# INSTRUCTION MANUAL

# FRG-7000

YAESU MUSEN CO., LTD.

TOKYO JAPAN.

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"WARNING : TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE."

# COMMUNICATIONS RECEIVER FRG-7000


## GENERAL DESCRIPTION

The model FRG-7000 is a high-performance, all solid state, communications receiver designed to cover the entire medium and high frequency

variety of conditions, and the continuously variable audio filter provides for minimizing the high

# SPECIFICATIONS

**Frequency Range:**
0.25 MHz - 29.9 MHz

**Type of Emissions:**
AM, SSB (USB or LSB), CW

**Sensitivity:**
SSB/CW: Better than 0.7μV at S/N 10 dB
AM: Better than 2μV at S/N 10 dB

**Selectivity:**
SSB/CW ±1.5 kHz (−6 dB), ±4 kHz (−50 dB)
AM ±3 kHz (−6 dB), ±7 kHz (−50 dB)

**Stability:**
Less than ±500 Hz at any 30 minutes after warm-up

**Antenna Requirements:**
[redacted]

50 Ohm unbalanced feed 1.6 MHz - 29.9 MHz

**Speaker Impedance:**
4 ohms

**Audio Output:**
2 watts

**Power Requirement:**
100/110/117/200/220/234 volts
AC 50/60 Hz

**Power Consumption:**
AC 25 VA

**Size:**
360 (W), 125 (H), 295 (D) mm

**Weight:**
Approx. 7 kg

## SEMICONDUCTOR COMPLEMENT

| | | | | | |
|---|---|---|---|---|---|
| IC | SN76514N | 2 | | μPC14305 | 1 |
| | TA7205AP | 1 | | μPC14308 | 2 |
| | MC1416 | 2 | | NJM78L05A | 1 |
| | MC14011 | 1 | FET | 3SK40M | 7 |
| | MC14016 | 1 | | 2SK19GR | 8 |
| | MC14027 | 1 | Tr. | 2SC372Y | 8 |
| | MC14081 | 1 | | 2SC373 | 4 |
| | MC14518B | 1 | | 2SC535A | 1 |
| | MC14519B | 1 | | 2SC784(O) | 1 |
| | MSM5502 | 1 | | 2SC828 | 1 |
| | MSM5592 | 1 | | MPS-A13 | 2 |
| | SN7407N | 2 | Ge Diode | 1S1007 | 11 |
| | SN74LS00N | 2 | Si Diode | 1S1555 | 17 |
| | SN74LS90N | 1 | | V06B | 8 |
| | SN74LS112N | 1 | LED | SL-103D | 2 |
| | SN74LS390N | 1 | LED Display | 5082-7286 | 1 |
| | SP8646B | 1 | | 5082-7740 | 5 |
| | μPA56C | 1 | | | |
| | μPD546C-1(CPU) | 1 | | | |

## ACCESSORIES

The following accessories are packaged along with your FRG-7000:

(1) MINIATURE PHONE PLUG 2 ea.
For use in EXT SP or REC jacks.

(2) PHONE PLUG 1 ea.
For use with headphones.

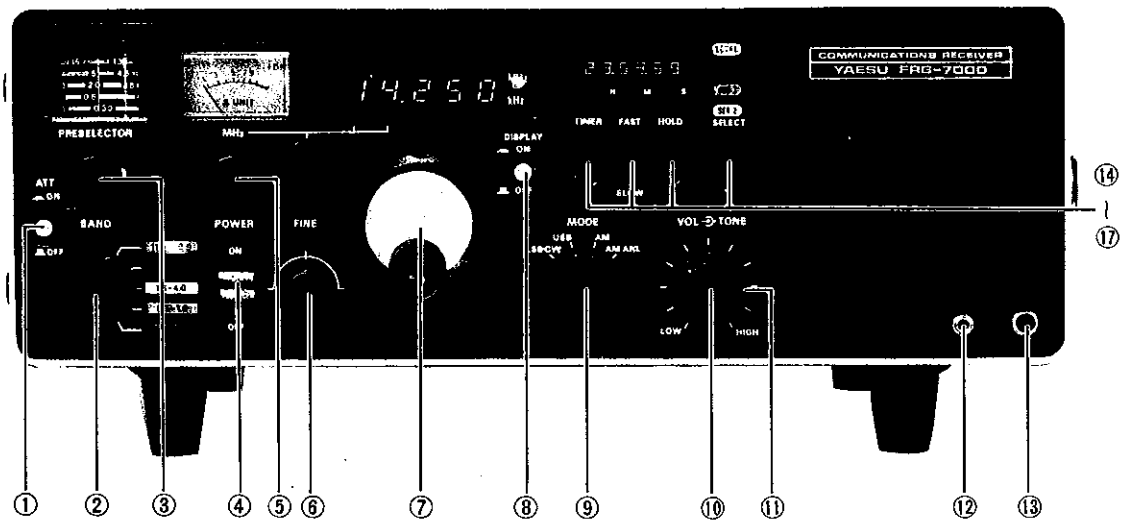
(3) RCA TYPE PLUGS 2 ea.
For use in control of station equipment through relay jacks on rear panel.

(4) UHF COAX PLUG 1 ea.
For connection to HF antenna using coaxial feedline.

(5) EXTRA FUSES 2 ea.
3 amp fuse plus another 1 amp or 0.5 amp fuse, depending on local supply voltage.

(6) WIRES 3M/10M 1 ea.
For indoor antennas.

# CONTROLS AND SWITCHES




The FRG-7000 has been specifically designed for ease of operation. All controls have been adjusted at the factory to ensure peak performance. The operator may be unfamiliar with the operation of some of the controls, and improper settings thereof may result in poor reception. For this reason, please become throughly familiar with the function of every control before attempting to operate the receiver.

## FRONT PANEL

### (1) ATT (ON, OFF)

The ATT switch activates an attenuator for the receiver front end to minimize overloading under extreme conditions of strong adjacent signals. Maximum receiver sensitivity occurs with the ATT switch OFF.

### (2) BAND

The BAND switch has five positions for selecting the proper preselector range for peaking the receiver circuits.

### (3) PRESELECT

The preselector peaks the receiver circuits for maximum sensitivity on the frequency being received. The preselector bands are color coded to match the color code of the band switch, and the preselector control should be tuned to the frequency in use by observation of the calibration marks on the color coded scale, and by listening for maximum signal or noise strength from the speaker.

### (4) POWER

This is the main on/off switch for the receiver. When it is in the OFF position, the timer circuit will turn the receiver on or off, according to the settings of SET 1 and SET 2 on the digital clock.

### (5) MHz

The MHz control selects the 1 MHz band to be tuned for reception. When the control is not set correctly, e.g. between the 6 MHz and 7 MHz segments, the UNLOCK lamp will light to indicate that adjustment is needed.

### (6) FINE

This control allows fine tuning of the received frequency.

### (7) MAIN TUNING KNOB

This is the main tuning control for the receiver.

### (8) DISPLAY (ON, OFF)

For conservation of energy, the front panel digital frequency display and lamps may be switched off with this button. The digital clock is not affected by this control.

### (9) MODE (LSB/CW, USB, AM, AM/ANL)

This control selects the desired mode:

| | |
|---|---|
| LSB/CW: | Lower sideband and CW |
| USB: | Upper sideband |
| AM: | Amplitude modulation |
| AM/ANL: | Amplitude modulation, automatic noise limiter |

### (10) VOL

This is the main volume control for the receiver.

### (11) TONE

This control varies the audio filter so as to emphasize either high or low audio tones.

### (12) REC

This jack is for recording purposes, and its output is set to approximately 50 mV, regardless of the setting of the volume control.

### (13) PHONES

This is a standard 1/4" headphone jack. When the headphone plug is inserted into the jack, the internal speaker is cut off.

### (14) TIMER

With proper setting of the SET 1 and SET 2 positions of the digital clock, placing the TIMER switch in the "down" position will allow automatic ON/OFF switching of the receiver by the digital clock.

### (15) FAST/SLOW

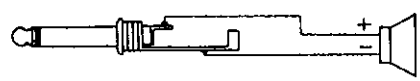
This lever switch is used for setting the digital clock. The fast speed is used for rapid advancement of the indicated time, and the slow speed is used for the final, fine adjustment.

### (16) HOLD

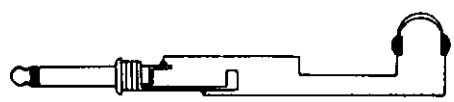
This lever switch will lock the digital clock on the indicated time. This switch is useful for alignment of the GMT and LOCAL indications, and also for time setting if the FAST/SLOW control advances the time too far.

### (17) SELECT

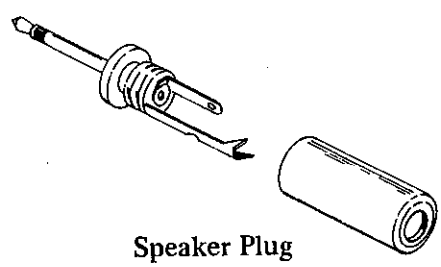
Each time the SELECT switch is pressed downward, the digital clock selection lamps are switched, corresponding to the change in the clock function. If the local time is being displayed (LOCAL lamp lighted), pressing the SELECT switch will cause the SET 1 lamp to light, and the clock will now display the time which has been programmed into the SET 1 position. Another press of the SELECT switch will cause SET 2 to be displayed, etc.



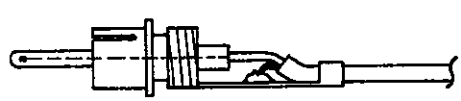

**Speaker Connection Via Headphone Plug**

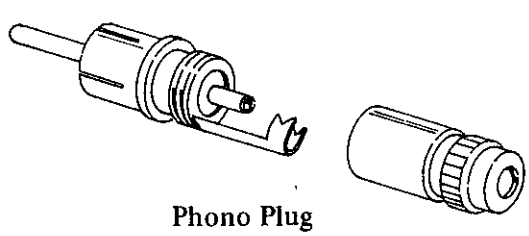


**Phone Plug**



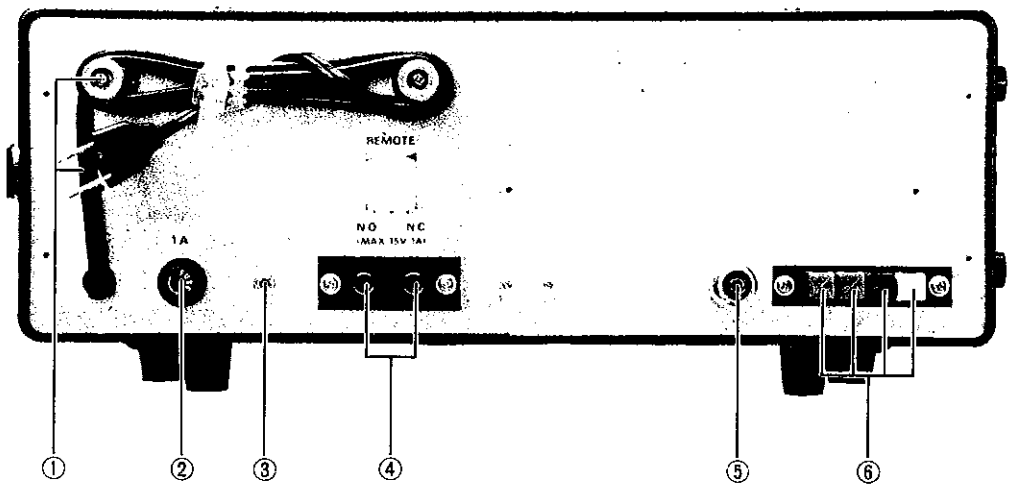
**Speaker Plug**





**Phono Plug**

# REAR PANEL




### (1) POWER CORD AND CORD HOLDER

The power cord may be wrapped around the cord holder for packing purposes.

### (2) FUSE

For 100/110/117 volt operation, a 1 amp fuse should be installed. For 200/220/234 volt operation, a 1/2 amp fuse should be installed. BE CERTAIN TO USE A FUSE OF THE PROPER RATING WHEN REPLACING FUSES.

### (5) SW2

This is a standard UHF connector for coax-fed shortwave antennas.

### (6) SW1, BC, E, MUTE

SW1 is a low-impedance connection for a random-length shortwave antenna.
BC is a high-impedance connection for a random-length shortwave antenna.
E is a ground connection.
MUTE is a connection for muting FRG-7000, as,

# INSTALLATION

Carefully remove FRG-7000 from its carton, and inspect it for any signs of physical damage. Should any damage be observed, immediately notify the shipping company, stating the damage in detail. Save the carton and the packing material for possible future use.

## LOCATION

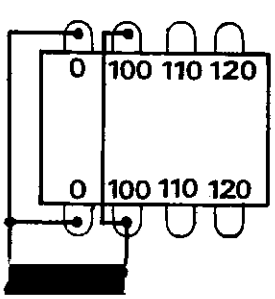
In general, the location of the FRG-7000 is not critical. However, it is recommended that exces-

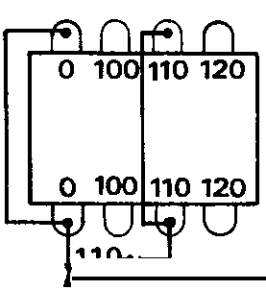
CAUTION

PERMANENT DAMAGE WILL RESULT IF IMPROPER AC SUPPLY VOLTAGE IS APPLIED TO THE RECEIVER. THE WARRANTY DOES NOT COVER DAMAGE CAUSED BY IMPROPER AC SUPPLY VOLTAGE.

Should it become necessary to adapt the FRG-7000 to a different AC supply voltage, refer to the chart below for the proper connections. After modification, make a notation on the rear panel

The FRG-7000 is supplied with a multi-voltage power transformer (export model only). Thus, when moving to an area where the supply voltage is different from your accustomed supply voltage, your FRG-7000 may still be used. Before commencing operation initially, BE SURE THAT THE VOLTAGE MARKED ON THE REAR OF THE RECEIVER AGREES WITH THE LOCAL AC SUPPLY VOLTAGE.




If fuse substitution is required, be certain to use a fuse of the proper rating. For 100 - 117 volt operation, use a 1 amp fuse; for 200 - 234 volts, use a 1/2 amp fuse. The fuse holder is located on the rear apron. The counter unit also has a fuse of 3 amps (for all voltages). This fuse is installed inside the cabinet.

CAUTION

BE CERTAIN TO USE A FUSE OF THE PROPER RATING. WARRANTY DOES NOT COVER DAMAGE CAUSED BY USE OF AN IMPROPER FUSE.

## ANTENNA AND GROUND

The antenna is the most important part of the

# OPERATION

## FREQUENCY SELECTION

The operating frequency is read directly from the digital display. All digits of the operating

The main tuning dial provides rapid frequency change, and the fine tuning control allows ±2.5 kHz adjustment for precise zeroing on the desired station.

The main tuning dial tunes a 1 MHz range, and thus controls the last three digits of the displayed frequency (000 to 999). For setting the digital

## PRESELECTOR OPERATION

For peaking the receiver circuits for maximum sensitivity on the desired frequency, the pre-

BAND switch should be rotated so that the preselector band appropriate for the operating frequency is selected. For example, for peaking for reception on 6.910 MHz, the 4.0 MHz - 11.0 MHz (green) range should be selected.

Next, rotate the PRESELECTOR control and observe the color-coded calibration of the pre-

## BROADCAST BAND (0.5 MHz - 1.6 MHz) OPERATION

Special caution should be observed when attempting broadcast band reception, as the MHz control may appear to select more than one range for the segment of the band below 1 MHz. Use only the position of the MHz control immediately adjacent to the 1.0 MHz - 2.0 MHz band.

## AMATEUR BAND RECEPTION

### SSB Voice Signals:

Virtually all amateurs use lower sideband (LSB) on the frequency bands below 7.3 MHz, and upper sideband (USB) above 14.0 MHz. Set the MODE switch to USB or LSB, as appropriate, and rotate the main tuning dial until a signal is clearly heard. The FINE control is extremely useful when tuning in SSB signals. The VOLUME

## SHORTWAVE BROADCAST RECEPTION

International shortwave broadcast stations use the AM mode. Turn the POWER switch ON (TIMER switch OFF), place the MODE switch in the AM position, and select the desired frequency as described in the previous section. The VOLUME control should be adjusted for a comfortable listening level. The TONE control may be adjusted to provide the desired fidelity, and the FINE control will allow precise adjustment of the received frequency.

In the presence of extremely strong signals, the ATT switch may be placed in the ON position to prevent overload of the receiver front end. Should impulse noise be present, the MODE switch may be placed in the AM/ANL position.

clearest reception level.

### CW (Morse Code Signals):

Amateur and commercial Morse Code transmissions may be received by placing the MODE switch in the LSB/CW position, and tuning the main dial and FINE controls for the desired listening tone.

| Power Switch | Timer Switch | RECEIVER | | | REMOTE | |
|---|---|---|---|---|---|---|
| | | | SET-1 | SET-2 | N.O. | N.C. |
| OFF | OFF | OFF | OFF | OFF | OPEN | CLOSE |
| ON | OFF | ON | ON | ON | OPEN | CLOSE |
| OFF | ON | OFF | ON | – | CLOSE | OPEN |
| | | | – | OFF | OPEN | CLOSE |
| ON | ON | ON | OFF | – | CLOSE | OPEN |
| | | | – | ON | OPEN | CLOSE |

## DIGITAL CLOCK OPERATION

The built-in digital clock will provide display of both your local time and Greenwich Mean Time (GMT). When the FRG-7000 is initially plugged in, the clock will indicate "00.00.00" and begin counting the seconds as they pass.

To set the clock to your local time, place the SELECT switch in the LOCAL position. Then use the FAST and SLOW switches to set the clock to the proper time. If desired, the clock may be set to some precise hour (for example, 11.00.00), and then the HOLD switch should be activated to hold the time at that point. When the time reaches exactly 11.00.00, release the HOLD switch, and the clock will resume counting. This technique is recommended for precise time calibration to a time standard such as WWV or JJY.

For setting to GMT time, it is recommended that the HOLD switch technique be used. Align the LOCAL time to a suitable point (e.g. 16.00.00) and activate the HOLD switch. Place the SELECT switch in the GMT position, and use the FAST and SLOW switch to calibrate the GMT clock with the GMT appropriate for the LOCAL time being held (e.g. 16.00.00 Eastern Standard Time = 21.00.00 GMT). Release the HOLD switch to

The timer circuitry has the effect of switching the condition of the receiver as determined by the POWER switch. That is, when the POWER switch is OFF, and the TIMER switch ON, the receiver will be OFF until the SET 1 time. Between the SET 1 and SET 2 times, the receiver will be ON, and between the SET 2 and SET 1 times the receiver will again be OFF.

When the POWER switch is in the ON position, these relations are reversed. That is, with the POWER switch ON, and the TIMER switch ON, the receiver will be ON until the SET 1 time. From the SET 1 time until the SET 2 time, the receiver will be OFF, and after the SET 2 time the receiver will be ON until the SET 1 time.

The REMOTE contacts are controlled by the TIMER relay. In the period between the SET 1 and SET 2 times, the normally open (N.O.) jack will be CLOSED, and the normally closed (N.C.) jack will be OPEN. With the TIMER switch OFF, regardless of the position of the POWER switch, the jacks are in their "normal" states.

For example, if you must be away from your station, but want to record a program, proceed as follows: preset the receiver to the proper frequency and peak the preselector, etc. Connect the FRG-7000 REC jack to the recording input

# CIRCUIT DESCRIPTION

The block diagram will provide you with a better understanding of this receiver. Basically, the FRG-7000 is a triple-conversion superheterodyne receiver utilizing a synthesized local oscillator for both the first and second mixers. The result is drift-free VFO operation.

The signal from the antenna is fed through the

$Q_{101}$ (3SK51-03). The amplified signal is fed

The 52.5 MHz output signal from $Q_{201}$ is fed to the second premixer $Q_{202}$ (3SK51-03), where the 52.5 MHz signal is mixed with a 63.2 MHz signal generated by $Q_{207}$ (2SK19GR), producing a 10.7 MHz IF signal.

The 10.7 MHz IF signal passes through a 10.7 MHz ceramic filter and is amplified by $Q_{203}$

where the 10.7 MHz signal is mixed with a 63.2

signal. This IF signal is amplified by $Q_{401}$ (3SK40M) and fed to a third mixer $Q_{402}$ (2SK19GR), where the IF signal is mixed with

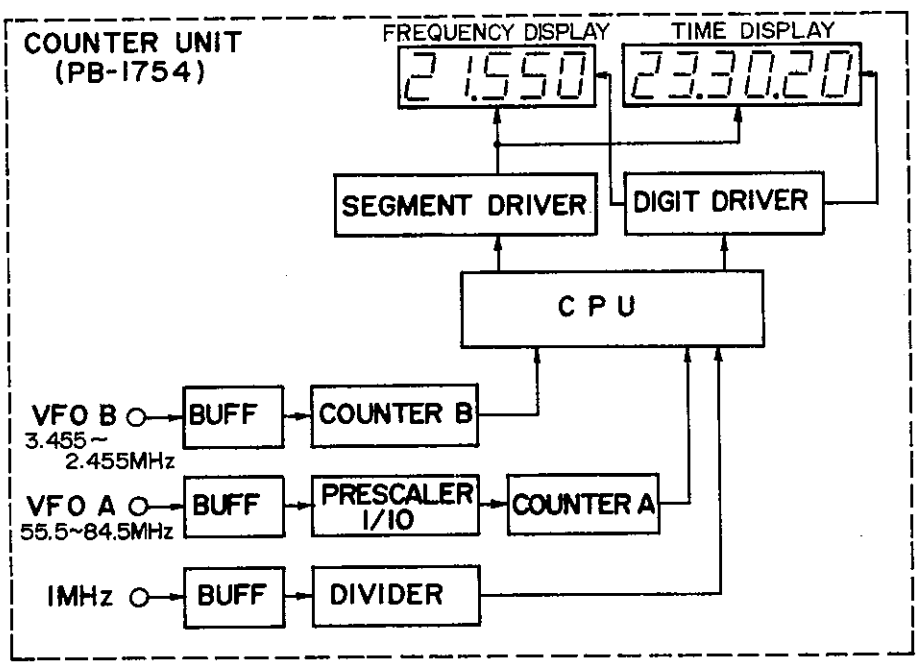
(2SC372Y). The MODE switch shifts the BFO frequency for reception of an LSB or USB signal.

The output from the detectors is amplified by

The counter unit utilizes a 4-bit microcomputer unit (CPU) to display the frequency being received. The CPU also drives the digital clock, which displays both local and GMT time. The clock section of the CPU controls the timer func-

tion for ON/OFF control of the receiver and peripheral station equipment.

The regulated power supply consists of four regulators: $Q_{601}$ (14308), $Q_{602}$ (NJM 78L09A), $Q_{603}$ (14308), and $Q_{604}$ (14305), to deliver stabilized voltages of 10V, 9V, 8V, and 5V to various circuits in the receiver.



# MAINTENANCE & ALIGNMENT

## GENERAL

The FRG-7000 has been carefully aligned and tested at the factory prior to shipment, and, with normal usage, it should not require other than the usual attention given to electronic equipment. Service or replacement of a major component many entail substantial realignment; under no circumstances, however, should realignment be attempted unless the operation of the receiver is fully understood and the malfunction has been definitely attributed to misalignment rather than component failure. Service work should be performed by experienced personnel using proper test equipment.

### (1) Local Oscillator $T_{207}$

Connect a VTVM between $TP_{202}$ and $TP_{204}$ (ground). Adjust $T_{207}$ for 0.6V RMS as indicated on the VTVM. Connect a frequency counter to $TP_{202}$, and make sure that the output frequency is 63.2 MHz.

### (2) Output level $T_{201}$ - $T_{206}$

Connect a VTVM between $TP_{108}$ and $TP_{109}$ (ground). Set the FRG-7000 MHz control to 29 MHz. Carefully adjust the MHz control for a maximum VTVM reading. Then peak $T_{201}$ - $T_{201}$ for a maximum VTVM reading.

### (3) Harmonic generator $TC_{501}$

Connect a frequency counter between $TP_{502}$ and $TP_{501}$ (ground), and adjust $TC_{501}$ for a reading of 1 MHz. The output voltage at $TP_{502}$ should be approximately 0.2V RMS.

### (4) Oscillator Unit $T_{301}$, $TC_{301}$

Connect a frequency counter between $TP_{107}$ and $TP_{104}$ (ground). Set the FRG-7000 MHz control to the fully counterclockwise position. Adjust $T_{301}$ for a reading of 54.0 MHz on the counter. Set the MHz control to the fully clockwise position, and adjust $TC_{301}$ for a reading of 85.2 MHz on the counter. Repeat the above adjustments, if necessary, until the UNLOCK lamp turns off at every 1 MHz incremental advancement of the MHz control.

### (5) VFO Frequency $T_{403}$, $TC_{403}$

This alignment should be performed after the receiver has been allowed to warm up 30 minutes. Connect a frequency counter between $TP_{402}$ and $TP_{404}$ (ground). Set the main tuning knob to the fully clockwise position, and adjust $T_{403}$ for a reading of 2380 kHz on the counter. Set the main tuning knob next to the fully counterclockwise position, and adjust $TC_{403}$ for a counter reading of 3480 kHz. Repeat this adjustment, if necessary, until complete tracking is accomplished The output voltage at $TP_{402}$ should be 0.3V - 0.6V RMS.

### (6) Second IF Alignment $T_{401}$, $T_{402}$, $TC_{401}$, $TC_{402}$

Connect a signal generator between $TP_{105}$ and $TP_{106}$ (ground). Set the MODE switch to the AM position, and set the signal generator output frequency to 2.1 MHz (the FRG-7000 display should indicate 900 kHz). Peak $T_{401}$ and $T_{402}$ for a maximum S-meter reading.

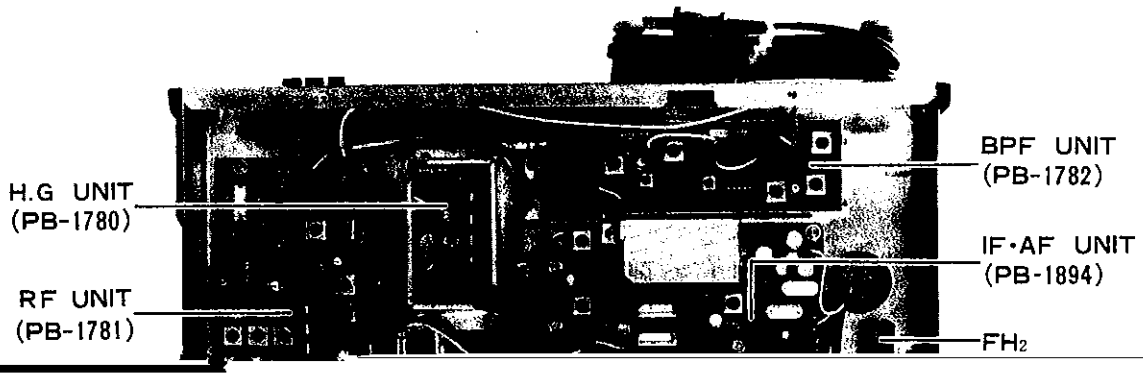
Set the signal generator to 2.9 MHz (the FRG-7000 digital display should indicate 100 kHz). Peak $TC_{401}$ and $TC_{402}$ for a maximum S-meter reading. Repeat the above adjustments until complete tracking is accomplished.

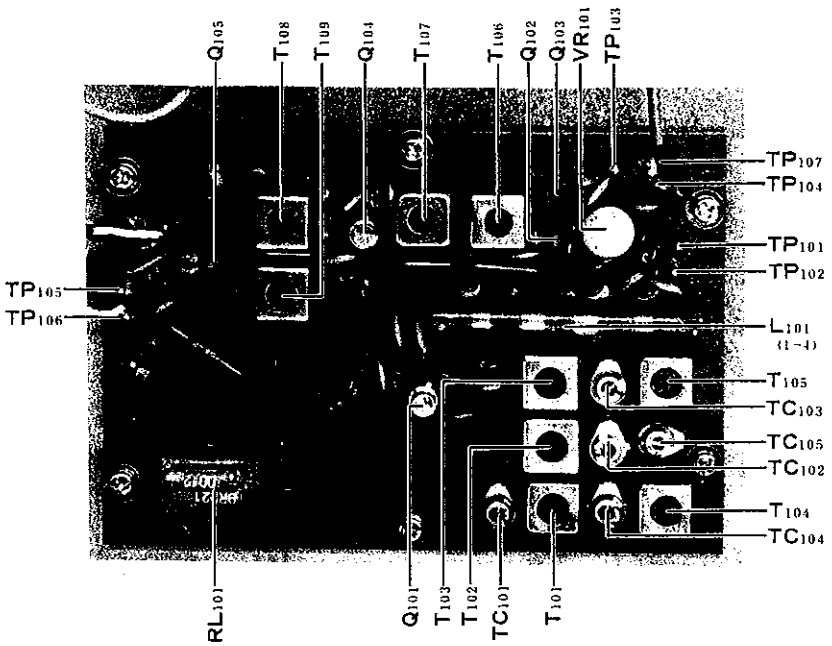
### (7) Third IF Alignment $T_{404}$, $T_{405}$

Connect a signal generator to $TP_{401}$ and $TP_{406}$ (ground), and set its output to 2.9 MHz (the FRG-7000 digital display should indicate 100 kHz). Peak $T_{404}$ and $T_{406}$ and $T_{405}$ for a maximum S-meter reading.

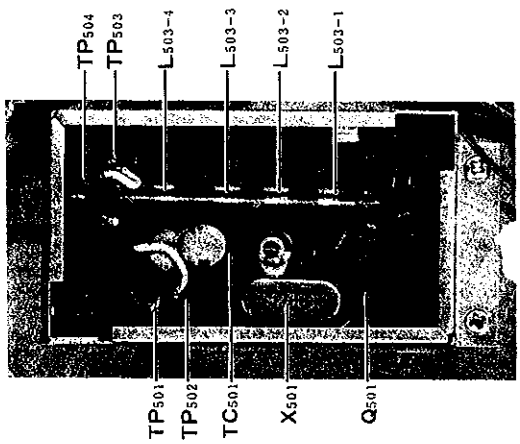
### (8) S-meter Sensitivity $VR_{401}$

Connect a signal generator to SW2, and apply an 11 MHz 100 dB signal. Tune the receiver to 11 MHz, and adjust $VR_{401}$ for a full scale reading on the S-meter.

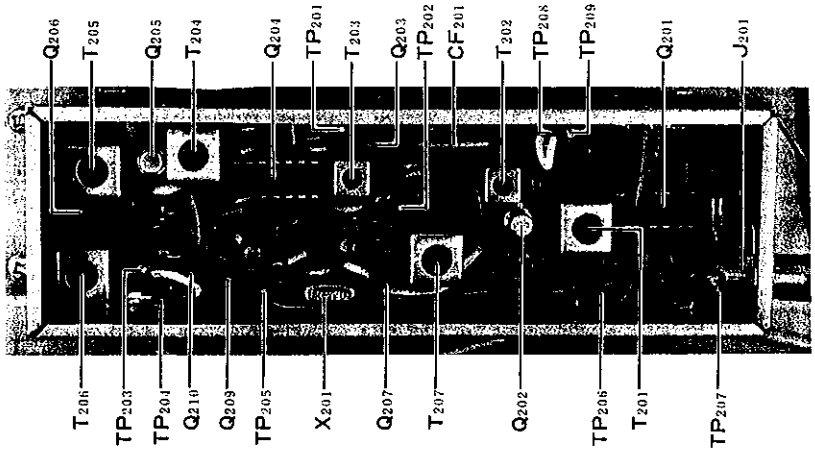

H.G UNIT
(PB-1780)
RF UNIT
(PB-1781)
BPF UNIT
(PB-1782)
IF·AF UNIT
(PB-1894)
FH2




RF UNIT(PB-1781)




H.G.UNIT(PB-1780)

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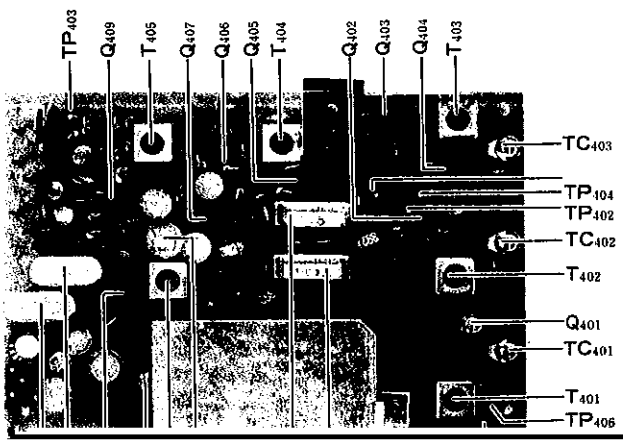

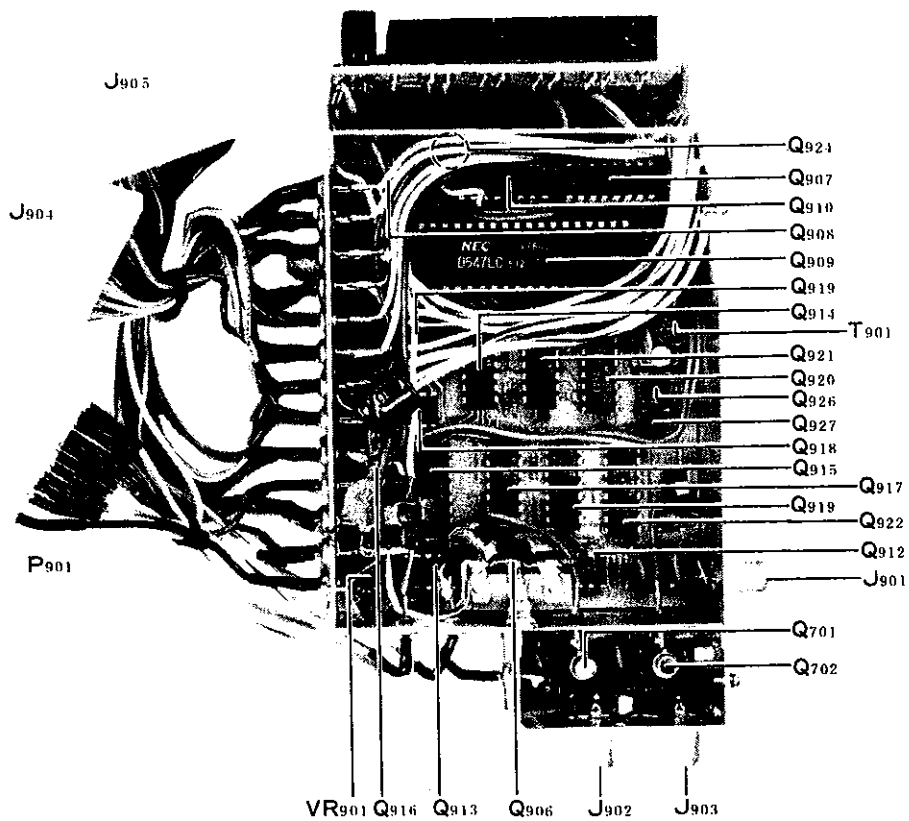


COUNTER UNIT(PB-1754)

# PARTS LIST

## MAIN CHASSIS

| Symbol No. | Part No. | Description |
|---|---|---|
| | | **RESISTOR** |
| R5 | 40143470 | Carbon film 1/4W VJ 47Ω |
| R3, 6 | 41143680 | " " " TJ 68Ω |
| R1 | 41143222 | " " " " 2.2kΩ |
| R2 | 40143223 | " " " VJ 22kΩ |
| R4 | 42124120 | " composition 1/2W GK 12Ω |
| R7, 8, 9 | 42124225 | " " " " 2.2MΩ |
| R10 | 44204339 | Wire wound 2W 3.3Ω |
| | | |
| | | **POTENTIOMETER** |
| VR1 | 49800104 | DM10A 10kΩB/10kΩB |
| | | |
| | | **CAPACITOR** |
| C2 | 31820050 | Ceramic disc 50WV 5PF CH |
| C3 | 30820103 | " " " 0.01μF |
| C1 | 36825104 | Mylar " 0.1μF |
| C4 | 34220108 | Electrolytic 25WV TT 1000μF |
| | | |
| | | **VARIABLE CAPACITOR** |
| VC1, 2 | 39000078 | CY-31A 335PF x 2 |
| VC3 | 39000079 | TSN 150Sx04-1 4PF |
| | | |
| | | **POWER TRANSFORMER** |
| PT1 | 52000062 | 52-62 |
| | | |
| | | **METER** |
| M1 | 74000380 | KTC-024 |
| | | |
| | | **SPEAKER** |
| SP1 | 76000022 | SM-92Y 4Ω 4W |
| | | |
| | | **SWITCH** |
| S1 | 62000002 | ESR-E365R20A |
| S2 | 62000020 | ESR-E264R20 |
| S3 | 65000012 | PW-22 |
| S4 | 65000038 | PW-42 |
| S5 | 64000053 | 8H2011 |
| | | |
| | | **RECEPTACLE** |
| J1 | 68000011 | M-BR-06D |
| J2 | 68040006 | SQ2450-03 |
| J3, 5 | 68020012 | SG8050-07 |
| J4 | 68030002 | SG7814 |
| J6 | 80043741 | UP-021 |

| | | |
|---|---|---|
| | | **FUSE** |
| F1 | 73000013 | 1A (100V~117V) |
| | 73000012 | 0.5A (200V~234V) |
| F2 | 73000003 | 3A |
| | | |
| | | **FUSE HOLDER** |
| FH1 | 69030005 | SN-1301 |
| FH2 | 69030003 | F3294 |
| | | |
| | | **PILOT LAMP** |
| PL1, 2, 13, 14 | 14000033 | BQ-034-22529A |
| PL3, 9~12 | 14000031 | BQ-034-22527A |
| PL4~8 | 14000032 | BQ-034-22528A |

## RF UNIT

| Symbol No. | Parts No. | Description |
|---|---|---|
| | 017811AZ | RF board with components |
| PB-1781A | 60417811 | P.C. Board |
| | | |
| | | **FET** |
| Q102, 103, 105 | 22800195 | 2SK19GR |
| Q104 | 23800401 | 3SK40M |
| Q101 | 22800513 | 3SK51-03 |
| | | |
| | | **DIODE** |
| D101 | 21015550 | Silicon 1S1555 |
| | | |
| | | **RESISTOR** |
| R121 | 40143100 | Carbon film 1/4W VJ 10Ω |
| R119 | 40143330 | " " " " 33Ω |
| R120 | 40143470 | " " " " 47Ω |
| R107, 122 | 40143101 | " " " " 100Ω |
| R102, 108, 113, 116, 124 | 40143221 | " " " " 220Ω |
| R103 | 41143221 | " " " TJ 220Ω |
| R104, 105 | 40143561 | " " " VJ 560Ω |
| R112 | 40143681 | " " " " 680Ω |
| R115 | 40143152 | " " " " 1.5kΩ |
| R110, | 40143103 | " " " " 10kΩ |
| R111 | 40143273 | " " " " 27kΩ |
| R118 | 40143393 | " " " " 39kΩ |
| R117 | 40143473 | " " " " 47kΩ |
| R101, 106, 109, 114, 123 | 40143104 | " " " " 100kΩ |

| | | | | | |
|---|---|---|---|---|---|
| | | **POTENTIOMETER** | | | |
| VR101 | 49905472 | SR19R 4.7kΩB | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | **THERMISTOR** | | | |
| TH101 | 29090005 | D-22A | | | |
| | | | | | |
| | | | | | |
| | | **CAPACITOR** | | | |
| C119 | 31820020 | Ceramic disc 50WV 2PF CH | | | |
| C106, 109, 124 | 31820030 | " " " 3PF " | | | |
| C111 | 31820050 | " " " 5PF " | | | |
| C120 | 31820150 | " " " 15PF " | | | |
| C113, 114, 126 | 31820220 | " " " 22PF " | | | |
| C110, 130 | 31820270 | " " " 27PF " | | | |
| C107, 108, 117 | 31820330 | " " " 33PF " | | | |
| C125 | 31820820 | " " " 82PF " | | | |
| C116 | 31829101 | " " " 100PF SL | | | |
| C132 | 30820102 | " " " 0.001μF | | | |
| C101~105, 112, 115, 118, 121~123, 127 | 30820103 | " " " 0.01μF | | | |
| C128, 133 | 30820473 | " " " 0.047μF | | | |
| C131 | 33824470 | Dipped mica " 47PF | | | |
| C129 | 33824151 | " " " 150PF | | | |
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| | | | | | |
| | | **TRIMMER CAPACITOR** | | | |
| TC102 | 39000002 | ECV-1ZW 20x32 20PF | | | |
| TC101, 103~105 | 39000004 | " 40x32 40PF | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | **TRANSFORMER** | | | |
| T101 | 55003293 | R12-5830 #220360 | | | |
| T102 | 55003200 | R12-5828 #220046 | | | |
| T103 | 55003201 | R12-5781 #220047 | | | |
| T104 | 55003202 | R12-5707 #220048 | | | |
| T105 | 55003203 | R12-5694 #220049 | | | |
| T106~109 | 55003204 | R12-1041B #220050 | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | **INDUCTOR** | | | |
| L101 | 55003212 | #220051 | | | |
| L103 | 53020018 | Micro inductor 10μH | | | |
| L102 | 53020008 | " " FL5H 68μH | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | **RELAY** | | | |
| RL101 | 70000035 | BR221D012 12V | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | **US PIN PLUG** | | | |
| P101 | 67020007 | SQ4052 | | | |
| | | | | | |
| | 91100008 | Wrapping terminal C | | | |

## BPF UNIT

| Symbol No. | Part No. | Description |
|---|---|---|
| | 017821AZ | BPF unit with components |
| PB-1782A | 60417821 | P.C. Board |
| | | **IC, FET & TRANSISTOR** |
| Q201, 204 | 25000104 | IC SN76514N |
| Q203, 206, 207 | 22800195 | FET 2SK19GR |
| Q202, 205 | 23800513 | 3SK51-03 |
| Q209 | 22303724 | Transistor 2SC372Y |
| Q210 | 22303730 | 2SC373 |
| Q208 | 22305351 | 2SC535A |
| | | |
| | | |
| | | |
| | | **DIODE** |
| D202, 203 | 21010070 | Germanium 1S1007 |
| D201 | 21015550 | Silicon 1S1555 |
| | | |
| | | |
| | | |
| | | **CRYSTAL** |
| X201 | 71500189 | HC-18/U 63.2MHz |
| | | |
| | | |
| | | |
| | | **CERAMIC FILTER** |
| CF201 | 71200020 | 10.7MF-S23 (SFG-10.7MA) |
| | | |
| | | |
| | | |
| | | |
| | | **RESISTOR** |
| R224 | 40143470 | Carbon film 1/4W VJ 47Ω |
| R207~209, 214~217 | 40143101 | " " " " 100Ω |
| R210 | 40143151 | " " " " 150Ω |
| R206 | 40143221 | " " " " 220Ω |
| R 219, 223 | 40143331 | " " " " 330Ω |
| R202, 220 | 40143471 | " " " " 470Ω |
| R201 | 40143102 | " " " " 1kΩ |
| R222 | 40143472 | " " " " 4.7kΩ |
| R204, 212, 221, 225 | 40143103 | " " " " 10kΩ |
| R203 | 40143273 | " " " " 27kΩ |
| R211 | 40143333 | " " " " 33kΩ |
| R205, 213, 218 | 40143473 | " " " " 47kΩ |
| | | |
| | | |
| | | |
| | | |
| | | **CAPACITOR** |
| C203, 240 | 31820050 | Ceramic disc 50WV 5PF CH |
| C201, 204, 212, 226 | 31820100 | " " " 10PF" |
| C202 | 31820220 | " " " 22PF" |

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|---|---|---|---|---|---|
| C213, 233, 236, 238 | 31820101 | Ceramic disc 50WV 100PF CH | | | |
| C209, 210, 216, 220, 223, 235, 239 | 30820102 | " " " 0.001μF | | | **CAPACITOR** |
| C206, 214, 217~219, 221, 222, 224, 227, 229~232, 234, 237, 241 | 30820103 | " " " 0.01μF | C301 | 31827070 | Ceramic disc 50WV 7PF UJ |
| C205, 207, 208, 211, 215, 225, 228 | 30820473 | " " " 0.047μF | C304 | 31827220 | " " " 22PF " |
| | | | C305 | 31827330 | " " " 33PF " |
| | | | C302, 303 | 30820103 | " " " 0.01μF |
| | | | C307, 308 | 30820473 | " " " 0.047μF |
| | | | | | **VARIABLE CAPACITOR** |
| | | | VC301 | 39000074 | C343C 15PFx4 |
| | | **TRANSFORMER** | | | **TRIMMER CAPACITOR** |
| T201, 204~206 | 55003294 | #220361 | TC301 | 39000001 | ECV-1ZW 10x32 10PF |
| T207 | 55003295 | #220362 | | | |
| T202, 203 | 55003296 | #220187 | | | |
| | | | | | **TRANSFORMER** |
| | | | T301 | 55003208 | #220052 |
| | | **INDUCTOR** | | | **INDUCTOR** |
| L201 | 55003206 | #220053 | L301 | 53010003 | Micro inductor 250μH |
| L202 | 55003207 | #220054 | | | |
| L204, 206 | 53020013 | Micro inductor 150μF | **IF, AF UNIT** | | |
| L203, 205 | 53020001 | " " 1mH | Symbol No. | Parts No. | Description |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| R420, 421 | 41143101 | Carbon film 1/4W TJ | 100Ω | C438, 444 | 32824510 | Dipped mica 50WV | 51PF |
| | 40143121 | " " " " | 120Ω | C458 | 32824820 | " " " | 82PF |
| R408, 410, 414, | 40143221 | " " " " | 220Ω | C460 | 32824121 | " " " | 120PF |
| 424, 426, 433, | | | | C435 | 32824271 | " " " | 270PF |
| 435, 437, 453 | | | | C441 | 32824391 | " " " | 390PF |
| R401 | 40143331 | " " " " | 330Ω | C432 | 32824471 | " " " | 470PF |
| R430 | 40143471 | " " " " | 470Ω | C462 | 32824681 | " " " | 680PF |
| R449 | 40143561 | " " " " | 560Ω | C431, 463 | 32824102 | " " " | 1000PF |
| R431 | 40143681 | " " " " | 680Ω | | 36825332 | Mylar " | 0.0033μF |
| R425, 440, 458 | 40143102 | " " " " | 1kΩ | C427 | 36825472 | " " | 0.0047μF |
| R416 | 40143152 | " " " " | 1.5kΩ | C426 | 36825103 | " " | 0.01μF |
| R415, 418, 419, | 40143222 | " " " " | 2.2kΩ | C437 | 36825223 | " " | 0.022μF |
| 422, 455, 457 | | | | C436 | 36825333 | " " | 0.033μF |
| R413, 417, 428, | 40143332 | " " " " | 3.3kΩ | C416, 420, 422, | 36825473 | " " | 0.047μF |
| 451 | | | | 442, 468 | | | |
| R448 | 40143392 | " " " " | 3.9kΩ | C445 | 36825104 | " " | 0.1μF |
| R452 | 40143472 | " " " " | 4.7kΩ | C428 | 36825224 | " " | 0.22μF |
| R411 | 40143822 | " " " " | 8.2kΩ | | 34220105 | Electrolytic 16WV | 1μF |
| R427 | 40143103 | " " " " | 10kΩ | C425, 447 | 34220225 | " " | 2.2μF |
| | 40143153 | " " " " | 15kΩ | C439 | 34220226 | " " | 22μF |
| R450, 460 | 40143183 | " " " " | 18kΩ | | 34220336 | " " | 33μF |
| | 40143223 | " " " " | 22kΩ | C442, 446, 448 | 34220476 | " " | 47μF |
| R459 | 40143333 | " " " " | 33kΩ | C440, 467, 469 | 34220107 | " " | 100μF |
| R406 | 40143393 | " " " " | 39kΩ | | | | |
| R404 | 40143473 | " " " " | 47kΩ | | | | |
| R402 | 40143563 | " " " " | 56kΩ | | | | |
| R436 | 40143683 | " " " " | 68kΩ | | | | |
| R412, 434, 441, | 40143104 | " " " " | 100kΩ | | | **TRIMMER CAPACITOR** | |
| 456 | | | | TC403 | 39000002 | ECV-1ZW 20x32 | 20PF |
| R405 | 40143154 | " " " " | 150kΩ | TC401, 402 | 39000005 | ECV-1ZW 50x32 | 50PF |
| R423, 438 | 40143224 | " " " " | 220kΩ | | | | |
| | | | | | | | |
| | | | | | | **TRANSFORMER** | |
| | | | | T401 | 55003209 | R12-5783 | #220060 |
| | | | | T402 | 55003210 | R12-5780 | #220061 |
| | | **THERMISTOR** | | T403 | 55003211 | R12-5775 | #220062 |
| TH401 | 29090005 | | D-22A | T404, 405 | 54140970 | R12-4097 | #220101 |
| | | | | T406 | 54140990 | R12-4099 | #220156 |
| | | | | | | | |
| | | | | | | **INDUCTOR** | |
| | | **POTENTIOMETER** | | L401. 402 | 53020022 | Micro inductor FL4H 4.7μH | |

| | | TRANSISTOR | REG UNIT | | |
|---|---|---|---|---|---|
| Q501 | 22303724 | 2SC372Y | Symbol No. | Part No. | Description |
| | | | | 017841AZ | Regulator unit with components |
| | | | PB-1784A | 60417841 | P.C. Board |
| | | | | | |
| | | DIODE | | | |
| D501, 502 | 21010070 | Germanium 1S1007 | | | |
| | | | | | IC |
| | | | Q604 | 25000105 | μPC 14305 |
| | | | Q601, 603 | 25000116 | μPC 14308 |
| | | CRYSTAL | Q602 | 25000170 | NJM 78L09A |
| X501 | 71600026 | HC-6/W 1MHz | | | |
| | | | | | |
| | | | | | |
| | | | | | DIODE |
| | | RESISTOR | D607, 608 | 21015550 | Silicon 1S1555 |
| R505, 506 | 40143101 | Carbon film 1/4W VJ 100Ω | D601~606 | 21090022 | " V06B |
| R503 | 40143221 | " " " " 220Ω | | | |
| R502 | 40143103 | " " " " 10kΩ | | | |
| R501 | 40143104 | " " " " 100kΩ | | | |
| | | | | | RESISTOR |
| | | | R602 | 42124220 | Carbon composition 1/2W GK 22Ω |

[redacted]

| | | CAPACITOR | | | | |
|---|---|---|---|---|---|---|

| | | RESISTOR | | | SWITCH |
|---|---|---|---|---|---|
| R703, 709 | 40143221 | Carbon film 1/4W VJ 220Ω | S801 | 64000107 | SLE 72251 |
| R704 | 40143152 | " " " " 1.5kΩ | S802 | 64000103 | SLE 62251 |
| R710 | 40143272 | " " " " 2.7kΩ | S803 | 64000106 | SLE 82301 |
| R702, 707 | 40143333 | " " " " 33kΩ | S804 | 64000108 | SLE 64251 |
| R705, 708 | 40143473 | " " " " 47kΩ | | | |
| R701, 706 | 40143474 | " " " " 470kΩ | | | |
| | | | | | MINI CONNECTOR |
| | | | J801 | 68060008 | 3024-15C |
| | | | P801, 802 | 67150008 | 5048-15A |
| | | | P803 | 68150006 | 3094-15A |
| | | CAPACITOR | | | |
| C701~704 | 30820103 | Ceramic disc 50WV 0.01μF | | | |
| C705 | 36226105 | Tantalum 16WV 1μF | | | |
| C706 | 32821102 | Feed thru 50WV 0.001μF | | | |
| | 91001102 | Seal terminal A102 | | | |
| | 91100008 | Wrapping terminal C | | | |

## SWITCH UNIT

| Symbol No. | Part No. | Description |
|---|---|---|
| | 017671AZ | Switch board with components |
| PB-1767A | 60417671 | P.C. Board |
| | | IC & TRANSISTOR |
| Q801 | 25000114 | IC MC14011 |
| Q803 | 25000176 | MC14016 |
| Q802 | 25000156 | MC14027 |
| Q804 | 25000093 | MC14081 |
| Q805~808 | 22303730 | Transistor 2SC373 |
| Q809 | 21090147 | Display 5082-7286 |
| | | DIODE |
| D801~806 | 21015550 | Silicon 1S1555 |
| | | RESISTOR |
| R802~806 | 42184103 | Carbon composition 1/8W GK 10kΩ |
| R801 | 42184473 | " " " " 47kΩ |
| | | CAPACITOR |
| C802 | 30820102 | Ceramic disc 50WV 0.001μF |
| C801 | 30820473 | " " " 0.047μF |
| C804 | 33824470 | Dipped mica " 47PF |
| C803 | 36326685 | Tantalum 20WV 6.8μF |

## COUNTER UNIT

| Symbol No. | Part No. | Description |
|---|---|---|
| | 017541AZ | Counter unit assembly with Buffer Display board |
| PB-1754A | 60417541 | P.C. Board |
| PB-1755 | 60417550 | P.C. Board |
| | | IC & TRANSISTOR |
| Q907, 910 | 25000143 | IC MC1416 |
| Q918 | 25000160 | MC14518 |
| Q919 | 25000174 | MC14519 |
| Q920 | 25000053 | MSM5502 |
| Q912 | 25000067 | MSM5592 |
| Q915, 923 | 25000140 | SN74LS00N |
| Q914, 921 | 25000171 | SN7407N |
| Q917 | 25000072 | SN74LS90N |
| Q913 | 25000170 | SN74LS112N |
| Q922 | 25000161 | SN74LS390N |
| Q916 | 25000159 | SP8646 |
| Q908 | 25000157 | μPA56C |
| Q909 | 25000158 | μPA547C-1 |
| Q906 | 25000172 | NJM78L05A |
| Q926, 927, 928 | 22303730 | Transistor 2SC373 |
| Q911 | 22308282 | 2SC828 |
| Q924, 925 | 22390001 | MPSA13 |
| Q901~905 | 21090135 | Display 5082-7740 |
| | | DIODE |
| D901, 902, 905 | 21015550 | Silicon 1S1555 |
| D903, 904 | 21090091 | LED SL103D |
| | | RESISTOR |
| R922, 949~955 | 40143390 | Carbon film RD1/4(F) 39Ω |
| R924, 928, 930, 956 | 40143221 | " " " 220Ω |
| R958 | 40143271 | " " " 270Ω |
| R903, 908, 909, 919 | 40143102 | " " " 1kΩ |
| R907, 925, 926 | 40143222 | " " " 2.2kΩ |

| | | | | | |
|---|---|---|---|---|---|
| R902 | 40143332 | " " " 3.3kΩ | | | **US PIN JACK** |
| R918 | 40143472 | " " " 4.7kΩ | J901~903 | 68020008 | SQ3056 |
| R927, 929, 959 | 40143562 | " " " 5.6kΩ | | | |
| R910~917 | 40143103 | " " " 10kΩ | | | |
| R920, 923, 939~941 | 40143223 | " " " 22kΩ | | | |
| | | | | | **IC SOCKET** |
| R901 | 40143273 | " " " 27kΩ | QS901~905 | 68140005 | 314-AG37D |
| R957 | 40143563 | " " " 56kΩ | QS906 | 68420001 | 116-42-30-114 |
| R904, 906, 931 | 40143104 | " " " 100kΩ | | | |
| R905 | 40143154 | " " " 150kΩ | | | |
| R942 | 47000003 | Block resistor 220Ω×7 | | 67200003 | Board joint 163740 |
| R932 | 47000007 | " " 22kΩ×7 | | | |

**ACCESSORIES**

| Symbol No. | Part No. | Description |
|---|---|---|
| | 67020003 | Record plug & external Speaker plug P2240 |
| | 67020002 | Headphone plug SH3001 |
| | 67020001 | RCA Pin plug CN7017P |
| | 67000005 | Antenna plug MP-5 |
| | 96000025 | Antenna wire A #250003 |
| | 96000026 | Antenna wire B #250004 |
| | 73000013 | Fuse (F1) 1A (100V~117V) |
| | 73000012 | 0.5A (200V~234V) |
| | 73000003 | Fuse (F2) 3A |

| | | |
|---|---|---|
| | | **POTENTIOMETER** |
| VR901 | 49800083 | PH822H501 500ΩB |
| | | |
| | | **CAPACITOR** |
| C901, 902, 904, 912, 913, 942 | 30820103 | Ceramic disc 50WV 0.01μF |
| C908, 910 | 30820473 | " " " 0.047μF |
| C944 | 33824300 | Dipped mica " 30PF |
| C907 | 33824151 | " " " 150PF |
| C903, 905 | 36133104 | Mylar 100WV 0.1μF (B32560-A11045) |
| | | |
| C906 | 36824102 | Styrol 50WV 1000PF |
| C909, 911 | 36326685 | Tantalum 20WV 6.8μF |
| C914~941 | 32821102 | Feed thru 50WV 0.001μF |
| C943 | 34220107 | Electrolytic 16WV TW 100μF |
| | | |
| | | **TRANSFORMER** |
| T901 | 55003084 | 7MC-312162NO #220188 |
| | | |
| | | **INDUCTOR** |
| L901, 902 | 55003069 | #220012 |
| | | |
| | | **MINI CONNECTOR** |
| P901 | 67110004 | **5048-11A** |
| J904 with wire | 68150007 | 5047-15 #240061 |
| J905 with wire | 68150008 | 5047-15 #240062 |

# CONVERSION CHART IN HOURS

| Time. Los Angeles. Seattle. Juneau. | Mountain Standard Time. Calgary, Denver, Phoenix. | Central Standard Time. Chicago, Costa Rica. | Eastern Standard Time. Montreal, New York. Peru. | Atlantic Standard Time. Argentina. Nova Scotia. | Greenland. Rio de Janeiro. Brazil. | Azores | Iceland. Canary Islands. | GMT | Central Europe. Berlin, Geneva, Stockholm. Vienna. | Eastern Europe. Athens. Cape Town. Cairo. Moscow | Arabia. Armenia. Ethiopia. Madagascar. | Mauritius. Iran. Reunion Island. | Central Russia. Bombay, India. | Calcutta, Novosibirsk Russia, Tibet. | Sumatra. Thailand, Laos. | Philippines. Perth. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | 0000 | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM |
| 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night | 0100 | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM |
| 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM | 0200 | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM |
| 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM | 0300 | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM |
| 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM | 3AM | 0400 | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | Noon |
| 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM | 3AM | 4AM | 0500 | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | Noon | 1PM |
| 0PM | 11PM | Mid Night | 1AM | 2AM | 3AM | 4AM | 5AM | 0600 | 7AM | 8AM | 9AM | 10AM | 11AM | Noon | 1PM | 2PM |
| 1PM | Mid Night | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 0700 | 8AM | 9AM | 10AM | 11AM | Noon | 1PM | 2PM | 3PM |
| Mid light | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 0800 | 9AM | 10AM | 11AM | Noon | 1PM | 2PM | 3PM | 4PM |
| 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 0900 | 10AM | 11AM | Noon | 1PM | 2PM | 3PM | 4PM | 5PM |
| 2AM | 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 1000 | 11AM | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM |
| 3AM | 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 1100 | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM |
| 4AM | 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | 1200 | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM |
| 5AM | 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | Noon | 1300 | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM |
| 6AM | 7AM | 8AM | 9AM | 10AM | 11AM | Noon | 1PM | 1400 | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM |
| 7AM | 8AM | 9AM | 10AM | 11AM | Noon | 1PM | 2PM | 1500 | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM |
| 8AM | 9AM | 10AM | 11AM | Noon | 1PM | 2PM | 3PM | 1600 | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night |
| 9AM | 10AM | 11AM | Noon | 1PM | 2PM | 3PM | 4PM | 1700 | 6PM | 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM |
| 0AM | 11AM | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 1800 | 7PM | 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM |
| 1AM | Noon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 1900 | 8PM | 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM | 3AM |
| oon | 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 2000 | 9PM | 10PM | 11PM | Mid Night | 1AM | 2AM | 3AM | 4AM |
| 1PM | 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 2100 | 10PM | 11PM | Mid Night | 1AM | 2AM | 3AM | 4AM | 5AM |
| 2PM | 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 2200 | 11PM | Mid Night | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM |
| 3PM | 4PM | 5PM | 6PM | 7PM | 8PM | 9PM | 10PM | 2300 | Mid Night | 1AM | 2AM | 3AM | 4AM | 5AM | 6AM | 7AM |


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