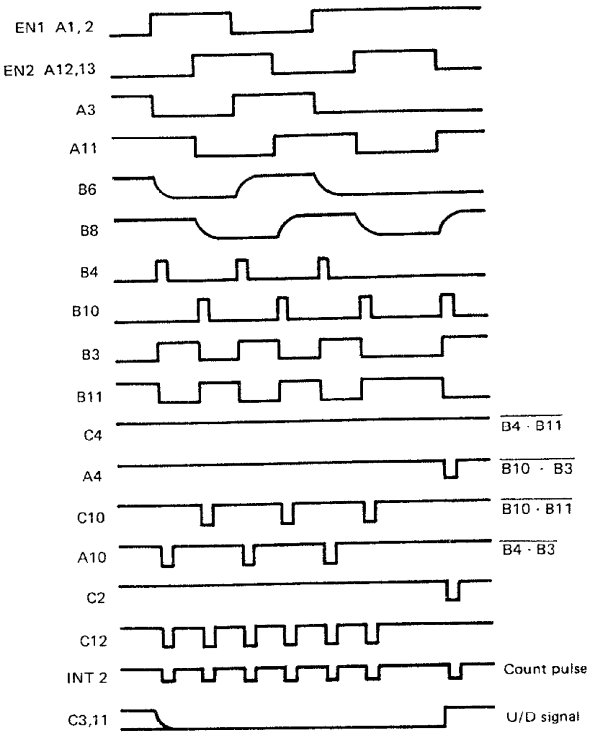


Fig. 14 Encoder timing chart

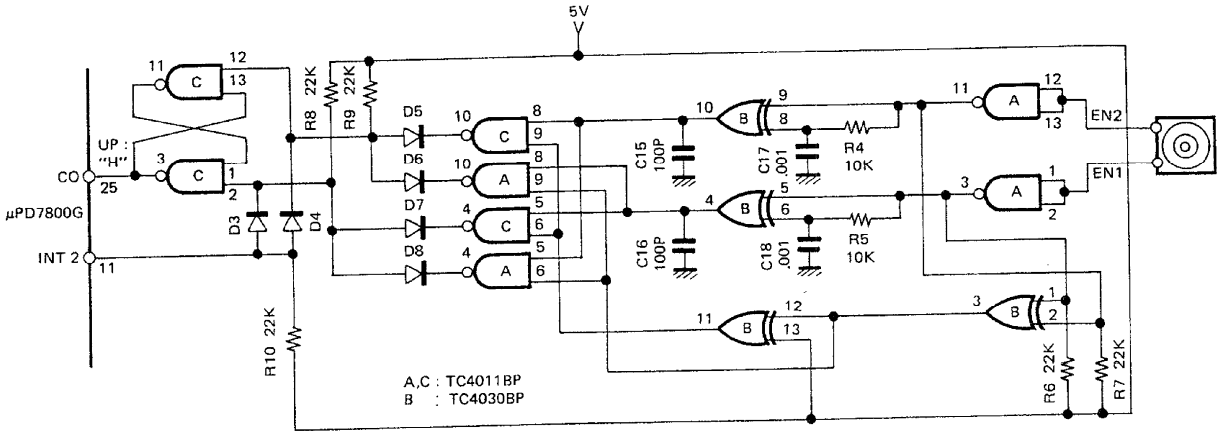


Fig. 13 Encoder waveform-shaping

CIRCUIT DESCRIPTION

• System Clock and System Reset Circuits

The μPD7800G microprocessor requires a 2.00MHz system clock, which is generated by ceramic oscillator X1 and IC4 (3/6, 4/6). Since the system clock consists of square waves, it contains infinite high-frequency harmonics that cause internal beats, so the frequency is moved slightly down to 1.99MHz to avoid interference in the amateur band.

IC3 is the reset circuit. When the supply voltage is approximately 4.3V, it sends a reset signal to the microprocessor and I/O ports that halts them immediately. The reset signal is cleared when the supply voltage goes above 4.3V; after the time constant determined by R3 and C10, the microprocessor is initialized and begins running. (**Fig. 15** is a schematic of IC3 and IC4 (3/6, 4/6); 7 **Fig. 16** is a reset timing chart.)

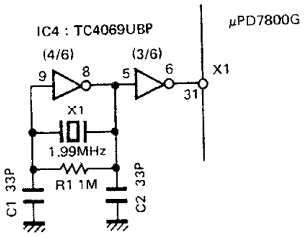


Fig. 15 System clock oscillation circuit

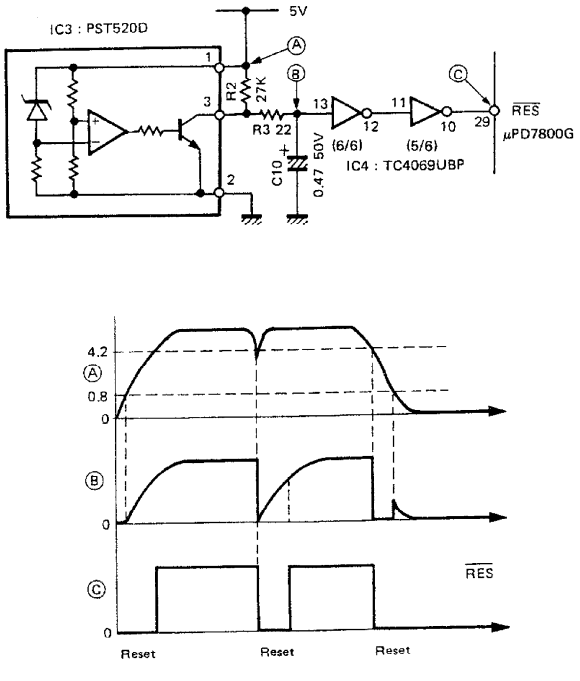
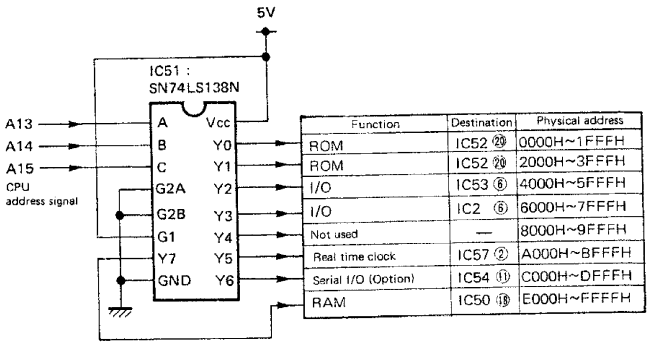


Fig. 16 Reset circuit and timing chart

• Address Control

The address signals (E0 to E15) from the microprocessor cannot be used directly to select chips; they must be decoded by IC51 : SN74LS138N to obtain a selection signal. IC51 has a 64K-byte memory area which is divided into eight 8K-byte blocks, one for each IC chip. **Fig. 17** shows the address control circuits, and **Fig. 18** is a memory map of the R-5000.



Function	Destination	Physical address
ROM	IC52 ⑳	0000H~1FFFH
ROM	IC52 ⑳	2000H~3FFFH
I/O	IC53 ⑥	4000H~5FFFH
I/O	IC2 ⑤	6000H~7FFFH
Not used	—	8000H~9FFFH
Real time clock	IC57 ②	A000H~BFFFH
Serial I/O (Option)	IC54 ⑪	C000H~DFFFH
RAM	IC50 ⑬	E000H~FFFFH

Fig. 17 Address control division

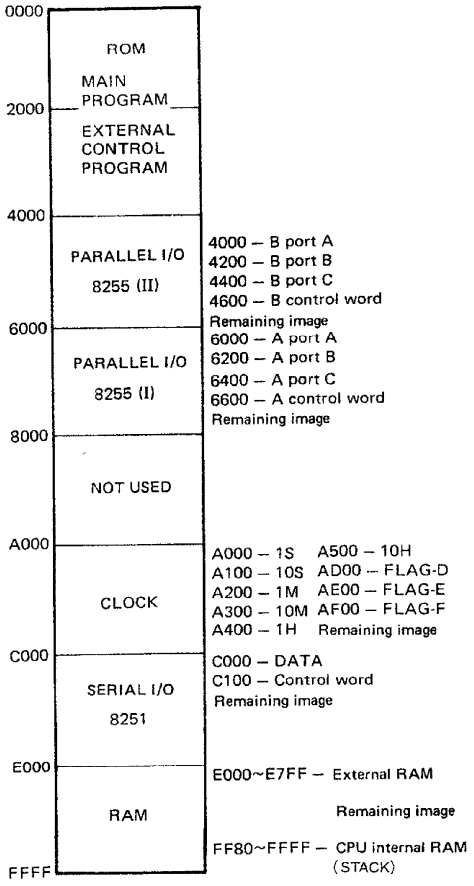


Fig. 18 Memory map

CIRCUIT DESCRIPTION

- **Real-Time Clock**

IC57 is a single-chip real-time clock connected to a 32.768kHz crystal oscillator (X51). The microprocessor reads current time data from this clock chip and displays it as CLOCK1. The clock chip divides the 32.768kHz frequency by 512 to produce a 64Hz signal that it uses to flash the colon every 0.5s and to generate microprocessor interrupts to read the time at 1s. When CLOCK2 is set, the difference from CLOCK1 is calculated each time CLOCK1 changes to create the CLOCK2 signal.

- **Display Drive Interface**

A timer in the microprocessor generates an interrupt approximately every 1ms for sending display data to the μPD6300C display driver chip in the Display unit. The data is sent serially from the microprocessor at a rate of 1MHz, but is divided to 500kHz by IC3 before being passed to the μPD6300C. The 13 digit, and the 7-segment signals are buffered by μPD6300. Dp is buffered by a transistor and the red characters are driven by 8V for intensity balance.

A total of 40 bits of display data is sent 8 bits at a time, followed by a negative enable pulse to latch the data in the μPD6300C and light the display.

The μPD6300C has a $\overline{BI}$ pin that can easily be connected to a duty-control type of dimmer. In the R-5000, a 555 timer is used for duty control by a one-shot multivibrator on the latch pulse ($\overline{LH}$). The $\overline{BI}$ pin is high when the dimmer is OFF and receives a square wave with a duty ratio of approximately 20% when the dimmer is ON.

Fig. 19 shows the Display circuits.

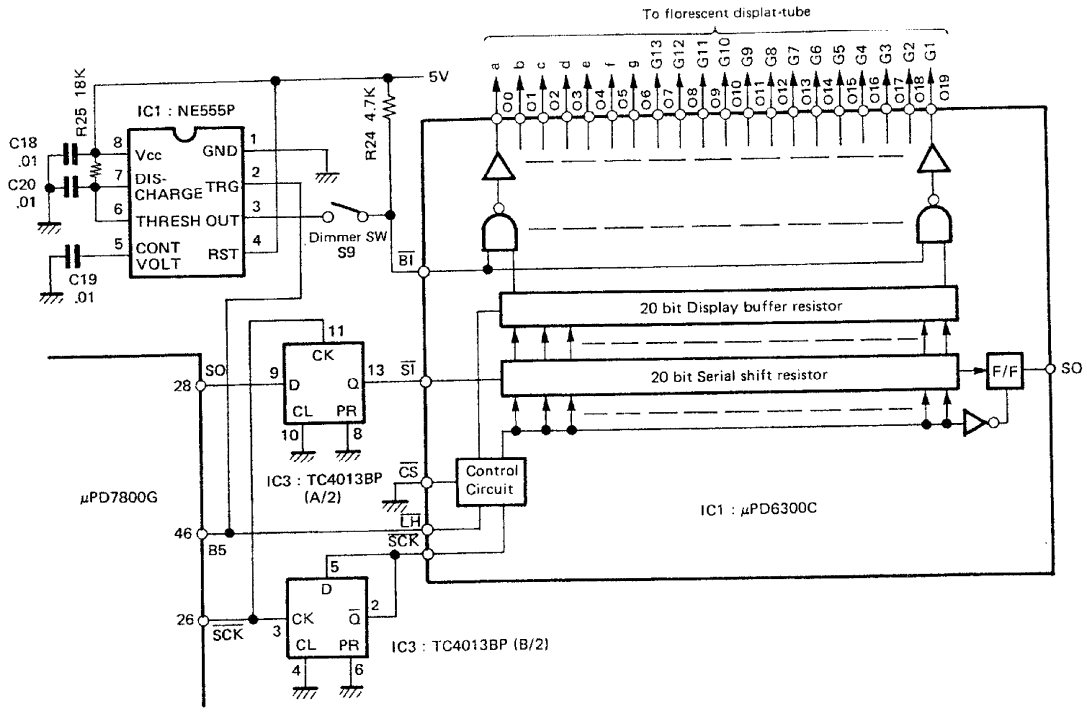


Fig. 19 Digital display circuit

CIRCUIT DESCRIPTION

• A/D Converter Analog Input

The R-5000 uses four A/D converters to generate digital signals for IF shifting, carrier point correction, scan speed and scan resume time, which are read by the microprocessor. The A/D converter in the Display unit is linked by the channel select signal and control signal for data input from the Control unit. The microprocessor sends the channel select signal first. A positive-going pulse from port B0 of IC2 : M5M82C55AP-5 resets the MB4052 A/D converter. After nine clock pulses from port C0 of the μPD7800G have been sent, the digital output of the A/D converter is sent to port C7 of microprocessor synchronized with the clock. **Fig. 20** and **21** show the ciruits associated with the A/D converter and the timing diagram.

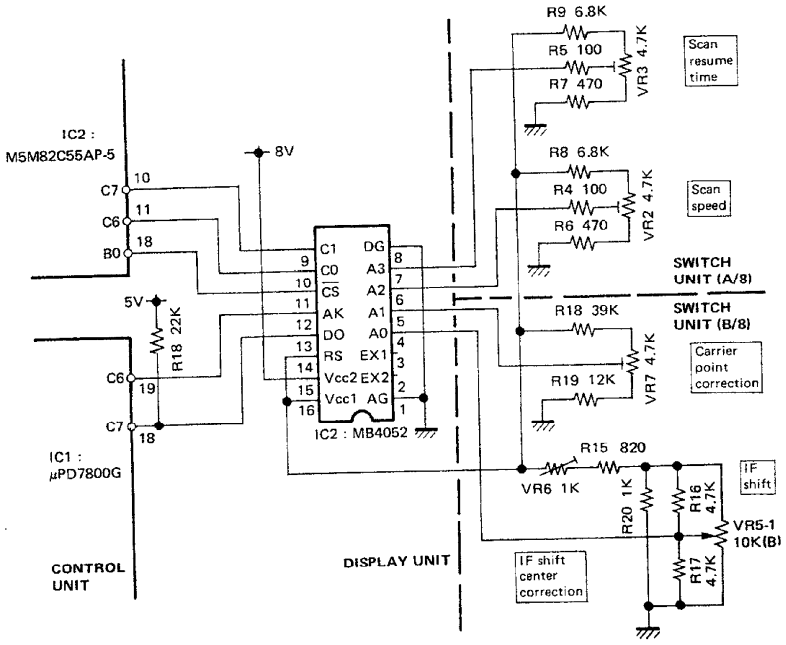


Fig. 20 A/D converter peripheral circuit

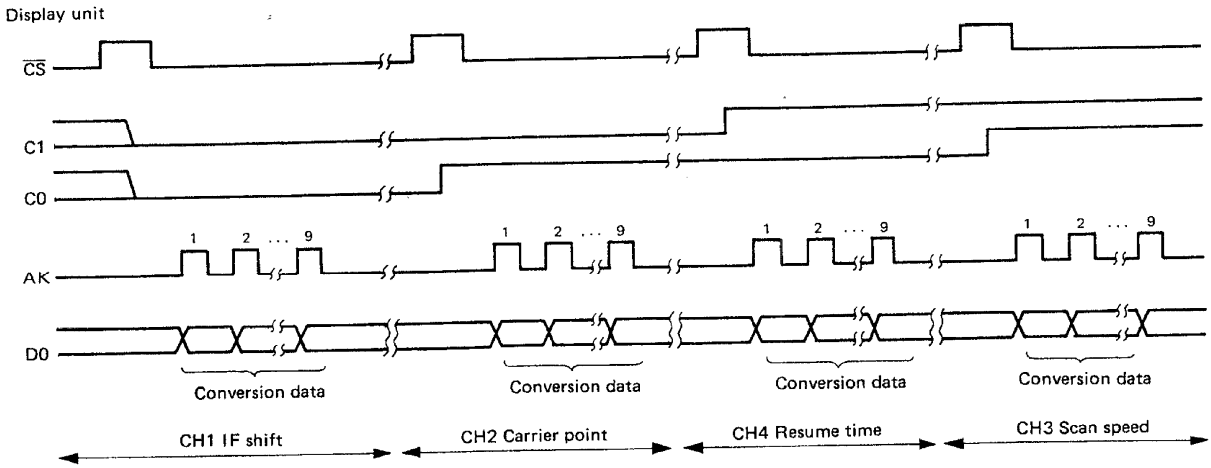


Fig. 21 A/D converter data timing chart

CIRCUIT DESCRIPTION

• PLL Data

The R-5000 has five phase-locked loops, four of which are standard and one of which is part of the optional VHF converter. Two types of loops are used: an MB87006 for serial data input and an MN61471C for 4-bit parallel data input. Data is generated from the VFO and the received frequency in memory by calcuculation, and sent to the PLL chips.

The MB87006 chip for PLL2, PLL3, and PLL5 uses serial input data. It requires two inputs: the reference frequency division ratio and variable divider data. Since the comparison frequency does not have to be changed, it is sent only once, when power is switched ON.

The MN6147C chip used for PLL1 and PLL4 is a 4-bit parallel device. Reference division data and variable division data are set by sending data eight times with clock pulses. The chip has an internal latch so only the bits that change in G1 to G7 are sent; data is latched on the G8 latch pulse, which shortens the data transfer time. (See **Fig. 22** and **23**.)

Ports B0 to B6 of IC2 : M5M82C55AP-5 and SCK and S0 of IC1 : μPD7800G are data output ports. From the microprocessor's built-in serial ports CSK and S0, the MB87006 phase-locked loop receives microprocessor data multipleded with display data. Latch enable pulses are sent from microprocessor ports B4 (LE2 for the UHF PLL) and B6 (LE1 for the HF PLL), and from port B5 of IC2 (CL2 for PLL2). At the MN6147C chip, ports B0 to B3 of IC2 are the four-bit data; the clock pulses come from port B4 of IC2 (CL1 for PLL1) and port B6 of IC2 (CL4 for PLL4)

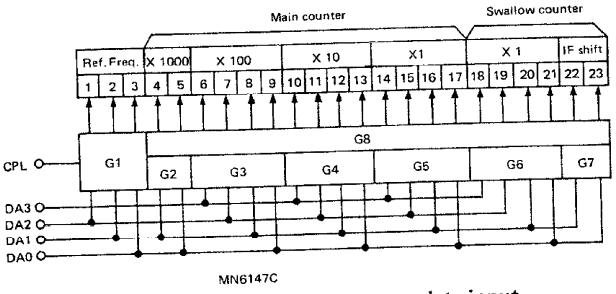


Fig. 22 Relationship between data input terminal and programmable counter

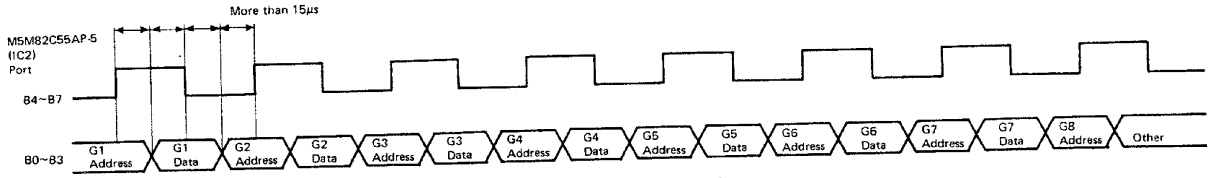


Fig. 23 MN6147C PLL data

• Band Information

The 4-bit band information from the Control unit is sent to the RF unit and optional converter unit, where it selects the RF bandpass filters and the VCO of the last phase-locked loop. Hexadecimal 0 to 9 designate the HF band, hexadecimal C to F the VHF band. **Table 4** indicates the bandpass filters and voltage-controlled oscillators selected by the band information.

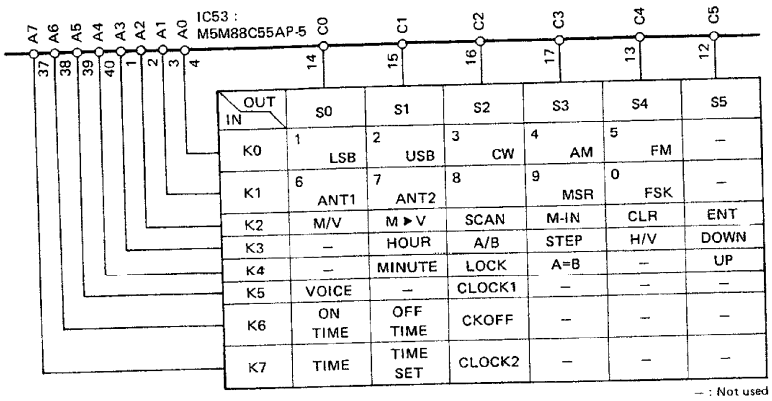
BAND data					B.P.F.	VCO	Active pin	
Hexa-decimal	RB3	RB2	RB1	RB0				
0	0	0	0	0	J (21.5~30MHz)	VCO 4	RF unit IC1 Goes "L" when selected.	pin 1
1	0	0	0	1	I (14.5~21.5MHz)	VCO 3		pin 2
2	0	0	1	0	H (10.5~14.5MHz)	VCO 2		pin 3
3	0	0	1	1	G (7.5~10.5MHz)			pin 4
4	0	1	0	0	F (5.5~7.5MHz)	VCO 1		pin 5
5	0	1	0	1	E (3.5~5.5MHz)			pin 6
6	0	1	1	0	D (2.5~3.5MHz)			pin 7
7	0	1	1	1	A (0~0.5MHz)			pin 9
8	1	0	0	0	B (0.5~1.6MHz)			pin 10
9	1	0	0	1	C (1.6~2.5MHz)			pin 11
A	1	0	1	0	Not used			
B	1	0	1	1				
C	1	1	0	0	VA (108~123MHz)	VCO LL	VC-20 IC103 Goes "L" when selected.	pin 12
D	1	1	0	1	VB (123~138MHz)	VCO L		pin 11
E	1	1	1	0	VC (138~155MHz)	VCO H		pin 10
F	1	1	1	1	VD (155~174MHz)	VCO HH		pin 9

Table 4 Relationship between BAND data, BPF and VCO

CIRCUIT DESCRIPTION

● **Key Scan**

Ports C and A of IC53 : M5M82C55AP-5 form the key scan matrix. The key scan signal is output on a negative pulse from port C. The corresponding column of port A is selected, and the state of the switch is read. If a switch at is on, the corresponding bit of port A goes low, indicating which switch has been pressed.



OUT / IN	S0	S1	S2	S3	S4	S5
K0	1 LSB	2 USB	3 CW	4 AM	5 FM	–
K1	6 ANT1	7 ANT2	8	9 MSR	0 FSK	–
K2	M/V	M►V	SCAN	M-IN	CLR	ENT
K3	–	HOUR	A/B	STEP	H/V	DOWN
K4	–	MINUTE	LOCK	A=B	–	UP
K5	VOICE	–	CLOCK1	–	–	–
K6	ON TIME	OFF TIME	CKOFF	–	–	–
K7	TIME	TIME SET	CLOCK2	–	–	–

– : Not used

Fig. 24 Keyscan matrix

● **Extended Functions**

Diodes D65 to D72 provide extended functions with definitions as listed in the table below. These extended functions are read only once, when power is turned ON.

		Shipped	When diode cut :
D65	Display	10Hz	100Hz
D66	Mode buzzer	Morus	Single tone
D67	FM step	STEP ON : 2.5kHz	STEP ON : 500Hz
D68	BUSY stop	FM, AM only	All mode
D69	Memory search	No exist	The BAND UP/DOWN switch is the search button, which is valid in the MSR and MCH modes. In the MCH mode the channels stored in memory are searched. In the MSR mode, the channels not stored in memory are searched.
D70 D71			Not used
D72	Memory protection	OFF	Memory Protection : ON Channel information that has been written into memory cannot be altered or erased. Channel information is erased, however, if back-up power is lost.

Table 5 Extended functions

● **Static input**

IC1 : μPD7800G

Terminal		Signal		Function
Name	No.	Symbol	Name	
C0	25	EUD	Encoder UP/DOWN signal	H : UP, L : DOWN
C1	24	PWR	Power switch signal	H : OFF, L : ON
C2	23	ULK	PLL low-digit unlock	H : LOCK, L : UNLOCK
C7	18	D0	A/D converter data	

IC53 : M5M82C55AP-5

Terminal		Signal		Function
Name	No.	Symbol	Name	
B0	18	MT2	External mute signal	H : NONE, L : MUTE
B1	19	BSY	BUSY signal (counter stop)	H : NONE, L : BUSY
B3	21	HUL	PLL IF high-digit unlock	H : UNLOCK, L : LOCK
B4	22	VUL	PLL VHF high-digit unlock	H : UNLOCK, L : LOCK
B6	24	C0	BUSY stop T0/C0	H : C0, L : T0
B7	25	BY	VS-1 BUSY signal	H : VS-1 sound output, L : NONE

Table 6 Static input signal list

● **DC-DC Converter**

The DC-DC converter drives the fluorescent indicator tubes in the Display unit. The converter changes 10V input into –21V and 3.4V AC outputs for the filaments. The negative voltage (–5V) required by the IF unit is delivered from the –21V. The converter consists of two 2SC1959(Y) self-oscillators with frequency of about 17kHz.

CIRCUIT DESCRIPTION

• External Control Baud Rate Oscillation Circuit

When serial data is exchanged between the R-5000 and a personal computer, usual transfer rate is 300, 1200, or 4800 baud. The desired baud rate is produced by a binary counter that divides the frequency of 2.4576MHz of ceramic oscillator (X50) in the Control unit.

The circuit can be set as high as 76.800 baud, best in practice the upper limit is 4800 or 9600. baud.

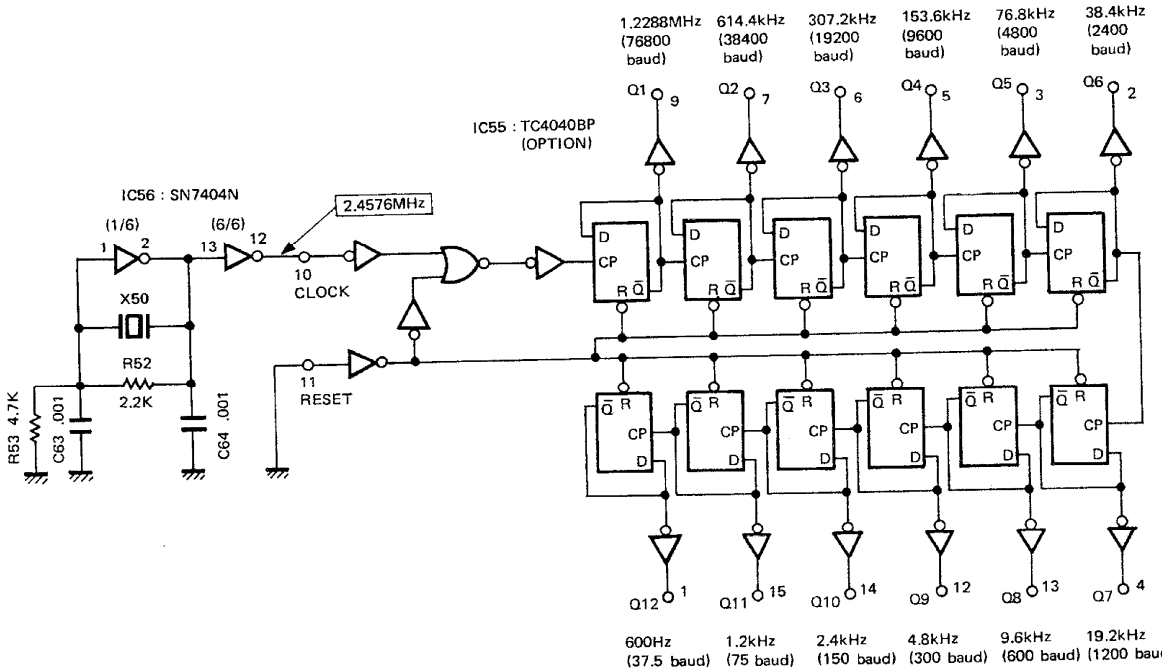


Fig. 25 Serial interface baud rate oscillation circuit

• Output Ports

1. Mode signals M1 to M6 (μPD7800G ports A0 to A5)

The signals designating the LSB, USB, CW, AM, FM, and FSK modes are sent from the microprocessor. When the mode lamp on the keyboard assembly lights, the corresponding mode signal is sent to the IF unit. These are open-collector output.

2. Timer Relay Signal TRL (μPD7800G port A6)

To support the timer and clock display functions of the R-5000, its microprocessor begins running as soon as the power cord is plugged in, and keeps running as soon as long as power is supplied. The timer relay signal turns the power of the receiver section ON and OFF at the time set by the power switch and timer switch, using an open-collector signal.

3. VS1 Data PS0 to PS4, SR (IC2 : M5M82C55AP-5 A0 to A5)

Ports S0 to S4 output audio data. After the audio data is set, SR goes active (high) to send the audio.

4. Blanking BLK (IC2 : M5M82C55AP-5)

This signal removes the clicking that accompanies PLL switching. The signal is active (high) during the blanking period.

5. LED Output (IC2 : M5M82C55AP-5)

These open-collector terminals carry data that drives the LED indicators on the keybaord assembly. All four of the IC pins are active-high open-collector outputs. The inidcators light when the output is active.

See **Table 7** for a table of inputs and outputs.

CIRCUIT DESCRIPTION

IC1 : μPD7800G

Terminal name	I/O	Active	Symbol	Function
A0	O	H	M1	LSB mode
A1	O	H	M2	USB mode
A2	O	H	M3	CW mode
A3	O	H	M4	AM mode
A4	O	H	M5	FM mode
A5	O	H	M6	FSK mode
A6	O	H	TRL	Timer relay
A7	O	H	BZ	
B0	O	H	B0	Band data
B1	O	H	B1	
B2	O	H	B2	
B3	O	H	B3	
B4	O	H	LE2	VHF PLL enable
B5	O	H	LEF	Display enable
B6	O	H	LE1	HF PLL enable
B7	O	H	RES	
C0	I	–	EUD1	Encoder UP/DOWN
C1	I	–	PWR	Power switch
C2	I	–	ULK	PLL low-figure unlock
C3	O	H	X	Display data
C4	O	L	DP	
C6	O	H	AK	A/D acknowledge
C7	I	–	D0	A/D data

IC2 : M5M82C55AP-5

Terminal name	I/O	Active	Symbol	Function
A0	O	H	PS0	VS-1
A1	O	H	PS1	
A2	O	H	PS2	
A3	O	H	PS3	
A4	O	H	PS4	
A5	O	H	SR	
A6	O	H	BLK	Blanking
B0	O	H	DA0	Combinedly used for ADCS and MN6147C data
B1	O	H	DA1	
B2	O	H	DA2	
B3	O	H	DA3	
B4	O	H	CL1	10Hz PLL
B5	O	H	CL2	50kHz PLL
B6	O	H	CL4	BFO PLL
C0	O	H	AL1	ANT1 LED
C1	O	H	AL2	ANT2 LED
C2	O	H	MSC	MCR LED
C3	O	H	LKL	LOCK LED
C6	O	H	C0	A/D address
C7	O	H	C1	

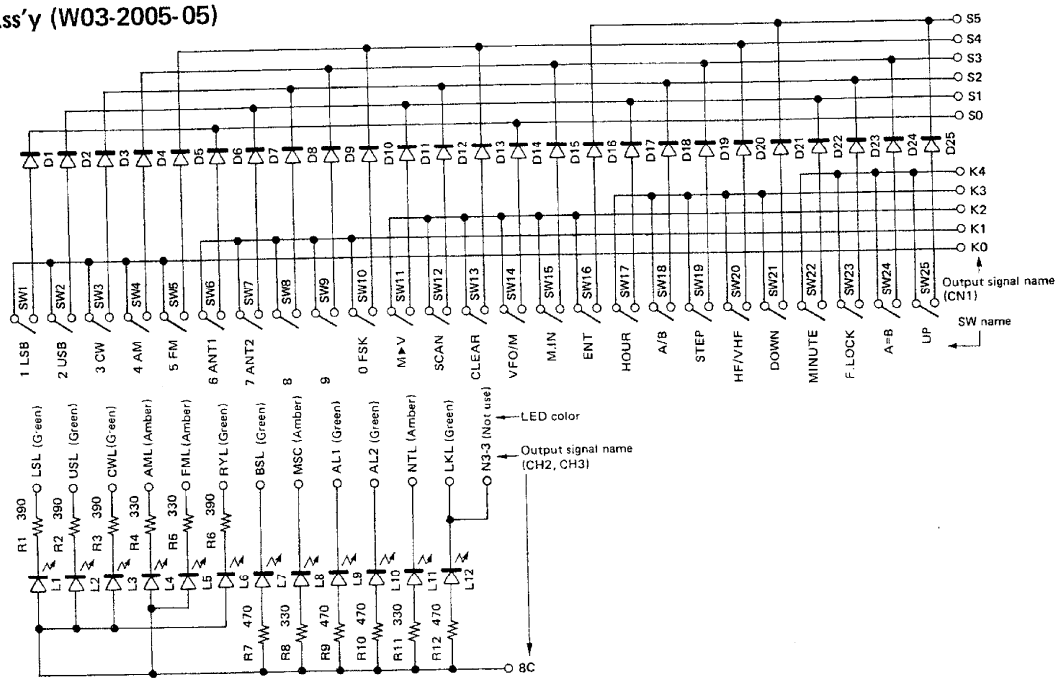
IC53 : M5M82C55AP-5

Terminal name	I/O	Active	Symbol	Function
A0	I	L	K0	Key sense column
A1	I	L	K1	
A2	I	L	K2	
A3	I	L	K3	
A4	I	L	K4	
A5	I	L	K5	
A6	I	L	K6	
A7	I	L	K7	
B0	I	H : Not MUTE, L : MUTE	MT2	External mute
B1	I	H : Not BUSY L : BUSY	BSY	BUSY signal
B3	I	H : UNLOCK L : LOCK	HUL	HF unlock
B4	I	H : UNLOCK L : LOCK	VUL	VHF unlock
B6	I	H : C0, L : T0	CO	Carrier operate
B7	I	H : Talking L : Not BSY	BY	VS-1 BSY signal
C0	O	L	S0	Key sense
C1	O	L	S1	
C2	O	L	S2	
C3	O	L	S3	
C4	O	L	S4	
C5	O	L	S5	

Table 7 I/O signal pin function

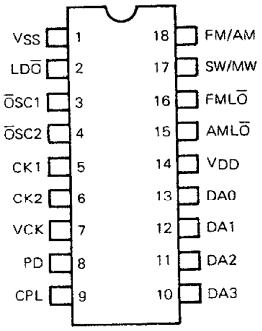
SEMICONDUCTOR DATA

Keyboard Ass'y (W03-2005-05)

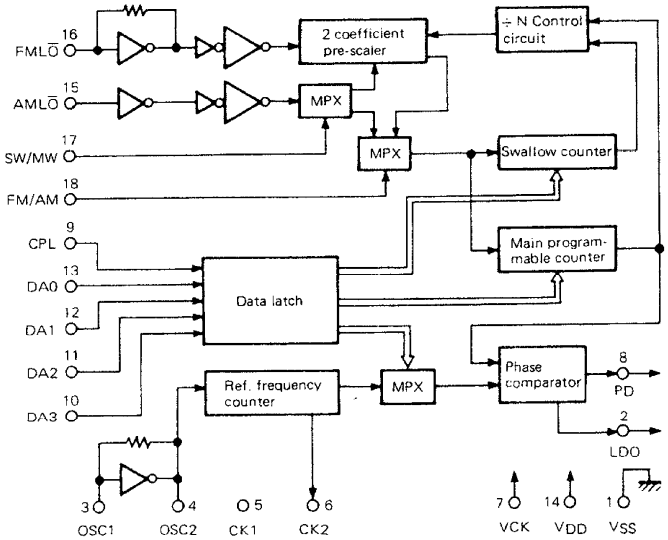


MN6147C (PLL unit IC2, IC14)

- **Terminal connection diagram**



- **Block diagram**



- **Terminal functions**

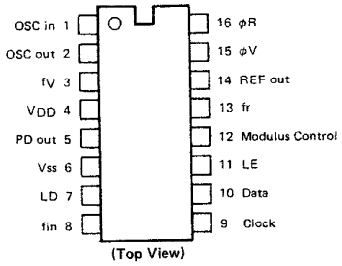
Terminal No.	Symbol	Terminal function	Terminal No.	Symbol	Terminal function
1	Vss	GND	10	DA3	Data and address input (MSB)
2	LDO(QO)	Lock detector output (OSC circuit output)	11	DA2	Data and address input
3	OSC1	4.5MHz X'tal OSC	12	DA1	
4	OSC2		13	DA0	Data and address input (LSB)
5	CK1	Clock output 1 (562.5kHz)*	14	VDD	Main power supply (+ 5V)
6	CK2	Clock output 2 (250Hz)	15	AMLO	AM band OSC signal input
7	VCK	Clock divider circuit, battery back-up (+ 5V)	16	FMLO	FM band OSC signal input
8	PD	Latch detector output (three states)	17	SW/MW	SW/MW select
9	CPL	Latch clock	18	FM/AM	FM/AM select

Note : One of three clock frequencies; 187.5kHz, 375kHz, and 1.125MHz can be selected by a wiring change.

SEMICONDUCTOR DATA

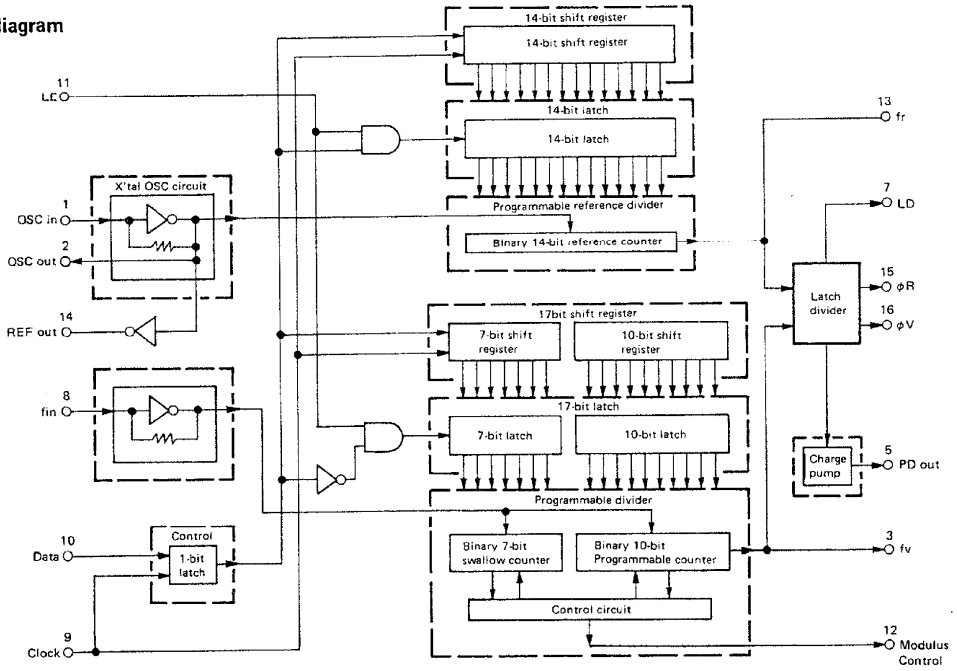
MB87006 (PLL unit IC8, IC12)

- **Terminal connection diagram**



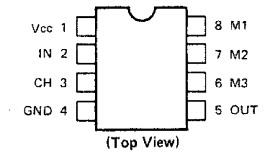
Terminal No.	I/O	Terminal name	Terminal No.	I/O	Terminal name
1	I	OSC in	9	I	Clock
2	O	OSC out	10	I	Data
3	O	fv	11	I	LE
4	—	VDD	12	O	Modulus Control
5	O	PD out	13	O	fr
6	—	VSS	14	O	REF out
7	O	LD	15	O	φV
8	I	fin	16	O	φR

- **Block diagram**

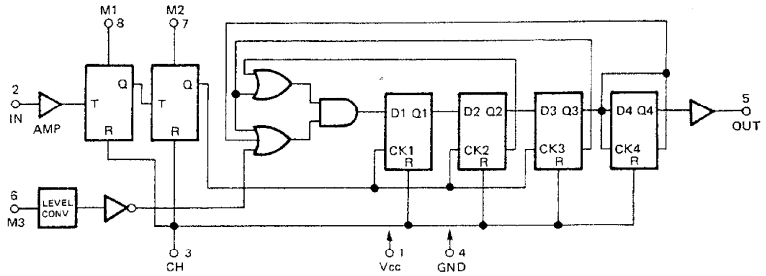


μPB551C (PLL unit IC9)

- **Terminal connection diagram**



- **Block diagram**



- **Divide ratio**

Divider ratio	M1	M2	M3
40	GND	GND	L
44	GND	GND	H
20	GND	Vcc	L
22	GND	Vcc	H
10	Vcc	Vcc	L
11	Vcc	Vcc	H

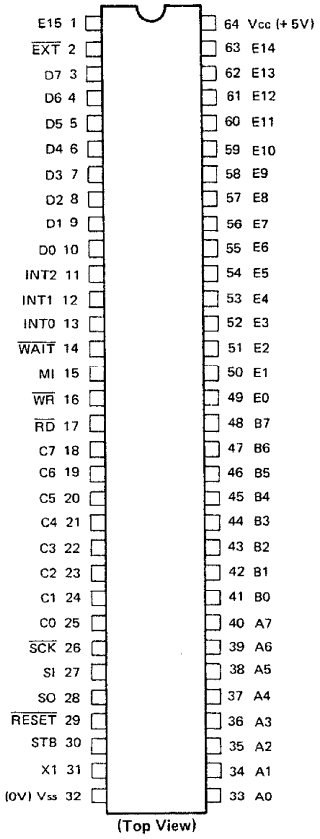
- **Terminal function**

Terminal No.	Symbol	Function
1	Vcc	Power supply terminal (+ 5V)
2	IN	AC signal input
3	CH	Check, Normally GND
4	GND	GND
5	OUT	Output terminal
6	M3	Frequency division ratio
7	M2	Frequency division ratio
8	M1	Frequency division ratio

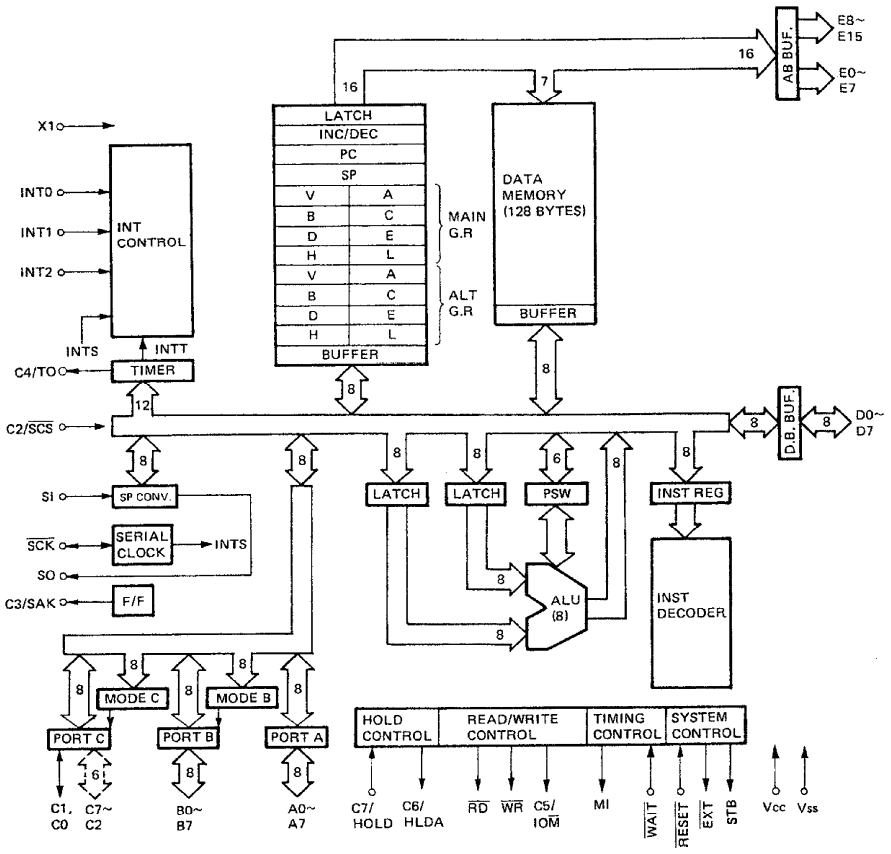
SEMICONDUCTOR DATA

μPD7800G (Control unit IC1)

- **Terminal connection diagram**

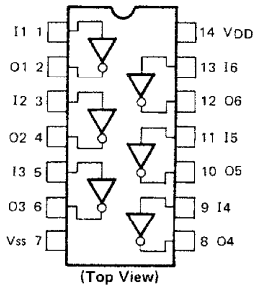


- **Block diagram**



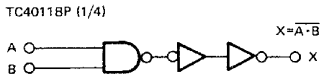
TC4069UBP (Control unit IC4)

- **Block diagram**

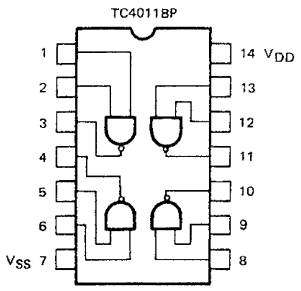


TC4011BP (Control unit IC5, IC7)

- **Logic circuit**

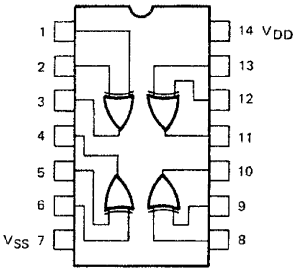


- **Block diagram**



TC4030BP (Control unit IC6)

- **Block diagram**



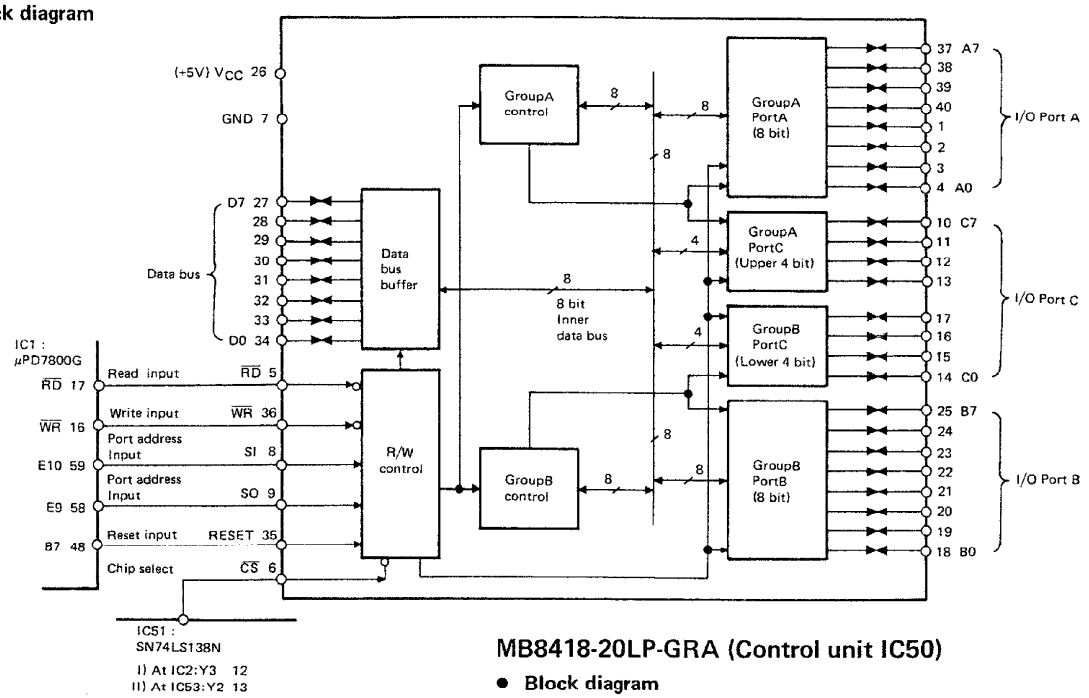
- **Truth table**

INPUT		OUTPUT
A	B	X
L	L	L
L	H	H
H	L	H
H	H	L

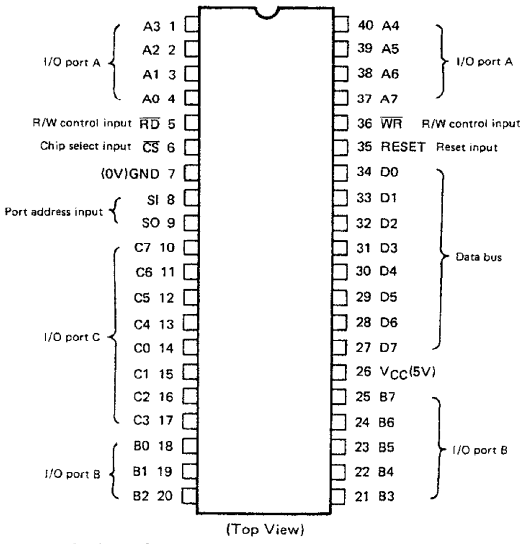
SEMICONDUCTOR DATA

M5M82C55AP-5 (Control unit IC2, IC53)

- **Block diagram**



- **Terminal connection diagram**

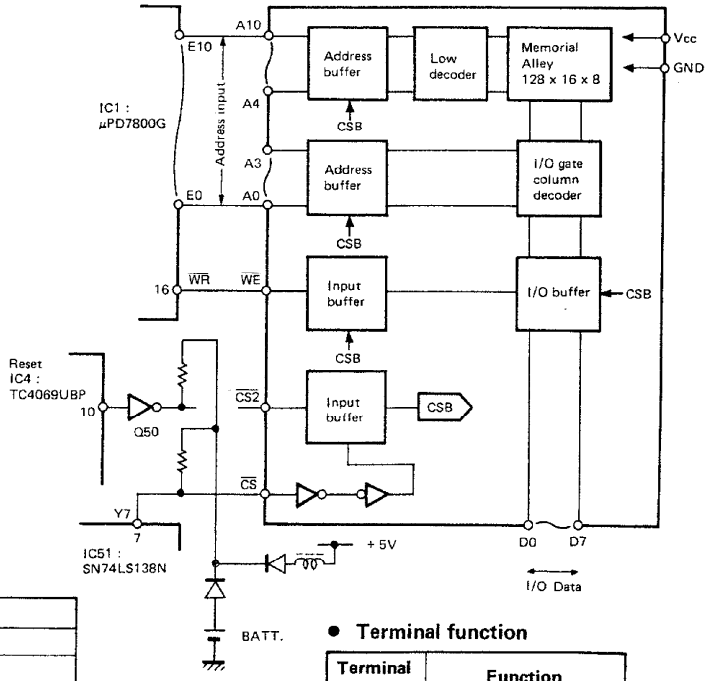


- **Basic function**

SI	SO	CS	RD	WR	Function
L	L	L	L	H	Data bus ← Port A
L	H	L	L	H	Data bus ← Port B
H	L	L	L	H	Data bus ← Port C
L	L	L	H	L	Port A ← Data bus
L	H	L	H	L	Port B ← Data bus
H	L	L	H	L	Port C ← Data bus
H	H	L	H	L	Control register ← Data bus
—	—	H	—	—	Data bus is in the high-impedance state.
H	H	L	L	H	Prohibit assortment

MB8418-20LP-GRA (Control unit IC50)

- **Block diagram**



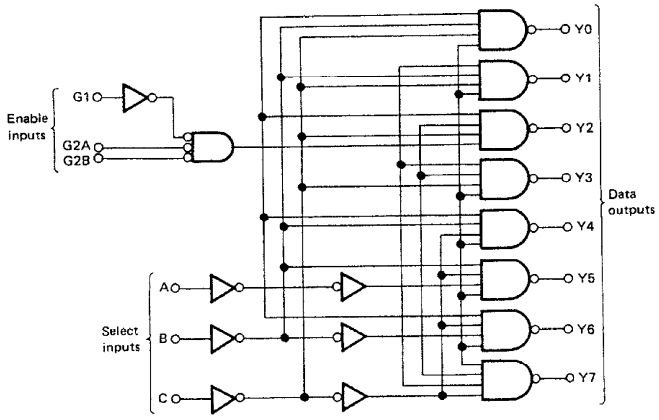
- **Terminal function**

Terminal name	Function
A0~A10	Address input
D0~D7	Data input/output
$\overline{CS}$	Chip select 1
$\overline{SC2}$	Chip select 2
$\overline{WE}$	Write enable
Vcc	Power supply (+ 5V)
GND	Ground

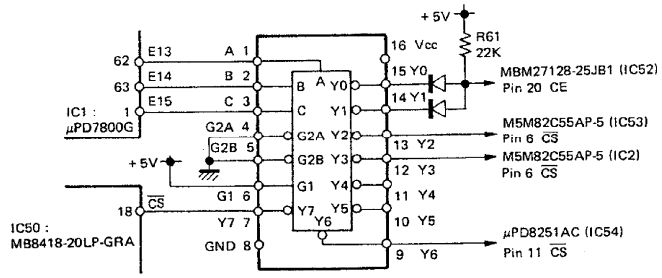
SEMICONDUCTOR DATA

SN74LS138N (Control unit IC51)

- **Logic circuit**

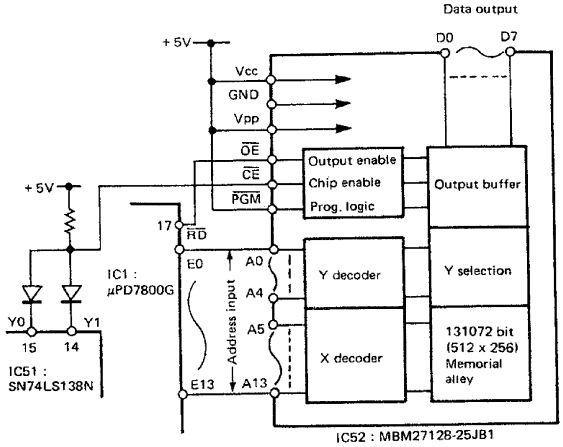


- **Block diagram**



MBM27128-25JB1 (Control unit IC52)

- **Block diagram**



- **Terminal function**

Terminal name	Function
A0~A13	Address input
D0~D7	Data output
$\overline{CE}$	Chip enable input
$\overline{OE}$	Output enable input
$\overline{PGM}$	Program input
Vcc	Power supply
Vpp	Program power supply
GND	Ground

- **Truth table**

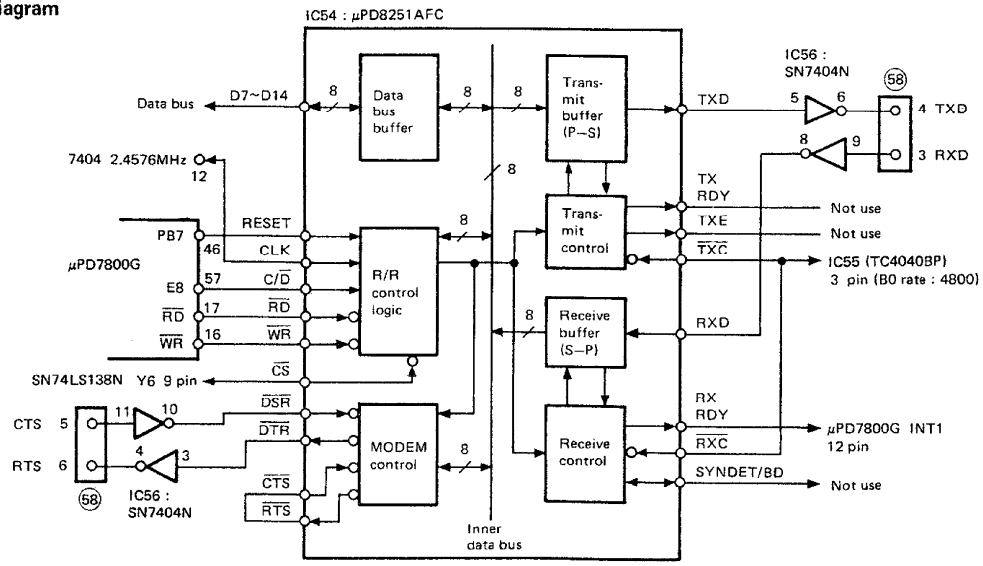
INPUT					OUTPUT							
Enable		Select										
G1	G2	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	H	H	H	H	H	L	H	H	H	H
H	L	H	L	L	H	H	H	H	L	H	H	H
H	L	H	L	H	H	H	H	H	H	L	H	H
H	L	H	H	L	H	H	H	H	H	H	L	H
H	L	H	H	H	H	H	H	H	H	H	H	L

Note 1 : G2 = G2A + G2B
Note 2 : H : High level
L : Low level
X : Either "H" or "L"

SEMICONDUCTOR DATA

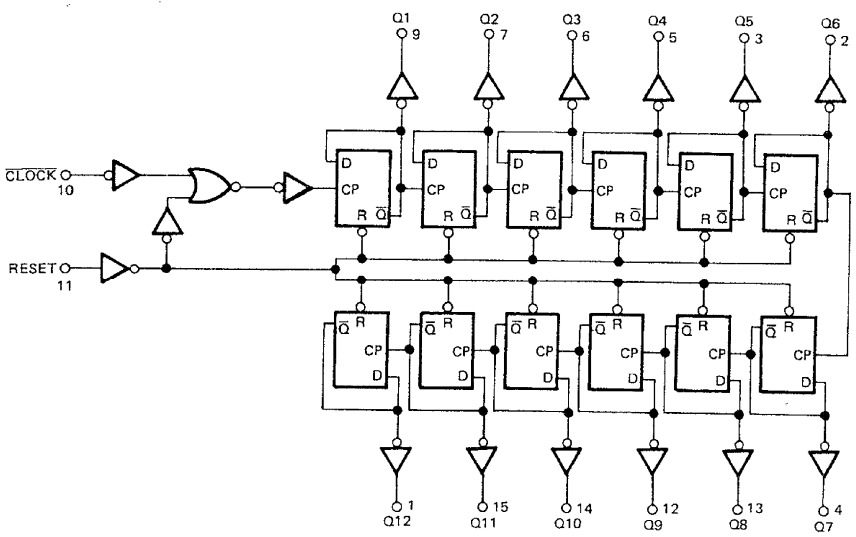
μPD8251AFC (Control unit IC54) : Optional

- **Block diagram**



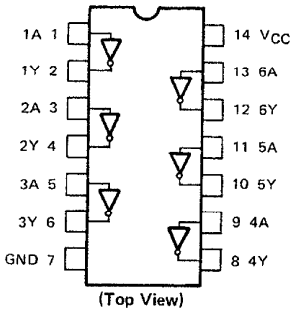
TC4040BP (Control unit IC55) : Optional

- **Block diagram**



SN7404N (Control unit IC56)

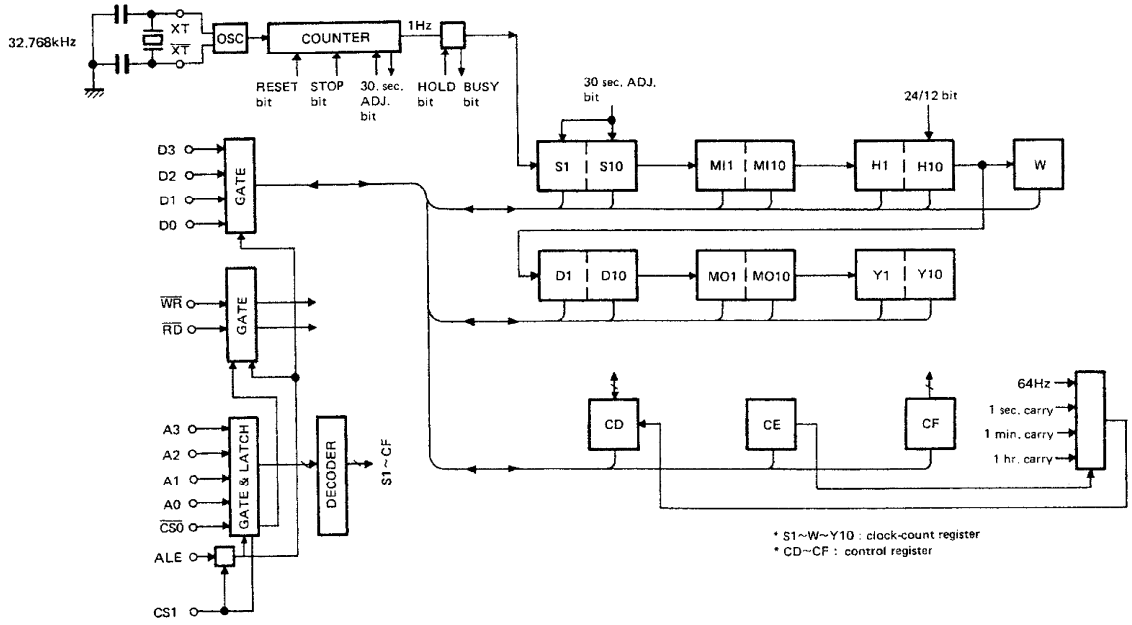
- **Block diagram**



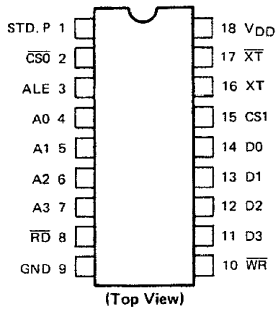
SEMICONDUCTOR DATA

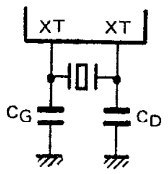
MSM6242RS (Control unit IC57)

- **Block diagram**



- **Terminal connection diagram**



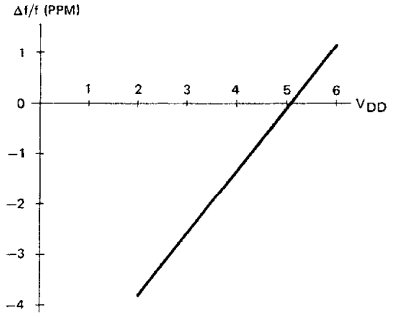


Crystal : NIPPA MX38T (32.768kHz)
Load capacitance C_L = 13pF
Equivalent serial resistance 30kΩ (max.)
Frequency characteristic secondary temperature coefficient : $-4.2 \times 10^{-8}/°C$

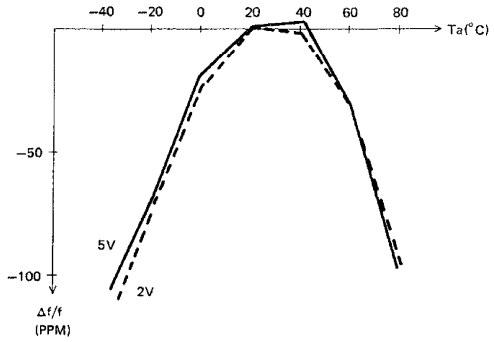
C_G, C_D : 22pF (with a temperature characteristic of "0")

X'tal filter (L77-1256-05) (Control unit X51)

- **Oscillation frequency dependency on supply voltage (Ta = 25°C)**



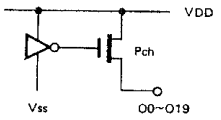
- **Oscillation frequency dependency on temperature**



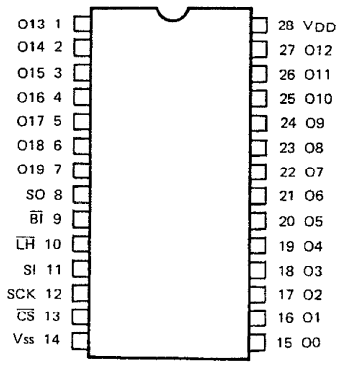
SEMICONDUCTOR DATA

μPD6300C (Display unit IC1)

- **Terminal function**

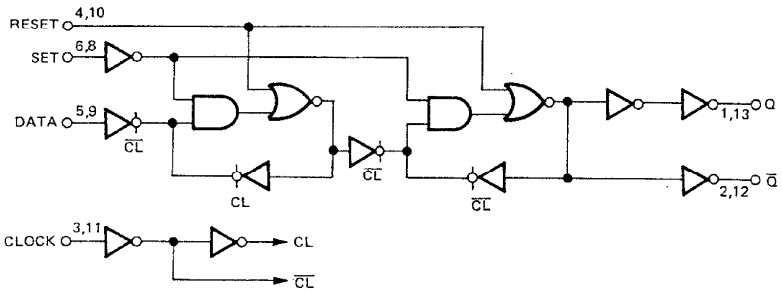
Terminal No.	Symbol	Terminal name	I/O	Function
1~7	O13~O19	FIP segment driver	O	High dielectric-strength (40V) output in the Pch open. Corresponds to the output of Q13~Q19.
8	SO	Serial data output pin	O	Output serial data the trailing edge of SCK, when the n-number of μPD6300Cs are connected in series, this can be connected to the SI of the following stage.
9	$\overline{BI}$	Blanking pin	I	This input can turn off all indicator or displays, and can dim them by applying a random duty pulse from outside. Active low.
10	$\overline{LH}$	Latch pin	I	Transmits the connects of the serial shift register to the buffer register at low level, to latch the connects at the rising time. Active rising (leading) edge.
11	SI	Serial data input pin	I	This is the data input pin. Inputs data to the shift register at the rising edge of SCK.
12	SCK	Serial clock input pin	I	Reads out the SI data to the shift register at the rising edge of SCK. Outputs data from SO at the trailing edge of SCK.
13	$\overline{CS}$	Chip select pin	I	When CS is high, this inhibits SCK and $\overline{LH}$, and when CS is low, activates SCK and $\overline{LH}$.
14	Vss	GND	—	Connect to the GND terminal of the system.
15~27	O0~O12	FIP segment driver	O	Pch open-drain system, high dielectric-strength output. Corresponds to the output of O0~O12. 
28	VDD	Power supply pin	—	5V ± 10%

- **Terminal connection diagram**

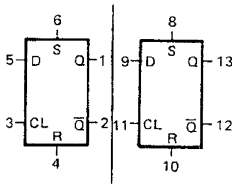


(Top View)

- **Logic circuit**



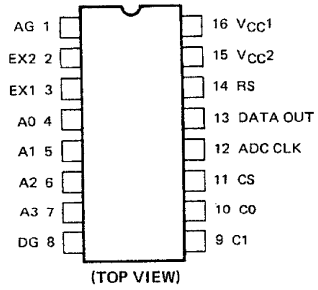
- **Block diagram**



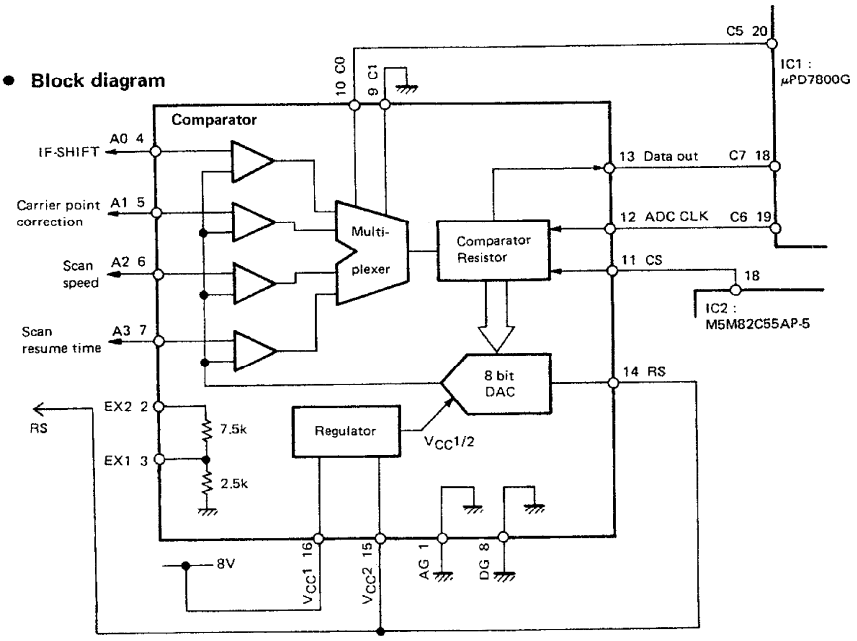
SEMICONDUCTOR DATA

MB4052 (Display unit IC2)

- **Terminal connection diagram**



- **Block diagram**



- **I/O signal pin function**

Pin No.	Pin name	Symbol	Function
1	Analog ground	AG	Ground terminal
2	Range expander input	EX2	Analog input pin for expanding the range.
3	Range expander output	EX1	Analog output pin for expanding the range. Connect to any pin from A0 to A3. By using EX1, EX2, the range is expanded to the X 4 range.
4~7	Analog entrance	A0~A3	4-ch analog input pin. Channel 1 is selected by channel select input C0 to C1.
8	Digital ground	DG	Ground terminal
9	Channel select input	C0	The input pin to designate the analog input channel for A/D converter. This signal is latched at the trailling edge of CS.
10		C1	
11	Chip select input	CS	This is the chip select input pin. When CS is inverted from "1" to "0", A/D converting starts and data output is enabled. After A/D converting is over or when an interrupt is required, set the CS back to "1".
12	A/D conversion clock	ADC CLK	This is the clock input pin for A/D conversion input to the comparator register sequentially. Conversion speed is determined by the clock speed. In the case of 8-bit, approx. 10 clocks will be needed. However, it is not necessary that the clock period be fixed.
13	Data output	DATA OUT	This is the open collector to output the result of A/D conversion. The data is output in the order of the start bit, most significant bit, 2nd significant bit, . . . , least significant bit, and the stop bit, synchronized with ADCCLK.
14	Range select input	RS	This is the input pin for selecting the voltage range of analog input. The VFS = VCC1/8 range is selected at "0", and the range of FVS = VCC1/2 is selected at "1". During conversion, hold this pin to "0" or "1".
15 16	Power supply pin 2 Power supply pin 1	VCC2 VCC1	When driving with 3.5V to 6.0V of power, connect VCC1 and VCC2 to each other, and apply the power voltage to them. When driving 8 to 18V of power, apply the power voltage to VCC2. At this time, the 5V stabilized voltage is output to VCC1, and approx. 10mA current can be supplied externally to the IC. When either 3.5~6.0V or 8~18V power is used, VCC1 is the reference voltage for A/D conversion.

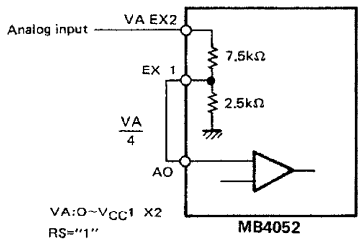
- **Channel select**

C1	C0	Selected Ch.
0	0	A0
0	1	A1
1	0	A2
1	1	A3

- **Range select**

RS	Conversion voltage range
0	$0 \sim \frac{Vcc1}{8}$
1	$0 \sim \frac{Vcc1}{2}$

- **Wiring example when expanding the range**



DESCRIPTION OF COMPONENTS

SWITCH UNIT (X41-3000-00)

Component	Function	Operation/condition
IC1	DIM brightness setting	
D1~8	Reverse current blocking	

AVR UNIT (X43-3000-00)

Component	Function	Operation/condition
IC1	10V AVR	Input voltage : 13.6V, Output voltage : 9.8V.
IC2	5V AVR	Input voltage : 9.5V, Output voltage : 5.0V.
Q1	Mute switching	"H" when muting, "L" otherwise.
Q2	8V AVR	Input voltage : 9.8V, Output voltage : 8.0V
D1~6,9	Reverse current blocking	
D7	8V AVR reference voltage	
D8	Battery charging circuit reference voltage	

RF UNIT (X44-3010-00)

Component	Function	Operation/condition
IC1	Band-pass data decoder	①21.5~30MHz ⑦ 2.5~3.5MHz ②14.5~21.5MHz ⑧ GND ③10.5~14.5MHz ⑨ 1.6~2.5MHz ④ 7.5~10.5MHz ⑩ 0.5~1.6MHz ⑤ 5.5~ 7.5MHz ⑪ 0~0.5MHz ⑥ 3.5~ 5.5MHz
Q1,2	RF amplifier	Cascode amplifier.
Q3,4	Mixer amplifier	Balanced mixer.
Q5,6	Post amplifier	Push-pull amplifier.
Q7	+ 9V line switching	ON during HF reception and OFF during VHF reception.
Q8~11	VCO	Q8 : 0~7.5MHz, Q9 : 7.5~14.5MHz Q10 : 14.5~21.5MHz, Q11 : 21.5~30MHz
Q12~14	Buffer amplifier	VCO buffer amplifier.
Q15	Buffer amplifier	PLL VCO buffer amplifier.
Q16	VFO amplifier	VCO buffer amplifier.
D1~3	Relay spike voltage killer	
D4,5	ATT relay reverse current blocking	Ensures proper relay operation with VC-20 attached.
D6,7	Receiver protection	Turned ON by excess antenna input power.
D8~27	BPF switching	D 8, 9 : 1.6~2.5MHz D18, 19 : 5.5~7.5MHz D10, 11 : 0.5~1.6MHz D20, 21 : 7.5~10.5MHz D12, 13 : 1.6~2.5MHz D22, 23 : 10.5~14.5MHz D14, 15 : 2.5~3.5MHz D24, 25 : 14.5~21.5MHz D16, 17 : 3.5~5.5MHz D26, 27 : 21.5~30MHz
D28	Voltage stabilizer	VCO circuit voltage stabilizer.
D29	VCO varicap diode	0~7.5MHz.
D30	VCO switching	0~7.5MHz.
D31	VCO varicap diode	7.5~14.5MHz.
D32	VCO switching	7.5~14.5MHz
D33	VCO varicap diode	14.5~21.5MHz.
D34	VCO switching	14.5~21.5MHz.
D35	VCO varicap diode	21.5~30MHz.
D36	VCO switching	21.5~30MHz.
D37	Q7 switching	HF/VHF switching.
D38,39	Switching	VCO, BPF switching.
D40	Voltage stabilizer	IC1 power supply.
D41	Reverse current blocking	Secures ANT1/ANT2 switching relay function.

DESCRIPTION OF COMPONENTS

IF UNIT (X48-3000-00)

Component	Function	Operation/condition
IC1 (1/2)	SSB detected signal pre-amplifier	Level matching and f-characteristic adjustment.
IC1 (2/2)	AM detected signal pre-amplifier	
IC2	AGC time constants switching	
IC3	AGC voltage amplifier and S meter driver	
IC4 (1/2)	SSB squelch switching	
IC4 (2/2)	D-AGC generator circuit	
IC5,6	FM IF	
IC7 (1/2)	FM detected signal pre-amplifier	Level matching, de-emphasis, and f-characteristic adjustment.
IC7 (2/2)	FM squelch switching	
IC8	Center detection window comparator	
IC9	Per-MODE detector output selector switching	
IC10	NOTCH, PEAK, and FLAT circuits	
IC11	NOTCH/PEAK/FLAT switching and squelch muting	
IC12	Active filter	
IC13	Audio power amplifier	
IC14	9V AVR	
IC15	SELECTIVITY control	
Q1	1st IF amplifier	Including D-AGC.
Q2	HET oscillator	49.2825MHz, 3rd overtone.
Q3	HET buffer amplifier	
Q4,5	2nd mixer	Balanced type.
Q6	UL blanking	Normally ON.
Q7	UL blanking	Normally OFF.
Q8	3rd local oscillator	8.375MHz.
Q9	3rd mixer	
Q10	NB gate	
Q11,12	NB noise amplifier	Including NB AGC.
Q13	NB noise buffer amplifier	
Q14	NB AGC driver	
Q15	NB blanking pulse generator	Including variable NB level feature.
Q16	NB blanking pulse generator	Including blanking delay time constant circuit.
Q17	NB gate driver	
Q18,20	2nd IF amplifier (MCF buffer)	Including temperature gain compensation feature.
Q19,21,22	2nd IF amplifier (MCF buffer)	Including AGC.
Q23	BFO amplifier	
Q24	2nd IF buffer amplifier	
Q25	NB blanking duty control	
Q26	AM detection	
Q27	AGC driver	
Q28	AGC time constant switch	
Q29	SSB squelch driver	
Q30	SSB squelch voltage follower	
Q31	Center detection switch	OFF when center is detected.
Q32,33	FM squelch noise amplifier	

DESCRIPTION OF COMPONENTS

Component	Function	Operation/condition
Q34	Per-MODE + B generator	Outputs 9V in other than AM and FM modes.
Q35	Per-MODE + B generator	Outputs 9V in FM mode.
Q36	BUSY LED driver	ON when lighted.
Q37	Center detection switch	ON when center is detected in AM or FM mode, OFF otherwise.
Q38	BUSY STOP switch	ON when BUSY state is removed.
Q39	REC OUT amplifier	
Q40	IF filter switch circuit driver	Outputs 9V during N operaiton.
Q41	IF filter switch circuit driver	Outputs 9V during M1 operation.
Q42	IF filter switch circuit driver	Outputs 9V during M2 operation.
Q43	IF filter switch circuit driver	Outputs 9V during W operation.
Q44	SELECTIVITY cancel switch	Outputs 9V in FM mode.
D1	IF input switch	ON for HF.
D2	IF input switch	ON for VHF.
D3	NB detector	
D4	Reverse current blocking	
D5~10	M2 filter switch	
D11~16	M1 filter switch	
D17~22	N filter switch	
D23	BFO signal input switch	ON in other than AM and FM modes.
D24~27	Ring detector	
D28	AGC detector	
D29	SSB squelch cancel in FM mode	Pulls SSQ down from FMG.
D30	SSB squelch reverse current blocking	ORed with FM squelch output (D34).
D31	AGC detector	
D32	FM squelch noise detector	
D33	Reverse current blocking	
D34	FM squelch output reverse current blocking	ORed with SSB squelch output (D30).
D35	Reverse current blocking	
D36	Center detection cancel in other than AM and FM mode	Pulls down center detection enbling level to "L".
D37	Mute signal reverse current blocking	Isolates microprocessor system from squelch system.
D38~40	M2 filter selection ORing circuit	
D41	M1 filter de-selection signal	
D42	M1 filter selection ORing circuit	
D43	M1 filter de-selection ORing circuit	
D44	N filter selection signal	
D45~47	N filter de-selection ORing circuit	
D48~51	Reverse current blocking (SELECTIVITY switch)	
D52~56	Reverse current blocking (per-MODE "L" signal system)	
D57,58,60	Reverse current blocking (per-MODE "L" signal system)	Provides an AND that produces "L" in other than AM and FM modes.
D59	AMG line reverse current blocking	
D61	FMG line reverse current blocking	
D62,63	Reverse current blocking (per-MODE "L" signal system)	Provides an AND that produces "L" in other than AM mode.
D64	Voltage clamper	Prevents negative voltage to IC2.

DESCRIPTION OF COMPONENTS

PLL UNIT (X50-3030-00)

Component	Function	Operation/condition
IC1	Reference frequency dividers (1/2)	①9MHz input ⑧、⑨9MHz output ⑤18MHz input ⑬ 4.5MHz output
IC2	PLL1 (VCO's least significant digit PLL)	②Unlock line; "L" when unlocking. ③9MHz input (1/2 fSTD) ⑧VCO lock voltage output. ⑨~⑬ Frequency division ratio setting inputs. ⑯90.000~99.998MHz input (CW : 89.840~99.838MHz, FSK : 90.458~100.456MHz)
IC3	Frequency divider (1/20)	④90.000~99.998MHz input (CW : 89.840~99.838MHz, FSK : 90.458~100.456MHz) ⑧4.5000~4.9999MHz output (CW : 4.4920~4.9919MHz, FSK : 4.5229~5.0228MHz)
IC4	Frequency divider (1/10)	①4.5000~4.9999MHz input (CW : 4.4920~4.9919MHz, FSK : 4.5229~5.0228MHz) ⑫450.00~499.99kHz output (CW : 449.20~499.19kHz, FSK : 452.29~502.28kHz)
IC5	Mixer (adding VCO1 to fBFO)	①9.2800~9.32999MHz output ②8.83MHz input (fBFO) ⑤450.00~499.99kHz input (CW : 449.20~499.19kHz, FSK : 452.29~502.28kHz)
IC6	Mixer (adding IC5 output to fBFO)	①58.5625~58.61249MHz output ②49.2825MHz input (fHET) ⑤9.2800~9.32999MHz input
IC7	Mixer (compositing PLL1 and PLL2 signals)	①37.55~38.50MHz or 36.55~37.50MHz output (PLL2 IF) ②58.5625~58.61249MHz input ⑤96.1125~97.11249MHz or 95.1125~96.11249MHz input
IC8	PLL2 (VFO's middle digit PLL)	①9MHz input (1/2 fSTD) ⑤VCO lock voltage output. ⑦PLL2 unlock output; "L" when muting.
IC9	PLL2 pre-scaler	②37.55~38.50MHz or 36.55~37.50MHz input (PLL2 IF)
IC10	Mixer (compositing PLL2 and PLL3 signals)	①38.0~20.0MHz, 18.0~7.0MHz output (PLL3 IF) ②58.1125~88.1125MHz input ⑤96.1125~97.11249MHz or 95.1125~95.11249MHz input (fVCO2)
IC11	PLL3 pre-scaler	③38.0~20.0MHz, 18.0~7.0MHz input (PLL3 IF)
IC12	PLL3 (VFO's final HF band PLL)	①9MHz input (1/2 fSTD) ⑤PLL3 output. ⑦Unlock line.
IC13	PLL3 low-pass filter	②、⑧ VCO voltage output for RF unit (3~6V) ③、⑦ PLL3 VCO lock voltage input.
IC14	PLL4 (BFO PLL)	②Unlock line; "L" when unlocking. ③4.5MHz input (1/4 fSTD) ⑧VCO lock voltage output. ⑨~⑬ Frequency division ratio setting inputs. ⑯33.7~34.3MHz, VCO4 oscillation signal input.

DESCRIPTION OF COMPONENTS

Component	Function	Operation/condition
IC15	Frequency divider (1/20)	④ Switched frequency input USB/CW : 33.7MHz, AM/FM : 34.0MHz, LSB/FSK : 34.3MHz ⑧ Divided frequency output USB/CW : 1.685MHz, AM/FM : 1.700MHz, LSB/FSK : 1.715MHz
IC16	Frequency divider (1/10)	① Switched frequency input USB/CW : 1.685MHz, AM/FM : 1.700MHz, LSB/FSK : 1.715MHz ⑫ Divided frequency output USB/CW : 168.5kHz, AM/FM : 170.0MHz, LSB/FSK : 171.5kHz.
IC17	Mixer	① BFO frequency output USB/CW : 8.8315MHz, AM/FM : 8.8300MHz, LSB/FSK : 8.8285MHz (BFO) ② 9MHz input (1/2 fSTD) ⑤ Switched frequency input USB/CW : 168.5kHz, AM/FM : 170.0kHz, LSB/FSK : 171.5kHz
IC18	5V AVR	Input : 9.0V, Output : 5.0V.
IC19	9V AVR	Input : 13.6V, Output : 9.0V.
Q1	Reference frequency crystal oscillator	18MHz.
Q2	18MHz buffer amplifier	
Q3	18MHz buffer amplifier	E–G : 800Vrms
Q4	PLL1 VCO	90.000~99.998MHz
Q5	VCO1 (PLL1) buffer amplifier	(CW : 89.840~99.838MHz, FSK : 90.458~100.456MHz).
Q6	PLL2 IF signal buffer amplifier	37.55~38.50MHz or 36.55~37.50MHz.
Q7	PLL2 VCO	96.1125~97.11249MHz or 95.1125~96.11249MHz.
Q8~10	VCO2 (PLL2) buffer amplifier	
Q11~14	PLL3 IF signal buffer amplifier	38.0~20.0MHz, 18.0~7.0MHz.
Q15	PLL4 VCO	33.7~34.3MHz.
Q16	VCO4 (PLL4) buffer amplifier	
Q17,18	BFO buffer amplifier	8.83MHz.
Q19	VC-20 reference frequency buffer amplifier	9MHz (1/2 fSTD)
Q20	HET buffer amplifier	49.2825MHz.
Q21	VFO buffer amplifier	58.1125~88.1125MHz.
Q22	VPL buffer amplifier	96.1125~97.11249MHz or 95.1125~96.11249MHz, VC-20 lower digit signal.
Q23	Lower digit unlock signal waveform shaping (PLL1 + PLL2 + PLL3)	"H" when unlocking.
Q24		"L" when unlocking.
Q25	HF-band PLL unlock signal waveform shaping	"H" when unlocking.
D1	Wired OR circuit	Composites lower digit PLL unlock signals.
D2,3	PLL1 VCO frequency variation element	Varicap diode ITT310TE.
D4	PLL2 VCO frequency variation element	Varicap diode 1SV153.
D6	Wired OR circuit	Composites unlock signals.
D7	PLL3 (IC12) power supply	+ 5V zener diode.
D8	Wired OR circuit	Composites lower digit PLL unlock signals.
D9,10	PLL4 VCO frequency variation element	Varicap diode 1SV153.
D11	BFO signal switching	
D12	VC-20 standard signal switching	
D13	VC-20 lower digit signal switching	
D14,15	Unlock signal waveform shaping	
D16~19	Final PLL data HF/VHF switching	

DESCRIPTION OF COMPONENTS

CONTROL UNIT (X53-3020-XX)

Component	Function	Operation/condition
IC1	Microprocessor (N-MOS)	8-bit microprocessor (see the circuit description).
IC2	I/O port (C-MOS)	Bus interface I/O ports, all are set up as output ports (see the I/O port table).
IC3	System reset	Generates a reset signal, which produces microprocessor operation and back-up timings, during power voltage rise and fall when the unit is turned on and off.
IC4	Inverter (C-MOS)	1/6, 2/6 : Beep tone oscillator. 3/6, 4/6 : System clock oscillator (1.99MHz). 5/5, 6/6 : System reset signal waveform shaping.
IC5~7	Encoder waveform shaping (C-MOS)	Converts the 2-phase encoder clock signal to the U/D direction and count clock pulse signals.
IC50	Static RAM (C-MOS)	Provides a 2K bytes x 8 bits area for working with or creating microprocessor data such as VFO and memory, etc. Its contents are backed up by the system reset signal.
IC51	Address decoder (TTL)	Divides the CPU address signal into the chip select signals for each memory IC; the 64K byte memory area is divided into eight 8K byte blocks.
IC52	ROM (N-MOS)	Contains control programs (including external control programs).
IC53	I/O port (C-MOS)	The bus interface I/O ports which are used as the key-scan matrix and for static input (see the I/O port table).
IC54 (Optional)	Serial I/O port (N-MOS)	The I/O port for external control by the microprocessor which generates an interrupt to the CPU each time a character is received.
IC55 (Optional)	Serial I/O port baud rate frequency divider (C-MOS)	Generates the clock signals of various baud rates for the serial I/O port.
IC56	Serial buffer and serial I/O baud rate clock oscillator (TTL)	1/6, 6/6 : Serial I/O port baud rate clock oscillator. 2/6, 3/6 : Serial input data buffer. 4/6, 5/6 : Serial output data buffer.
IC57	Real-time clock (C-MOS)	Provides a clock which continues to serve also in back-up mode.
Q1	Timer relay switching	Turns the power and timer switches on and off to allow the receiver section to be turned on and off according to the timer; energizes the relay when "H".
Q2	FM mode signal buffer	Active in FM mode and the open collector connection output drives the IF unit FM mode signal and the "FM" LED on the keyboard ass'y.
Q3	FSK mode signal buffer	Active in FSK mode and the open collector connection output drives the IF unit FSK mode signal and the "FSK" LED on the keyboard ass'y.
Q4	AM mode signal buffer	Active in AM mode and the open collector connection output drives the IF unit AM mode signal and the "AM" LED on the keyboard ass'y.
Q5	CW mode signal buffer	Active in CW mode and the open collector connection output drives the IF unit CW mode signal and the "CW" LED on the keyboard ass'y.
Q6	USB mode signal buffer	Active in USB mode and the open collector connection output drives the "USB" LED on the keyboard ass'y.
Q7	LSB mode signal buffer	Active in LSB mode and the open collector connection output drives the "LSB" LED on the keyboard ass'y. The USB and LSB signals are mixed with a diode switch to produce the IF unit SSB mode signal.
Q14	ANT1 LED driver	Drives the ANT1 LED while in HF band reception.
Q15	ANT2 LED driver	Drives the ANT2 LED while in HF band reception and also serves as the signal to drive the ANT1/ANT2 switch relay.
Q16	MSCR LED driver	Drives the MSCR LED during memory scrolling.

DESCRIPTION OF COMPONENTS

Component	Function	Operation/condition
Q17	LOCK LED driver	Drives the F.LOCK LED when F.LOCK is enabled.
Q50	RAM back-up control	Puts the RAM in back-up mode when power is turned off.
D1,2	SSB mode signal compositing	Composites the LSB and USB mode signals to produce the IF unit SSB mode signal.
D3,4	Encoder count pulse compositing	Shapes the 2-phase encoder count pulse waveform to provide the encoder count pulse.
D5~8	Encoder count pulse compositing	Composites quadrupled count pulse.
D9	Beep switching	Switches the beep oscillator ON/OFF with the beep pulse. "H" input enables the BEEP output.
D51,52	Power switching	Provides power switching for RAM back-up.
D53,54	ROM chip select signal compositing	Composites select signals for two 8K byte blocks to provide the 16K byte ROM select signal.
D65	Expansion feature switch	Selects either the 10Hz or 100Hz display; conduction displays 10Hz and cut-off displays 100Hz.
D66	Expansion feature switch	Controls the mode buzzer; conduction gives a series of Morse code sounds and cut-off gives a single short sound.
D67	Expansion feature switch	Controls the FM step when STEP ON; conduction : 2.5kHz, cut-off : 500Hz.
D68	Expansion feature switch	Controls BUSY STOP; conduction enables BUSY STOP in AM and FM modes only and cut-off enables BUSY STOP in all modes.
D69	Expansion feature switch	Controls memory search; conduction disables memory search and cut-off enables memory search.
D70,71	Expansion feature switch	Not used (reserved for future use).
D72	Expansion feature switch	Control memory control; conduction protects memory and cut-off does not protect memory.
D85,86	Power switching	Switches power for clock IC back-up.

DISPLAY UNIT (X54-3010-00)

Component	Function	Operation/condition
IC1	Serial input high voltage resisting fluorescent tube driver	Converts serial data from the control unit to a parallel form and drives the fluorescent display tube driver. ①~⑦、⑮~㉗ High voltage resisting output ports. ⑨ Dimmer blanking input. ⑩ Latch pulse. ⑪ Serial data input. ⑫ Serial clock input.
IC2	A/D converter	Converts the analog voltage input to a digital value and outputs it to the CPU. ④ IF shift ⑥ Scan speed ⑤ Carrier point correction ⑦ Scan resume time.
IC3	Clock frequency divider	Divides the CPU serial clock and 1MHz data rate to the clock and 500kHz data rate for IC1.
Q1	Dp driver	Drives the decimal point Dp of the fluorescent tube; "H" input lights up.
Q2	Red character driver	Drives the red characters of the fluorescent tube with an 8V supply; "H" input lights the red characters.
Q3	Inverter	Reverses the red character lighting level; "L" input produces the lighting level.
Q4,5	DC-DC converter oscillator	Generates the intermediate AC voltage for the fluorescent tube drive DC-DC converter.
D1~4	High voltage rectifier	The rectifier bridge for the fluorescent tube drive negative voltage.
D5	Negative voltage supply	Supplies −5V to the IF unit.
D6	Filament bias voltage generator	Supplies the bias voltage for the fluorescent display tube filament.

DESCRIPTION OF COMPONENTS

AGC (X59-3010-00)

Component	Function	Operation/condition
IC1	AGC time-constant selection control	Determines a time constant according to the used mode and AGC switch position.
IC2	AGC time-constant circuit connection switch	"H" control input connects the circuit and "L" disconnects the circuit.

S METER (X59-3020-00)

Component	Function	Operation/condition
Q1	External mute control switch	ON when muting.
Q2	S meter driver	
Q3,4	AGC driver	
Q5	Voltage buffer	
D1	Reverse current blocking	
D2	AGC driver (Q3,4) temperature compensation	

NOTCH (X59-3030-00)

Component	Function	Operation/condition
IC1	Active BPF NOTCH gain compensation amplifier	

SELECT (X59-3040-00)

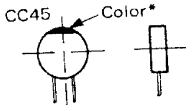
Component	Function	Operation/condition
IC1	Squelch gate (1/4) NOTCH module output selection switch (2/4, 3/4, 4/4)	Control input "H" : open, "L" : muting.
Q1,2	NOTCH mode control	Determines the operation mode according to the used mode and NOTCH switch position.
Q3	NOTCH LED driver	Sinks the lighting current.
D1	CWG line reverse current blocking	

PARTS LIST

CAPACITORS

CC 45 TH 1H 220 J
1 2 3 4 5 6

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



• Capacitor value

0 1 0 = 1pF
1 0 0 = 10pF
1 0 1 = 100pF
1 0 2 = 1000pF = 0.001μF
1 0 3 = 0.01μF
2 2 0 = 22pF
1st number | Multiplier
2nd number

• 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 −20	+ 80 −20	+ 100 −0	More than 10μF −10~ + 50 Less than 4.7μF −10~ + 75

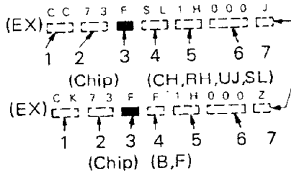
Code	B	C	D	F	G
(pF)	± 0.1	± 0.25	± 0.5	± 1	± 2

Less than 10 pF

• Rating voltage

2nd word / 1st word	A	B	C	D	E	F	G	H	J	K	V
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



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

Dimension

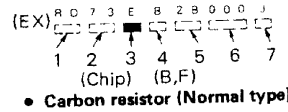
Dimension code	L	W	T
Empty	5.6 ± 0.5	5.0 ± 0.5	Less than 2.0
E	3.2 ± 0.2	1.6 ± 0.2	Less than 1.25
F	2.0 ± 0.3	1.25 ± 0.2	Less than 1.25

Dimension

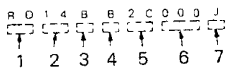
Dimension code	L	W	T	Wattage
E	3.2 ± 0.2	1.6 ± 0.2	0.57	2B
F	2.0 ± 0.3	1.25 ± 0.2	0.45	2A

RESISTORS

• Chip resistor (Carbon)



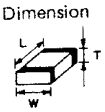
• Carbon resistor (Normal type)



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				

Dimension



PARTS LIST

N : New parts

SEMICONDUCTOR

Item	Re-marks	Part No.
Diode		1N60
		1S1007
		1S1555
		1S1587
	N	1SS132
		1SS133
		1SS141VE
		BA282
	N	D5S4M
		DAP401
	N	DAP601
		MA858
		MC911
		MC921
		MC931
		S15VB10
		US1090
		V06B
Varicap Diode		1SV153
		ITT310TE
Chip Diode		DAN202(K)
Zener Diode		MTZ3.9JB
		MTZ5.1JA
		MTZ7.5JA
		MTZ9.1JC
		UZ3.31BCA
Thermister		112-202-2
		112-501-2
TR		2SB698(E,F)
		2SC1907
		2SC1959(Y)
		2SC2053
		2SC2458(Y)
		2SC2459(BL)
		2SC2668(Y)
		2SC2787(L)
		2SC3113(B)
Chip TR		2SA1162(Y)
		2SC2712(Y)
Digital TR		DTA114ES
		DTA124EK
		DTA124ES
		DTA144ES
		DTC114ES
		DTC124ES
	N	DTC143ES
		DTC144ES
		DTC144WK
		DTC144WS
FET		2SK125
		2SK161(GR)
		2SK192A(GR)*J
		3SK73(Y)
Chip FET		2SK211(GR)
IC	N	AN78M09
		AN78N05
	N	AN78N09
		BA718
		M5M82C55AP-5
		M54459L
		MB3713
		MB4052
		MB8418-20LP-GRA
		MB87006
	N	MBM27128-25JB1
		MC6147C
		MN6147C
	N	MSM6242RS
		NE555P
		NJM2903S
		NJM4558M
		NJM4558S
		PST520D
		SN74S74N
		SN74LS73AN
		SN74LS90N
		SN74LS138N
		SN74LS145N
		SN16913P
		SN7404N
	N	TA78010AP
		TC4001BF
		TC4011BP
		TC4013BP
		TC4030BP
		TC4066BF
		TC4066BP
		TC4069UBP
		TC4071BP
	N	UA7805
		μPB551C
		μPC577H
		μPD6300C
		μPD7800G

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Ref. No. 参照番号	Address 位置	New Parts 新	Parts No. 部品番号	Description 部品名／規格	Destination 仕向	Remarks 備考
			R-5000			
1	1B	＊	A01-1019-02	CASE (A)UPPER		
2	3A	＊	A01-1020-02	CASE (B)LOWER		
3	2C	＊	A20-2594-13	PANEL ASSY		
6	2G,2J	＊	A22-0750-02	SUB PANEL		
7	1E,2E	＊	A23-1494-03	REAR PANEL	K1	
7	1E,2E	＊	A23-1495-03	REAR PANEL	M1T1W1	
7	1E,2E	＊	A23-1495-03	REAR PANEL	W2X1	
-		＊	A20-2595-13	PANEL		
-		＊	A21-1510-04	DRESSING PANEL		
⚠ 8	2D	＊	B40-3673-04	MODEL NAME PLATE	K1	
⚠ 8	2D	＊	B40-3674-04	MODEL NAME PLATE	M1W1W2	
⚠ 8	2D	＊	B40-3675-14	MODEL NAME PLATE	T1	
9	1A,3A		B41-0338-04	CAUTION SHEEL	K1	
10	2D		B41-0384-04	CAUTION SHEEL	K1	
11	1A		B05-0711-14	SARAN NET (SP)		
12	2C	＊	B43-1071-04	BADGE	K1M1W1	
12	2C	＊	B43-1071-04	BADGE	W2X1	
12	2C	＊	B43-1073-14	BADGE	T1	
13	1M	＊	B50-8101-00	INSTRUCTION MANUAL	K1M1W1	
13	1M	＊	B50-8101-00	INSTRUCTION MANUAL	W2X1	
13	1M	＊	B50-8103-00	INSTRUCTION MANUAL	T1	
14	1M		B46-0410-10	WARRANTY CARD	K1	
15	1K		B41-0525-04	CAUTION SHEEL	K1	
M101	2I	＊	B31-0659-15	S METER		
PL101	1G		B30-0817-15	PILOT LAMP (14V,80MA)		
⚠ C101,102			C91-1075-05	CERAMIC 470PF		
⚠ C103			C91-0647-05	CERAMIC 0.01UF P		
⚠ 16	1L	＊	E30-1305-15	AC POWER CORD	M1	
⚠ 16	1L	＊	E30-1328-15	AC POWER CORD	T1	
⚠ 16	1L	＊	E30-1329-05	AC POWER CORD	W1W2	
⚠ 16	1L	＊	E30-1342-05	AC POWER CORD	X1	
⚠ 16	1L	＊	E30-2071-05	AC POWER CORD	K1	
18	2D		E23-0473-04	TERMINAL (ANT GND)		
-			E40-3238-05	PIN CONNECTOR (3P)		
-		＊	E40-5068-05	PIN CONNECTOR (11P)		
J101	2D		E04-0164-05	RF COAXIAL CABLE RECEPTACLE		
⚠ J102	2E	＊	E03-0166-05	AC INLET		
J103	2E	＊	E20-0383-05	TERMINAL BOARD (3P)		
21	1D	＊	F02-0431-04	HEAT SINK		
24	1K		F11-1004-13	SHIELDING COVER(CONTROL)		
28	2E	＊	F19-0649-14	BLIND PLATE		
29	2E		F19-0610-04	CONNECTOR MASK		
⚠ 32		＊	F29-0072-05	INSULATOR (AC)		
35	1A		F20-0562-14	INSULATING BOARD(DISP-CONT)		
⚠ -			F05-4021-05	FUSE (4A)	K1	
⚠ -			F05-4022-05	FUSE (4A)	M1	
⚠ -			F05-4024-05	FUSE (4A)	T1W1W2	
⚠ -			F05-4024-05	FUSE (4A)	X1	
-		＊	F11-1043-14	SHIELDING COVER(RF)		
-		＊	F11-1048-04	SHIELDING COVER(VS-1)		
-			F20-0521-04	INSULATING BOARD(LITHIUM BATT)		

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

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-		*	F20-0561-04	INSULATING BOARD(VS-1)		
36	2C		G02-0505-05	KNOB FIXED SPLING		
37	1H		G10-0610-04	FELT (FIP)		
38	2J		G10-0638-14	FELT (LED)		
39	3A,3B		G53-0507-04	PACKING (CASE SIDE)		
40	2C		G13-0830-04	CUSHION (CLOCK)		
41	2C	*	G16-0511-04	TURNTABLE SHEET(PANEL)		
-			G10-0639-04	FELT (S METER)		
42	2L		H12-1315-04	CUSHION		
43	2L	*	H10-2621-02	PACKING FIXTURE(F)		
44	2M	*	H10-2622-02	PACKING FIXTURE(R)		
45	2L		H20-1410-03	PROTECTIVE COVER		
46	1L		H25-0105-04	PROTECTIVE BAG (AC CORD)		
48	3L	*	H01-8030-04	CARTON BOX (INSIDE)	K1M1W1	
48	3L	*	H01-8030-04	CARTON BOX (INSIDE)	W2X1	
48	3L	*	H01-8031-04	CARTON BOX (INSIDE)	T1	
49	3A		J02-0442-04	FOOT (X2)F		
50	1G		J21-2779-14	MOUNTING HARDWARE(PILOT LAMP)		
51	1K		J21-4177-14	MOUNTING HARDWARE(PRINT BOARD)		
52	1A	*	J21-4208-14	MOUNTING HARDWARE(SP)		
53	3A		J21-4208-04	MOUNTING HARDWARE(ASSIST FOOT)		
54	2F		J30-0526-04	SPACER (SLIDE SW)		
55	1F		J32-0765-04	HEX BOSS (6.5MM)		
56	2G		J32-0782-04	HEX BOSS (11MM)		
57	1G,1H		J32-0792-04	HEX BOSS (10MM)		
58	1H		J32-0793-04	HEX BOSS (11MM)		
59	1J,1K		J32-0794-04	HEX BOSS (5MM)		
60	1G	*	J32-0800-04	HEX BOSS (11.5MM)		
61	2E		J42-0442-05	AC POWER CORD BUSHING		
62	3B		J02-0323-05	FOOT (X2)R		
63	3A		J02-0440-04	ASSISTANT FOOT		
64	1A,2A		J02-0441-05	FOOT (X4)		
-			J19-1363-05	LEAD HOLDER		
-			J61-0307-05	WIRE BAND		
65	3B		K01-0407-05	HANDLE		
66	2C		K21-0778-02	KNOB (MAIN)		
67	2C		K23-0710-04	KNOB (INSIDE)		
68	2C		K23-0753-04	KNOB (SELECTIVITY)		
69	2Z		K23-0782-04	KNOB (RF ATT)		
70	2C		K29-0741-34	KNOB ASSY (OUT SIDE)		
71	1C		K29-0758-14	PUSH KNOB (POWER)		
72	2C		K29-0782-05	SLIDE KNOB (CLOCK)		
73	2D		K29-3001-14	PUSH KNOB (NOTCH)		
74	2C		K29-3002-14	PUSH KNOB (VOICE)		
⚠ T101	1D	*	L01-8051-05	POWER TRANSFORMER	K1	
⚠ T101	1D		L01-8306-05	POWER TRANSFORMER	M1T1W1	
⚠ T101	1D		L01-8306-05	POWER TRANSFORMER	W2X1	
80	2A,2B		N10-2030-46	HEXAGON NUT (SP)		
81	2C		N15-1030-41	FLAT WASHER (PANEL)		
82	2C		N19-0637-04	FLAT WASHER (MAIN KNOB)		
-			N89-2606-45	BINDING HEAD TAPTITE SCREW		
A	2E,2F		N09-0256-05	GND SCREW (SUB PANEL)		

E: Scandinavia & Europe H:Audio Club K: USA P: Canada W:Europe
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	B	2I		N09-0644-04	BIND SCREW (METER,KEY BOARD)		
	C	1A,2E		N35-3006-41	BINDING HEAD MACHINE SCREW		
	D	1C,1D		N09-2013-05	SCREW (PT)		
	F	1F,1G		N32-2606-46	FLAT SCREW (SW UNIT)		
	G	1C,2D		N32-3004-46	FLAT SCREW (SUB PANEL)		
	H	1F		N32-3006-46	FLAT SCREW (PILOT LAMP)		
	K	2E,1H		N35-2605-41	BIND SCREW (DISP,CONT)		
	L	2C,2D		N35-3006-45	BINDING HEAD MACHINE SCREW		
	M	1D,2D		N87-2606-46	BRAZIER HEAD TAPTITE SCREW		
	N	1D,2E		N87-3006-41	BRAZIER HEAD TAPTITE SCREW(PNL		
	P	3A		N87-3008-41	BRAZIER HEAD TAPTITE SCREW		
	Q	1D		N87-3016-46	BRAZIER HEAD TAPTITE SCREW		
	R	2E		N35-2606-41	BIND SCREW (SW,ETC.)		
	U	1K		N09-0658-04	ROUND SCREW (SHIELD COVER)		
	R101,102			RD14BB2E103J	RD 10K J 1/4W		
⚠	R103			R92-0173-05	RC 2.2M M 1/2W	K1	
⚠	S101	1D,2E		S29-2406-05	ROTARY SWITCH	M1T1W1	
⚠	S101	1D,2E		S29-2406-05	ROTARY SWITCH	W2X1	
	SP101	2A		T07-0222-15	LOUDSPEAKER(FULLRANGE)		
⚠	D101	1D		S15VB10	DIODE		
⚠	IC101	1D		AN78M09	IC		
	86	1G		W02-0373-25	ENCODER ASSY		
	87	2I	*	W03-2005-15	KEYBOARD ASSY		
⚠	-		*	W09-0364-05	LITHIUM BATTERY		
	92	1G,2H	*	X41-3000-00	SWITCH UNIT		
	93	1C	*	X43-3000-00	AVR UNIT		
	94	2D	*	X44-3010-00	RF UNIT		
	95	1D	*	X48-3000-00	IF UNIT		
	96	2D	*	X50-3030-00	PLL UNIT		
	97	1J,2K	*	X53-3020-11	CONTROL UNIT	K1M1T1	
	97	1J,2K	*	X53-3020-11	CONTROL UNIT	W1	
	97	1J,2K	*	X53-3020-61	CONTROL UNIT	W2	
	97	1J,2K	*	X53-3020-71	CONTROL UNIT	X1	
	98	1H,2H		X54-3010-00	DISPLAY UNIT		
	SWITCH UNIT (X41-3000-00)						
	C1			CQ92M1H272K	MYLAR 2700PF K		
	C6			CE04EW1H010M	ELECTRO 1.0UF 50WV		
	C7			CE04EW1E470M	ELECTRO 47UF 25WV		
	C9 -11			CK45E2H472P	CERAMIC 4700PF P		
	C20			CQ92M1H103K	MYLAR 0.010UF K		
	-			E23-0453-05	TERMINAL		
	-			E40-3237-05	PIN CONNECTOR (2P)		
	-			E40-3238-05	PIN CONNECTOR (3P)		
	-			E40-3239-05	PIN CONNECTOR (4P)		
	-			E40-3240-05	PIN CONNECTOR (5P)		
	-			E40-3241-05	PIN CONNECTOR (6P)		
	-			E40-5066-05	PIN CONNECTOR (9P)		
	J1	2F		E11-0418-05	PHONE JACK (PHONES)		
	J2	2F		E11-0414-05	PHONE JACK (REC)		
	J3	2E		E06-0754-05	DIN CONNECTOR(REMOTE)		
	J4	2E		E06-0656-05	DIN CONNECTOR(6P) ACC1		

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	R23			RS14KB3A470J	FL-PROOF RS 47 J 1W		
	VR1	1G	*	R24-9406-05	POTENTIOMETER(SQ,NOTCH)		
	VR2 ,3			R12-1069-05	TRIMMING POT.(4.7K)		
	VR4	2H		R19-3420-05	POTENTIOMETER(AF,RF)		
	VR5	2H	*	R19-9410-05	POTENTIOMETER(NB,IF SHIFT)		
	VR6			R12-1066-05	TRIMMING POT.(1K)		
	VR7			R12-1069-05	TRIMMING POT.(4.7K)		
	S1	1G	*	S29-1435-05	ROTARY SWITCH (SELECTIVITY)		
	S2	2H		S01-2431-05	ROTARY SWITCH (RF ATT)		
	S3	1G		S31-2405-05	SLIDE SWITCH (CLOCK)		
	S4	1G		S40-2441-15	PUSH SWITCH (VOICE)		
	S5	1G		S40-2440-15	PUSH SWITCH (DIM,ETC)		
	S6 ,7	1G		S40-2441-15	PUSH SWITCH (VOICE)		
	S8 ,9	1G		S40-2440-15	PUSH SWITCH (DIM,ETC)		
⚠	S10	1F	*	S40-2457-05	PUSH SWITCH (POWER)		
	D1 -8			1SS133	DIODE		
	IC1			NE555P	IC		
	AVR UNIT (X43-3000-00)						
⚠	C1			C90-2047-05	ELECTRO 15000UF 25WV		
	C4			C91-1008-05	CERAMIC 0.022UF K		
	C5			CE04EW1E220M	ELECTRO 22UF 25WV		
	C8			CE04EW1E220M	ELECTRO 22UF 25WV		
	C9			C91-1008-05	CERAMIC 0.022UF K		
	C10			CE04EW1E220M	ELECTRO 22UF 25WV		
	C11			CE04EW1A470M	ELECTRO 47UF 10WV		
	C12			C91-1008-05	CERAMIC 0.022UF K		
	-			E23-0453-05	TERMINAL		
	CN1			E40-3239-05	PIN CONNECTOR (4P)		
	CN2			E40-3240-05	PIN CONNECTOR (5P)		
	CN3			E40-3242-05	PIN CONNECTOR (7P)		
	CN4			E40-3238-05	PIN CONNECTOR (3P)		
	CN5			E08-0272-05	RECTANGULAR RECEPTACLE(2P)		
	CN6			E40-3240-05	PIN CONNECTOR (5P)		
	CN7			E08-0373-05	RECTANGULAR RECEPTACLE(3P)		
	CN8			E40-3238-05	PIN CONNECTOR (3P)		
	-		*	F02-0429-04	HEAT SINK		
	-			J13-0055-05	FUSE HOLDER		
	-			N09-0641-05	SCREW		
	-			N35-3006-46	BINDING HEAD MACHINE SCREW		
	R4			RS14KB3A101J	FL-PROOF RS 100 J 1W		
⚠	R5 ,6			R92-0514-05	FUSE RESIST 4.7 J 1/4W		
⚠	R7 ,8		*	R92-0513-05	FUSE RESIST 10 G 1/4W		
⚠	RL1		*	S51-2418-05	RELAY		
⚠	D1		*	D5S4M	DIODE		
	D2			V06B	DIODE		
	D3			1SS133	DIODE		
	D4			1S1555	DIODE		
	D5 ,6			V06B	DIODE		
	D7			MTZ9.1JC	ZENER DIODE		
	D8			UZ3.3BCA	ZENER DIODE		

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D9		*	1SS133	DIODE		
⚠ IC1		*	TA78010AP	IC(VOLTAGE REGULATOR/ +10V)		
IC2		*	UA7805	IC(AVR)		
Q1			DTC124ES	DIGITAL TRANSISTOR		
⚠ Q2			2SC1959(Y)	TRANSISTOR		
RF UNIT (X44-3010-00)						
C3 ,4			CC45CH1H390J	CERAMIC 39PF J		
C7			CK45B1H102K	CERAMIC 1000PF K		
C8 ,9			CC45CH1H390J	CERAMIC 39PF J		
C10			CC45CH1H220J	CERAMIC 22PF J		
C11			CC45CH1H120J	CERAMIC 12PF J		
C12			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C16 ,17			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C18			C91-0117-05	CERAMIC 0.01UF K		
C19			CQ92M1H392K	MYLAR 3900PF K		
C20			CQ92M1H272K	MYLAR 2700PF K		
C21			CQ92M1H562K	MYLAR 5600PF K		
C22			CQ92M1H222K	MYLAR 2200PF K		
C23			CQ92M1H392K	MYLAR 3900PF K		
C24			CQ92M1H152K	MYLAR 1500PF K		
C25			CQ92M1H122K	MYLAR 1200PF K		
C26			CK45B1H471K	CERAMIC 470PF K		
C27			CK45B1H821K	CERAMIC 820PF K		
C28			CK45B1H471K	CERAMIC 470PF K		
C29			CK45B1H182K	CERAMIC 1800PF K		
C30			CK45B1H102K	CERAMIC 1000PF K		
C31			CK45B1H681K	CERAMIC 680PF K		
C32			CK45B1H471K	CERAMIC 470PF K		
C33			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C34			C91-0117-05	CERAMIC 0.01UF K		
C35 -37			CQ92M1H333K	MYLAR 0.033UF K		
C38		*	C91-1081-05	FIXED CAPACITOR(510PF,50WV)		
C39		*	C91-1082-05	FIXED CAPACITOR(560PF,50WV)		
C40		*	C91-1081-05	FIXED CAPACITOR(510PF,50WV)		
C42			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C43			CK45F1H473Z	CERAMIC 0.047UF Z		
C44			CK45B1H471K	CERAMIC 470PF K		
C45		*	C91-1080-05	FIXED CAPACITOR(390PF,50WV)		
C46		*	C91-1079-05	FIXED CAPACITOR(360PF,50WV)		
C47			C91-1054-05	FIXED CAPACITOR(330PF,50WV)		
C49			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C50			CK45F1H473Z	CERAMIC 0.047UF Z		
C51			CK45B1H471K	CERAMIC 470PF K		
C52			CC45RH1H201J	CERAMIC 200PF J		
C53			CC45RH1H301J	CERAMIC 300PF J		
C54			CC45RH1H201J	CERAMIC 200PF J		
C56			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C57			CK45F1H473Z	CERAMIC 0.047UF Z		
C58			CK45B1H471K	CERAMIC 470PF K		
C59			CC45RH1H301J	CERAMIC 300PF J		
C60			CC45RH1H161J	CERAMIC 160PF J		
C61			CC45RH1H221J	CERAMIC 220PF J		
C63			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C64			CK45F1H473Z	CERAMIC 0.047UF Z		
C65			CK45B1H471K	CERAMIC 470PF K		

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C66			CC45RH1H161J	CERAMIC	160PF J		
C67			CC45RH1H101J	CERAMIC	100PF J		
C68			CC45RH1H161J	CERAMIC	160PF J		
C70			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C71			CK45F1H223Z	CERAMIC	0.022UF Z		
C72			CK45B1H471K	CERAMIC	470PF K		
C73			CC45RH1H161J	CERAMIC	160PF J		
C74			CC45RH1H620J	CERAMIC	62PF J		
C75			CC45RH1H101J	CERAMIC	100PF J		
C77			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C78			CK45F1H223Z	CERAMIC	0.022UF Z		
C79			CK45B1H471K	CERAMIC	470PF K		
C80			CC45RH1H820J	CERAMIC	82PF J		
C81			CC45RH1H560J	CERAMIC	56PF J		
C82			CC45RH1H390J	CERAMIC	39PF J		
C84			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C86			CK45B1H471K	CERAMIC	470PF K		
C87			CC45RH1H680J	CERAMIC	68PF J		
C88			CC45RH1H470J	CERAMIC	47PF J		
C89			CC45RH1H220J	CERAMIC	22PF J		
C91			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C93			CK45B1H471K	CERAMIC	470PF K		
C95			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C96			CK45B1H182K	CERAMIC	1800PF K		
C97			C91-0117-05	CERAMIC	0.01UF K		
C98			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C100			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C101			C91-0117-05	CERAMIC	0.01UF K		
C102			CC45SL1H390J	CERAMIC	39PF J		
C103			CC45RH1H330J	CERAMIC	33PF J		
C104			CC45SL1H680J	CERAMIC	68PF J		
C105			CC45SL1H150J	CERAMIC	15PF J		
C106			CK45B1H102K	CERAMIC	1000PF K		
C107			CE04EW1H010M	ELECTRO	1.0UF 50WV		
C108			C91-1008-05	CERAMIC	0.022UF K		
C109			CK45B1H471K	CERAMIC	470PF K		
C111			CC45SL1H050C	CERAMIC	5.0PF C		
C112,113			C91-0119-05	CERAMIC	0.047UF K		
C114,115			CC45RH1H120J	CERAMIC	12PF J		
C116			C91-0117-05	CERAMIC	0.01UF K		
C117			CK45B1H471K	CERAMIC	470PF K		
C120,121			C91-0667-05	CERAMIC	0.0047UF K		
C122,123			CC45RH1H150J	CERAMIC	15PF J		
C124			CK45B1H471K	CERAMIC	470PF K		
C125			C91-0667-05	CERAMIC	0.0047UF K		
C126			CK45B1H222K	CERAMIC	2200PF K		
C127			C91-0667-05	CERAMIC	0.0047UF K		
C130			CE04EW1H2R2M	ELECTRO	2.2UF 50WV		
C131			C91-0119-05	CERAMIC	0.047UF K		
C132			C91-0117-05	CERAMIC	0.01UF K		
C133			CE04EW1H4R7M	ELECTRO	4.7UF 50WV		
C134			CC45UJ1H270J	CERAMIC	27PF J		
C135			CC45RH1H220J	CERAMIC	22PF J		
C136			CC45RH1H100D	CERAMIC	10PF D		
C137			CC45RH1H120J	CERAMIC	12PF J		

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C138			CE04EW1A471M	ELECTRO 470UF 10WV		
C139			C91-0119-05	CERAMIC 0.047UF K		
C140			CK45B1H102K	CERAMIC 1000PF K		
C141			CC45RH1H080D	CERAMIC 8.0PF D		
C142			CK45B1H222K	CERAMIC 2200PF K		
C143			CC45UJ1H220J	CERAMIC 22PF J		
C144			CC45RH1H220J	CERAMIC 22PF J		
C145,146			CC45RH1H100D	CERAMIC 10PF D		
C147			CK45B1H102K	CERAMIC 1000PF K		
C148			CC45RH1H080D	CERAMIC 8.0PF D		
C149			CK45B1H222K	CERAMIC 2200PF K		
C150			CC45UJ1H180J	CERAMIC 18PF J		
C151			CC45RH1H220J	CERAMIC 22PF J		
C152,153			CC45RH1H100D	CERAMIC 10PF D		
C154			CK45B1H102K	CERAMIC 1000PF K		
C155			CC45RH1H080D	CERAMIC 8.0PF D		
C156			CK45B1H222K	CERAMIC 2200PF K		
C157			C91-0119-05	CERAMIC 0.047UF K		
C158			CC45UJ1H270J	CERAMIC 27PF J		
C159			CC45RH1H270J	CERAMIC 27PF J		
C160			CC45RH1H100D	CERAMIC 10PF D		
C161			CC45RH1H050C	CERAMIC 5.0PF C		
C162			CK45B1H102K	CERAMIC 1000PF K		
C163			CC45RH1H080D	CERAMIC 8.0PF D		
C164			CK45B1H182K	CERAMIC 1800PF K		
C165			CC45RH1H030C	CERAMIC 3.0PF C		
C166			CK45B1H471K	CERAMIC 470PF K		
C167			C91-0667-05	CERAMIC 0.0047UF K		
C168			CC45CH1H100D	CERAMIC 10PF D		
C169			CC45CH1H080D	CERAMIC 8.0PF D		
C170			CC45CH1H180J	CERAMIC 18PF J		
C171			CC45CH1H050C	CERAMIC 5.0PF C		
C172			CC45CH1H180J	CERAMIC 18PF J		
C173			CC45CH1H070D	CERAMIC 7.0PF D		
C174			CK45B1H222K	CERAMIC 2200PF K		
C175			C91-0667-05	CERAMIC 0.0047UF K		
C176			CK45B1H471K	CERAMIC 470PF K		
C178			CC45CH1H100D	CERAMIC 10PF D		
C179			CK45B1H222K	CERAMIC 2200PF K		
C180,181			CK45B1H182K	CERAMIC 1800PF K		
C182			CK45B1H471K	CERAMIC 470PF K		
C183			C91-0667-05	CERAMIC 0.0047UF K		
C184			CK45B1H222K	CERAMIC 2200PF K		
C185			CK45B1H182K	CERAMIC 1800PF K		
C186			C91-0769-05	CERAMIC 0.01UF M		
C190,191			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C192,193			CK45B1H102K	CERAMIC 1000PF K		
C194			CC45CH1H390J	CERAMIC 39PF J		
C195			CC45CH1H220J	CERAMIC 22PF J		
C197			C91-0119-05	CERAMIC 0.047UF K		
C198			CC45CH1H050C	CERAMIC 5.0PF C		
-			E04-0157-05	RF COAXIAL CABLE RECEPTACLE(1P		
-			E23-0512-05	TERMINAL (MKR)		
CN1			E40-3239-05	PIN CONNECTOR (4P)		

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CN2			E40-3237-05	PIN CONNECTOR (2P)		
CN3			E40-3238-05	PIN CONNECTOR (3P)		
CN4			E40-3240-05	PIN CONNECTOR (5P)		
CN5			E40-3241-05	PIN CONNECTOR (6P)		
CN6			E40-3237-05	PIN CONNECTOR (2P)		
CN7			E40-3239-05	PIN CONNECTOR (4P)		
CN8			E40-3237-05	PIN CONNECTOR (2P)		
TP1			E40-0211-05	PIN CONNECTOR (2P)		
-			F11-0793-14	SHIELDING COVER		
-			F11-0892-04	SHIELDING COVER		
L1			L40-1511-13	SMALL FIXED INDUCTOR(150UH)		
L2 ,3			L34-1124-05	COIL		
L4			L34-0691-05	COIL		
L5			L40-1021-13	SMALL FIXED INDUCTOR(1MH)		
L6			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L7			L40-1801-14	SMALL FIXED INDUCTOR(18UH)		
L8			L40-1201-14	SMALL FIXED INDUCTOR(12UH)		
L9			L40-8291-14	SMALL FIXED INDUCTOR(8.2UH)		
L10			L40-3991-14	SMALL FIXED INDUCTOR(3.9UH)		
L11			L40-5691-14	SMALL FIXED INDUCTOR(5.6UH)		
L12			L40-3982-14	SMALL FIXED INDUCTOR(0.39UH)		
L13			L40-1092-14	SMALL FIXED INDUCTOR(1UH)		
L14			L40-2292-14	SMALL FIXED INDUCTOR(2.2UH)		
L15		*	L34-4008-05	COIL		
L16			L40-1005-25	SMALL FIXED INDUCTOR(10UH)		
L17		*	L34-4008-05	COIL		
L18		*	L34-4010-05	COIL		
L19			L40-8295-25	SMALL FIXED INDUCTOR(8.2UH)		
L20		*	L34-4010-05	COIL		
L21		*	L34-4009-05	COIL		
L22			L40-4795-25	SMALL FIXED INDUCTOR(4.7UH)		
L23		*	L34-4009-05	COIL		
L24		*	L34-4005-05	COIL		
L25			L40-3995-25	SMALL FIXED INDUCTOR(3.9UH)		
L26		*	L34-4005-05	COIL		
L27		*	L34-4006-05	COIL		
L28			L40-3395-25	SMALL FIXED INDUCTOR(3.3UH)		
L29		*	L34-4006-05	COIL		
L30		*	L34-4007-05	COIL		
L31			L40-2795-25	SMALL FIXED INDUCTOR(2.7UH)		
L32		*	L34-4007-05	COIL		
L33		*	L34-4004-15	COIL		
L34			L40-1595-25	SMALL FIXED INDUCTOR(1.5UH)		
L35		*	L34-4004-15	COIL		
L36		*	L34-4002-05	COIL		
L37			L34-2245-05	COIL		
L38		*	L34-4002-05	COIL		
L39			L40-1021-13	SMALL FIXED INDUCTOR(1MH)		
L40			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L41			L40-6891-13	SMALL FIXED INDUCTOR(6.8UH)		
L42			L40-1021-13	SMALL FIXED INDUCTOR(1MH)		
L43			L40-1021-12	SMALL FIXED INDUCTOR(1MH)		
L44			L34-2161-15	COIL		
L45			L34-0691-05	COIL		

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L46			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L47			L40-1001-14	SMALL FIXED INDUCTOR(10UH)		
L48		*	L34-4003-05	COIL		
L50		*	L34-4003-05	COIL		
L51 -54			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L55			L40-4711-13	SMALL FIXED INDUCTOR(470UH)		
L56			L32-0652-05	OSCILLATING COIL		
L57			L40-2292-14	SMALL FIXED INDUCTOR(2.2UH)		
L58			L32-0653-05	OSCILLATING COIL		
L59			L40-2292-14	SMALL FIXED INDUCTOR(2.2UH)		
L60			L32-0653-05	OSCILLATING COIL		
L61			L40-2292-14	SMALL FIXED INDUCTOR(2.2UH)		
L62		*	L34-4000-05	OSCILLATING COIL		
L63			L40-2292-14	SMALL FIXED INDUCTOR(2.2UH)		
L64			L34-1124-05	COIL		
L65 ,66			L34-1182-05	COIL		
L67			L40-6882-14	SMALL FIXED INDUCTOR(0.68UH)		
L68 ,69			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L70			L40-4701-13	SMALL FIXED INDUCTOR(47UH)		
L71 -74			L33-0605-05	CHOKE COIL		
L75 ,76			L40-3391-14	SMALL FIXED INDUCTOR(3.3UH)		
T1 ,2			L19-0324-05	BALUN TRANSFORMER		
T3 ,4			L19-0347-05	BALUN TRANSFORMER		
RB1			R90-0457-05	MULTI-COMP (4.7KX10)		
VR1			R12-1429-05	TRIMMING POT. (500)		
W23			R92-0150-05	JUMPER REST 0 OHM		
W32			R92-0150-05	JUMPER REST 0 OHM		
RL1 -3			S51-1428-05	RELAY		
D1 -3			1S1555	DIODE		
D4 ,5			1SS133	DIODE		
D6 ,7			US1090	DIODE		
D8			MA858	DIODE		
D9			1S1007	DIODE		
D10			MA858	DIODE		
D11			1S1007	DIODE		
D12			MA858	DIODE		
D13			1S1007	DIODE		
D14			MA858	DIODE		
D15			1S1007	DIODE		
D16			MA858	DIODE		
D17			1S1007	DIODE		
D18			MA858	DIODE		
D19			1S1007	DIODE		
D20			MA858	DIODE		
D21			1S1007	DIODE		
D22			MA858	DIODE		
D23			1S1007	DIODE		
D24			MA858	DIODE		
D25			1S1007	DIODE		
D26			MA858	DIODE		
D27			1S1007	DIODE		
D28			MTZ7.5JA	ZENER DIODE		
D29			ITT310TE	VARI-CAP DIODE		

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D30		*	1SS132	DIODE		
D31			ITT310TE	VARI-CAP DIODE		
D32		*	1SS132	DIODE		
D33			ITT310TE	VARI-CAP DIODE		
D34		*	1SS132	DIODE		
D35			ITT310TE	CARI-CAP DIODE		
D36		*	1SS132	DIODE		
D37			DAP401	DIODE		
D38			MC911	DIODE		
D39		*	DAP601	DIODE		
D40			MTZ5.1JA	ZENER DIODE		
D41			1SS133	DIODE		
IC1			SN74LS145N	IC(DUAL MONO MALTI)ECODER)		
Q1 -6			2SK125	FET		
Q7			2SB698(E,F)	TRANSISTOR		
Q8 -11			2SK192A(GR)*J	FET		
Q12			2SC1907	TRANSISTOR		
Q13			2SC2668(Y)	TRANSISTOR		
Q14			2SC1907	TRANSISTOR		
Q15			2SC2668(Y)	TRANSISTOR		
Q16			2SC2053	TRANSISTOR		
IF UNIT (X48-3000-00)						
C2			CC45RH1H070D	CERAMIC 7.0PF D		
C3			CC45CH1H150J	CERAMIC 15PF J		
C5			C91-0667-05	CERAMIC 0.0047UF K		
C7			CC45RH1H050C	CERAMIC 5.0PF C		
C9 ,10			CC45CH1H270J	CERAMIC 27PF J		
C11			CC45CH1H330J	CERAMIC 33PF J		
C14			CC45CH1H050C	CERAMIC 5.0PF C		
C16			CC45RH1H030C	CERAMIC 3.0PF C		
C17			CC45CH1H0R5C	CERAMIC 0.5PF C		
C22			CC45SL1H390J	CERAMIC 39PF J		
C23			CC45SL1H221J	CERAMIC 220PF J		
C25			CK45B1H222K	CERAMIC 2200PF K		
C26			CC45SL1H221J	CERAMIC 220PF J		
C30			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C36			CE04EW1E470M	ELECTRO 47UF 25WV		
C37			CK45B1H222K	CERAMIC 2200PF K		
C38			CK45B1H182K	CERAMIC 1800PF K		
C39			CC45SL1H101J	CERAMIC 100PF J		
C47			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C48			CC45SL1H101J	CERAMIC 100PF J		
C51			CK45B1H471K	CERAMIC 470PF K		
C52			CC45RH1H201J	CERAMIC 200PF J		
C53			CE04EW1H2R2M	ELECTRO 2.2UF 50WV		
C54			CE04EW1H100M	ELECTRO 10UF 50WV		
C55			CK45B1H471K	CERAMIC 470PF K		
C56			CE04EW1H0R1M	ELECTRO 0.1UF 50WV		
C60			CK45B1H182K	CERAMIC 1800PF K		
C75			CK45B1H182K	CERAMIC 1800PF K		
C90			CC45SL1H221J	CERAMIC 220PF J		
C93			CC45CH1H150J	CERAMIC 15PF J		
C94			CC45SL1H560J	CERAMIC 56PF J		
C96			CE04EW1A101M	ELECTRO 100UF 10WV		

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C97			CK45B1H471K	CERAMIC	470PF	K		
C98			CK45B1H221K	CERAMIC	220PF	K		
C99			CQ92M1H183K	MYLAR	0.018UF	K		
C100			CC45CH1H330J	CERAMIC	33PF	J		
C101			CC45CH1H220J	CERAMIC	22PF	J		
C103			CK45B1H222K	CERAMIC	2200PF	K		
C107			CE04EW1A101M	ELECTRO	100UF	10WV		
C108			CK45B1H471K	CERAMIC	470PF	K		
C109			CQ92M1H183K	MYLAR	0.018UF	K		
C110			CC45SL1H390J	CERAMIC	39PF	J		
C111			CC45SL1H470J	CERAMIC	47PF	J		
C112			CK45B1H221K	CERAMIC	220PF	K		
C114			CE04EW1A101M	ELECTRO	100UF	10WV		
C115			CC45SL1H101J	CERAMIC	100PF	J		
C117			CE04EW1HR47M	ELECTRO	0.47UF	50WV		
C118			CE04EW1H3R3M	ELECTRO	3.3UF	50WV		
C119			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C120			CE04EW1H4R7M	ELECTRO	4.7UF	50WV		
C121			CE04EW1H100M	ELECTRO	10UF	50WV		
C122			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C123			CE04EW1C330M	ELECTRO	33UF	16WV		
C125			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C127			CE04EW1E470M	ELECTRO	47UF	25WV		
C128			CC45SL1H101J	CERAMIC	100PF	J		
C130			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C136			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C139			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C143			CK45B1H122K	CERAMIC	1200PF	K		
C144			CQ92M1H332K	MYLAR	3300PF	K		
C145			CK45B1H391K	CERAMIC	390PF	K		
C150			CE04EW1E470M	ELECTRO	47UF	25WV		
C152			CC45SL1H121J	CERAMIC	120PF	J		
C153			CQ92M1H333K	MYLAR	0.033UF	K		
C155			CE04EW1H3R3M	ELECTRO	3.3UF	50WV		
C157,158			CE04EW1E470M	ELECTRO	47UF	25WV		
C160,161			CE04EW1H2R2M	ELECTRO	2.2UF	50WV		
C162			CE04EW1H100M	ELECTRO	10UF	50WV		
C163,164			CQ92M1H154K	MYLAR	0.15UF	K		
C165			CQ92M1H123K	MYLAR	0.012UF	K		
C166			CQ92M1H183K	MYLAR	0.018UF	K		
C167			CE04EW1A101M	ELECTRO	100UF	10WV		
C168			CQ92M1H333K	MYLAR	0.033UF	K		
C169			CE04EW1E470M	ELECTRO	47UF	25WV		
C170			CQ92M1H683K	MYLAR	0.068UF	K		
C171			CE04EW1H220M	ELECTRO	22UF	50WV		
C172			CE04EW1H010M	ELECTRO	1.0UF	50WV		
C173			CE04EW1E101M	ELECTRO	100UF	25WV		
C174			CE04EW1H220M	ELECTRO	22UF	50WV		
C175			CQ92M1H104K	MYLAR	0.10UF	K		
C176			CE04EW1E470M	ELECTRO	47UF	25WV		
C177			CE04EW1H220M	ELECTRO	22UF	50WV		
C178			CQ92M1H332K	MYLAR	3300PF	K		
C179			CE04EW1E471M	ELECTRO	470UF	25WV		
C183,184			CE04EW1E102M	ELECTRO	1000UF	25WV		
C186			CE04EW1H010M	ELECTRO	1.0UF	50WV		

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C188			CE04EW1E470M	ELECTRO 47UF 25WV		
C191			CE04EW1H0R1M	ELECTRO 0.1UF 50WV		
C192			CC45SL1H470J	CERAMIC 47PF J		
-			E04-0154-05	RF COAXIAL CABLE RECEPTACLE		
-			E11-0414-05	PHONE JACK		
-			E23-0512-05	TERMINAL		
-			E29-0434-05	INTERCONNECTOR		
-			E31-2170-15	CONNECTING WIRE		
-			E33-1761-00	FINISHED WIRE SET		
-			E40-0517-05	PIN CONNECTOR		
-			E40-5059-05	PIN CONNECTOR		
CN1			E40-3241-05	PIN CONNECTOR (6P)		
CN2			E40-5066-05	PIN CONNECTOR (9P)		
CN3			E40-3238-05	PIN CONNECTOR (3P)		
CN4			E40-3237-05	PIN CONNECTOR (2P)		
CN6			E40-3239-05	PIN CONNECTOR (4P)		
CN7			E40-3243-05	PIN CONNECTOR (8P)		
CN8 ,9			E40-3240-05	PIN CONNECTOR (5P)		
CN10,11			E40-3238-05	PIN CONNECTOR (3P)		
CN12			E40-3240-05	PIN CONNECTOR (5P)		
CN13			E40-3237-05	PIN CONNECTOR (2P)		
TP1			E40-0211-05	PIN CONNECTOR		
-		*	F02-0430-14	HEAT SINK		
-			F11-0817-04	SHIELDING COVER		
-			F11-0818-24	SHIELDING COVER(COVER)		
-			J32-0761-04	BOSS		
CF1			L72-0315-05	CERAMIC FILTER (CFW455F)		
L1			L34-4003-05	COIL (58.1MHZ)		
L2			L32-0678-05	OSCILLATING COIL(58.1MHZ)		
L3			L34-4003-05	COIL (58.1MHZ)		
L4			L34-2074-05	COIL		
L5 ,6		*	L33-0693-05	CHOKE COIL (0.68UH)		
L7 ,8			L34-2116-15	COIL		
L9			L30-0509-05	IFT (8.83MHZ)		
L10			L34-0781-05	COIL		
L11			L34-2124-05	COIL		
L12			L40-2211-14	SMALL FIXED INDUCTOR(220UH)		
L13 ,14			L30-0503-05	IFT (455KHZ)		
L15 ,16			L34-0941-05	COIL		
L17 ,18			L40-2211-14	SMALL FIXED INDUCTOR(220UH)		
L19			L34-0678-05	COIL		
L20			L40-2211-15	SMALL FIXED INDUCTOR(220UH)		
L21			L34-0537-05	COIL		
L22			L34-0781-05	COIL		
L23			L40-1592-14	SMALL FIXED INDUCTOR(1.5UH)		
L24			L30-0519-05	IFT (455KHZ)		
L25			L30-0503-05	IFT (455KHZ)		
L26			L79-0446-05	COIL (DISCRI)		
L27 ,28			L40-1021-14	SMALL FIXED INDUCTOR(1MH)		
L29			L40-3391-13	SMALL FIXED INDUCTOR(3.3UH)		
L30			L40-1011-14	SMALL FIXED INDUCTOR(100UH)		
X1		*	L77-1319-05	CRYSTAL RESONATOR(49.2825MHZ)		
X2		*	L77-1320-05	CRYSTAL RESONATOR(8.375MHZ)		

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XF1			L71-0243-05	MCF (58.1125MHZ)		
XF2		*	L71-0266-05	MCF (8.83MHZ)		
XF3			L71-0208-15	MCF (YK-88S)		
-			N09-0641-05	SCREW		
-			N30-3010-46	PAN HEAD MACHINE SCREW		
-			N35-3006-46	BINDING HEAD MACHINE SCREW		
-			N35-3008-46	BINDING HEAD MACHINE SCREW		
⚠ R243		*	R92-0681-05	FIXED RESISTOR (1W,4.7OHM)		
VR1			R12-1066-05	TRIMMING POT. (1K)		
VR2			R12-3099-05	TRIMMING POT. (47K)		
VR3			R12-1069-05	TRIMMING POT. (4.7K)		
VR4			R12-1066-05	TRIMMING POT. (1K)		
VR5			R12-5046-05	TRIMMING POT. (100K)		
VR6			R12-3098-05	TRIMMING POT. (33K)		
VR7 ,8			R12-3096-05	TRIMMING POT. (10K)		
W64			R92-0150-05	JUMPER REST 0 OHM		
D1 ,2			BA282	DIODE		
D3			MC931	DIODE		
D4			1SS133	DIODE		
D5 -23			1S1587	DIODE		
D24 -27			1N60	DIODE		
D28			MC931	DIODE		
D29			1SS133	DIODE		
D30			1S1587	DIODE		
D31			MC911	DIODE		
D32			MC931	DIODE		
D33 -36			1SS133	DIODE		
D37			MC921	DIODE		
D38 -41			1SS133	DIODE		
D42 ,43			MC921	DIODE		
D44 -48			1SS133	DIODE		
D49			1S1587	DIODE		
D50 -55			1SS133	DIODE		
D56			MC921	DIODE		
D57 -60			1SS133	DIODE		
D61			1S1587	DIODE		
D62 ,63			1SS133	DIODE		
D64			1SS141VE	DIODE		
D65			1SS133	DIODE		
IC1			NJM4558S	IC(OP AMP X2)		
IC4			NJM2903S	IC(DUAL COMPALATOR)		
IC5 ,6			UPC577H	IC(OP AMP)		
IC7			NJM4558S	IC(OP AMP X2)		
IC8			NJM2903S	IC(DUAL COMPALATOR)		
IC9			TC4066BP	CMOS IC(ANALOG SW X4)		
IC12			NJM4558S	IC(OP AMP X2)		
⚠ IC13			MB3713	IC(AF POWER AMP)		
⚠ IC14		*	AN78N09	IC(VOLTAGE REGULATOR/ +15V)		
IC15			TC4071BP	IC(OR X4) X4)		
Q1			3SK73(Y)	FET		
Q2 ,3			2SC2668(Y)	TRANSISTOR		
Q4 ,5			2SK125	FET		
Q6			DTC114ES	DIGITAL TRANSISTOR		
Q7			DTC144WS	DIGITAL TRANSISTOR		

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Q8			2SC2668(Y)	TRANSISTOR		
Q9 -12			3SK73(Y)	FET		
Q13			2SC2787(L)	TRANSISTOR		
Q14 ,15			2SC2458(Y)	TRANSISTOR		
Q16			DTA124ES	DIGITAL TRANSISTOR		
Q17			DTC124ES	DIGITAL TRANSISTOR		
Q18			2SC2787(L)	TRANSISTOR		
Q19			3SK73(Y)	FET		
Q20			2SC2787(L)	TRANSISTOR		
Q21 ,22			3SK73(Y)	FET		
Q23 ,24			2SC2787(L)	TRANSISTOR		
Q25			2SC3113(B)	TRANSISTOR		
Q26 ,27			2SC2458(Y)	TRANSISTOR		
Q28			DTC144ES	DIGITAL TRANSISTOR		
Q29			2SC2458(Y)	TRANSISTOR		
Q30			2SK161(GR)	FET		
Q31			DTA144ES	DIGITAL TRANSISTOR		
Q32 ,33			2SC2459(BL)	TRANSISTOR		
Q34			DTA124ES	DIGITAL TRANSISTOR		
Q35			DTA144ES	DIGITAL TRANSISTOR		
Q36 -38			DTC144WS	DIGITAL TRANSISTOR		
Q39			2SC2458(Y)	TRANSISTOR		
Q40 -43			DTA114ES	DIGITAL TRANSISTOR		
Q44			DTA144ES	DIGITAL TRANSISTOR		
TH1 ,2			112-501-2	THERMISTOR (500)		
TH3			112-202-2	THERMISTOR (2K)		
IC2			X59-3010-00	COMPOSITE UNIT (AGC)		
IC3			X59-3020-00	COMPOSITE UNIT (S METER)		
IC10			X59-3030-00	COMPOSITE UNIT (NOTCH)		
IC11			X59-3040-00	COMPOSITE UNIT (SELECT)		
PLL UNIT (X50-3030-00)						
C1			CC45CH1H470J	CERAMIC 47PF J		
C2			CC45CH1H101J	CERAMIC 100PF J		
C4			CC45SL1H271J	CERAMIC 270PF J		
C5			CK45B1H271K	CERAMIC 270PF K		
C9			CC45SL1H220J	CERAMIC 22PF J		
C13			CE04EW1A470M	ELECTRO 47UF 10WV		
C20			CQ92M1H473K	MYLAR 0.047UF K		
C21			CK45B1H182K	CERAMIC 1800PF K		
C22			CE04EW1A470M	ELECTRO 47UF 10WV		
C23			C91-1008-05	CERAMIC 0.022UF K		
C24			CC45UJ1H100D	CERAMIC 10PF D		
C25			CC45UJ1H390J	CERAMIC 39PF J		
C26			CC45UJ1H220J	CERAMIC 22PF J		
C27			CC45CH1H040C	CERAMIC 4.0PF C		
C28 -31			CK45B1H182K	CERAMIC 1800PF K		
C32			CK45B1H222K	CERAMIC 2200PF K		
C33			CK45B1H182K	CERAMIC 1800PF K		
C34			CE04EW1A470M	ELECTRO 47UF 10WV		
C36			CK45B1H271K	CERAMIC 270PF K		
C37			CC45UJ1H151J	CERAMIC 150PF J		
C38			CK45B1H471K	CERAMIC 470PF K		
C39			CC45SL1H680J	CERAMIC 68PF J		
C41			CK45B1H271K	CERAMIC 270PF K		

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C43 -45			C91-1008-05	CERAMIC 0.022UF K		
C51			C91-1008-05	CERAMIC 0.022UF K		
C52			CC45SL1H101J	CERAMIC 100PF J		
C53			CC45CH1H050C	CERAMIC 5.0PF C		
C54			CC45SL1H101J	CERAMIC 100PF J		
C55			CK45B1H222K	CERAMIC 2200PF K		
C59 ,60			CK45B1H182K	CERAMIC 1800PF K		
C61			CC45CH1H1R5C	CERAMIC 1.5PF C		
C66			CK45B1H182K	CERAMIC 1800PF K		
C70			CS15E1HR33M	TANTAL 0.33UF 50WV		
C71			CK45B1H182K	CERAMIC 1800PF K		
C72 ,73			CC45UJ1H100D	CERAMIC 10PF D		
C74			CC45UJ1H390J	CERAMIC 39PF J		
C75			CK45B1H182K	CERAMIC 1800PF K		
C76			CE04EW1A101M	ELECTRO 100UF 10WV		
C77			CC45UJ1H100D	CERAMIC 10PF D		
C78			CC45CH1H030C	CERAMIC 3.0PF C		
C79			CC45CH1H080D	CERAMIC 8.0PF D		
C80			CC45CH1H030C	CERAMIC 3.0PF C		
C81 ,82			CK45B1H182K	CERAMIC 1800PF K		
C85 ,86			CK45B1H182K	CERAMIC 1800PF K		
C87			CK45B1H222K	CERAMIC 2200PF K		
C88 ,89			CK45B1H182K	CERAMIC 1800PF K		
C91			C91-1008-05	CERAMIC 0.022UF K		
C92			CK45B1H222K	CERAMIC 2200PF K		
C95			CC45CH1H060D	CERAMIC 6.0PF D		
C96			CC45CH1H100D	CERAMIC 10PF D		
C97			CC45CH1H270J	CERAMIC 27PF J		
C98			CC45CH1H060D	CERAMIC 6.0PF D		
C99			CC45CH1H270J	CERAMIC 27PF J		
C100			CC45CH1H040C	CERAMIC 4.0PF C		
C101			CC45CH1H050C	CERAMIC 5.0PF C		
C102,103			CK45B1H221K	CERAMIC 220PF K		
C104			CK45B1H182K	CERAMIC 1800PF K		
C107			C91-1008-05	CERAMIC 0.022UF K		
C108			CK45B1H182K	CERAMIC 1800PF K		
C109			C91-1008-05	CERAMIC 0.022UF K		
C112			CE04EW1A470M	ELECTRO 47UF 10WV		
C113			CK45B1H222K	CERAMIC 2200PF K		
C115			C91-1008-05	CERAMIC 0.022UF K		
C116			CE04EW1A470M	ELECTRO 47UF 10WV		
C120			CE04EW1A470M	ELECTRO 47UF 10WV		
C121			C91-1008-05	CERAMIC 0.022UF K		
C122,123		*	C91-1083-05	FIXED CAPACITOR(0.4UF)		
C130			CQ92M1H473K	MYLAR 0.047UF K		
C132			CE04EW1A470M	ELECTRO 47UF 10WV		
C133			CC45UJ1H050C	CERAMIC 5.0PF C		
C134			CC45UJ1H390J	CERAMIC 39PF J		
C135			C91-1008-05	CERAMIC 0.022UF K		
C138			CC45CH1H010C	CERAMIC 1.0PF C		
C139			CC45UJ1H270J	CERAMIC 27PF J		
C144			CE04EW1A470M	ELECTRO 47UF 10WV		
C145			CK45B1H821K	CERAMIC 820PF K		
C146			CK45B1H391K	CERAMIC 390PF K		
C147			CK45B1H152K	CERAMIC 1500PF K		

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C148			CC45SL1H151J	CERAMIC 150PF J		
C149			C91-1008-05	CERAMIC 0.022UF K		
C151			CK45B1H821K	CERAMIC 820PF K		
C152			C91-1008-05	CERAMIC 0.022UF K		
C154			C91-1008-05	CERAMIC 0.022UF K		
C157			CC45CH1H050C	CERAMIC 5.0PF C		
C158			C91-1008-05	CERAMIC 0.022UF K		
C160-163			C91-1008-05	CERAMIC 0.022UF K		
C164			CC45CH1H030C	CERAMIC 3.0PF C		
C165			CC45CH1H270J	CERAMIC 27PF J		
C166			CC45CH1H070D	CERAMIC 7.0PF D		
C167			CC45CH1H150J	CERAMIC 15PF J		
C169			CC45SL1H150J	CERAMIC 15PF J		
C170			C91-1008-05	CERAMIC 0.022UF K		
C172			CC45CH1H180J	CERAMIC 18PF J		
C173			CK45B1H222K	CERAMIC 2200PF K		
C174,175			CK45B1H182K	CERAMIC 1800PF K		
C177			CK45B1H222K	CERAMIC 2200PF K		
C178			CC45CH1H150J	CERAMIC 15PF J		
C179			CC45CH1H100D	CERAMIC 10PF D		
C180			CC45CH1H150J	CERAMIC 15PF J		
C181			CK45B1H182K	CERAMIC 1800PF K		
C182			CC45CH1H030C	CERAMIC 3.0PF C		
C183			CC45CH1H150J	CERAMIC 15PF J		
C184			CE04EW1A470M	ELECTRO 47UF 10WV		
C186			CE04EW1H010M	ELECTRO 1.0UF 50WV		
C188			C91-1008-05	CERAMIC 0.022UF K		
C189			CE04EW1A470M	ELECTRO 47UF 10WV		
C192			C91-1008-05	CERAMIC 0.022UF K		
C205			CE04EW1A470M	ELECTRO 47UF 10WV		
C207-209			CC45CH1H220J	CERAMIC 22PF J		
C210,211			CQ92M1H102K	MYLAR 1000PF K		
C214			C91-1008-05	CERAMIC 0.022UF K		
TC1			C05-0031-15	TRIMMING CAP (10PF)		
-			E29-0440-14	TERMINAL (GND)		
BF0			E04-0157-05	RF COAXIAL CABLE RECEPTACLE		
CN1 ,2			E40-3237-05	PIN CONNECTOR (2P)		
CN3			E40-3240-05	PIN CONNECTOR (5P)		
CN4			E40-3239-05	PIN CONNECTOR (4P)		
CN6			E40-3243-05	PIN CONNECTOR (8P)		
HET			E04-0157-05	RF COAXIAL CABLE RECEPTACLE		
MKR			E23-0512-05	TERMINAL		
CF1			L72-0350-05	CERAMIC FILTER (9.285MHZ)		
CF2			L72-0351-05	CERAMIC FILTER (8.83MHZ)		
L3 ,4			L40-1511-13	SMALL FIXED INDUCTOR(150UH)		
L5			L32-0666-15	OSCILLATING COIL		
L6			L40-1592-13	SMALL FIXED INDUCTOR(1.5UH)		
L7			L40-1021-13	SMALL FIXED INDUCTOR(1MH)		
L8 ,9			L40-1811-25	SMALL FIXED INDUCTOR(180UH)		
L10 ,11			L34-2026-05	COIL		
L12 ,13			L34-2108-15	COIL		
L14			L34-1182-05	COIL		
L15			L40-1592-13	SMALL FIXED INDUCTOR(1.5UH)		
L16			L32-0676-05	OSCILLATING COIL		

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L17			L40-2211-13	SMALL FIXED INDUCTOR(220UH)		
L18			L40-1511-13	SMALL FIXED INDUCTOR(150UH)		
L19 -21			L40-6882-14	SMALL FIXED INDUCTOR(0.68UH)		
L22			L40-4791-14	SMALL FIXED INDUCTOR(4.7UH)		
L23			L40-2211-12	SMALL FIXED INDUCTOR(220UH)		
L24			L40-6811-13	SMALL FIXED INDUCTOR(680UH)		
L25			L32-0675-05	OSCILLATING COIL		
L26			L40-1001-13	SMALL FIXED INDUCTOR(10UH)		
L27			L40-1021-13	SMALL FIXED INDUCTOR(1MH)		
L28 ,29			L40-5611-25	SMALL FIXED INDUCTOR(560UH)		
L30			L34-0781-05	COIL		
L31 ,32			L40-1001-14	SMALL FIXED INDUCTOR(10UH)		
L33			L34-1181-05	COIL		
L34			L40-3382-14	SMALL FIXED INDUCTOR(0.33UH)		
L36			L34-1181-05	COIL		
L37			L40-1011-14	SMALL FIXED INDUCTOR(100UH)		
X1			L77-1318-05	CRYSTAL RESONATOR(18MHZ)		
IB1			R90-0600-05	MULTI-COMP (100PFX4)		
IB2			R90-0584-05	MULTI-COMP (100PFX7)		
VR1			R12-4414-05	TRIMMING POT. (50KB)		
D1			1SS133	DIODE		
D2 ,3			ITT310TE	VARI CAP DIODE		
D4			1SV153	VARI CAP		
D6			1SS133	DIODE		
D7			MTZ5.1JA	ZENER DIODE (5.1V)		
D8			1SS133	DIODE		
D9 ,10			1SV153	VARI CAP		
D11 -13			1S1587	DIODE		
D14 ,15			1SS133	DIODE		
D16 -19			BA282	DIODE		
IC1			SN74LS73AN	IC(DUAL JK-FF)		
IC2			MN6147C	IC(FREQ SYNTHESYZER PLL)		
IC3			M54459L	IC(PRE SCALER)		
IC4			SN74LS90N	IC(DECADE COUNRERS)		
IC5 -7			SN16913P	IC(DUBLE BALANCED MIXERS)		
IC8			MB87006	IC(FREQ SYNTHESIZER PLL))		
IC9			UPB551C	IC(PRE SCALER 1/20 OR 1/100)		
IC10			SN16913P	IC(DUBLE BALANCED MIXERS)		
IC11			SN74S74N	IC(DUAL D-FF)		
IC12			MB87006	IC(FREQ SYNTHESIZER PLL))		
IC13			BA718	IC(OP AMP X2)		
IC14			MN6147C	IC(FREQ SYNTHESYZER PLL)		
IC15			M54459L	IC(PRE SCALER)		
IC16			SN74LS90N	IC(DECADE COUNRERS)		
IC17			SN16913P	IC(DUBLE BALANCED MIXERS)		
IC18			AN78N05	IC(AVR) 5V		
⚠ IC19			AN78M09	IC(AVR) 9V		
Q1			2SC2668(Y)	TRANSISTOR		
Q2 ,3			2SC2787(L)	TRANSISTOR		
Q4 -7			2SC2668(Y)	TRANSISTOR		
Q8			2SC1907	TRANSISTOR		
Q9 ,12			2SC2668(Y)	TRANSISTOR		
Q13			2SC1907	TRANSISTOR		
Q14 -16			2SC2668(Y)	TRANSISTOR		

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Q17 -19			2SC2787(L)	TRANSISTOR		
Q20 -22			2SC2668(Y)	TRANSISTOR		
Q23			DTA124ES	DIGITAL TRANSISTOR		
Q24			DTC124ES	DIGITAL TRANSISTOR		
Q25			DTC144WS	DIGITAL TRANSISTOR		
CONTROL UNIT (X53-3020-XX) -11 : K,M,T,W1 -61 : W2 -71 : X						
C1 ,2			CC45CH1H330J	CERAMIC 33PF J		
C4			C90-0822-05	ELECTRO 47UF 16WV		
C7			C90-0822-05	ELECTRO 47UF 16WV		
C10			CE04CW1HR47M	ELECTRO 0.47UF 50WV		
C11			CE04CW1C470M	ELECTRO 47UF 16WV		
C14			C90-0822-05	ELECTRO 47UF 16WV		
C15 ,16			CC45SL1H101J	CERAMIC 100PF J		
C19			CQ92M1H472K	MYLAR 4700PF K		
C22			C90-0822-05	ELECTRO 47UF 16WV		
C28			CQ92M1H103K	MYLAR 0.010UF K		
C39 -41			C91-0753-05	CERAMIC 470PF K		
C51		*	C90-2046-05	ELECTRO 22UF 10WV		
C55			C90-0822-05	ELECTRO 47UF 16WV		
C57			C90-0822-05	ELECTRO 47UF 16WV		
C59			C90-0822-05	ELECTRO 47UF 16WV		
C62			C90-0822-05	ELECTRO 47UF 16WV		
C73		*	C90-2046-05	ELECTRO 22UF 10WV		
C74 ,75			CC45CH1H220J	CERAMIC 22PF J		
C76 ,77			CK45B1H471K	CERAMIC 470PF K		
C100-106			C91-0753-05	CERAMIC 470PF K		
-			E02-0114-05	IC SOCKET (16P)		
-			E02-2001-05	IC SOCKET (28P)		
-			E23-0512-05	TERMINAL		
-			E31-3161-05	CONNECTING WIRE(A,13P)		
-			E31-3162-05	CONNECTING WIRE(B,12P)		
-			E31-3163-05	CONNECTING WIRE(C,9P)		
CN1			E40-3238-05	PIN CONNECTOR (3P)		
CN2			E40-3239-05	PIN CONNECTOR (4P)		
CN4			E40-3240-05	PIN CONNECTOR (5P)		
CN5 ,6			E40-3241-05	PIN CONNECTOR (6P)		
CN10			E40-3240-05	PIN CONNECTOR (5P)		
CN11			E40-3243-05	PIN CONNECTOR (8P)		
CN12			E40-3242-05	PIN CONNECTOR (7P)		
CN13			E40-5066-05	PIN CONNECTOR (9P)		
CN14			E40-3243-05	PIN CONNECTOR (8P)		
CN15			E40-3239-05	PIN CONNECTOR (4P)		
CN16			E40-3242-05	PIN CONNECTOR (7P)		
CN53			E40-3243-05	PIN CONNECTOR (8P)		
CN54,55			E40-3241-05	PIN CONNECTOR (6P)		
CN56			E40-3237-05	PIN CONNECTOR (2P)		
CN57			E40-3240-05	PIN CONNECTOR (5P)		
CN58			E40-3241-05	PIN CONNECTOR (6P)		
CN59			E40-3237-05	PIN CONNECTOR (2P)		
-			J31-0503-05	COLLAR		
L1			L40-1011-13	SMALL FIXED INDUCTOR		
L2			L40-1011-03	SMALL FIXED INDUCTOR		
L4			L40-1011-14	SMALL FIXED INDUCTOR		
L5			L40-1011-03	SMALL FIXED INDUCTOR		

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L23			L40-1011-14	SMALL FIXED INDUCTOR		
L50 ,51			L40-1011-14	SMALL FIXED INDUCTOR		
L52			L40-1011-13	SMALL FIXED INDUCTOR		
L53 -55			L40-1011-03	SMALL FIXED INDUCTOR		
L57			L40-1011-14	SMALL FIXED INDUCTOR		
L58 ,59			L40-4701-14	SMALL FIXED INDUCTOR		
X1			L78-0019-05	RESONATOR (1.99MHZ)		
X50			L78-0015-05	RESONATOR (2.45MHZ)		
X51			L77-1256-05	CRYSTAL RESONATOR(32.768KHZ)		
RB1			R90-0510-05	MULTI-COMP (4.7KX8)		
RB50			R90-0510-05	MULTI-COMP (4.7KX8)		
RB51			R90-0521-05	MULTI-COMP (47KX7)		
RB52			R90-0597-05	MULTI-COMP (1KX4)		
D1 -9			1SS133	DIODE		
D51 -54			1SS133	DIODE		
D65 -72			1SS133	DIODE		
D73			1SS133	DIODE	X1	
D74 -76			1SS133	DIODE	W2	
D79			1SS133	DIODE		
D85 ,86			1SS133	DIODE		
IC1			UPD7800G	IC(MICROPROCESSOR)		
IC2		*	M5M82C55AP-5	IC(CMOS PROGRAMMABLE I/O)		
IC3			PST520D	IC(LOW POWER RESET)		
IC4			TC4069UBP	IC(INVERTER X6)		
IC5			TC4011BP	IC(NAND X4)		
IC6			TC4030BP	IC(EXCLUSIVE OR X4)		
IC7			TC4011BP	IC(NAND X4)		
IC50			MB8418-20LP-GRA	IC(16K RAM)		
IC51			SN74LS138N	IC(DECODERS)		
IC52		*	MBM27128-25JB1	IC(128K CMOS UV-EPROM)		
IC53		*	M5M82C55AP-5	IC(CMOS PROGRAMMABLE I/O)		
IC56			SN7404N	IC(6-CIRCUIT INVERTER)		
IC57		*	M5M6242RS	IC(REAL TIME CLOCK)		
Q1 -7			DTC143ES	DIGITAL TRANSISTOR		
Q14 -17		*	DTC143ES	DIGITAL TRANSISTOR		
Q50			DTC144WS	DIGITAL TRANSISTOR		
DISPLAY UNIT (X54-3010-00)						
C1			C90-0871-05	ELECTRO 220UF 16WV		
C3			C90-0504-05	ELECTRO 10UF 35WV		
C4			C092M1H223K	MYLAR 0.022UF K		
C5 -7			C90-0504-05	ELECTRO 10UF 35WV		
C11			C90-0822-05	ELECTRO 47UF 16WV		
C15			C90-0822-05	ELECTRO 47UF 16WV		
CN1			E40-3243-05	PIN CONNECTOR (8P)		
CN2			E40-3242-05	PIN CONNECTOR (7P)		
CN3			E40-3240-05	PIN CONNECTOR (5P)		
CN4			E40-3238-05	PIN CONNECTOR (3P)		
CN5			E40-3240-05	PIN CONNECTOR (5P)		
CN56			E40-3242-05	PIN CONNECTOR (7P)		
L1 ,2			L40-1011-13	SMALL FIXED INDUCTOR(100UH)		
L3			L40-1011-14	SMALL FIXED INDUCTOR(100UH)		
L4			L40-1011-13	SMALL FIXED INDUCTOR(100UH)		
T1			L19-0323-05	BALUN TRANSFORMER		

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RB1			R90-0511-05	MULTI-COMP (47KX8)		
RB2			R90-0193-05	MULTI-COMP 47KX9 J 1/6W		
RB3			R90-0520-05	MULTI-COMP (47KX5)		
W50 -53			R92-1061-05	JUMPER REST 0 OHM		
S7 -60			S40-2440-15	PUSH SWITCH		
D1 -4			1S1555	DIODE		
D5			MTZ5.1JA	ZENER DIODE		
D6			MTZ3.9JB	ZENER DIODE		
FIP1			FIP13BM7	DISPLAY TUBE		
IC1			UPD6300C	IC(FL LATCH DRIVER)		
IC2			MB4052	IC(4CH 8BIT A/D CONVERTER(ADC)		
IC3			TC4013BP	IC(D FLIP-FLOP X2)		
Q1 ,2			DTA114ES	DIGITAL TRANSISTOR		
Q3			DTC144WS	DIGITAL TRANSISTOR		
⚠ Q4 ,5			2SC1959(Y)	TRANSISTOR		
AGC (X59-3010-00)						
-			E23-0471-05	TERMINAL		
R1 -4			RK73FB2A223J	CHIP R 22K J 1/10W		
R5			RK73EB2B224J	CHIP R 220K J 1/8W		
W1			R92-0670-05	CHIP R 0 OHM		
W2 ,3			R92-0679-05	FIXED RESISTOR		
IC1			TC4001BF	IC(NOR X6)		
IC2		*	TC4066BF	IC(BILATERAL SWITCH X4)H)		
S METER (X59-3020-00)						
-			E23-0471-05	TERMINAL		
R1			RK73FB2A103J	CHIP R 10K J 1/10W		
R2			RK73FB2A101J	CHIP R 100 J 1/10W		
R3			RK73FB2A222J	CHIP R 2.2K J 1/10W		
R4			RK73FB2A223J	CHIP R 22K J 1/10W		
R5			RK73FB2A103J	CHIP R 10K J 1/10W		
R6			RK73FB2A152J	CHIP R 1.5K J 1/10W		
R7			RK73FB2A332J	CHIP R 3.3K J 1/10W		
R8			RK73FB2A682J	CHIP R 6.8K J 1/10W		
R9			RK73FB2A562J	CHIP R 5.6K J 1/10W		
R10			RK73FB2A103J	CHIP R 10K J 1/10W		
W1 -3			R92-0670-05	CHIP R 0 OHM		
D1 ,2			DAN202(K)	CHIP DIODE		
Q1			2SC2712(Y)	CHIP TRANSISTOR		
Q2 ,3			2SA1162(Y)	CHIP TRANSISTOR		
Q4			2SC2712(Y)	CHIP TRANSISTOR		
Q5			2SK211(GR)	CHIP FET		
NOTCH (X59-3030-00)						
C1 ,2			CK73FB1H682K	CHIP C 6800PF K		
C3			CK73FB1H271K	CHIP C 270PF K		
-			E23-0471-05	TERMINAL		
R1 -4			RK73FB2A913J	CHIP R 91K J 1/10W		
R5			RK73FB2A681J	CHIP R 680 J 1/10W		
R6			RK73FB2A913J	CHIP R 91K J 1/10W		
R7			RK73FB2A471J	CHIP R 470 J 1/10W		
R8			RK73FB2A913J	CHIP R 91K J 1/10W		

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R9			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R10			RK73FB2A913J	CHIP R 91K J 1/10W		
R12			RK73FB2A102J	CHIP R 1.0K J 1/10W		
R13			RK73FB2A684J	CHIP R 680K J 1/10W		
W1			R92-0670-05	CHIP R 0 OHM		
IC1			NJM4558M	IC(OP AMP X2)		
SELECT (X59-3040-00)						
-			E23-0471-05	TERMINAL		
R1			RK73FB2A223J	CHIP R 22K J 1/10W		
R2			RK73FB2A472J	CHIP R 4.7K J 1/10W		
R3 -5			RK73FB2A474J	CHIP R 470K J 1/10W		
W1			R92-0670-05	CHIP R 0 OHM		
W2 -5			R92-0679-05	FIXED RESISTOR		
D1			DAN202(K)	CHIP DIODE		
IC1			TC4066BF	IC(BILATERAL SWITCH X4)H)		
Q1			DTA124EK	DIGITAL TRANSISTOR		
Q2 ,3			DTC144WK	DIGITAL TRANSISTOR		

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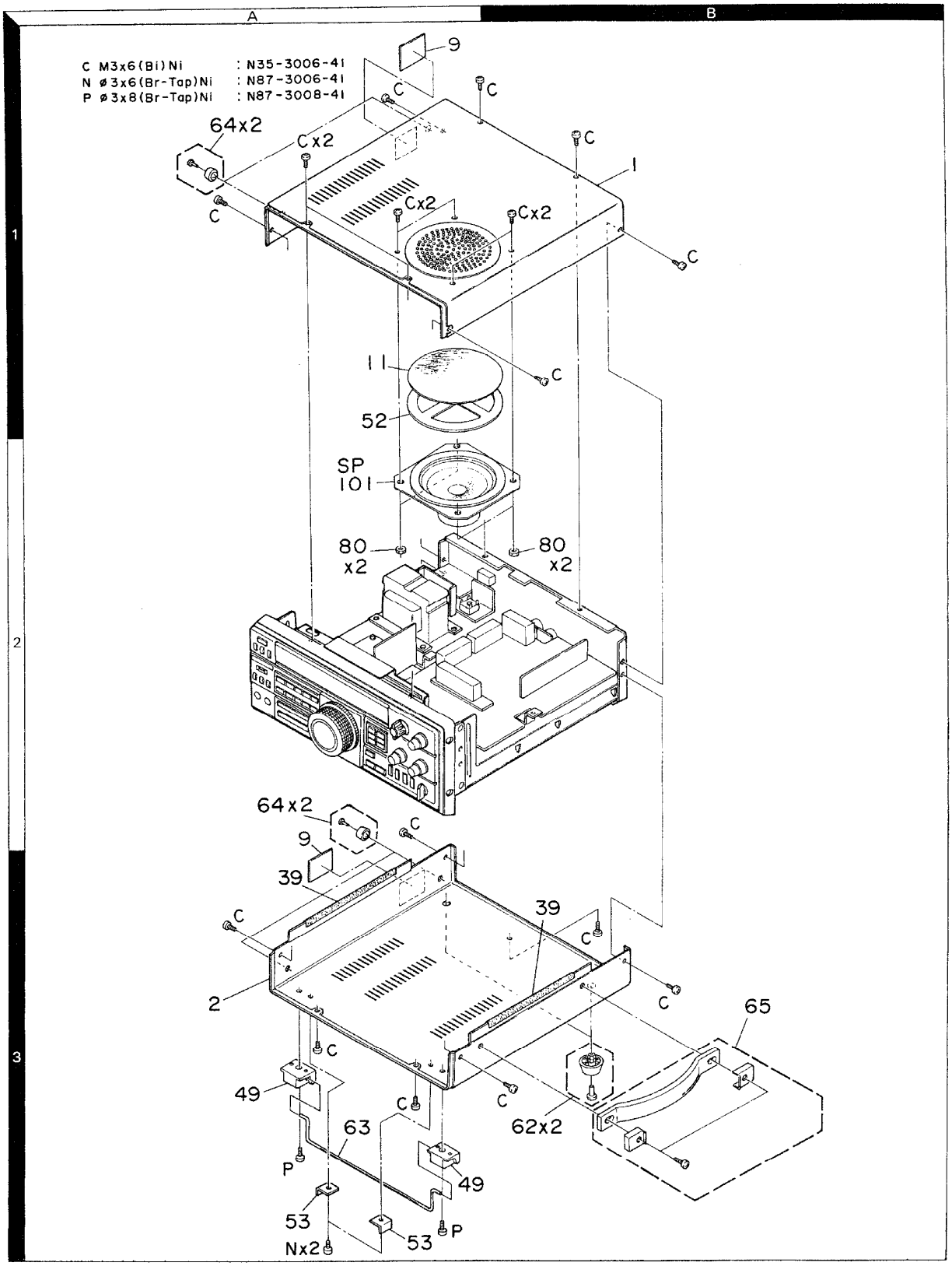
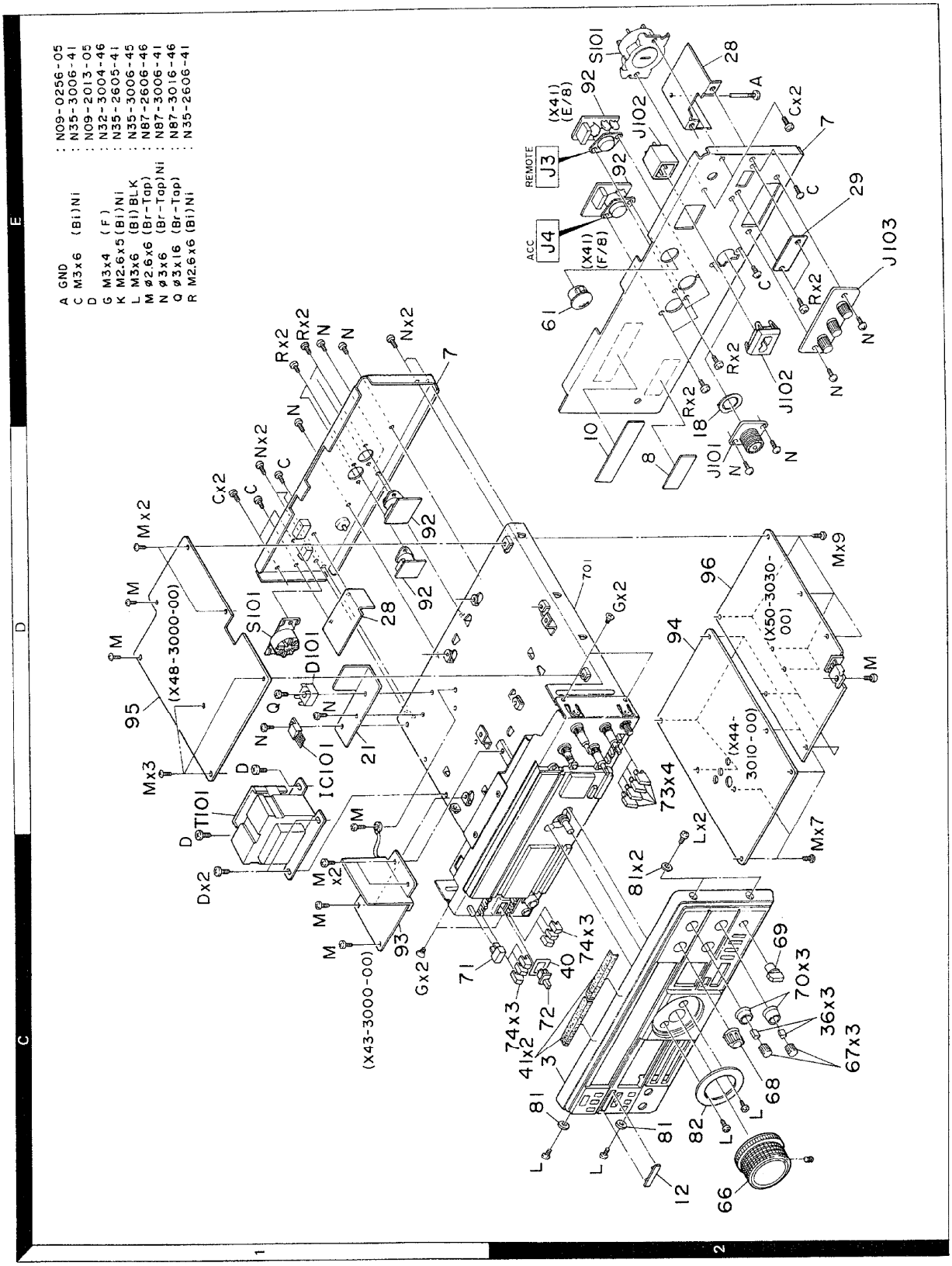
DISASSEMBLY



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

DISASSEMBLY



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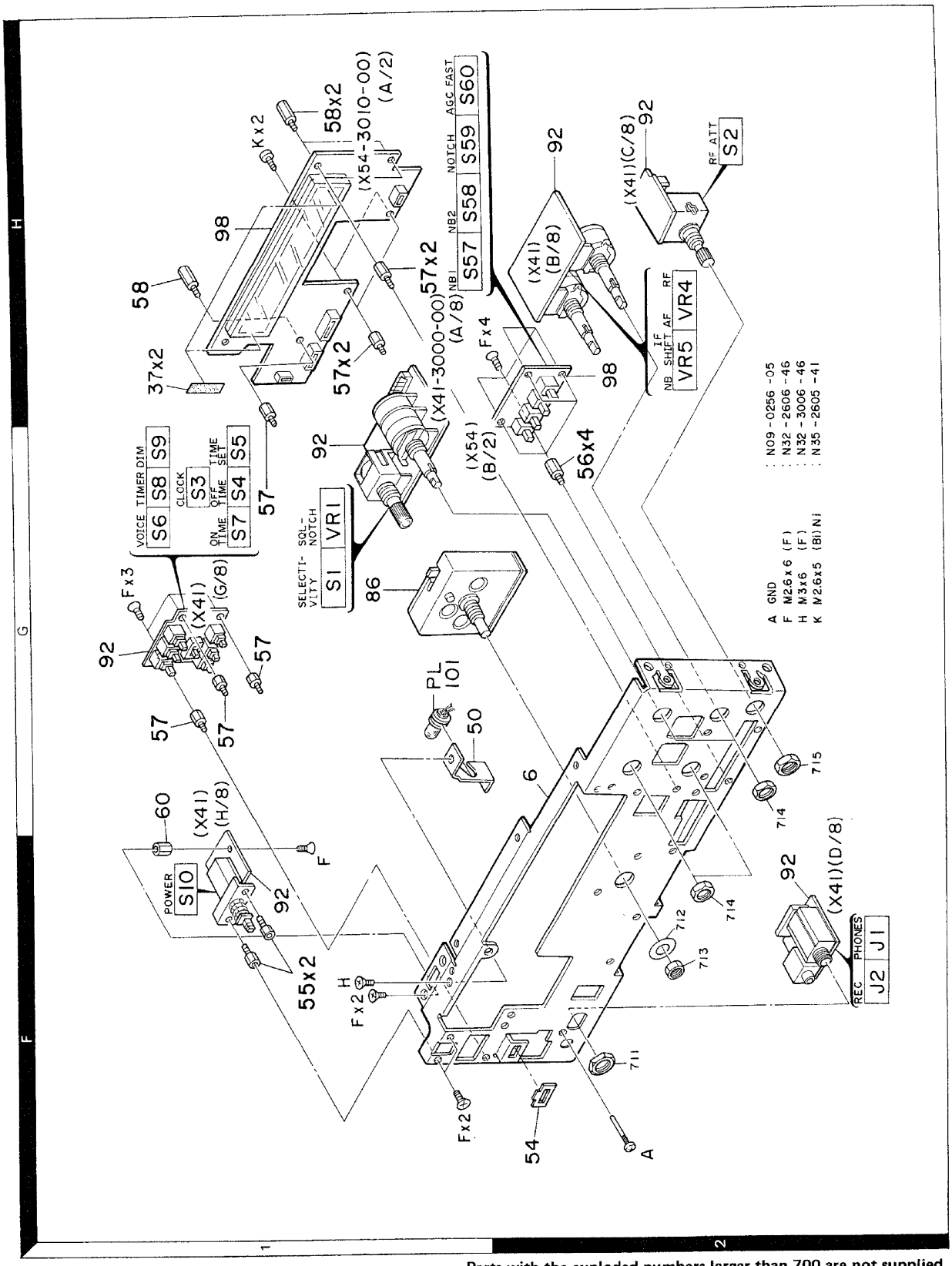
DISASSEMBLY



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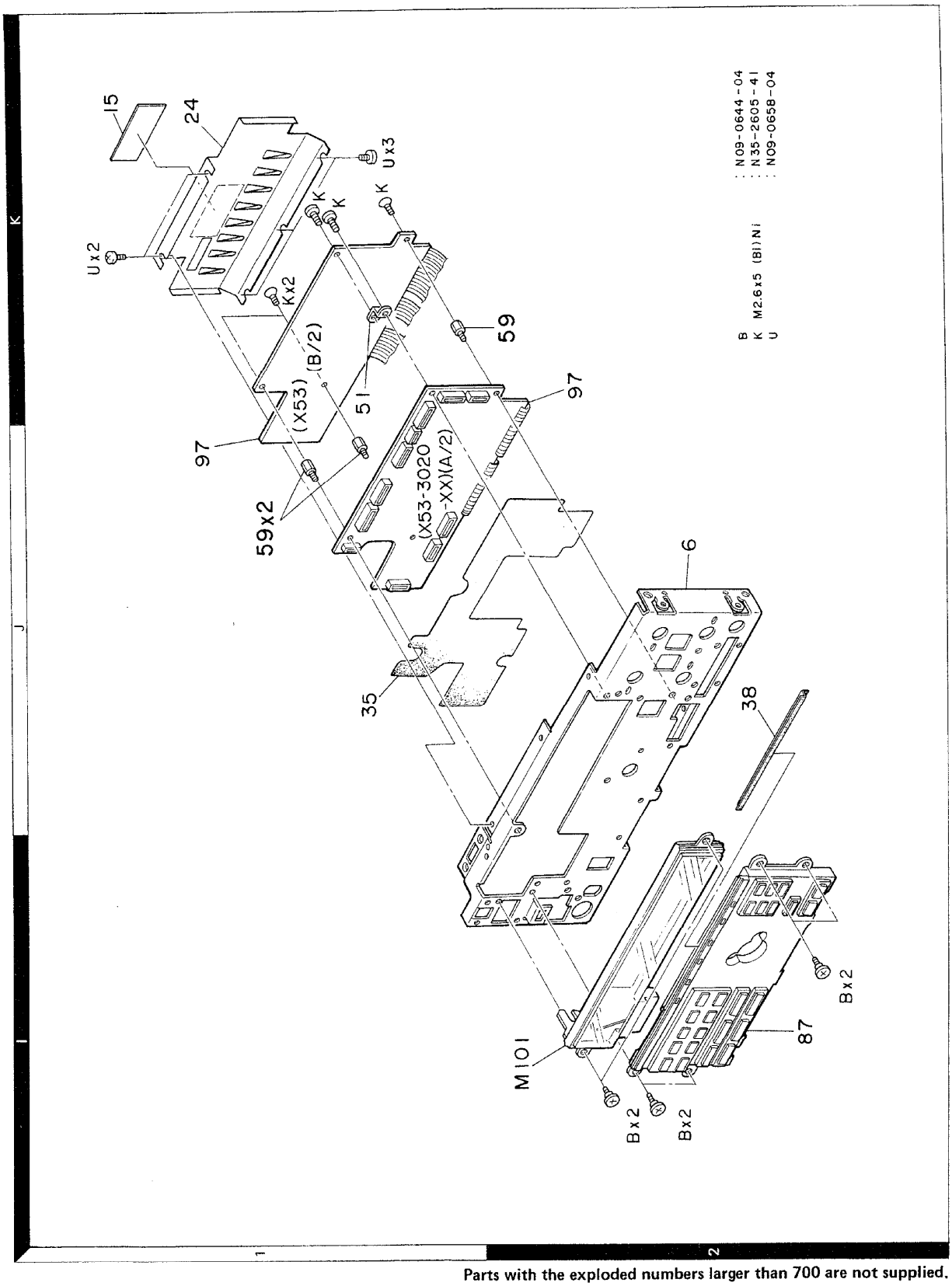
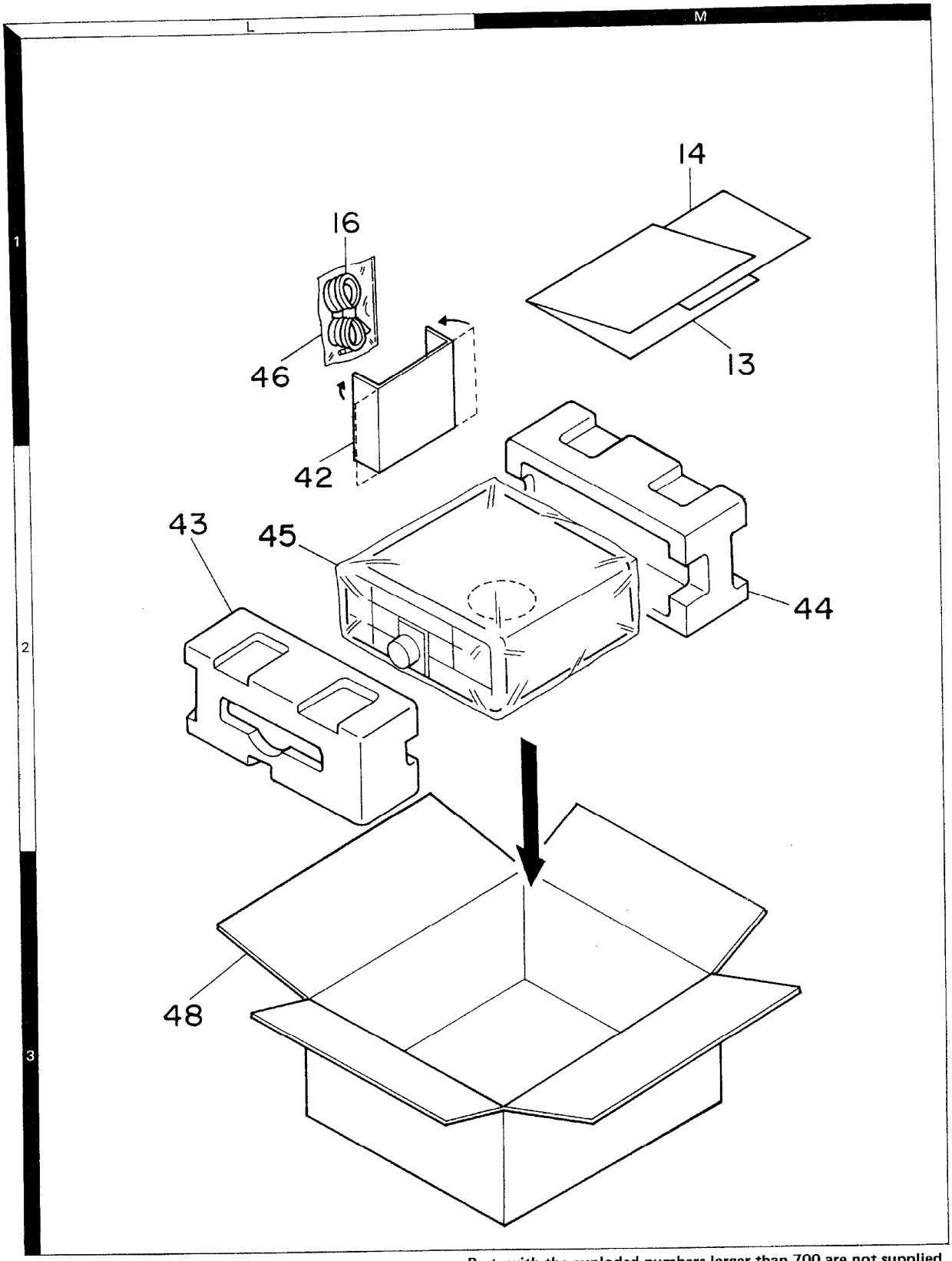
DISASSEMBLY



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

PACKING

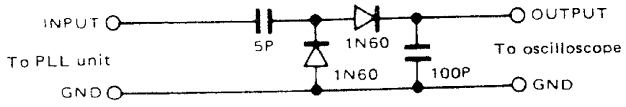


Parts with the exploded numbers larger than 700 are not supplied.

ADJUSTMENT

REQUIRED TEST EQUIPMENT

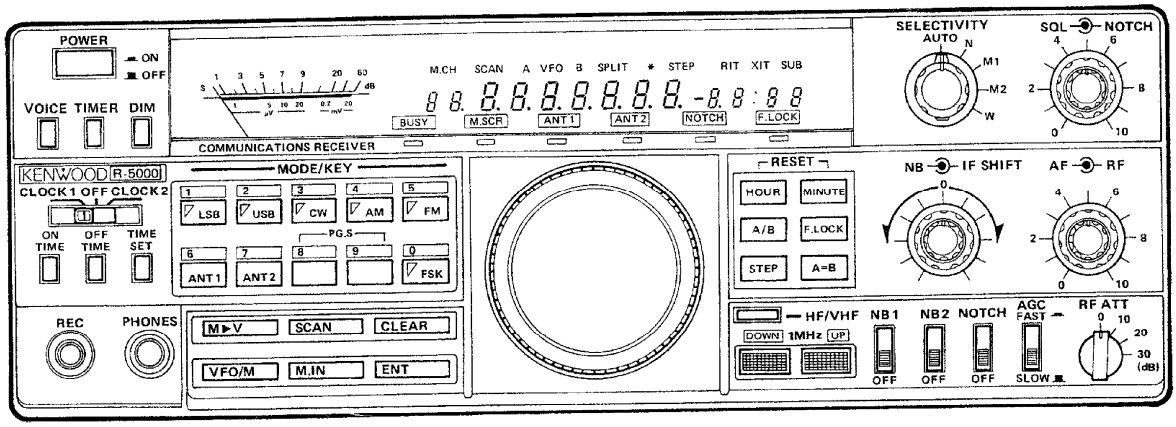
1. **DC Voltmeter (DC V.M)**
   1) Input resistance : More than 1MΩ
   2) Voltage range : F.S. = 1.5V to 1000V, AC/DC
   NOTE : A high-precision multimeter may be used. However, accurate readings can not be obtained for high-impedance circuits.
2. **DC Ammeter**
   1) Current range : 1.5A, 3A, 20A, High-precision ammeter may be used.
3. **RF VTVM (RF V.M)**
   1) Input impedance : 1MΩ and less than 3pF, min.
   2) Voltage range : F.S. = 10mV to 300V
   3) Frequency range : 10kHz to 100MHz or greater
4. **AF Voltmeter (AF V.M)**
   1) Frequency range : 50Hz to 10kHz
   2) Input resistance : 1MΩ or greater
   3) Voltage range : F.S. = 10mV to 30V
5. **AF Dummy Load**
   1) Imp
   1) Impedance : 8Ω
   2) Dissipation : 3W or greater
6. **Oscilloscope (OSCILLO)**
   Requires high sensitivity, and external synchronization capability.
7. **Sweep Generator (Sweep Gen.)**
   1) Center frequency : 50kHz to 200MHz
   2) Frequency deviation : Maximum±35MHz
   3) Output voltage : 0.1V or greater
8. **Standard Signal Generator (SSG)**
   1) Frequency range : 50kHz to 500MHz
   2) Output : −20dB/0.1μV to 120dB/1V
   3) Output impedance : 50Ω
   4) AM and FM modulation can be possible.
   NOTE : Generator must be frequency stable.
9. **Frequency Counter (f.counter)**
   1) Minimum input voltage : 50mV
   2) Frequency range : 500MHz or greater
10. **Noise Generator**
    Must generate ignition noise containing harmonics beyond 30MHz.
11. **Spectrum Analyzer**
    1) Frequency range : 100kHz to 200MHz or greater
    2) Bandwidth : 1kHz to 3MHz
12. **Tracking Generator**
    1) For adjustment of RF BPF/MCF
13. **Detector**
    1) For adjustment of PLL/VCO BPF



PREPARATION

1) Unless otherwise specified. Knob and switches should be set as follows :

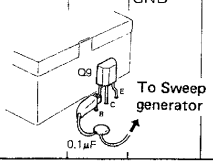
POWER SW	OFF
SQL VR	MIN
NOTCH VR	CENTER
NB VR	MIN
IF SHIFT VR	CENTER
AF VR	MIN
RF VR	MAX
TIMER SW	OFF
DIM SW	OFF
F.LOCK SW	OFF
CLOCK SW	OFF
TIME SET SW	OFF
SELECTIVITY SW	AUTO
HF/VHF SW	HF
NB1 SW	OFF
NB2 SW	OFF
NOTCH SW	OFF
AGC SW	SLOW
RF ATT SW	0

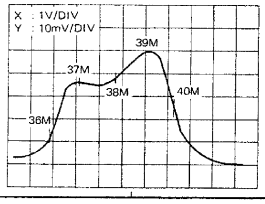


ADJUSTMENT

PLL ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Reference FREQ.		f. counter	PLL	IC1 ⑤	PLL	TC1	18.000.00MHz	±10Hz
		RF V.M					Check	300~350mV
2. PLL1	1) FREQ. : 14.999.99 MODE : FSK	DC V.M	PLL	TP1	PLL	L5	1.5V	1.4~1.6V
	2) FREQ. : 15.000.00 MODE : CW						Check	3.7~4.3V
		RF V.M		IC2 ⑯			Check	70~100mV
3. PLL2	1) FREQ. : 15.000.00 MODE : FM	DC V.M	PLL	TP2	PLL	L16	2.0V	1.9~2.1V
	2) FREQ. : 14.999.99 MODE : FM						Check	3.0~3.6V
		RF V.M		IC7 ⑤			Check	25~45mV
4. PLL3	1) FREQ. : 15.000.00 MODE : FM	f.counter	PLL	TP3	PLL	TC1	23.000.00MHz	±10Hz
		RF V.M					Check	40~120mV
5. PLL4	1) FREQ. : 15.000.00 MODE : FM	DC V.M	PLL	TP4	PLL	L25	25V	2.4~2.6V
	2) FREQ. : 15.000.00 MODE : USB IF SHIFT VR : Center						Check	2.8~3.0V
		RF V.M		IC5 ④			Check	60~90mV
6. BFO output		RF V.M	PLL	BFO	PLL	L30	MAX.	7mV (Ref.)
7. BPF 1		RF V.M	PLL	IC7 ②	PLL	L10, L11	MAX. then 2dB down. down with L10.	6mV (Ref.)
8. BPF 2	1) Connect the oscilloscope to TP5. Connect the Sweep Gen. to Q9 (base) thru the condensor.	SCOPE Sweep Gen.	PLL	TP5 GND Q9 (base) GND	PLL	L12, L13	Adjust as shown below.	





OTHER ADJUSTMENT

Item	Condition	Measurement			Adjustment			Specification/Remarks
		Test equipment	Unit	Terminal	Unit	Part	Method	
1. Reset	1) Set the Power SW ON, while depressing the A=B key.	Display					Check	VFO A 15.000.00 MODE : AM ANT : ANT1 BUSY : lit on
2. Voltage check (1)	1)	DC V.M	IF	⑦ -8			14V	13.5~15.0V
				⑦ -4			−5V	4.5~5.5V
				⑦ -1			9V	8.5~9.5V
	2) MODE : FM			② -5			(FMG)	Less than 1.0V
	3) MODE : FSK			② -4			(RYG)	Less than 1.0V
	4) MODE : AM			② -3			(AMG)	Less than 1.0V
	5) MODE : CW			② -2			(CWG)	Less than 1.0V
	6) MODE : USB			② -1			(SSG)	Less than 1.0V
3. RFG	1)	DC V.M	IF	TP3	IF	VR2	3.0V	2.9~3.1V
4. Voltage check (2)	1)	DC V.M	PLL	W31			9V	8.5~9.5V
				L23			5V	4.6~5.3V
			RF	W42			8.9V	8.4~9.4V
							Depress the HF/VHF key once.	0V momentarily, then turns 8.9V again.
				⑦ -1			9V	8.5~9.5V