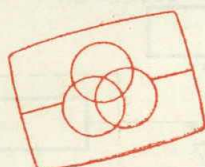


# HI FI QUARTZ CONTROLLED FM STEREO TUNER

## MODEL NO. AT-9700H, E, K



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# AIWA®

## (SERVICE MANUAL)

Code No., 09-970-000-20



DATE OF ISSUE 11/1978

### SPECIFICATIONS

<b>Semiconductors:</b>	23 ICs, 6 FETs, 61 transistors, 67 diodes, 43 LEDs	<b>Selectivity:</b>	±200 kHz	20 ± 5 dB (narrow)
<b>Power source:</b>	AC 110–120 V/220–240 V (switchable)		±300 kHz	20 ± 5 dB (normal)
<b>Power consumption:</b>	28W		±400 kHz	more than 70 dB (narrow)
<b>Dimensions:</b>	448 (W) x 149 (H) x 376 (D) mm	<b>Frequency scale accuracy:</b>		more than 50 dB (normal)
<b>Weight:</b>	8.7 kg			more than 85 dB (narrow)
<b>Frequency range:</b>	87.5–108.0 MHz (E model) 87.4–109.0 MHz (K, H model)	<b>Muting threshold:</b>		±150 kHz (at 88, 108 MHz)
<b>Frequency response:</b>	Mono 40~50 Hz less than 1.0 dB 50~6,300 Hz less than 0.2 dB 6,300~12,500 Hz less than 0.5 dB Stereo 30~15,000 Hz +0.2 dB -0.5 dB 50~10,000 ±0.2 dB	<b>Stereo separation:</b>		±30 kHz (at 98 MHz)
<b>50 dB Quieting sensitivity:</b>	Mono 12 ± 3 dB (normal) 12 ± 3 dB (narrow) Stereo 35 ± 3 dB (normal) 35 ± 3 dB (narrow)		at 100 Hz	19 ± 5 dB (narrow)
<b>Usable sensitivity:</b>	3 ± 2 dB (normal) 3 ± 2 dB (narrow) (at 88, 98, 108 MHz)			more than 45 dB (normal)
<b>Image rejection ratio:</b>	more than 110 dB (at 98 MHz)		at 1 kHz	more than 25 dB (narrow)
<b>IF interference ratio:</b>	more than 80 dB (at 98 MHz)			more than 50 dB (normal)
<b>AM suppression ratio:</b>	65 ± 5 dB (at 98 MHz)		at 10 kHz	more than 25 dB (narrow)
<b>Capture ratio:</b>	less than 2 dB (normal) less than 3 dB (narrow)		at 15 kHz	more than 40 dB (normal)
<b>Spurious rejection ratio:</b>	more than 110 dB (normal) more than 110 dB (narrow)			more than 25 dB (narrow)
<b>SN ratio:</b>	Mono 81 ± 4 dB (normal) 81 ± 4 dB (narrow) Stereo more than 70 dB (normal)	<b>Distortion:</b>		more than 30 dB (normal)
		(1 kHz, Mono 75 kHz deviation Stereo		more than 20 dB (narrow)
		67.5 kHz deviation, pilot 7.5 kHz		
		at 10 kHz	Mono	less than 0.035% (normal)
				less than 0.3% (narrow)
			Stereo	less than 0.05% (normal)
				less than 0.5% (narrow)
			Stereo	less than 0.1% (normal)
				less than 0.7% (narrow)

- Specifications and external appearance are subject to change without notice due to product improvement.



## SPECIAL CIRCUITRY DESCRIPTION

### 1. Quartz crystal-controlled PLL MPX

MPX sections configured with PLL (phase-locked loop) circuits are now widely being used in order to enhance the stability of the separation. This makes it possible to resist aging and facilitate adjustments without using an LC resonance circuit.

In the PLL MPX section, a 38 kHz switching signal which is phase synchronized with the 19 kHz pilot signal provided from the detector is obtained and the stereo demodulation operation is performed.

The 76 kHz oscillator, (voltage-controlled oscillator) receives the DC voltage and its oscillation frequency undergoes a change. The frequency divider serves to scale down the frequency to half the 76 kHz frequency (38 kHz), this operation switches the composite signals and these are then separated into the left and right channel signals. In order to configure the phase-locked loop, the difference in phase between that of the pilot signal and that of the 19 kHz signal, which is scaled down from the 38 kHz signal is detected and a servo loop is configured so that the value of this difference is accurately set to  $90^\circ$ . If the free-running frequency of the VCO shifts greatly from the 76 kHz frequency, the above-mentioned  $90^\circ$  phase difference can no longer be maintained and the separation is no longer obtained. The loop gain is increased to prevent these phenomena from occurring. This means that even if the free-running frequency of the VCO is not exactly 76 kHz (adjustments, aging, temperature variations), the separation does not suffer much deterioration.

However, should this operation be conducted for a signal other than the pilot signal, the VCO is activated and beat distortion is generated. This beat distortion does not only exist in the high-frequency components of the signals but also in the difference components with the 19 kHz signals (10 kHz with 9 kHz signals).

In order to suppress this beat distortion, the loop gain is decreased and only the pilot signal is supplied to the PLL in some tuners with a resonance circuit. However, such tuners are not able to take advantage of the reduction of aging in the separation.

The AT-9700 gets round this problem by using a quartz crystal for the VCO and a phase-locked loop is configured with 19 kHz signals across a  $\pm 4$  Hz range. This helps to yield an MPX section in which both beat distortion and aging are reduced to the bare minimum.

The AT-9700 also employs a pilot canceler circuit and for general signals, those with a frequency over 15 kHz are suppressed by the filter. The cut-off frequency of the filter is set at 19 kHz and a wide-band reproduction sound is provided.

### 2. Quartz crystal-controlled servo lock system

Accurate tuning is essential for the high-quality reception of broadcasts. Even with a high level of selectivity, the interference is worsened at times if the broadcasting station is not tuned in properly. Furthermore, the distortion deteriorates with detuning. All this means that the actual tuning operation is extremely important from the viewpoint of making the tuner display its performance to the full.

The quartz crystal-controlled servo lock system is designed to provide both accurate and easy tuning.

#### 2-1. Description of operation

##### 1) Servo lock system

First, an outline of the servo lock system is given. Fig. 1 shows its basic configuration.

The local oscillator employs a variable capacitor, and the oscillation frequency undergoes the changes shown in Fig. 2 in accordance with the control voltage. In addition, the output of the detector also undergoes change as indicated in Fig. 3 in accordance with the input frequency.

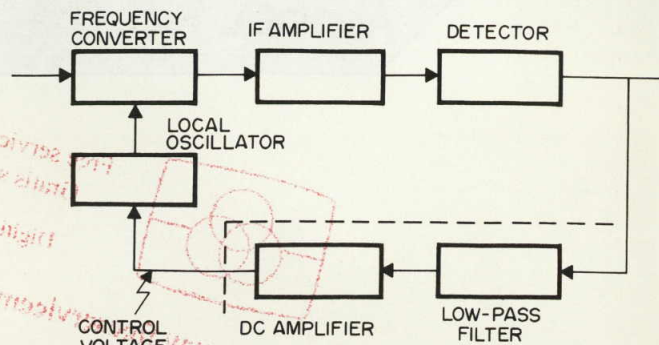


Fig. 1

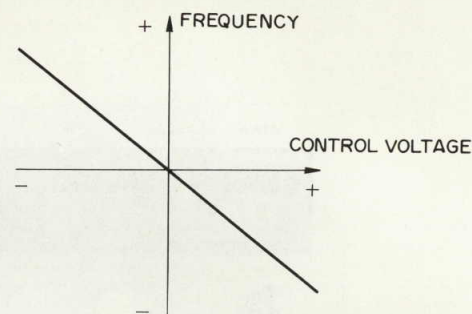


Fig. 2

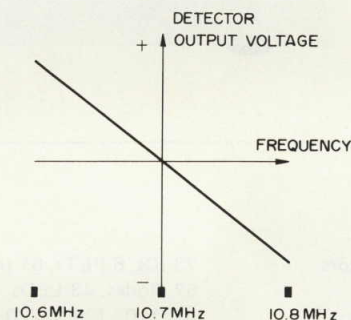


Fig. 3

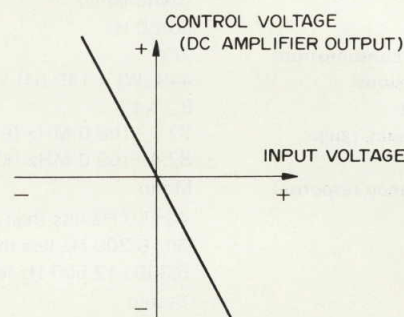


Fig. 4

Accurate tuning means that the local oscillator frequency is higher than the intermediate frequency (10.7 MHz) with relation to the frequency of the broadcasting station which is being tuned in. In this case, the detector output is 0 V, and the output of the DC amplifier, or in other words the control voltage of the local oscillator becomes 0 V. This means that the local oscillator frequency does not change.

When the frequency of the broadcasting station is not tuned in accurately, for instance, if the local oscillator frequency is high and the intermediate frequency is higher than 10.7 MHz, the detector output goes negative. As shown in Fig. 4 by the input and output characteristics, the DC amplifier acts as an inverting amplifier. Therefore, the output goes positive and the local oscillator frequency is reduced. In this way, compensation is provided even if the tuning shifts.



The operation is the same as that provided by an AFC. However, since the DC amplifier is performing the operation, the compensation capability is increased.

In order to compensate for the local oscillation frequency, a control voltage which agrees with the error frequency is required. This is applied by the DC components in the detector output. Therefore, in order to compensate for the frequency, the detector output takes on DC components. In other words, it is not possible to compensate for the tuning point perfectly. Nevertheless, if the detector output is amplified by the DC amplifier, the DC components in the detector output aimed at providing the same control voltage need only be small and it is then possible to compensate up to a more accurate tuning point.

In this kind of servo lock system (generally known as an AFC with a DC amplifier), a greater compensation capability is featured than an AFC with a normal configuration within the limited detuning range.

## 2) Quartz crystal-controlled servo system

There is, conversely, a disadvantage in providing the servo lock system with a high compensation capability. As with a wide-range AFC, once high input strength signals are caught, it no longer becomes possible to receive the weaker signals on either side of the tuning point, and in extreme cases there is a certain amount of danger in receiving at the point where there is a shift from the RF amplifier stage tuning point.

This demerit can be resolved if the servo lock function can be made to work only with a range centering on an accurate tuning point. To do this, the accurate tuning point must be predicted beforehand, and the operation of the servo lock system must be controlled. However, it is not possible to memorize all the frequencies of the broadcasting stations. Most stations broadcast on a frequency which is an integer of 100 kHz and so the servo control function is made to operate at 100 kHz intervals across a range of  $\pm 40$  kHz. Fig. 5 is a block diagram of the quartz crystal-controlled servo lock system.

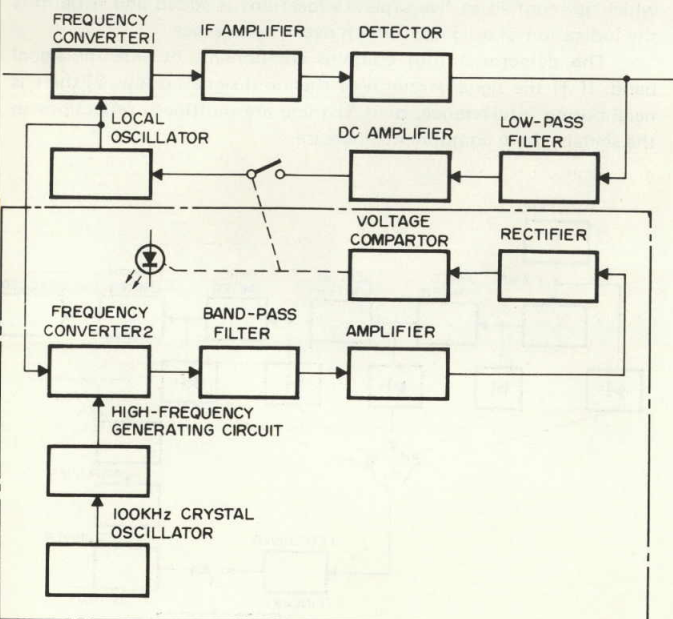


Fig. 5

The output signals of the 100 kHz crystal oscillator are expanded up to the frequency range of the local oscillator (about 98 MHz to 120 MHz) corresponding to the reception frequency by the high-frequency generating circuit. The beat with the local oscillator output is taken out by frequency converter 2. As long as the beat components with a frequency of 50 kHz and below are taken out by the filter, it is possible to obtain beat components equivalent to the detuned frequency. (See Fig. 6). If these components are further passed through a filter so that those with a frequency of 20 kHz and above are taken out, beat components are provided only when the local oscillator frequency shifts more than 20 kHz with respect to the 100 kHz integer.

After the beat components are amplified and then rectified, the servo lock is activated only when the resulting value is less than the constant voltage.

When the servo lock function starts to operate, the control voltage undergoes small changes, and when the servo lock function stops operating, this voltage returns sharply to 0 V.

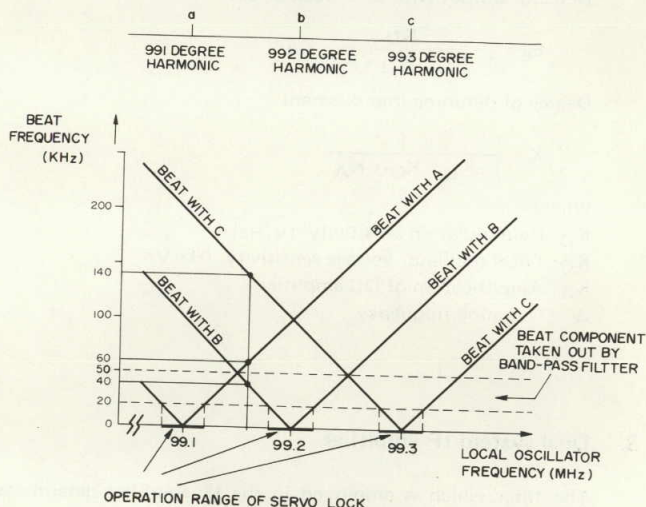


Fig. 6

When the local oscillator frequency is 99.16 MHz, the beat components are as follows

- 40 kHz – Beat with 100 kHz 99.2 degree harmonic
  - 60 kHz – Beat with 100 kHz 99.1 degree harmonic
  - 140 kHz – Beat with 100 kHz 99.3 degree harmonic
  - 160 kHz – Beat with 100 kHz 99.0 degree harmonic
  - 240 kHz – Beat with 100 kHz 99.4 degree harmonic
- Not indicated in figure

Among these components, the 40 kHz component passes through the 20-50 kHz band-pass filter.

When the local oscillator frequency is 99.21 MHz, the beat components are as follows

- 10 kHz – Beat with 100 kHz 99.2 degree harmonic
- 90 kHz – Beat with 100 kHz 99.3 degree harmonic
- 110 kHz – Beat with 100 kHz 99.1 degree harmonic

None of these components passes through the 20-50 kHz band-pass filter.



With this kind of configuration, once the tuning pointer is set near the accurate tuning point, the servo lock function is activated. If the local oscillator frequency shifts more than 20 kHz with respect to the tuning point with a manual operation performed by the user, the servo lock function stops. (The changes in the frequency per unit time caused by manual operation are much higher compared with drift and these can be identified by the low-pass filter.) The servo lock function will continue to operate even when there is a shift in the frequency of over 20 kHz with respect to small frequency variations caused by temperature drift.

**Remarks:****Servo lock effect**

Detector output with servo lock at OFF

$$E_e = K_D \cdot \Delta$$

Detector output with servo lock at ON

$$E_e = \frac{K_D}{1 - K_D \cdot K_O \cdot K_A} \cdot \Delta$$

Degree of detuning improvement

$$K = \frac{1}{1 - K_D \cdot K_O \cdot K_A}$$

Where:

$K_D$ : Demodulation sensitivity (V/Hz)

$K_O$ : Local oscillator voltage sensitivity (Hz/V)

$K_A$ : Amplification of DC amplifier

$\Delta$ : Detuning frequency

**3. Dual system IF amplifier**

The filter which is employed in the IF amplifier determines both the distortion of the audio source which is demodulated and the selectivity which indicates the interference suppression capability. These two aspects of the filter's performance are made reciprocal technologically. If the selectivity is increased, the distortion is also increased. In the AT-9700, however, an independent dual system IF amplifier is used. For the narrow (sharp) channel is used a narrow band ceramic filter in order to yield a high selectivity, and for the normal channel is used an LC filter featuring a superior group delay response for determining the distortion once a satisfactory selectivity is provided under conditions of normal use. Either of these can be selected manually although normally the channel which is most suited to the reception state is chosen with the automatic selectivity selector circuit.

In actual fact, the normal channel uses two 6-pole LC filters (BPF 1, 2). The group delay response is adjusted with a direct-view device in order to obtain a flat response. Moreover a MOS FET-based cascade amplifier (Q6 3SK40L, Q7 2SC1923), a 2-stage differential amplifier (IC3 TA7302P) and a Darlington differential amplifier (IC 4, 5, 6, 7, 8  $\mu$ C 1163H) are employed for amplification at a low level of noise and phase distortion.

The narrow (sharp) channel employs two 4-pole narrow band ceramic filters (CF 1, 2). The same amplification devices are used as those for the normal channel, and the undesirable feedback is reduced to the bare minimum and the most is derived from the characteristics of the two filters.

**4. Auto selectivity selector**

When the components outside the signal band (100 kHz to 400 kHz) which are contained in the detector output exceed the set level, the auto selectivity selector is switched over to narrow (sharp). (If there are interference signals at a 300 kHz detuned point, the components outside the signal band centering on 300 kHz appear in the detector output.)

The degree of interference depends entirely on the modulation rate of the interference signals. Therefore, after the auto selectivity selector has automatically switched over to narrow (sharp), the modulation rate of the interference signals falls, and the degree of interference is alleviated. When the auto selectivity selector is switched back to normal, the modulation rate is not constant and so this switching process continues all the time.

The restoration of the selector to the normal mode is performed at that point when another station is tuned in.

At the time of the band selection operation, the IF signals are momentarily cut off and there is a muting effect serving to suppress the noise temporarily just before the switching operation. When the muting switch is set to the OFF position, the restoration of the band to the normal mode is not performed automatically. With stations whose signals are received only weakly when the muting switch is at the OFF position, the narrow (sharp) band is mostly selected, and since the switch is being kept at the OFF position all the time, the muting effect is temporarily irritating to listen to.

**5. Ten-point LED display**

A ten-point LED (light-emitting diode) display serves to indicate the signal strength and the reception quality of the signals. Fig. 7 is a block diagram of the circuitry.

In order to display the signal strength, a DC voltage is required which rectifies the subcarrier of the intermediate frequency and is proportional to the signal strength. In the AT-9700, a DC voltage which is rectified at five separate locations is added and it permits the indication of a signal strength over a wide range.

The detector output contains components outside the signal band. If 1) the signal strength of the input signals is low, 2) there is neighboring interference, or if 3) there are multipath reflections in the signals, these components increase.

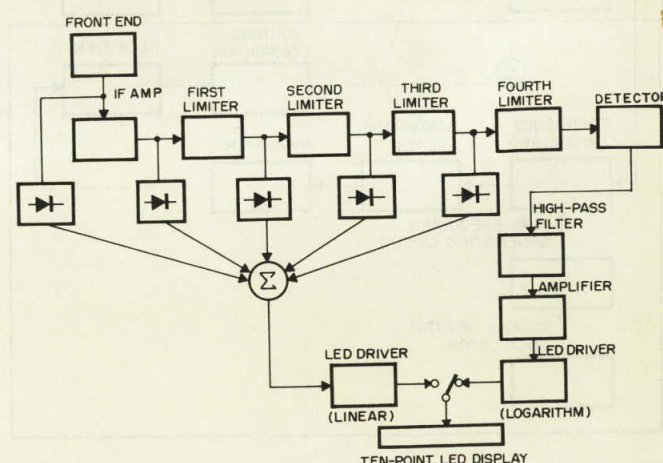


Fig. 7



IC 18 (SN16889) is used in the LED drivers for the indication of the signal strength. In proportion to the value of the DC voltage which is applied, this IC causes the LEDs to come on further and further to the right of the display. Since this is a 5-point IC, two units are used, one for the bottom (left) half and the other for the top (right) half of the display. The output of the second LED from the left is used as the muting control signals, and the output of the third LED from the left is used as the forced release control signal.

IC 19 (SN16880) is employed as the LED driver which is used to display the quality of the reception. It causes the LEDs to light up from left to right logarithmically with respect to the AC voltage which is applied.

Since two different indications are provided by the same display, it is conceivable that the user may read out the indication incorrectly. Therefore, the signal strength is indicated by the LEDs coming on step-by-step, and the reception indication is step-less in order to avoid any confusion.

## 6. FM demodulator with gating demodulator (GD)

Fig. 8 shows the basic circuit of the demodulator. The values of the coil and capacitor are such that the resonance point is set to the intermediate frequency. Therefore, the phase of E2 is delayed  $90^\circ$  at the intermediate frequency (10.7 MHz) with respect to E1. Fig. 12 shows the phase of E2 with respect to E1. In the vicinity of this 10.7 MHz frequency, the phase of E2 is delayed in proportion to the frequency.

When a positive potential is applied to the gate of the n-channel MOS FET, the channel resistance decreases. Conversely, when a negative potential is applied, the channel resistance increases. Fig. 11 shows how E3 varies according to the frequency and it is produced by dividing E1 with the MOS FET channel resistance and R1. When the E3 carrier frequency band is eliminated, a potential which is proportionate to the frequency is provided.

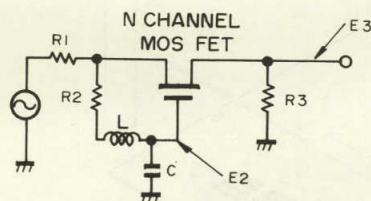


Fig. 8

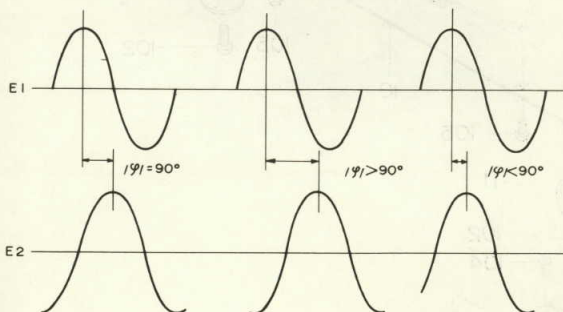


Fig. 9

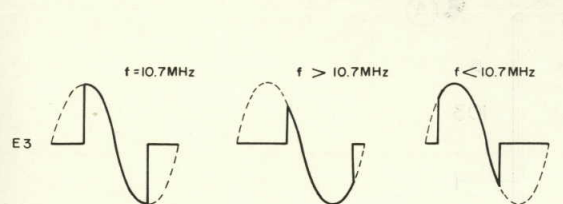


Fig. 10

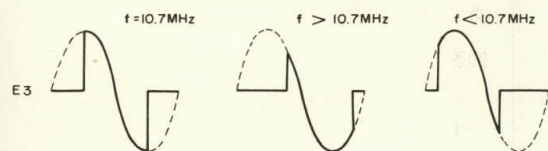


Fig. 11

Fig. 13 shows a detail of Fig. 12. It indicates that the phase variation based on the coil and capacitor (LC) is not strictly linear, that the variation in the phase per unit frequency is highest at the resonance point (10.7 MHz) and that the further it is removed from this resonance point on either side, the smaller it becomes. For this reason, the frequency versus E3 DC potential is as shown in Fig. 13.

The absolute value of E3 increases, the further the frequency is shifted from the 10.7 MHz resonance point. This is the same, however, even when E1 increases.

E1 is divided by the R1 and R2 LC series resonance circuit and obtained. This means that, as shown in Fig. 14, it is at its minimum at the LC resonance point. Therefore, if the E2 phase lag is linear with respect to the frequency, the E3 DC potential will be as shown in Fig. 15, the non-linearity of the phase lag in Fig. 13 is compensated for, and overall linearity is produced.

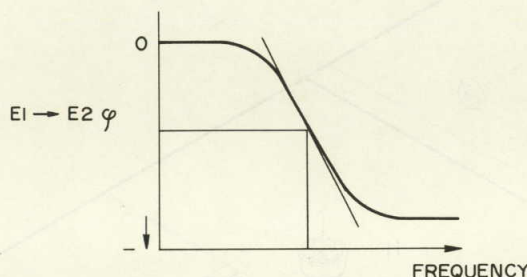


Fig. 12

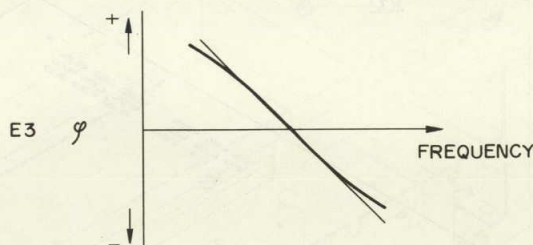


Fig. 13

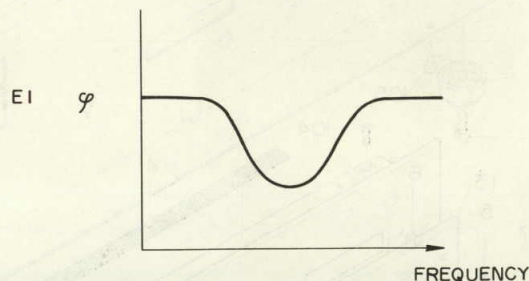


Fig. 14

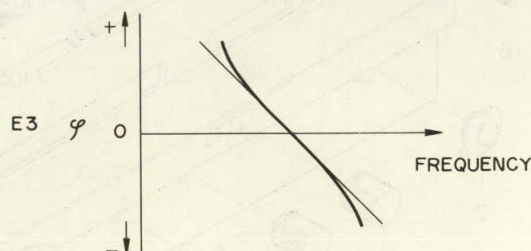


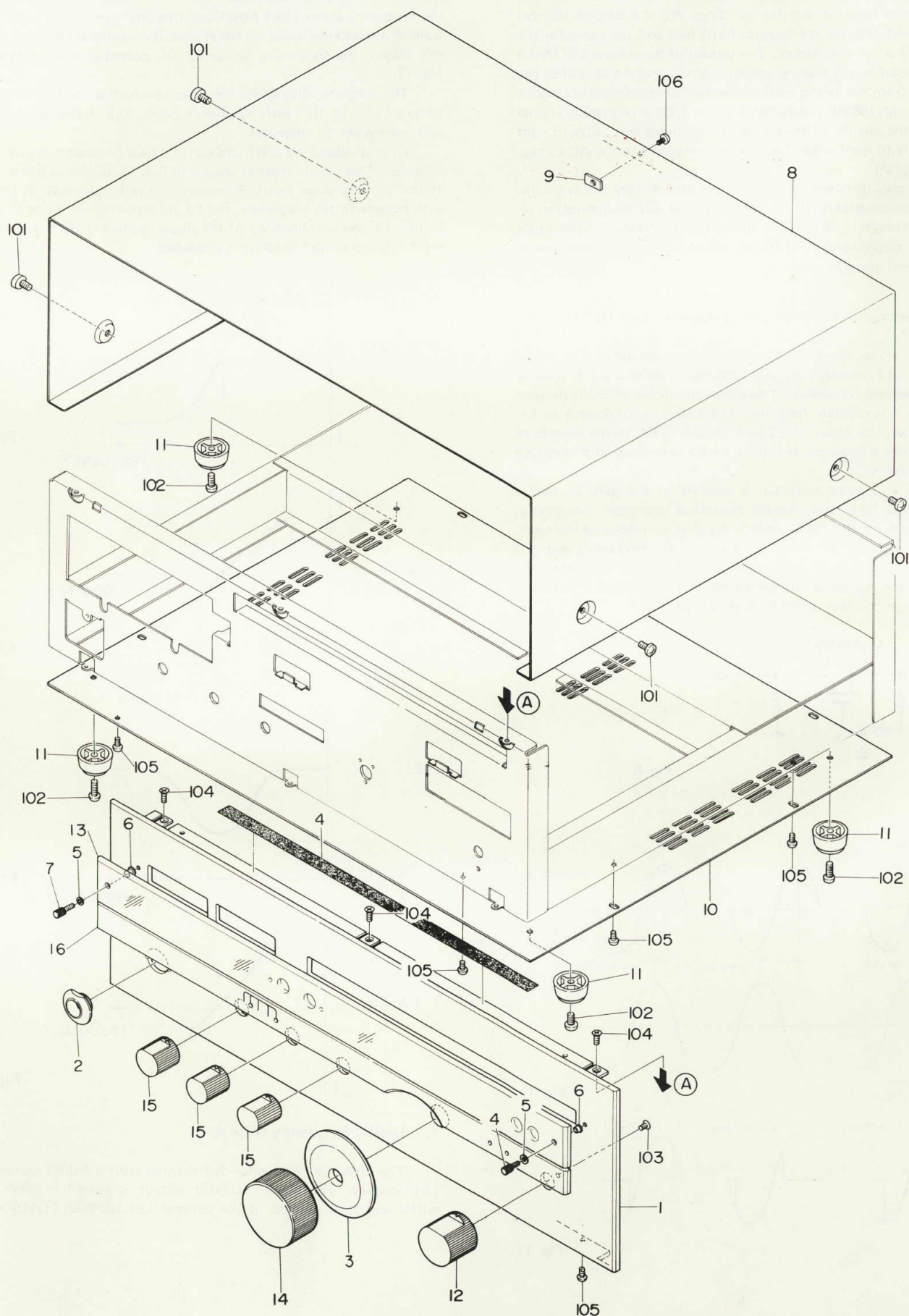
Fig. 15

## 7. Digital frequency display

The reception frequency is indicated with a 4-digit numerical LED display. The local oscillator output is passed through the buffer and then applied to the counter LSI [IC 800, (T-1400B)].

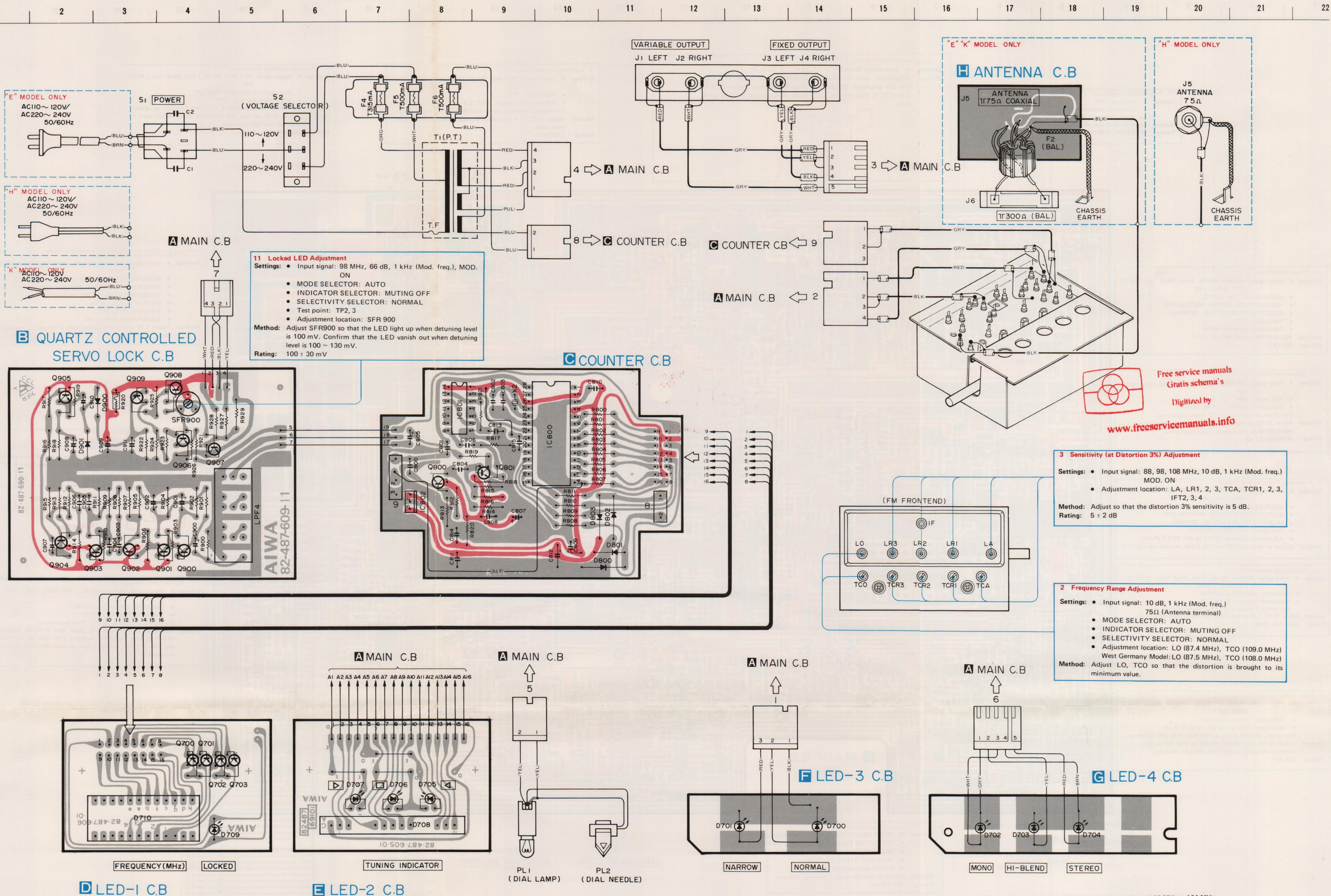


# EXPLODED VIEW-1





## WIRING-1



NOTES (1) B (+) Pattern (2) The voltage is the reference value measured with a tester (20 K ohms/V DC) when there are no signals.



A

B

C

D

E

F

G

H

I

J

K

L

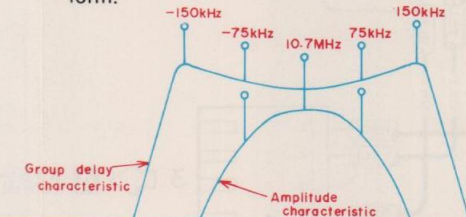
M

N

O

**16 Free Running Adjustment**  
 Settings: • Test point: TP8  
 • Adjustment location: SFR5  
 For others, proceed as for 11. 12. Phase adjustment.  
 Method: Adjust SFR5 so that the frequency is 152,000 Hz  
 Rating: 152,000 Hz  $\pm$  0.001%

**1 Group delay characteristic Adjustment**  
 Settings: • Adjustment location: IFT 1, SFR 1, 2, TC 1, 2  
 Method: Adjustment used to the direct viewing system. Adjust IFT 1 so that the amplitude characteristic level is maximum. Adjust SFR 1, 2 and TC 1, 2 so that the group delay characteristic is below wave form.



**7 Limiter Level Adjustment**  
 Settings: • Input signal: 10.7 MHz, 30 dB, 1 kHz (Mod. freq.), MOD. ON  
 • Test point: TP6  
 • Adjustment location: IFT2, 3, 4  
 For others, proceed as for 4. 10.7 MHz Trap Coil adjustment.  
 Method: Adjust IFT2, 3, 4 so that the voltage is brought to its maximum value.  
 Rating: 1,000 mV

**6 Distortion (MONO) Adjustment**  
 Settings: • Input signal: 10.7 MHz, 96 dB, 1 kHz (Mod. freq.), MOD. ON  
 • Test point: VARIABLE OUTPUT  
 • Adjustment location: IFT5  
 For others, proceed as for 4. 10.7 MHz Trap Coil adjustment.  
 Method: Adjust IFT5 so that the distortion becomes the same for both left and right channels.  
 Rating: 0.02  $\pm$  0.01%

**12 Phase Adjustment**  
 Settings: • Input signal: 98 MHz, 66 dB, 1 kHz (Mod. freq.), MOD. OFF, 90% (L + R)  
 • MODE SELECTOR: AUTO  
 • INDICATOR SELECTOR: MUTING OFF  
 • SELECTIVITY SELECTOR: NORMAL  
 • Test point: TP7  
 • Adjustment location: SFR4  
 Method: Adjust SFR4 so that the level is 0 V.  
 Rating: 0  $\pm$  0.5 V

**14 Separation Adjustment**  
 Settings: • Input signal: 98 MHz, 66 dB, 1 kHz (Mod. freq.), MOD. ON  
 • Test point: TP8  
 • Adjustment location: SFR9, SFR6  
 For others, proceed as for 12. Phase adjustment.  
 Method: Adjust SFR9 so that the separation is more than 53 dB. And adjust SFR6 so that leakage is minimum value.  
 Rating: More than 53 dB

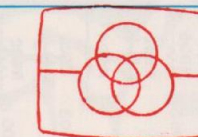
**9 Frequency Response Adjustment**  
 Settings: • Input signal: 10.7 MHz, 96 dB, 100 Hz, 1 kHz, 3 kHz (Mod. freq.), MOD. ON  
 • MODE SELECTOR: AUTO  
 • INDICATOR SELECTOR: MUTING OFF  
 • SELECTIVITY SELECTOR: NORMAL  
 • Test point: VARIABLE OUTPUT  
 • Adjustment location: SFR 7 (L-ch), SFR 8 (R-ch)  
 Method: Adjust so that the 100 Hz and 3 kHz outputs are identical.

**15 Carrier Leak Adjustment**  
 Settings: • Input signal: 98 MHz, 66 dB, 1 kHz (Mod. freq.), MOD. ON L + R (MOD. 0, 90%)  
 • Test point: VARIABLE OUTPUT  
 • Adjustment location: SFR6, L16  
 For others, proceed as for 12. Phase adjustment.  
 Method: Adjust SFR6, L16 so that the carrier leak is more than 70 dB.  
 Rating: More than 70 dB

**8 Fixed Output Level Adjustment**  
 Settings: • Input signal: 10.7 MHz, 96 dB, 400 Hz (Mod. freq.), MOD. ON  
 • Test point: FIXED OUTPUT  
 • Adjustment location: SFR3, SFR10 (R-ch)  
 For others, proceed as for 4. 10.7 MHz Trap Coil adjustment.  
 Method: Adjust SFR3 and SFR10 (R-ch) so that the output becomes the same for both left and right channels.  
 Rating: 500 mV

**4 10.7 MHz Trap Coil Adjustment**  
 Settings: • Input signal: 10.7 MHz, 96 dB, 1 kHz (Mod. freq.), MOD. OFF  
 • MODE SELECTOR: AUTO  
 • INDICATOR SELECTOR: MUTING OFF  
 • SELECTIVITY SELECTOR: NORMAL  
 • OUTPUT LEVEL: MAX  
 • Test point: TP1, TP3  
 • Adjustment location: L15  
 Method: Adjust L15 so that the output level is reduced to minimum value.

**5 DC Zero Center Adjustment**  
 Settings: • Test point: TP2, TP3  
 • Adjustment location: L14  
 For others, proceed as for 4. 10.7 MHz Trap Coil adjustment.  
 Method: Pointer is oscillated right and left of indicator points "0" center.



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**13 Muting Level Adjustment**  
 Settings: • Input signal: 98 MHz, 66 dB, 1 kHz (Mod. freq.), MOD. OFF  
 • Test point: VARIABLE OUTPUT  
 • Adjustment location: SFR11  
 For others, proceed as for 12. Phase adjustment.  
 Method: Adjust so that the signal to noise ratio is 45 dB. Adjust SFR11 so that the MONO indicator LED light up. Confirm that the STEREO indicator light up when the input level is increased by 1 dB.

**10 REC. Level Check Adjustment**  
 Settings: • MODE SELECTOR: REC LEVEL CHECK  
 • INDICATOR SELECTOR: MUTING OFF  
 • SELECTIVITY SELECTOR: NORMAL  
 • Test point: FIXED OUTPUT  
 • Adjustment location: SFR 12  
 Method: Adjust so that the output becomes 250 mV.  
 Rating: 250  $\pm$  5 mV

MONO  
 HI-BLEND 2  
 HI-BLEND 1  
 AUTO  
 S5  
 MODE SELECTOR

A MAIN C.B

S4  
 INDICATOR SELECTOR

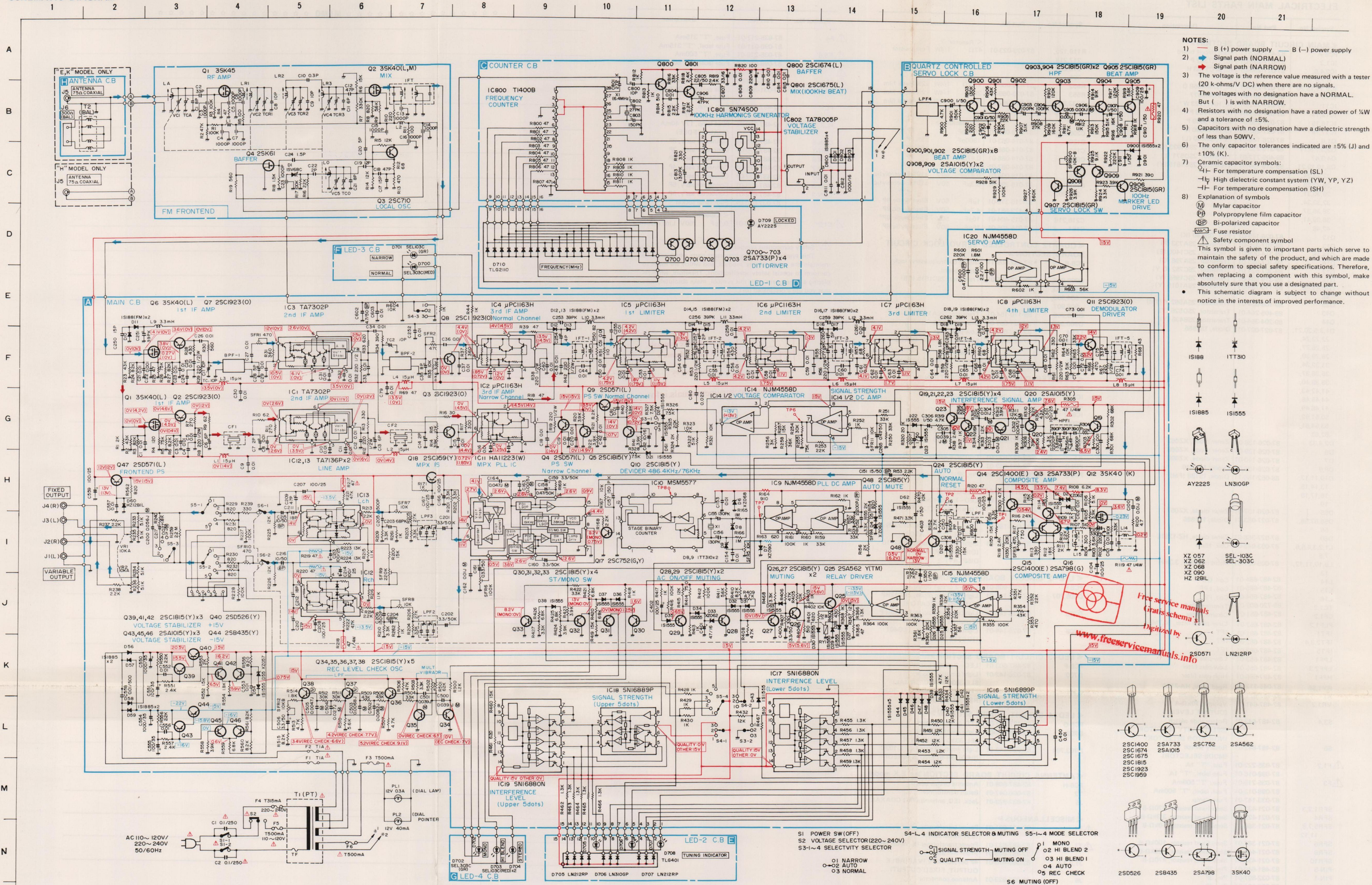
S3  
 SELECTIVITY SELECTOR

VR1,2  
 OUTPUT LEVEL

LED-3 C.B



## SCHEMATIC DIAGRAM





ELECTRICAL MAIN PARTS LIST

Symbol No.	Part No.	Description
« MAIN CIRCUIT BOARD SECTION »		
PCB-A	82-487-602-11	Main circuit board
IC1,3	87-027-288-01	IC, TA7302 P
IC2,4,5,6,7,8	87-027-290-01	IC, $\mu$ PC1163 H
IC9,14,15,20	87-027-235-01	IC, NJM-4558 D
IC10	87-027-291-01	IC, MSM5577
IC11	87-027-292-01	IC, HA11223 W
IC12,13	87-027-289-01	IC, TA7136 P
IC16,18	87-027-268-01	IC, SN16889 P
IC17,19	87-027-293-01	IC, SN16880 N
Q1,6	87-026-148-01	FET, 3SK40 (L)
Q2,3,7,8,11	89-319-233-01	Transistor, 2SC1923 (O)
Q4,9,47	89-405-712-01	Transistor, 2SD571 (L)
Q5,10,19,21,22,23,24,26,27,28,29,30,31,32,33,34,35,36,37,38,39,41,42,48	89-318-154-01	Transistor, 2SC1815 (Y)
Q12	87-026-149-01	FET, 3SK40 (K)
Q13	89-107-336-01	Transistor, 2SA733 (P)
Q14,15	89-314-005-01	Transistor, 2SC1400 (E)
Q16	89-107-985-01	Transistor, 2SA798 (G)
Q17	89-307-524-01	Transistor, 2SC752 (G,Y)
Q18	89-319-594-01	Transistor, 2SC1959 (Y)
Q20,43,45,46	89-110-154-01	Transistor, 2SA1015 (Y)
Q25	89-105-624-01	Transistor, 2SA562 Y (TM)
Q40	89-405-264-01	Transistor, 2SD526 (Y)
Q44	89-204-354-01	Transistor, 2SB435 (Y)
D1,3,5,20,21,22,23,24,25,26,27,28,29,30,31,32,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,61,62,63	87-026-138-01	Zener diode, XZ062
D2,4,33	87-026-139-01	Zener diode, XZ068
D6	87-026-140-01	Zener diode, XZ090
D7	87-026-136-01	Diode, 1TT310
D8,9	88-052-188-11	Diode, 1S188 (FM)
D10,11,12,13,14,15,16,17,18,19	87-026-137-01	Zener diode, XZ057
D55	87-027-083-01	Diode, 1S1885
D56,57,58,59	87-027-368-01	Zener diode, HZ-12BIL
D60	87-003-048-01	Coil, 15 $\mu$ H
L1,2,3,4,5,6,7,8	87-005-091-01	Micro inductor, 3.3mH
L9,10,11,12,13	82-487-684-01	Coil, GD
L14	82-487-685-01	Coil, LPF
L15	82-487-654-01	Coil, PE
L16	85-720-609-01	Trimmer 10pF
TC1,2	82-487-651-01	Ceramic filter
CF1,2	82-487-652-01	Liner phase filter, 10.7MHz
PLF1,2	82-487-681-01	IFT
IFT1	82-487-682-01	IFT
IFT2,3,4	82-487-683-01	IFT
IFT5	82-487-653-01	Low-pass filter
LPF1	82-487-655-01	Low-pass filter
LPF2,3	82-487-656-01	High-pass filter
HPF1	87-045-112-01	Reed relay, HA-212S
RY1,S6	82-487-621-01	Crystal, 486kHz
X1	82-487-641-01	Volume, 10k $\Omega$ -A (OUTPUT LEVEL)
VR1,2	82-487-643-01	Rotary slide switch (SELECTIVITY SELECTOR, INDICATOR SELECTOR)
S3,4	82-487-642-01	Rotary switch (MODE SELECTOR)
S5	87-035-222-01	Fuse, "T" 1A
△F1,2	87-098-016-01	Fuse label, "T" 1A
△F3	87-035-219-01	Fuse, "T" 500mA
	87-098-013-01	Fuse, label, "T" 500mA
	87-033-147-01	Fuse clamp
SFR1,2,3	87-021-433-01	Semi-fixed resistor, 470 $\Omega$ -B
SFR4	87-021-423-01	Semi-fixed resistor, 3.3k $\Omega$ -B
SFR5,7,8,11,12	87-021-366-01	Semi-fixed resistor, 10k $\Omega$ -B
SFR6	87-021-367-01	Semi-fixed resistor, 100k $\Omega$ -B
SFR9	87-021-440-01	Semi-fixed resistor, 220k $\Omega$ -B
SFR10	87-021-433-01	Semi-fixed resistor, 470 $\Omega$ -B
PIN-5	82-481-649-01	Pin, 2P
PIN-1	87-032-897-01	Pin, 3P
PIN-7	87-032-904-01	Pin, 4P
PIN-2,4	82-481-647-01	Pin, 4P
PIN-3,6	87-032-905-01	Pin, 5P

Symbol No.	Part No.	Description
< Resistor >		
R119,120,217,218,219,220,305	87-029-023-01	47 $\Omega$ 1/4W Fuse resistor
R552	87-029-068-01	1.5k $\Omega$ 1/4W $\pm$ 2% Metal film
R553	87-029-069-01	2k $\Omega$ 1/4W $\pm$ 2% Metal film
R233,234,235,236	87-029-062-01	5.1k $\Omega$ 1/4W $\pm$ 2% Metal film
< Capacitors >		
C205,206	87-019-093-01	1500pF PP
C150	87-014-063-01	1800pF $\pm$ 5% PP
C152	87-014-065-01	2200pF $\pm$ 5% PP
C600	87-014-086-01	0.47 $\mu$ F 100V PP
C601	87-014-087-01	2.2 $\mu$ F PP
C158	87-019-094-01	0.47 $\mu$ F 50V $\pm$ 10% Electrolytic
C159,160,201,202	87-015-398-01	3.3 $\mu$ F 90V $\pm$ 10% Electrolytic
C350	87-015-379-01	1 $\mu$ F 50V Electrolytic BP
C602	82-473-681-01	4.7 $\mu$ F 50V Electrolytic BP
C215,216	87-015-404-01	10 $\mu$ F 50V Electrolytic BP
C151	87-015-405-01	15 $\mu$ F 50V Electrolytic BP

« QUARTZ CONTROLLED SERVO LOCK CIRCUIT BOARD SECTION »

PCB-B	82-487-609-11	Quartz controlled servo lock circuit board
Q900,901,902,903,904,905,906,907	89-318-155-01	Transistor, 2SC1815 (GR)
Q908,909	89-110-154-01	Transistor, 2SA1015 (Y)
D900,901	87-027-097-01	Diode, 1S1555
LPF4	82-487-657-01	Low-pass filter
SFR900	87-021-557-01	Semi-fixed resistor, 10k $\Omega$ -B
< Resistor >		
R920	87-029-023-01	47 $\Omega$ 1/4W Fuse resistor

« COUNTER CIRCUIT BOARD SECTION »

PCB-C	82-487-607-21	Counter circuit board
IC800	87-027-294-01	IC, T-1400 B
IC801	87-027-302-01	IC, SN74500
IC802	87-027-295-01	IC, TA78005P
Q800	89-316-742-01	Transistor, 2SC1674 (L)
Q801	89-316-752-01	Transistor, 2SC1675 (L)
D800,801,802,803	87-027-083-01	Diode, 1S1885
X1	82-487-622-01	Crystal, 6.4MHz
PIN-8	82-481-649-01	Pin, 2P
PIN-9	87-032-897-01	Pin, 3P

« LED-1 CIRCUIT BOARD SECTION »

PCB-D	82-487-606-01	LED-1 circuit board
Q700,701,702,703	89-107-336-01	Transistor, 2SA733 (P)
D709	87-026-160-01	Light emitting diode, AY222S (LOCKED INDICATOR)
D710	87-026-147-01	Light emitting diode, TLG2110 (DIGITAL FREQUENCY DISPLAY)

« LED-2 CIRCUIT BOARD SECTION »

PCB-E	82-487-605-01	LED-2 circuit board
D705,707	87-026-145-01	Light emitting diode, LN212RP (TUNING INDICATOR)
D706	87-026-146-01	Light emitting diode, LN310G P (TUNING INDICATOR)
D708	87-026-144-01	Light emitting diode, TLG401 (10 STEP DISPLAY)

« LED-3 CIRCUIT BOARD SECTION »

PCB-F	82-487-603-01	LED-3 circuit board
D700	87-026-142-01	Light emitting diode, SLE-303C (GR) (NORMAL)
D701	87-026-143-01	Light emitting diode, SEL-103C, RED (NARROW)

« LED-4 CIRCUIT BOARD SECTION »

PCB-G	82-487-604-01	LED-4 circuit board
D702	87-026-142-01	Light emitting diode, SEL-303C (GR)(MONO)
D703,704	87-026-143-01	Light emitting diode, SEL-103C (RED) (HI-BLEND, STEREO)

« ANTENNA CIRCUIT BOARD SECTION » = E,K model

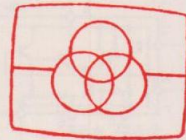
PCB-H	82-487-608-01	Antenna circuit board
T2	87-006-047-01	Balun transformer
J5	87-032-922-01	Jack, IEC, antenna (75 $\Omega$ COAXIAL)

« MISCELLANEOUS »

△T1	82-487-631-01	Power transformer (E,H model only)
△T1	82-487-633-01	Power transformer (K model only)
	82-487-645-01	Front end ass'y
J1,2,3,4	82-306-670-01	4P pin jack ass'y (VARIABLE OUTPUT, FIXED OUTPUT)
J5	87-032-923-01	Antenna connector (H model only)
J6	82-488-656-01	FM DIN antenna terminal 300 $\Omega$ (E,K model only)

Symbol No.	Part No.	Description
△F4	87-035-217-01	Fuse, "T" 315mA
△F5,6	87-098-011-01	Fuse label, "T" 315mA
	87-035-219-01	Fuse, "T" 500mA
△S1	87-098-013-01	Fuse label, "T" 500mA
△S2	82-473-710-01	Fuse holder, 3P
	87-031-408-01	Push switch (POWER)
	87-031-364-01	Slide switch (VOLTAGE SELECTOR)
PL1	82-487-661-01	Pilot lamp, 12V 0.3A (DIAL LAMP)
PL2	82-487-663-01	Pilot lamp, 12V 40mA (DIAL NEEDLE)
CON-5	82-487-671-01	Connector ass'y, 2P
CON-1	82-487-670-01	Connector ass'y, 3P
CON-9	82-487-674-01	Connector ass'y, 3P
CON-7	82-487-675-01	Connector ass'y, 4P
CON-2	82-487-677-01	Connector ass'y, 4P
CON-6	82-487-673-01	Connector ass'y, 5P
CON-3	82-487-672-01	Connector ass'y, 5P
	87-032-503-01	Pilot lamp socket
< Capacitor >		
△C1,2	84-190-622-01	0.1 $\mu$ F 250V Line capacitor

△ Safety component symbol  
This symbol is given to important parts which serve to maintain the safety of the product, and which are made to conform to special safety specifications. Therefore, when replacing a component with this symbol, make absolutely sure that you use a designated part.



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## PARTS LIST

## MECHANICAL PARTS

■ \* mark in this part list shows exclusive part  
(which is used) for only Model AT-9700.

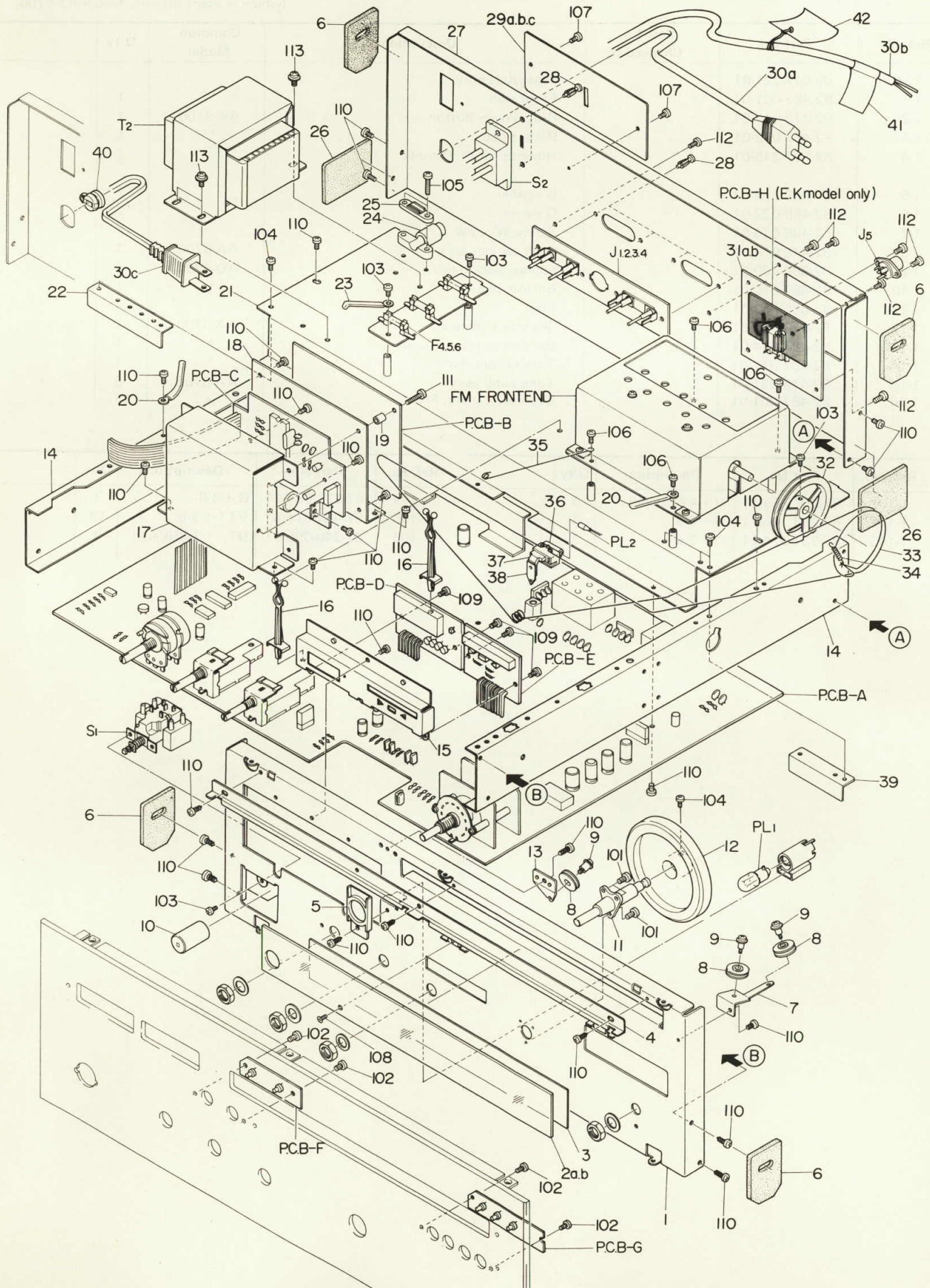
Ref. No.	Part No.	Part No. Changed to	Description	Common Model	Q'ty	
1~4	09-047-121-01		Panel Assembly			
1-1	82-487-001-01		Front sash	*	1	
1-2	82-478-012-01		Ring, Power button	AA-8700	1	
1-3	82-487-012-01		Ring, Knob	*	1	
1-4	82-397-245-01		Himeron cloth, Cabinet		1	
1-5	82-488-024-01		G washer		2	
1-6	82-488-023-01		G sleeve		2	
1-7	82-488-016-01		Screw, Window		2	
1-8	82-478-048-01		Steel cabinet ass'y	AA-8700	1	
1-9	82-380-439-01		Spacer, Back panel	AD-6500	1	
1-10	82-487-010-01		Bottom plate	*	1	
1-11	87-085-162-01		Foot		4	
1-12	82-478-008-01		Selector knob ass'y	AA-8700	1	
1-13	82-487-004-01		Decorative plate, Front	*	1	
1-14	82-487-017-01		Tuning knob ass'y	*	1	
1-15	82-478-031-01		Tone knob ass'y	AA-8700	3	
1-16	82-487-001-01		Decorative plate, Front	*	1	

Ref. No.	Part No.	Description	Q'ty	
1-101	87-257-169-11	U + 4-6(Black)	3	
1-102	87-253-170-11	U + 4-8	4	
1-103	87-231-074-21	Q + 2.6-8	3	

Ref. No.	Part No.	Description	Q'ty	
1-104	87-231-094-21	Q + 3-6	3	
1-105	87-081-511-01	VTT + 3-6	12	
1-106	87-340-095-01	UT <sub>1</sub> + 3-8(Black)	3	



EXPLODED VIEW-2





Ref. No.	Part No.	Part No. Changed to	Description	Common Model	Q'ty
2-1	82-487-201-01		Front chassis	*	1
2-2a	82-487-013-01		Dial plate (E, K model only)	*	1
2-2b	82-487-020-01		Dial plate (H model only)	*	1
2-3	82-487-007-01		Dial back plate	*	1
2-4	82-487-203-01		Frame, Dial	*	1
2-5	82-487-215-01		Light cover	*	1
2-6	82-473-245-01		Spacer A, Side panel	AX-7500	2
2-7	82-487-204-01		Holder A, Roller	*	1
2-8	82-470-276-01		Roller, 14φ	AF-3030	3
2-9	87-081-483-01		Motor screw, M2.6		3
2-10	82-339-025-01		AC switch button ass'y		1
2-11	82-487-208-11		Flywheel shaft ass'y	*	1
2-12	82-487-207-01		Flywheel	*	1
2-13	82-487-205-01		Holder B, Roller	*	1
2-14	82-478-202-01		Chassis, Side	AA-8700	2
2-15	82-487-216-01		Dis-play plate	*	1
2-16	82-487-614-01		Wire clamp	*	2
2-17	82-487-611-01		Shield case A	*	1
2-18	82-487-612-01		Shield case B	*	1
2-19	82-375-244-01		Collar, AC button		2
2-20	87-064-080-01		Wire binder		2
2-21	82-487-213-01		Sub-chassis ass'y	*	1
2-22	82-487-222-01		Auxiliary plate L	*	1
2-23	87-038-039-01		Wire binder		1
2-24	87-085-094-01		Holder A, AC power cord (E, K model only)		1
2-25	87-085-095-01		Holder B, AC power cord (E, K model only)		1
2-26	82-473-247-01		Spacer B, Side panel	AX-7500	2
2-27	82-487-002-01		Back panel	*	1
2-28	87-085-102-01		Nylon rivet, 3.5-5.5		1
2-29a	82-487-016-01		Name plate, Spec. (E model only)	*	1
2-29b	82-487-019-01		Name plate, Spec. (K model only)	*	1
2-29c	82-487-021-01		Name plate, Spec. (H model only)	*	1
2-30a	87-034-877-01		AC power cord (E model only)		1
2-30b	87-034-872-01		AC power cord (K model only)		1
2-30c	87-034-826-01		AC power cord (H model only)		1
2-31a	82-487-217-01		Antenna terminal plate (E, K model only)	*	1
2-31b	82-487-219-01		Antenna terminal plate (H model only)	*	1
2-32	82-487-206-01		Dial drum	*	1
2-33	87-096-045-01		Dial string	*	1
2-34	82-487-220-01		Drum spring	*	1
2-35	82-487-221-01		Guide, Wire	*	1
2-36	82-470-013-01		Holder, Dial pointer	AF-3030	1
2-37	82-487-011-01		Dial pointer	*	1
2-38	82-487-008-01		Decorative plate, Dial pointer	*	1
2-39	82-487-223-01		Auxiliary plate R	*	1
2-40	87-085-101-01		Cord bushing (H model only)		1
2-41	87-056-008-01		Label, AC power cord (K model only)		1
2-42	87-056-007-01		Tag, Main voltage (K model only)		1

Ref. No.	Part No.	Description	Q'ty
2-101	87-261-073-21	V + 2.6-6	3
2-102	87-261-093-21	V + 3-5	4
2-103	87-261-094-21	V + 3-6	5
2-104	87-261-095-21	V + 3-8	5
2-105	87-261-099-21	V + 3-15	2
2-106	87-264-169-11	V + 4-6	4
2-107	87-257-033-01	U + 2-4(Black)	2

Ref. No.	Part No.	Description	Q'ty
2-108	87-231-035-21	Q + 2-6	1
2-109	87-081-501-01	VTT + 2.6-4	4
2-110	87-081-511-01	VTT + 3-6	31
2-111	87-081-514-01	VTT + 3-12	2
2-112	87-081-854-01	VTT <sub>2</sub> + 3-6 (Black)	8
2-113	87-500-169-11	VF + 4-6	4



## HARDWARE NOMENCLATURE

**V:** Pan head screw



**Example:**

**V + 3 - 6**

Length in mm  
Diameter in mm  
Type of Slot  
Type of Head

**U:** Binding head screw



**Q:** Flat countersunk head screw



**Example:**

**Q + 3 - 6**

Length in mm  
Diameter in mm  
Type of Slot  
Type of Head

**UT1:** Binding head tapping screw



**VF:** Flange and Pan head screw



**VTT:** Pan head tap-tight screw



**VTT2:** Pan head tap-tight screw

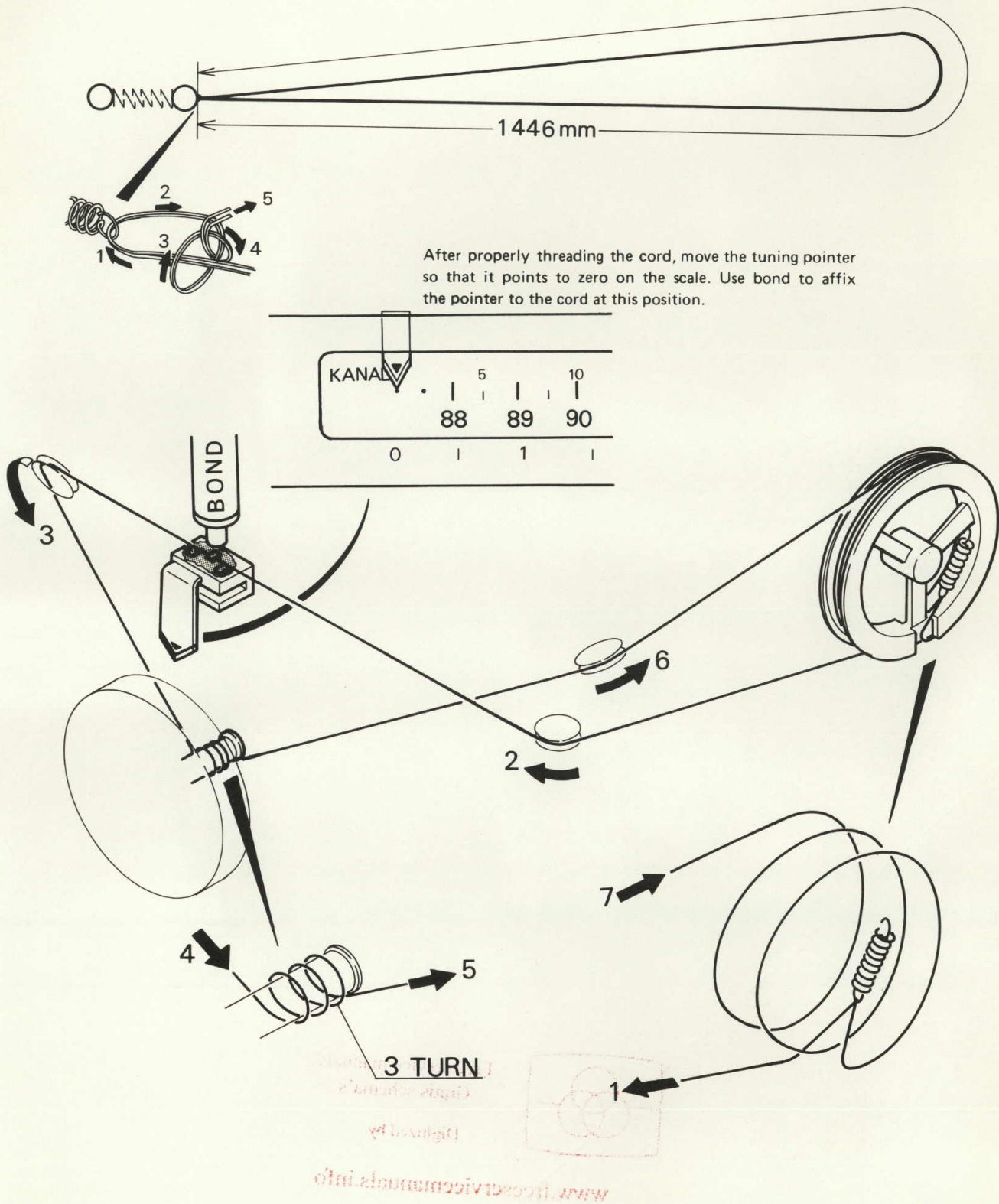


## ACCESSORIES/PACKAGE

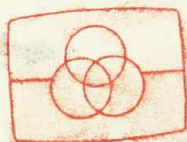
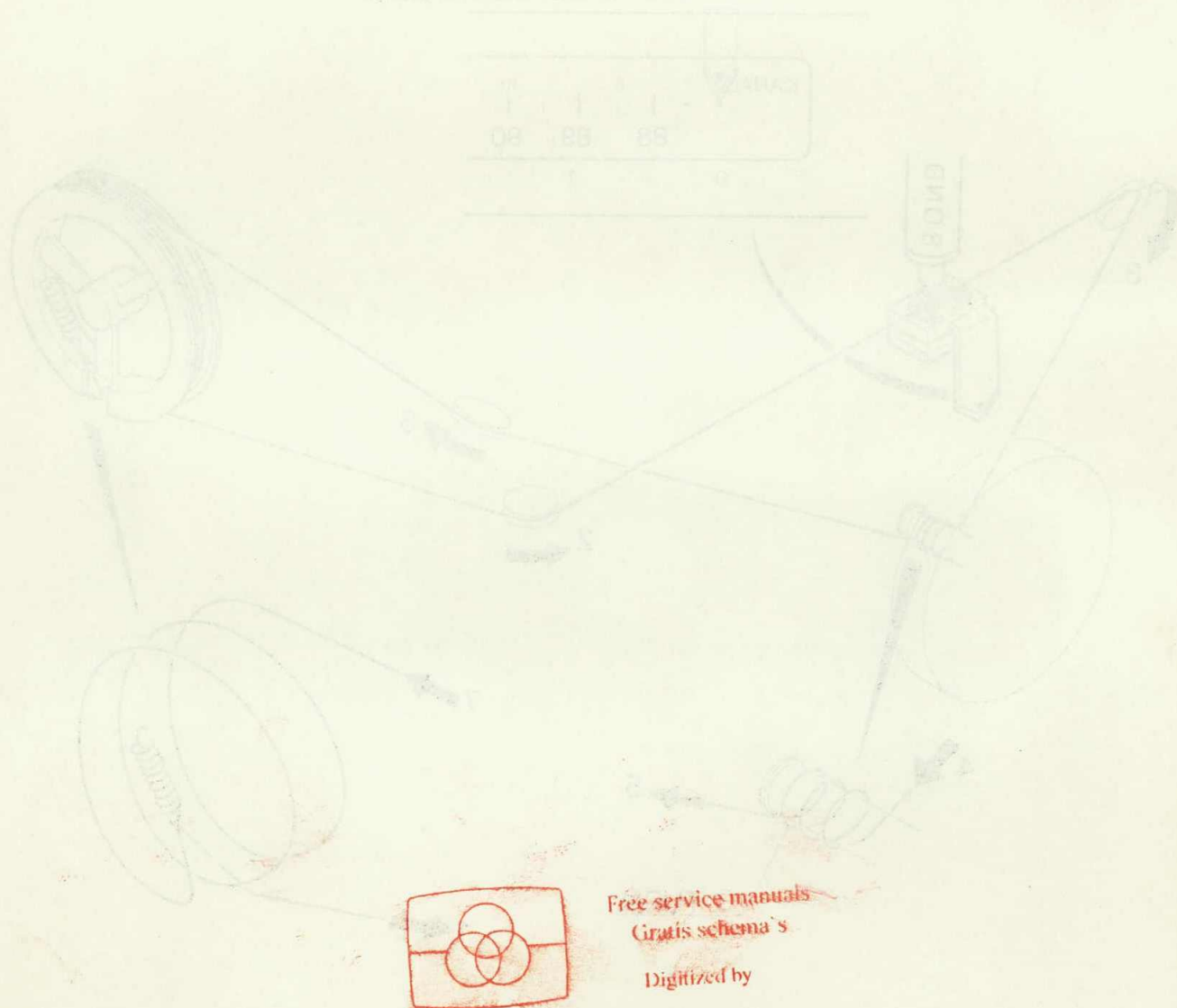
Ref. No.	Part No.	Part No. Changed to	Description	Common Model	Q'ty
1	82-487-851-01		Printed indiv., Packing	*	1
2	82-487-852-01		Cushion L, Printed indiv.	*	1
3	82-487-853-01		Cushion R, Printed indiv.	*	1
4	87-051-131-01		Poly-vinyl sack		1
5	87-056-564-01		Curl stopper		2
6	87-056-607-01		Poly-vinyl sack		1
7a	82-487-901-01		Instructions booklet (E model only)	*	1
7b	82-487-902-01		Instructions booklet (K model only)	*	1
7c	82-487-903-01		Instructions booklet (H model only)	*	1
8	87-051-171-01		Poly-vinyl sack		1
9	87-056-007-01		Tag, Main voltage (K model only)		1
10	87-056-008-01		Label, AC power cord (K model only)		1
11	87-056-009-01		Distributors list		1
12	86-944-619-01		Connection cord, CW-129KS		1
13	87-032-845-01		Siemens plug (H model only)		1
14a	87-032-933-01		M/F adaptor (K model only)		1
14b	87-032-931-01		75/300Ω adaptor (H model only)		1
15a	87-043-046-01		FM antenna (E, K model only)		1
15b	87-043-025-01		FM antenna (H model only)		1
16	87-058-023-01		Cord biner		1



DIAL CORD STRINGING







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