# PLL FREQUENCY SYNTHESIZER AND CONTROLLER
## FOR FM/MW/LW TUNER

The μPD1708AG-011/μPD1708AG-211, a CMOS LSI chip developed for Europe, USA and Oceania, incorporating PLL frequency synthesizer, controller, prescaler and LCD driver.

It is a 52 pin Plastic flat package and it has selection function for manual tuning by push button or rotary switch μPD1708AG-011/μPD1708AG-211 can be constructed corporating many function and high performance FM/MW/LW digital tuning system.

## FEATURES

- FM/MW/LW stations in Europe, USA and Australia can be selected.
- LCD driver (5 V ±10 % drive, 1/2 duty, 1/2 bias frame frequency: 100 Hz)
- Built-in prescaler (150 MHz)
- Rotary switch and push button can be selected for manual tuning.
- Preset memory display with 7 segment digits
- Preset station memories for 18 stations (FM, 6: MW, 6; LW, 6)
- Last station memories for each FM/MW/LW station (total three stations).
- IF of AM is 450 kHz for USA and Oceania; 459 kHz for Europe.
- Built-in clock (24 hour system for Europe, 12 hour system for USA and Oceania).
- Single power supply 5 V ±10 %
- 52 pin plastic flat package
- Selectable lead type
     Lead bent type   :  μPD1708AG-011-00
     Straight lead type:  μPD1708AG-211-03

## FUNCTIONS
**Receiving frequencies, channel spacing, reference frequencies, and intermediate frequencies**

| AREA | BAND | FREQUENCY RANGE | CHANNEL SPACING | REFERENCE FREQUENCY | INTERMEDIATE FREQUENCY |
|---|---|---|---|---|---|
| Europe | FM | 87.5 to 108.0 MHz | 50 kHz | 12.5 kHz | 10.650, 10.675, 10.700, 10.725 MHz |
| | MW | 522 to 1 620 kHz | 9 kHz | 9 kHz | 459 kHz |
| | LW | 146 to 290 kHz | Auto 9 kHz | 1 kHz | 459 kHz |
| | | | Manual 1 kHz | | |
| USA | FM | 87.5 to 107.9 MHz | 200 kHz | 12.5 kHz | 10.650, 10.675, 10.700, 10.725 MHz |
| | MW | 530 to 1 620 kHz | 10 kHz | 10 kHz | 450 kHz |
| Oceania | FM | 87.5 to 108.0 MHz | 100 kHz | 12.5 kHz | 10.650, 10.675, 10.700, 10.725 MHz |
| | MW | 522 to 1 620 kHz | 9 kHz | 9 kHz | 450 kHz |

### Radio Functions

(1) Auto up/down tuning (sawtooth wave mode)

Scan up
Scan down } ...................... Reception every 8 seconds

Seek up
Seek down } ...................... Received station is held

The | MANUAL UP | or | MANUAL DOWN | key is used to select the up or down direction of scanning or seek.

(2) Manual up/down tuning (sawtooth wave mode)

| MANUAL UP |
| MANUAL DOWN | } ...................... The momentary switch is used for step by step tuning. If this switch is pressed for 0.5 second or longer, high-speed tuning continues until the switch is released. On the other hand, the rotary switch can be used for tuning based on the pulse count modulation method.

(3) Preset station memory call ..... Six stations can be preset with six buttons for each band
Six stations can be preset with one button for each band

(4) Last sation memory ........... each FM, MW, LW band

(5) Band selection

USA and Oceania .............. ┌→ FM → MW ─┐

Europe ............................ ┌→ FM → MW → LW ─┐

## Display Functions

(1) Dinamic display by incorporating LCD driver

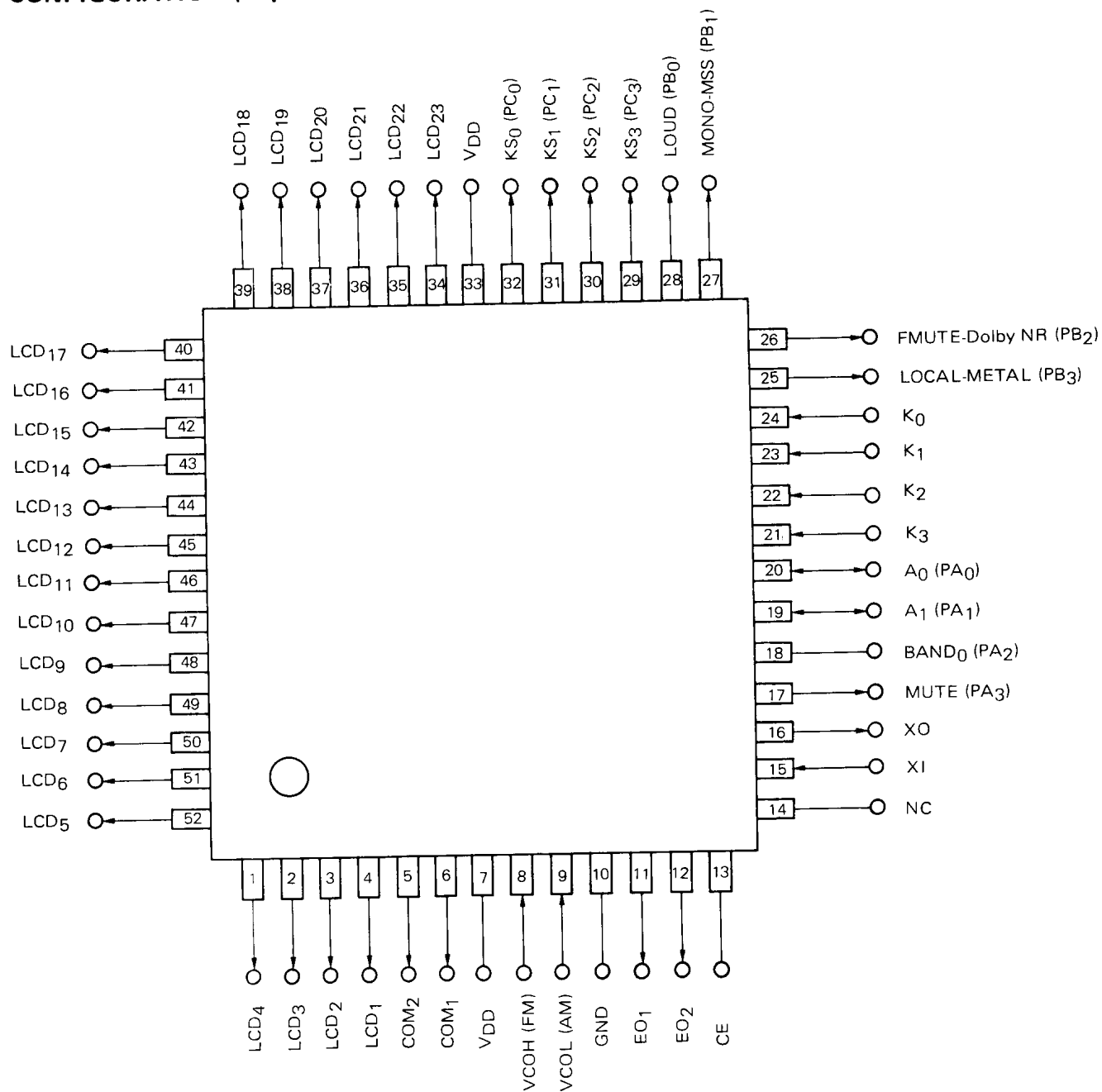(2) Preset memory display with 7 segment digits

## Clock Functions

(1) Display

USA and Oceania ..........12 hour system (display of AM/PM)

Europe ........................... 24 hour system

(2) Independent adjustment of minute and second (by pressing the ME and MU/MD keys simultaneously)

## Tape Recorder Functions

(1) METAL control output

(2) Dolby NR* control output

(3) MSS control output

(4) LOUDNESS control output

* Dolby® and the double-D symbol are registered trademarks of Dolby Laboratories Licensing Corporation.

## PIN CONFIGURATION (Top View)

Top pins (left to right): 39 LCD18, 38 LCD19, 37 LCD20, 36 LCD21, 35 LCD22, 34 LCD23, 33 VDD, 32 KS0 (PC0), 31 KS1 (PC1), 30 KS2 (PC2), 29 KS3 (PC3), 28 LOUD (PB0), 27 MONO-MSS (PB1)

Left pins (top to bottom):
- 40 LCD17
- 41 LCD16
- 42 LCD15
- 43 LCD14
- 44 LCD13
- 45 LCD12
- 46 LCD11
- 47 LCD10
- 48 LCD9
- 49 LCD8
- 50 LCD7
- 51 LCD6
- 52 LCD5

Right pins (top to bottom):
- 26 FMUTE-Dolby NR (PB2)
- 25 LOCAL-METAL (PB3)
- 24 K0
- 23 K1
- 22 K2
- 21 K3
- 20 A0 (PA0)
- 19 A1 (PA1)
- 18 BAND0 (PA2)
- 17 MUTE (PA3)
- 16 XO
- 15 XI
- 14 NC

Bottom pins (left to right): 1 LCD4, 2 LCD3, 3 LCD2, 4 LCD1, 5 COM2, 6 COM1, 7 VDD, 8 VCOH (FM), 9 VCOL (AM), 10 GND, 11 EO1, 12 EO2, 13 CE

NC   (No Connection)

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## PIN DESCRIPTION

| PIN NO. | PIN SYMBOL | PIN NAME | DESCRIPTION |
|---|---|---|---|
| 1 to 4<br>34 to 52 | $LCD_4$ to $LCD_1$<br>$LCD_{23}$ to $LCD_5$ | LCD segment<br>signal out | LCD segment signal output pins. (1/2 duty, 1/2 bias) |
| 5<br>6 | $COM_1$<br>$COM_2$ | LCD common<br>signal out | LCD common signal output pins. |
| 7<br>33 | $V_{DD}$ | Power input | Device power pin. 5 V ±10 % is supplied during PLL operation and 3.5 − 5.5 V is supplied during operation of a clock only. Voltage may be supplied to either pin 7 or pin 33. |
| 8 | VCOH(FM) | VCO input for<br>FM | Pin to input FM station output.<br>Cut DC with a capacitor because an AC amplifier is built in. |
| 9 | VCOL(AM) | VCO input for<br>MW/LW | Pin to input MW/LW station output.<br>Cut DC with a capacitor because an AC amplifier is built in. |
| 10 | GND | Ground | Connect to system ground. |
| 11<br>12 | $EO_1$<br>$EO_2$ | Error output | Pins to output a charge pump of the phase detector constituting PLL. If the divided oscillation frequency is higher than the reference frequency, high level signals are output from these pins; otherwise, low level signals are output. If they are the same, floating occurs.<br>Since the same signals are output to $EO_1$ and $EO_2$, they may be connected to any LPF (low pass filter) of FM, MW, and LW. |
| 13 | CE | Chip enable | Device selection signal input pin.<br>High level . . . Normal operation<br>Low level . . . No display, PLL operation stop, operation of clock only, memory<br>                holding<br>All data can be displayed by setting the CE pin to low level and port A0 to high level for checking. |
| 14 | NC | No connection | This terminal is not connected with anything. |
| 15<br>16 | XI<br>XO | Crystal oscillator | Crystal oscillator connection pins. A 4.5 MHz crystal oscillator is connected. |
| 17 | MUTE | Mute output | Pin to output the muting signal for eliminating the shock noise emitted when PLL lock is unlocked and the pop sound emitted during TAPE/RADIO selection (active high).<br>(See the MUTE output timing chart for details.) |
| 18 | BAND0 | FM/MW selection | Output pin for FM/MW selection.<br>A high level signal is output when FM is selected; a low level signal is output when MW is selected. |
| 19<br>20 | $A_0$<br>$A_1$ | Port $A_0$<br>Port $A_1$ | Output signal pins used to receive the diode initial set matrix only when the device is reset first. After this, these pins are used to input key matrix key return signals. |
| 21 to 24 | $K_3$ to $K_0$ | Key return<br>signal input | Key matrix key return signal input pins. |
| 25 | LOCAL-METAL | LO/DX and<br>METAL output<br>pin | LO/DX output pin in the RADIO mode (active high).<br>METAL output pin in the TAPE mode (active high). |

| PIN NO. | PIN SYMBOL | PIN NAME | DESCRIPTION |
|---|---|---|---|
| 26 | FMUTE-<br>Dolby NR | FM MUTE and<br>Dolby NR output<br>& BAND1 | FM MUTE output pin in the RADIO mode (active low).<br>Dolby NR output pin in the TAPE mode (active low).<br>For use in Europe, this pin is used as an LW band output pin. |
| 27 | MONO-MSS | MONO/STEREO<br>and MSS output | MONO/STEREO output pin in the RADIO mode (active high).<br>MSS output pin in the TAPE mode (active high). |
| 28 | LOUD | LOUD output pin | LOUDNESS output pin (active high).<br>This pin operates in both the RADIO and TAPE modes. |
| 29 to 32 | $KS_3$ to $KS_0$ | Key source | Key matrix signal source output pin. |

For pin 26, the BAND/PIN description table:

| BAND \ PIN | FM | MW | LW |
|---|---|---|---|
| BAND0 | 1 | 0 | 0 |
| BAND1 | 0 | 0 | 1 |

1: High level
0: Low level

# CONTENTS

# 1. KEY MATRIX

## 1.1 CONFIGURATION OF KEY MATRIX

|  | $K_0(24)$ | $K_1(23)$ | $K_2(22)$ | $K_3(21)$ | $A_0(20)$ | $A_1(19)$ |
|---|---|---|---|---|---|---|
| $KS_0(32)$ | LOUD | MONO-MSS | LOCAL-METAL | FMUTE-Dolby NR | RECALL | MEMORY ENABLE |
| $KS_1(31)$ | M2 | M3 | M4 | M5 | M6 | BAND |
| $KS_2(30)$ | SD | M1 | SCAN | SEEK | MANUAL DOWN | MANUAL UP |
| $KS_3(29)$ | POWER | RADIO | STEREO | ROTARY |  |  |
| $A_0(20)$ | KEY1 | KEY2 | KEY3 | TAPE RUN |  |  |
| $A_1(19)$ | AREA1 | AREA2 | IF1 | IF2 |  |  |



Momentary switch



Alternate or transistor switch



Diode matrix (diode short circuit or open)

## 1.2 SWITCH CONNECTION
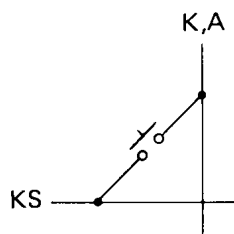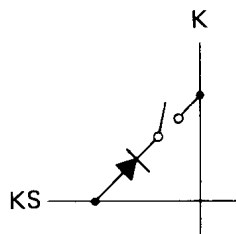


Momentary switch    Alternate switch    Diode matrix    Transistor switch
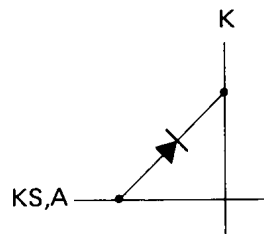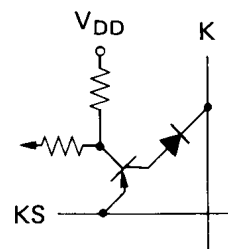
## 1.3 KEY MATRIX CONNECTION



⊕ Momentary switch

□ Alternate switch or transistor switch

△ Diode matrix

KS$_0$  KS$_1$  KS$_2$  KS$_3$

K$_0$  24
K$_1$  23
K$_2$  22
K$_3$  21
A$_0$  20
A$_1$  19

33 kΩ ×6
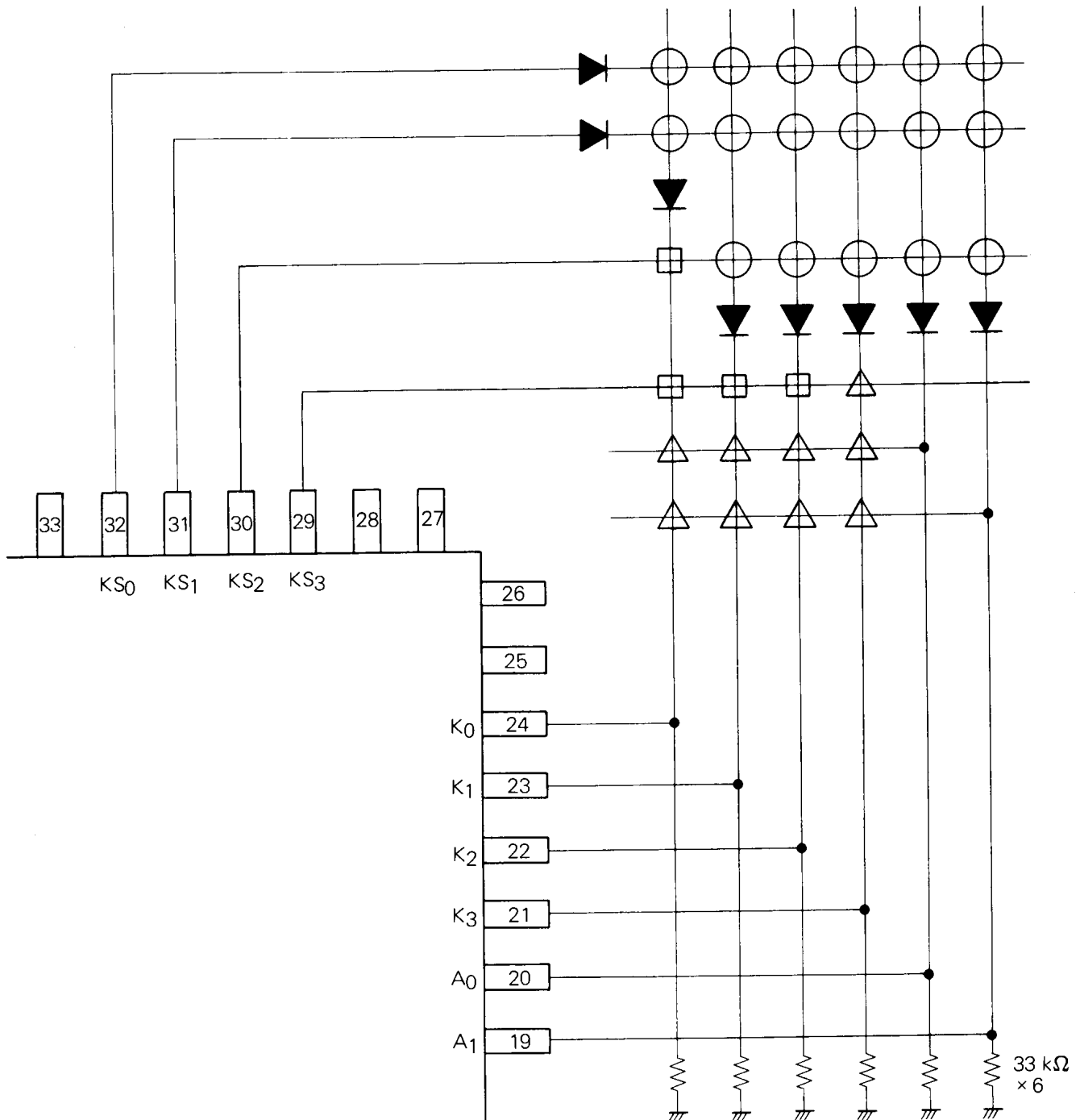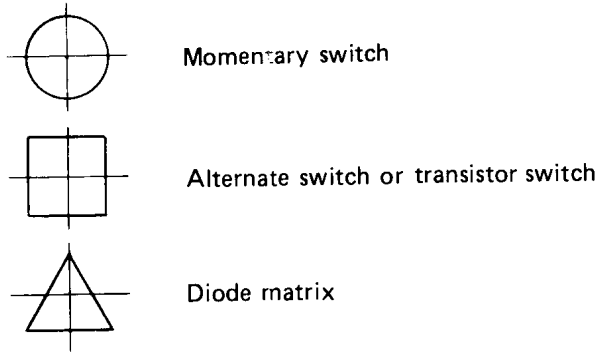
## 1.4 DESCRIPTION OF KEY MATRIX

### 1.4.1 INITIALIZATION DIODE MATRIX

There are six types of initial set diode matrixes. These are read only when the power is first supplied to $V_{DD}$ (Power ON Reset) and the CE pin level changes from low to high (CE Reset). In other cases, the states of diode matrixes are ignored.

(1)   Area (USA, Oceania, Europe) setting switches
       AREA1, AREA2

(2)   FM IF offset value setting switches
       IF1, IF2

(3)   Control key selector switches
       KEY1, KEY2

(4)   Preset key use method (random or sequential access method) selector switch
       ACCESS

(5)   Switch for selecting normal or reverse indication in TAPE mode
       TAPE
       RUN

(6)   Switch for selecting rotary switch for manual tuning
       ROTARY
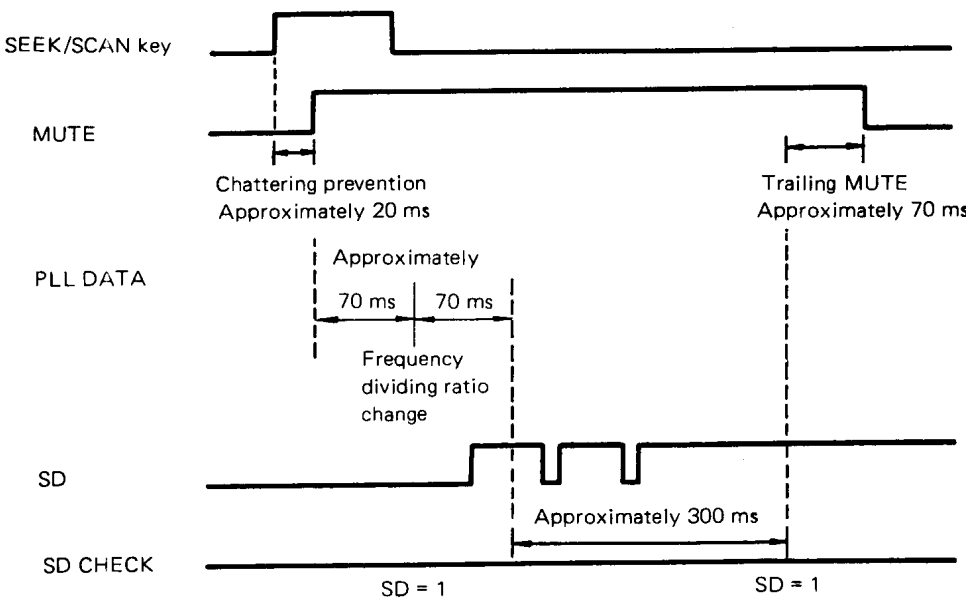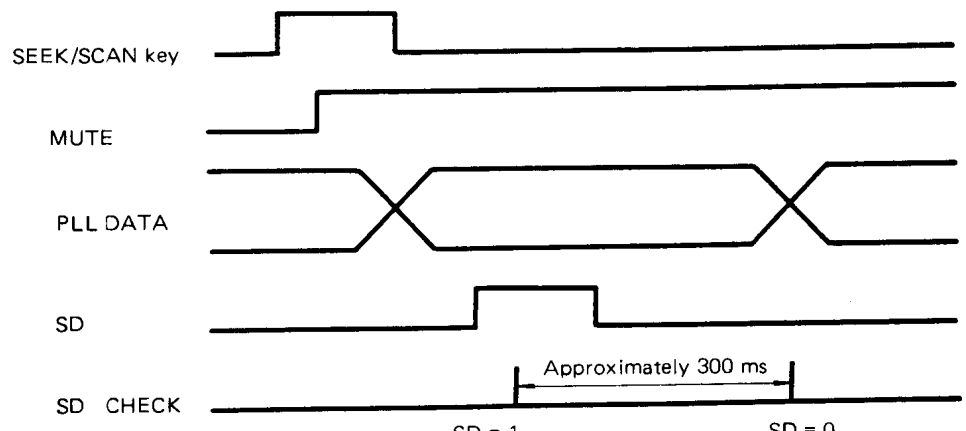
For these settings, connect (1) or open (0) the intersections on matrixes with diodes.

| SYMBOL | DESCRIPTION |
|---|---|
| AREA1<br><br>AREA2 | Select an area.<br><br>| AREA1 | AREA2 | AREA |<br>|---|---|---|<br>| 0 | 0 | USA |<br>| 0 | 1 | Oceania |<br>| 1 | 0 | Europe |<br>| 1 | 1 | ———— * |<br><br>* This setting is inhibited. |
| IF1<br><br>IF2 | Sets an FM IF offset value.<br>Four intermediate frequencies can be set without changing the displayed frequency.<br><br>| IF1 | IF2 | INTERMEDIATE FREQUENCY |<br>|---|---|---|<br>| 0 | 0 | 10.700 MHz |<br>| 0 | 1 | 10.725 |<br>| 1 | 0 | 10.675 |<br>| 1 | 1 | 10.650 | |
| KEY1<br><br>KEY2 | Selects control keys with momentary switches.<br><br>| KEY1 | KEY2 | LOCAL | FMUTE | MONO | METAL | DolbyNR | MSS |<br>|---|---|---|---|---|---|---|---|<br>| 0 | 0 | O | X | X | X | O | O |<br>| 0 | 1 | O | O | O | O | X | X |<br>| 1 | 0 | O | O | X | O | O | O |<br>| 1 | 1 | O | O | O | O | O | O |<br><br>O ... Effective<br>X ... Not effective |
| ACCESS | Determines whether the preset keys are to be used in the random or sequential access mode.<br>0 ...   Keys M1 to M6 are used in the random access mode.<br>1 ...   Key M1 is used in the sequential access mode. |
| TAPE<br>RUN | Selects normal or reverse indication in the TAPE mode.<br>0 ...   Display<br>1 ...   No display |
| ROTARY | Determines whether the rotary switches are to be used for MU and MD in the manual tuning mode.<br>0 ...   Push buttons are used.<br>1 ...   A rotary switch is used.  The time for preventing Manual Up/Manual Down chattering is reduced and response to high speed pulses is enabled. |

## 1.4.2 ALTERNATE SWITCHES

Unlike initial set switches, these switches can be operated at any time.

| SYMBOL | DESCRIPTION |
|---|---|
| POWER | Set to 1 when the main switch is set to ON and $V_{DD}$, CE pins are set to high level.<br><br>0 . . . Time is displayed unconditionally.<br><br>1 . . . Ordinary radio or tape recorder operation is performed.<br><br>Attention to condition of RADIO switch. |
| RADIO | Effective only when the POWER switch is ON and selects either the RADIO or TAPE mode.<br><br>POWER / RADIO table:<br><br>POWER 0, RADIO 0 — Clock display<br>POWER 0, RADIO 1 — Inhibition<br>POWER 1, RADIO 0 — TAPE mode *<br>POWER 1, RADIO 1 — RADIO mode<br><br>($V_{DD}$, CE = High)<br><br>TAPE mode<br>Time is displayed.<br>Keys related to tape recorder and time adjustment are effective.<br>* PLL is operated in TAPE mode when selected Europe station.<br>RADIO mode<br>Display is made according to priority. The display can be reversed for 8 seconds with the RECALL key. |
| STEREO | Used as the input to the stereo indicator in the RADIO mode and input for normal/reverse display in the TAPE mode.<br><br>STEREO 0, RADIO 1 — Stereo display OFF; STEREO 0, RADIO 0 — Normal display ON<br>STEREO 1, RADIO 1 — Stereo display ON; STEREO 1, RADIO 0 — Reverse display ON |

The embedded RADIO table:

| POWER | RADIO | |
|---|---|---|
| 0 | 0 | Clock display |
| 0 | 1 | Inhibition |
| 1 | 0 | TAPE mode * |
| 1 | 1 | RADIO mode |

($V_{DD}$, CE = High)

The embedded STEREO table:

| STEREO | RADIO | |
|---|---|---|
| | 1 | 0 |
| 0 | Stereo display OFF | Normal display ON |
| 1 | Stereo display ON | Reverse display ON |

| SYMBOL | FUNCTION |
|---|---|
| SD | Input to the station detector during seek or scanning.<br>For the FM band in Europe, this switch must be set to 1 within approximately 35 ms after PLL is locked. For other areas, it must be set to 1 within approximately 70 ms.<br>When SD is set to 1, seek or scanning stops; if it is not set to 1 approximately 300 ms later, seek or scanning restarts.<br><br>○ Station is found<br><br>SEEK/SCAN key<br><br>MUTE<br>├─┤ Chattering prevention Approximately 20 ms     ├─┤ Trailing MUTE Approximately 70 ms<br><br>PLL DATA<br>Approximately 70 ms │ 70 ms<br>Frequency dividing ratio change<br><br>SD<br>Approximately 300 ms<br><br>SD CHECK<br>SD = 1      SD = 1<br><br>○ Station not found (noise)<br><br>SEEK/SCAN key<br><br>MUTE<br><br>PLL DATA<br><br>SD<br>Approximately 300 ms<br><br>SD CHECK<br>SD = 1      SD = 0 |

## 1.4.3 MOMENTARY SWITCHES AND FUNCTIONS

There are 17 momentary switches

| SYMBOL | FUNCTION |
|---|---|
| MANUAL UP<br><br>MANUAL DOWN | Keys for manual tuning.<br>A momentary or rotary pulse generation switch can be used.<br>When ROTARY key is set to OFF, a momentary switch can be used. When ROTARY key is set to ON, a rotary switch can be used.<br>○ Momentary switch<br>When this switch is pressed once, frequency goes up (Manual Up) or down (Manual Down) by one step. If this switch is pressed for 0.5 second or longer, the frequency changes quickly until the switch is released. The clock can be adjusted by pressing this switch while pressing the MEMORY ENABLE switch.<br><br>MEMORY ENABLE  MANUAL UP  . . . . .  Minute adjustment<br><br>MEMORY ENABLE  MANUAL DOWN  . . . . .  Hour adjustment<br><br>○ Rotary switch<br>Every time this switch is set to ON, frequency goes up (MU) or down (MD) by one step. Quick tuning is not performed if this switch is pressed for 0.5 second or longer.<br>Note: In case of selecting rotary switch, MUTE is not output in operating UP/DOWN. |
| MEMORY ENABLE | This key is used when frequencies are written in memories, the clock is adjusted together with a MANUAL UP or MANUAL DOWN key, or the prior mode is switched together with the RECAL key.<br>○ For frequency display<br>When this key is released, the channel display blinks for 8 seconds at 0.5 second intervals. If a key, M1 to M6, is pressed during blinking, the displayed frequency is written into the corresponding memory, then blinking stops.<br>If no key is pressed within 8 seconds, the channel display continues to blink; blinking stops 8 seconds later and write is inhibited.<br>○ For clock display<br>Hour and minute can be adjusted by pressing the MU and MD keys while the channel display is blinking. When ROT is set to OFF, quick adjustment is enabled by pressing this switch for 0.5 second or longer.<br>In the RADIO mode, the channel display stops blinking when this key is pressed together with the RECALL key; the prior mode is reversed. |

| SYMBOL | FUNCTION |
|---|---|
| SEEK | Automatic tun ng keys.(Sawtooth wave mode)<br>Automatic tuning stops when the SD matrix is set on. A direction of UP/DOWN is followed by pushed MANUAL UP or MANUAL DOWN before. Automatic tuning does not stop if the following keys are pressed:<br><br>MEMORY ENABLE   RECALL   LOUD<br><br>MONO-MSS   LOCAL-METAL   FMUTE DolbyNR<br>See the explanation of the SD matrix for details. |
| SCAN | Automatic tuning stops when the SD matrix is set on and the frequency is held for approximately 8 seconds. If the SCAN key is not pressed within 8 seconds, automatic tuning restarts. If SCAN key is pressed again in searching, automatic tuning stops and the frequency is held. Other operations are the same as those of the SEEK key. |
| RECAL | In the RADIO mode, the clock and frequency displays are reversed. The display not in the prior mode is displayed for 8 seconds, then the prior mode is reset. When this key is pressed together with the MEMORY ENABLE key, the prior mode can be reversed. |
| M1 to M6 | Keys for calling or writing preset memories.<br>Keys M1 to M6 are used in the random access mode. Only key M1 is used in the sequential access mode.<br>When SM is set to OFF, a random access mode is selected. When it is set to ON, a sequential access mode is selected. When power is first supplied to $V_{DD}$ the contents of M1 of FM are accessed.<br>○ Random access mode<br>Keys M1 to M6 are used. Each key corresponds to independent memories for FM, MW, and LW. When a key is pressed, the frequency memorized in the corresponding memory is called. If one of keys M1 to M6 is pressed within 8 seconds (the channel indication is blinking) after the MEMORY ENABLE key is pressed during frequency display, the displayed frequency is written in the corresponding memory.<br>○ Sequential access mode<br>Only key M1 is used. There are six memories for each band (FM, MW, and LW). When key M1 is pressed, the station following the number displayed last at the preset station display position is called.<br>If the MEMORY ENABLE key is pressed during frequency display, the channel display starts blinking; select a station with a MANUAL UP, MANUAL DOWN, SEEK UP, or SEEK DOWN key. When key M1 is released, the number at the preset station display position is incremented by 1 (number 6 is followed by number 1, sawtooth mode). Accordingly, the dispalyed frequency is assigned to the displayed preset station number. |
| BAND | Band selector key.<br>The next band is selected every time this key is pressed.     Europe:⌐FM → MW → LW⌐<br>Others: ⌐FM → MW⌐<br><br>When a new band is selected, output pins BAND0 and FMUTE-Dolby NR & BAND1 and displays of FM, MW, and FMUTE-LW are reversed. (See the explanation of FMUTE-Dolby NR & BAND1 for details on output pins. |

| SYMBOL | FUNCTION |
|---|---|
| LOUD | LOUDNESS selector key<br>When this key s pressed, output pin LOUD and the LOUD display are reversed.<br>This key can be used as a general purpose key for both the RADIO and TAPE modes. When power is first supplied to $V_{DD}$ output pin LOUD is set to low level and the LOUD display is initialized to the off state. |
| MONO-MSS | The RADIO and TAPE modes are independent. This key can be inactivated with alternate switches KEY1 and KEY2.<br>○ RADIO mode<br>This key is used as a MONO/STEREO selector key only when FM is selected. Output pin MONO/STEREO-MSS and the MSS display are reversed every time this key is pressed.<br>○ TAPE mode<br>This key is used as an MSS selector key.<br>Output pin MONO/STEREO-MSS and the MSS display are reversed every time this key is pressed.<br>In both the RADIO and TAPE modes, output pin MONO/STEREO-MSS is set to low level and each mode display is set in the initial state (OFF) when power is first supplied to $V_{DD}$. |
| LOCAL-METAL | The RADIO and TAPE modes are independent. Only the METAL position can be deactivated with alternate switches KEY1 and KEY2.<br>○ RADIO mode<br>This key is used as an LO/DX selector key.<br>Output pin LO/DX-METAL and the LOCAL display are reversed every time this key is pressed.<br>○ TAPE mode<br>This key is used as a METAL selector key.<br>Output pin LO/DX-METAL and the METAL display are reversed every time this key is pressed.<br>In both the RADIO AND TAPE modes, output pin LO/DX-METAL is set to low level and each mode display is set to the initial state (OFF). |
| FMUTE-Dolby NR | The RADIO and TAPE modes operate independently. When European bands are selected, this key is not effective. This key can be deactivated with alternate switches KEY1 and KEY2.<br>○ RADIO mode<br>This key is used as an FM MUTE key which is effective only in the FM mode.<br>Output pin FMUTE-Dolby NR and the MUTE display are reversed every time this key is pressed.<br>Output pin FMUTE-Dolby NR is set to low level and the MUTE display is set to the initial state (OFF) when power is first supplied to $V_{DD}$.<br>○ TAPE mode<br>This key is used as a Dolby NR selector key.<br>Output pin FMUTE-Dolby NR and the Dolby NR display are reversed every time this key is pressed.<br>OUtput pin FMUTE-Dolby NR is set to high level and the Dolby NR display is set to the initial state (OFF) when power is first supplied to $V_{DD}$. |

**Key Scan Timing Chart**
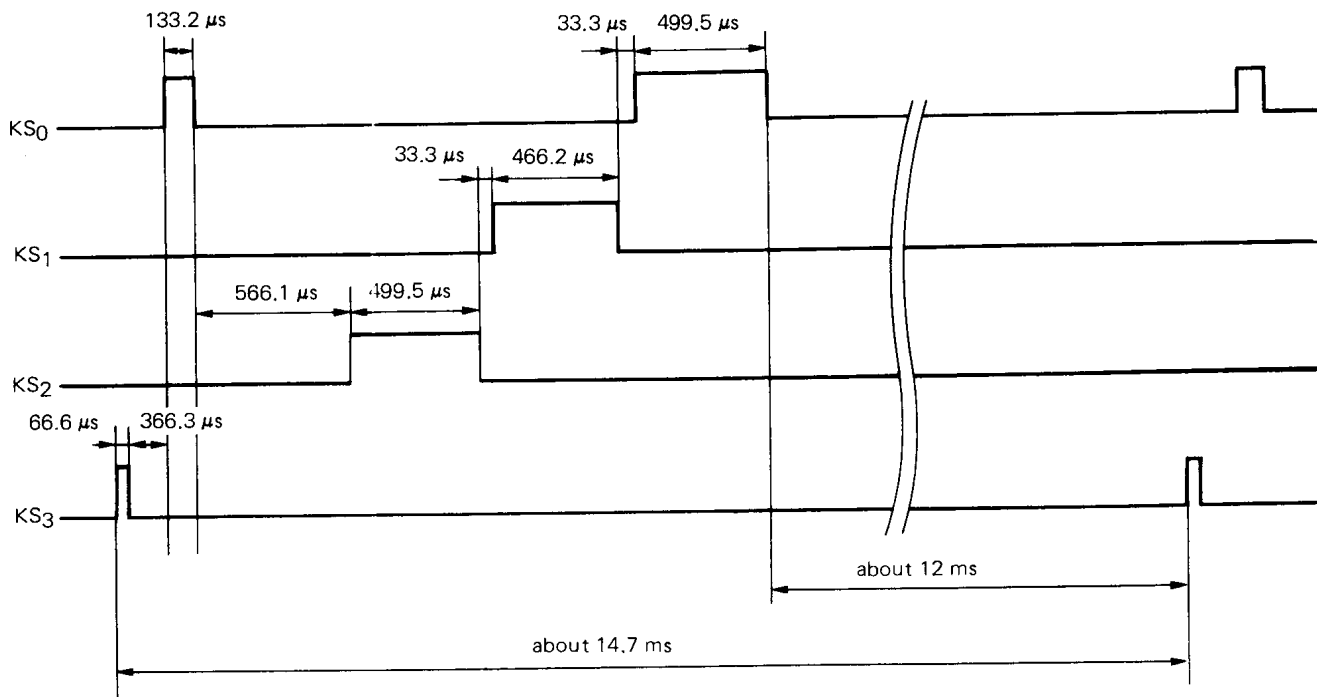


**Preset Memory Initial Setting**

(1) When power is first supplied, preset memories M1 to M6 are set as follows:

| BAND | Area | M1 | M2 | M3 | M4 | M5 | M6 | Unit |
|---|---|---|---|---|---|---|---|---|
| FM | Europe | 87.5 | 98.1 | 108.0 | 93.1 | 95.7 | 107.7 | MHz |
| | USA | 87.5 | 98.1 | 107.9 | 93.1 | 95.7 | 107.7 | |
| | Oceania | 87.5 | 98.1 | 108.0 | 93.1 | 95.7 | 107.7 | |
| MW | Europe | 522 | 612 | 999 | 1404 | 1620 | 810 | KHz |
| | USA | 530 | 610 | 1000 | 1400 | 1620 | 810 | |
| | Oceania | 522 | 612 | 999 | 1404 | 1620 | 810 | |
| LW | Europe | 146 | 155 | 200 | 218 | 290 | 254 | |

(2) In case of RADIO mode, receiving band is FM band, and called a minimum frequency in FM band.

(3) The clock is one a.m.

When CE terminal is set to high and $V_{DD}$ is not OFF, preset memories are as follows:
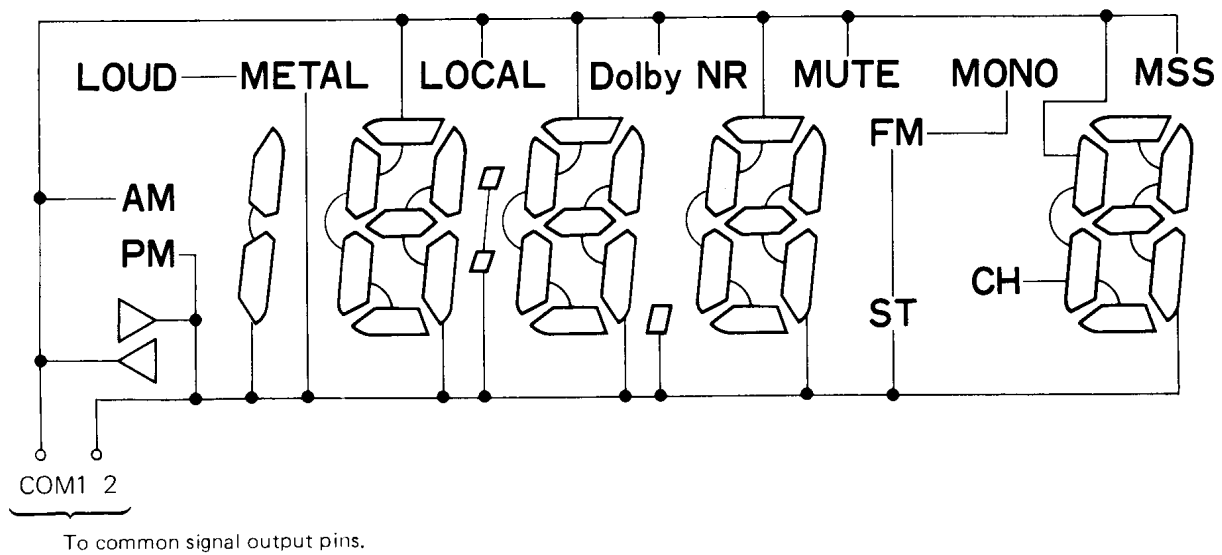
(1) Data of preset station memories M1 to M6 and last station memories are what is written before CE terminal is set from high to low.

(2) In case of RADIO mode, condition of memory is what is before CE terminal is set to low from high.

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## 2. DISPLAY

### 2.1 DISPLAY CONNECTION

○ **LCD Pattern for USA and Oceania**



To LCD segment signal output pins.



To common signal output pins.

To LCD segment signal output pins.

To common signal output pins.

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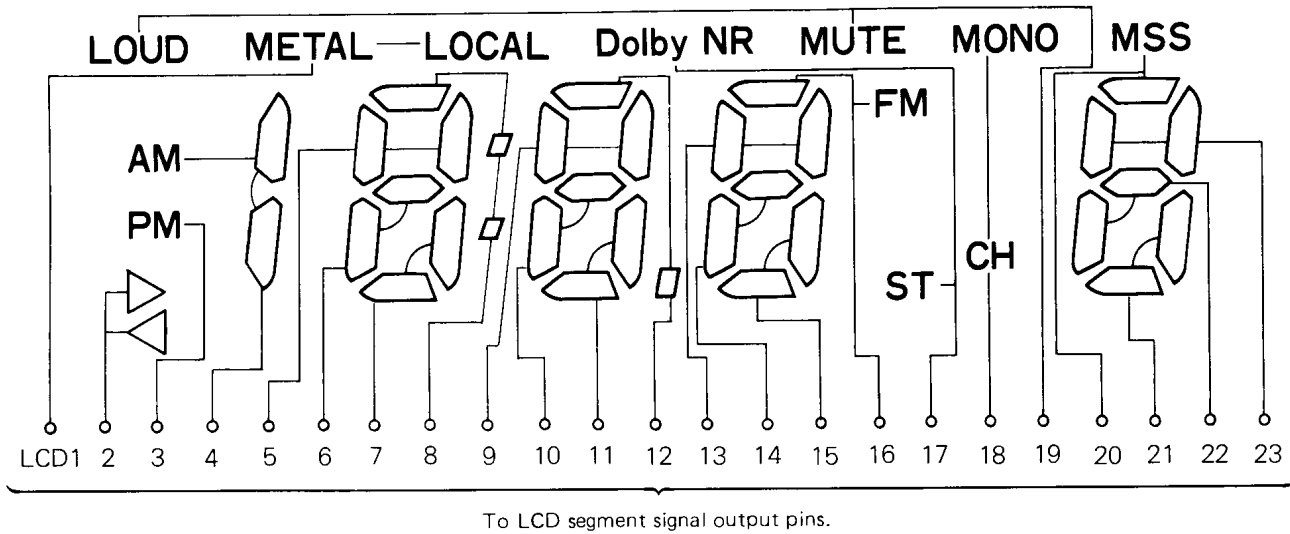
## 2.2 DISPLAY TYPE

$$1234567890$$
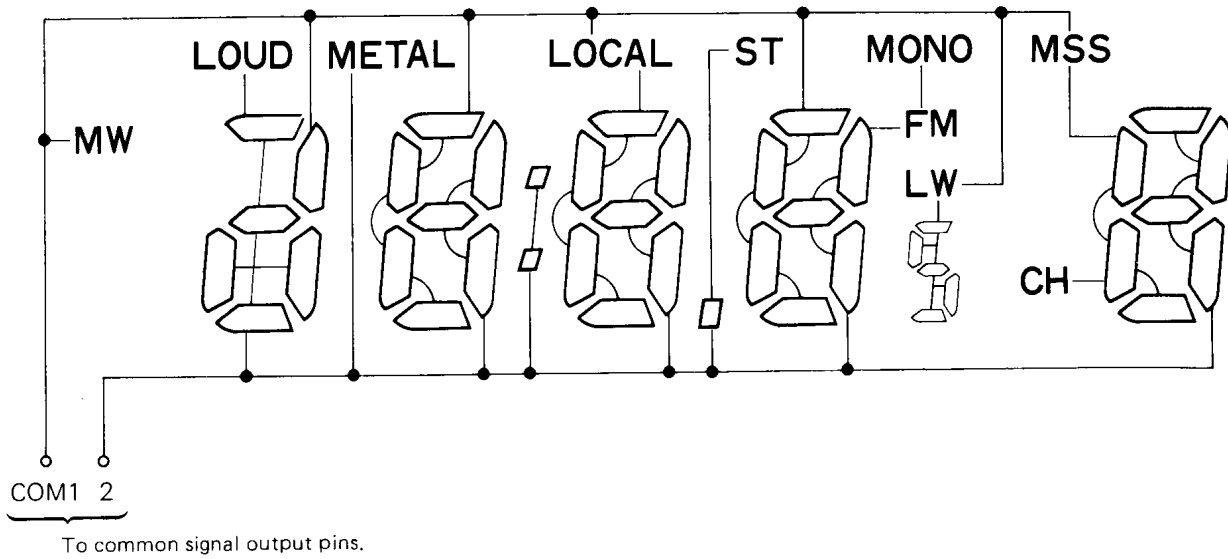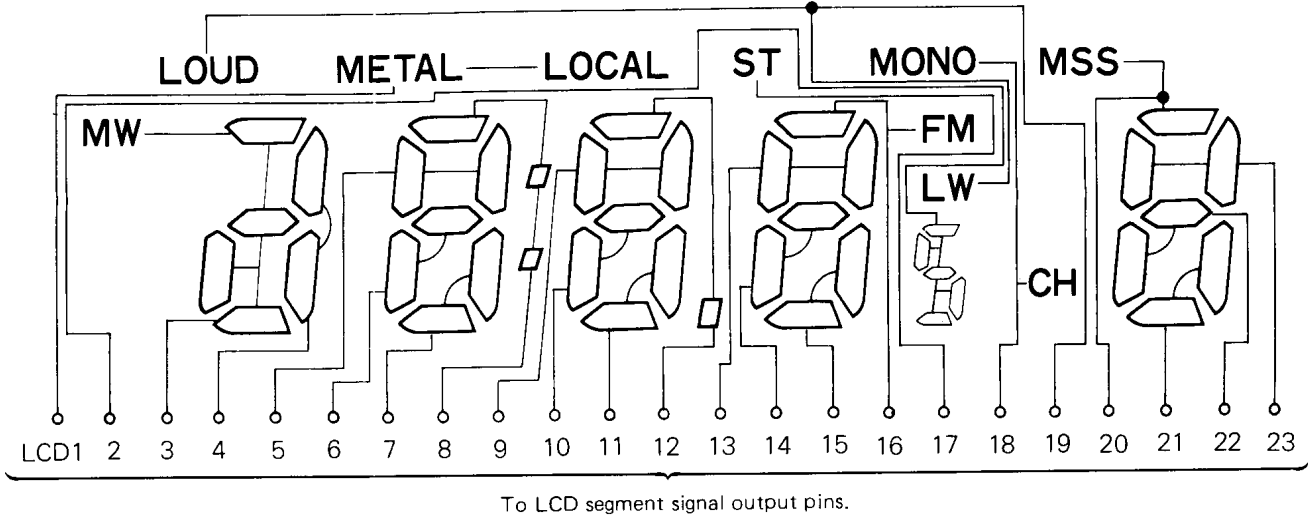
## 2.3 DESCRIPTION OF DISPLAY

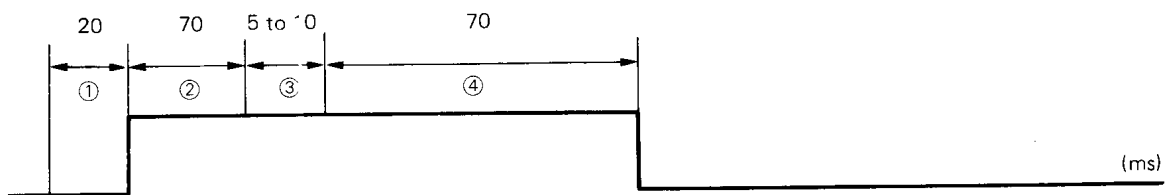| DISPLAY | EXPLANATION |
|---|---|
| FM  FM<br>AM  MW<br>LW | Band display.  The display which corresponds to the currently received band lights up only in the frequency display mode. |
| AM<br>PM | A.M./P.M. indication for 12 hour clock.<br>This display is in USA and Oceania, but in Europe is 24-hour clock. |
| MONO | MONO/STEREO display when receiving FM band.<br>This display lights up only in the FM band frequency display mode. |
| CH | Lights up during preset memory display.  It remains lighted when the preset memory is read or written, and when receiving frequency corresponds with the frequency.  Also, it blinks at 1 Hz intervals for 8 seconds when the preset memory can be written. |
| LOUD | Lights up and turns out the light when \| LOUD \| key is pushed every a time. |
| MUTE | Lights up when FMUTE terminal is high level. |
| METAL<br>Dolby NR<br>MSS | Lights up and turns out the light in TAPE mode when each key is pushed every a time.<br>Lights up when each output terminal is high level. |

## 2.4 LCD DRIVE SIGNAL



1/2 duty 1/2 bias timing chart of LCD driver
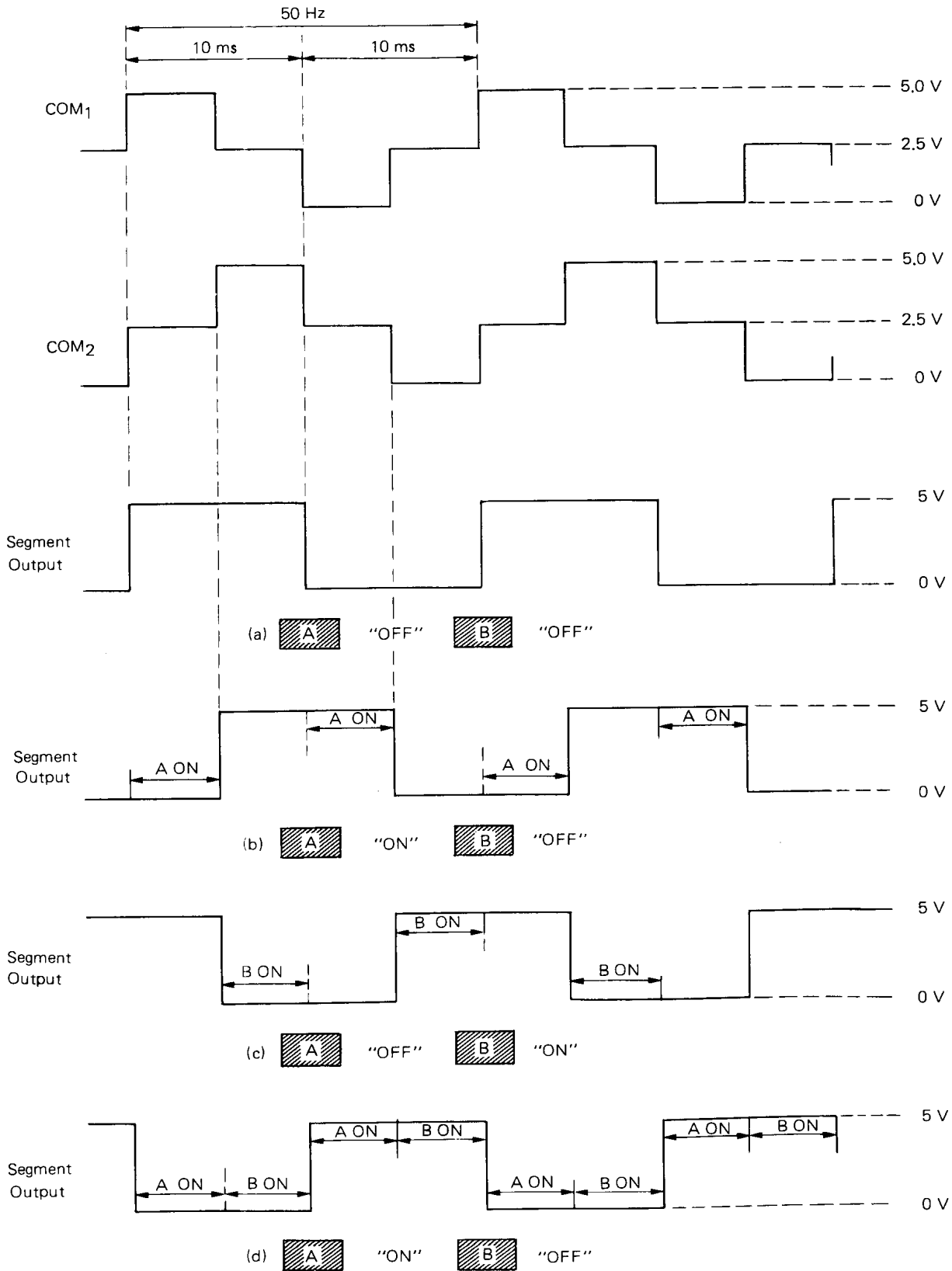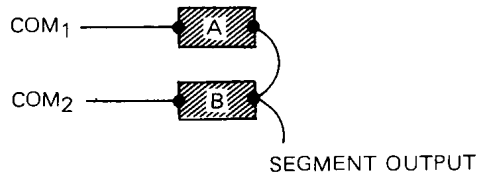
# 3. TIMING CHART (MUTE OUTPUT (ACTIVE-HIGH) TIMING CHART)

① Key on chattering prevention time

② MUTE leading time

③ Frequency division ratio setting and display contents change time

④ MUTE trailing time

⑤ Wait time until SD detection

⑥ Wait time until SD check

⑦ Wait time until PLL locking (depends on the externally connected LPF constant)

## (1) Manual Up/Down

| 20 | 70 | 5 to 10 | 70 |
|---|---|---|---|
| ① | ② | ③ | ④ |

(ms)

Band edge

| 20 | 70 | 5 to 10 | 250 to 375 |
|---|---|---|---|
| ① | ② | ③ | ④ |

(ms)

## (2) Seek Up

Station found

| 20 | 70 | 5 to 10 | 35 to 70 | 5 to 10 | 35 to 70 | 250 to 375 | 70 |
|---|---|---|---|---|---|---|---|
| ① | ② | ③ ⑦ | ⑤ | ③ ⑦ | ⑤ | ⑥ | ④ |

SD (Low)  SD (High)  SD (High)

(ms)

Noise

| 20 | 70 | 5 to 10 | 35 to 70 | 5 to 10 | 35 to 70 | 250 to 375 | 5 to 10 | 35 to 70 |
|---|---|---|---|---|---|---|---|---|
| ① | ② | ③ ⑦ | ⑤ | ③ ⑦ | ⑤ | ⑥ | ③ ⑦ | ⑤ |

SD (Low)  SD (High)  SD (Low)  SD (Low)

(ms)

## (3) Scan up

| 20 | 70 | 5 to 10 | 35 to 70 | 5 to 10 | 35 to 70 | 250 to 375 | 70 | 8000 | 70 | 5 to 10 | 35 to 70 |
|---|---|---|---|---|---|---|---|---|---|---|---|

① ② ③ ⑦ ⑤ ③ ⑦ ⑤ ⑥ ④ ② ③ ⑦ ⑤ (ms)

SD (Low)　SD (High)　SD (High)
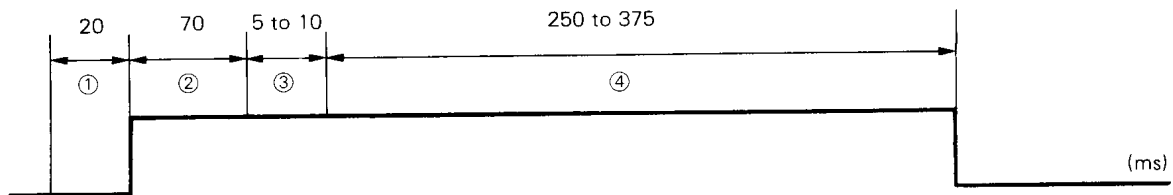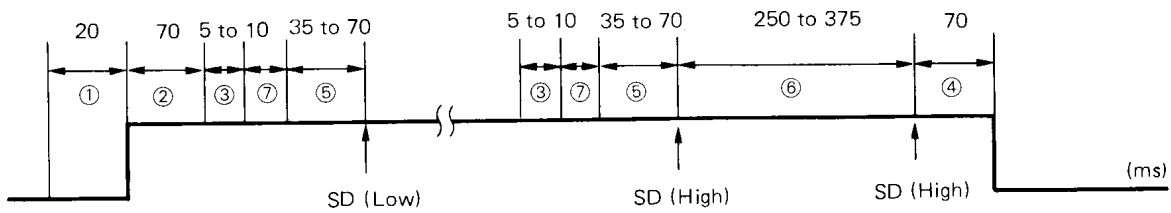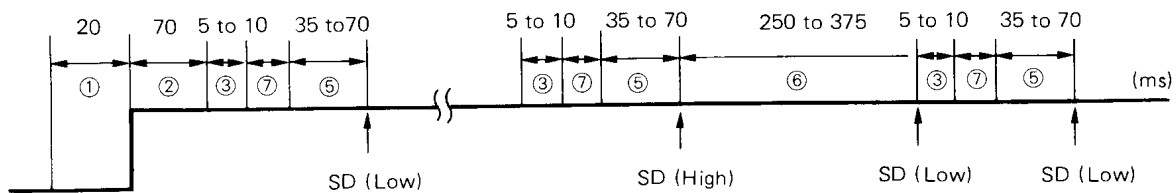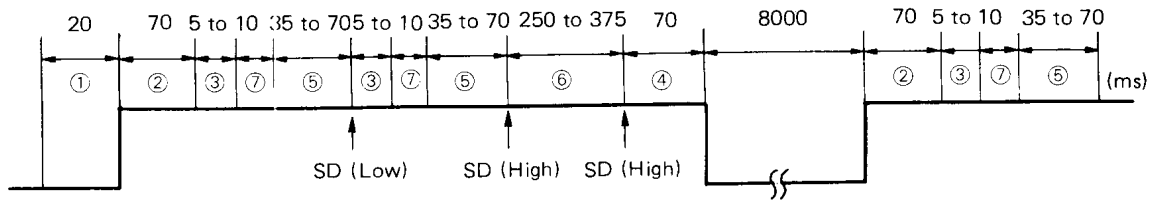
Same as seek when noise is detected.

Band edge

| 20 | 70 | 5 to 10 | 250 to 375 | 35 to 70 | 250 to 375 | 70 |
|---|---|---|---|---|---|---|

① ② ③ ④ ⑦ ⑤ ⑥ ④ (ms)

SD (High)　SD (High)
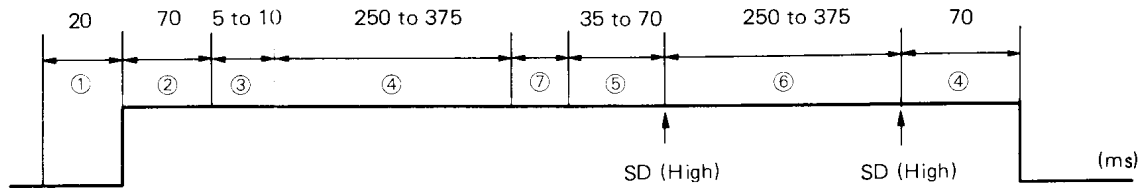
## (4) When preset memory is called

| 20 | 70 | 5 to 10 | 250 to 375 |
|---|---|---|---|

① ② ③ ④ (ms)
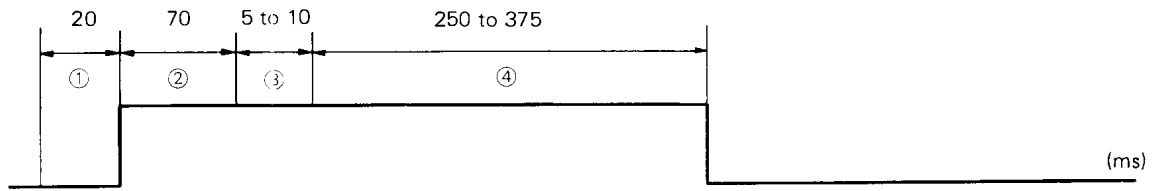
## (5) When reception band is switched

| 20 | 70 | 5 to 10 | 250 to 375 |
|---|---|---|---|

① ② ③ ④ (ms)
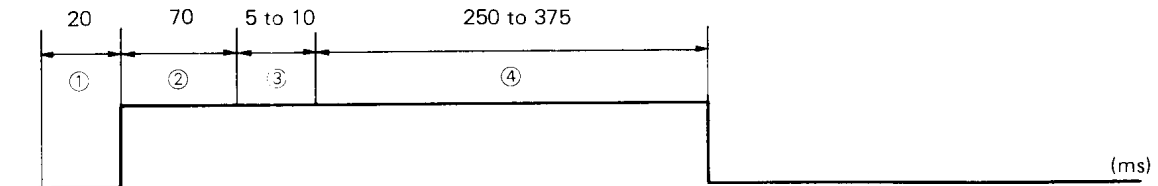
## (6) When RADIO mode changes (Low → High, High → Low)

| 20 | 70 | 5 to 10 | 250 to 375 |
|---|---|---|---|

① ② ③ ④ (ms)
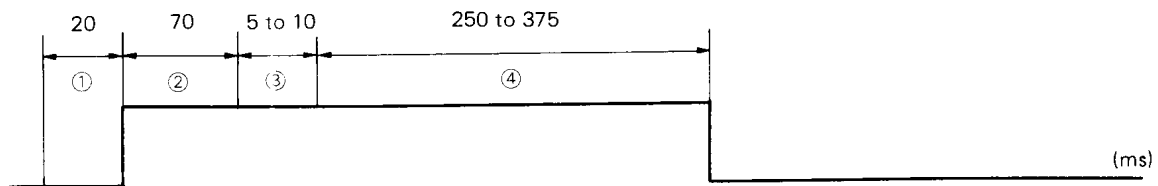
## (7) When POWER switch changes from low to high level

| 20 | 70 | 5 to 10 | 250 to 375 |
|---|---|---|---|

① ② ③ ④ (ms)
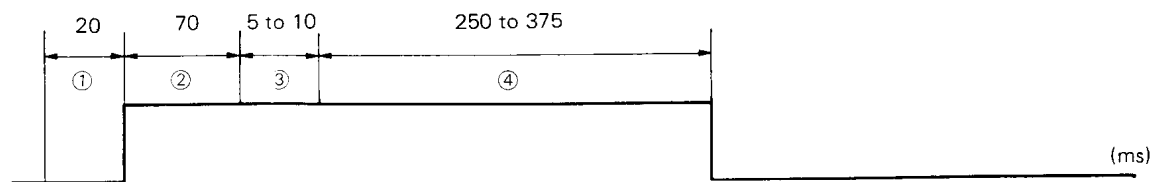
## 4. APPLICATION CIRCUIT
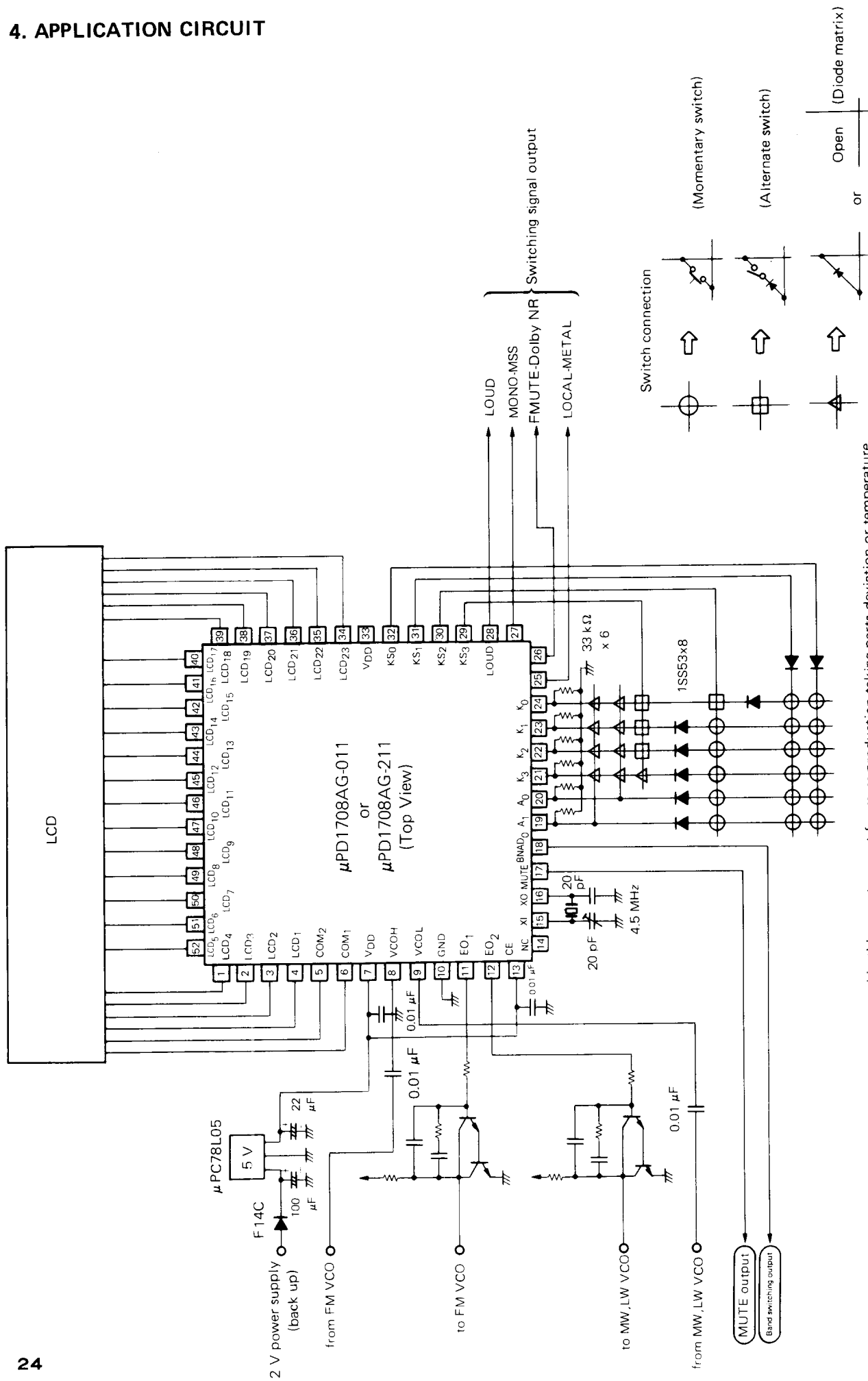


The application circuit and constant presented in this report are not for mass production taking parts deviation or temperature characteristics into consideration. For patent regarding the circuits in this report, NEC does not bear any responsibility.

# 5. ELECTRICAL CHARACTERISTICS

## 5.1 ABSOLUTE MAXIMUM RATINGS

| | | | |
|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | −0.3 to +6.0 | V |
| Input Voltage | $V_I$ | −0.3 to +$V_{DD}$ +0.3 | V |
| Output Voltage | $V_O$ | −0.3 to +$V_{DD}$ + 0.3 | V |
| Output Absorption Current | $I_O$ | 10 | mA |
| Ambient Temperature | $T_a$ | −40 to + 85 | $^\circ$C |
| Storage Temperature | $T_{stg}$ | −55 to + 125 | $^\circ$C |

## 5.2 RECOMMENDED OPERATING CONDITIONS

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITION |
|---|---|---|---|---|---|---|
| Power Supply Voltage | $V_{DD}$ | 4.5 | 5.0 | 5.5 | V | |
| Ambient Temperature | $T_a$ | −40 | | +85 | $^\circ$C | |
| Input Oscillation | $V_{in}$ | 0.3 | | 4.5 | Vp-p | VCOL (AM) terminal |
| Input Oscillation | $V_{in}$ | 0.5 | | 4.5 | Vp-p | VCOH (FM) terminal |

## 5.3 DC CHARACTERISTICS ($V_{DD}$ = +4.5 to +5.5 V, $T_a$ = −40 to +85 $^\circ$C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITION |
|---|---|---|---|---|---|---|
| Power Supply Voltage | $V_{DD1}$ | 4.5 | 5.0 | 5.5 | V | CPU and PLL operation |
| Power Supply Voltage | $V_{DD2}$ | 3.5 | | 5.5 | V | CPU operation only |
| Power Supply Current | $I_{DD1}$ | | 15 | | mA | VCOH(FM) terminal (When 120 MHz is input) |
| Power Supply Current | $I_{DD2}$ | | 400 | | $\mu$A | Clock operation only |
| Data Retention Voltage | $V_{DR}$ | 2.5 | | $V_{DD}$ | V | When clock oscillation is stopped |
| Data Retention Current | $I_{DR}$ | | 1 | 10 | $\mu$A | When clock oscillation is stopped $V_{DD}$=5 V |
| High Level Output Current | $I_{OH1}$ | −1.0 | −2.5 | | mA | PORT A,B,C,$EO_1$,$EO_2$ terminals $V_{OH}=V_{DD}-1$ V |
| High Level Output Current | $I_{OH2}$ | −10 | −18 | | $\mu$A | $LCD_1$ to $LCD_{23}$ terminals $V_{OH}=V_{DD}-1$ V |
| High Level Output Current | $I_{OH3}$ | −20 | −60 | | $\mu$A | $COM_1$, $COM_2$ terminals $V_{OH}=V_{DD}-1$ V |
| Low Level Output Current | $I_{OL1}$ | 1.0 | 3.8 | | mA | PORT A,$C_1$,$C_0$,$EO_1$, $EO_2$ terminals $V_{OL}=1$ V |
| Low Level Output Current | $I_{OL2}$ | 25 | 100 | | $\mu$A | PORT B,$C_2$, $C_3$ $V_{OL}=1$ V |
| Low Level Output Current | $I_{OL3}$ | 10 | 30 | | $\mu$A | $LCD_1$ to $LCD_{23}$ terminals $V_{OL}=1$ V |
| Low Level Output Current | $I_{OL4}$ | 20 | 80 | | $\mu$A | $COM_1$,$COM_2$ terminals $V_{OL}=1$ V |
| High Level Input Current | $I_{IH1}$ | 10 | 35 | 60 | $\mu$A | $K_0$ to $K_3$ terminals $V_{IH}=V_{DD}=5$ V |
| High Level Input Current | $I_{IH2}$ | 100 | 300 | | $\mu$A | VCOH, VCOL, XI terminals $V_{IH}=V_{DD}=5$ V |
| Output Leak Current | $I_L$ | | | ±1 | $\mu$A | $EO_1$, $EO_2$ terminals |
| High Level Input Voltage | $V_{IH1}$ | 0.7 $V_{DD}$ | | | V | $PA_0$ to $PA_3$ terminals |
| High Level Input Voltage | $V_{IH2}$ | 0.6 $V_{DD}$ | | | V | $K_0$ to $K_3$ terminals |
| High Level Input Voltage | $V_{IH3}$ | 0.8 $V_{DD}$ | | | V | CE terminals |
| Low Level Input Voltage | $V_{IL1}$ | | | 0.3 $V_{DD}$ | V | $PA_0$ to $PA_3$ terminals |
| Low Level Input Voltage | $V_{IL2}$ | | | 0.2 $V_{DD}$ | V | $K_0$ to $K_3$ terminals |
| Low Level Input Voltage | $V_{IL3}$ | | | 0.2 $V_{DD}$ | V | CE terminals |
| Output Level | $V_O$ | 2.3 | | 2.8 | V | $COM_1$,$COM_2$ terminals 1/2 bias voltage $V_{DD}$=5 V |

## 5.4 AC CHARACTERISTICS ($V_{DD}$ = +4.5 to +5.5 V, $T_a$ = −40 to +85 °C)

| CHARACTERISTIC | SYMBOL | MIN. | TYP. | MAX. | UNIT | CONDITION |
|---|---|---|---|---|---|---|
| Operating Frequency | $f_{AML}$ | 0.59 | | 20 | MHz | VCOL(AM) terminals $V_i$=0.1 $V_{p-p}$, $V_{DD}$=4.5 V |
| Operating Frequency | $f_{FM-1}$ | 10 | | 130 | MHz | VCOH(FM) terminals, $V_i$=0.3 $V_{p-p}$, $V_{DD}$=4.5 V |
| Operating Frequency | $f_{FM-2}$ | 10 | | 150 | MHz | VCOH(FM) terminals, $V_i$=0.5 $V_{p-p}$, $V_{DD}$=4.5 V |

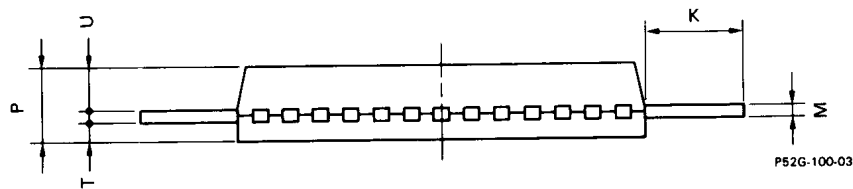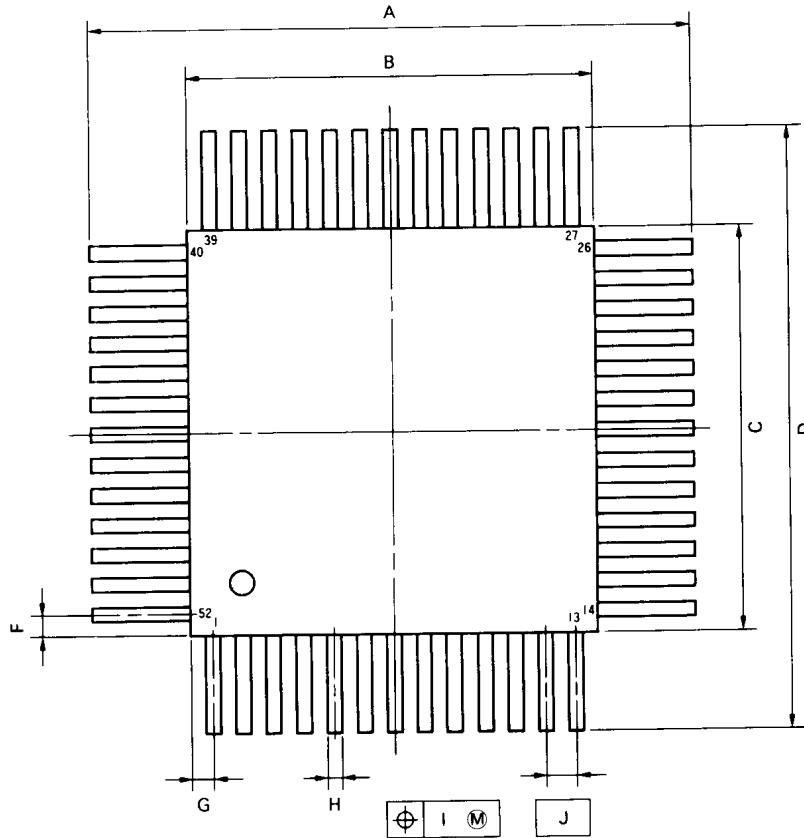## 6. PACKAGE DIMENSIONS (Unit: mm)

### μPD1708AG-011-00
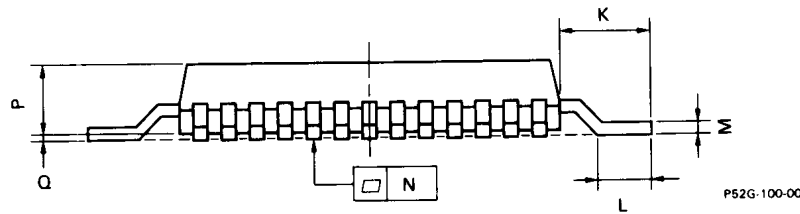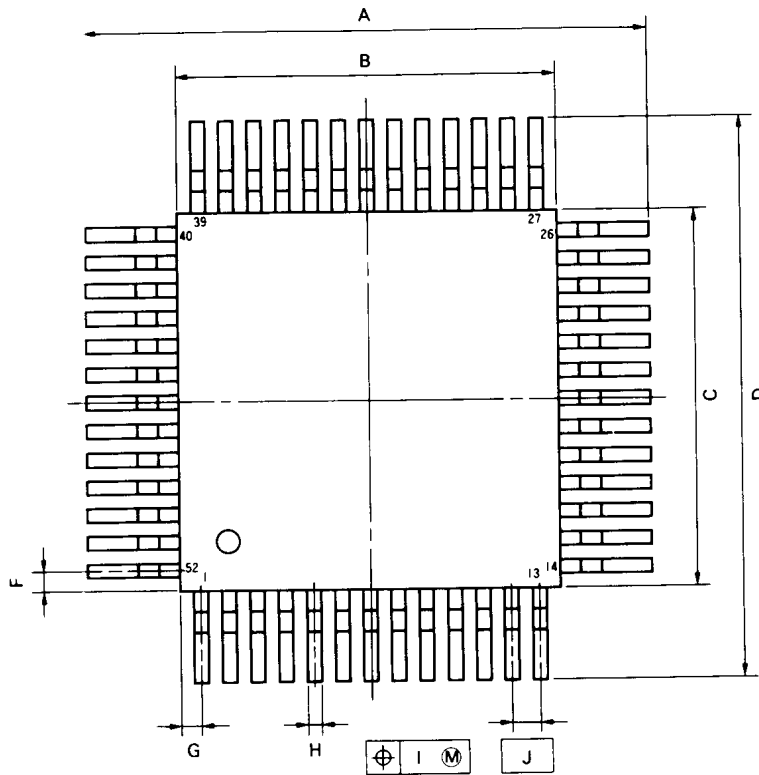


P52G-100-00

**NOTE**

Each lead centerline is located within 0.20 mm (0.008 inch) of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS | INCHES |
|------|-------------|--------|
| A | $21.0^{+0.4}$ | $0.827^{+0.016}$ |
| B | $14^{+0.2}$ | $0.551^{+0.009}_{-0.008}$ |
| C | $14^{+0.2}$ | $0.551^{+0.009}_{-0.008}$ |
| D | $21.0^{+0.4}$ | $0.827^{+0.016}$ |
| F | 1.0 | 0.039 |
| G | 1.0 | 0.039 |
| H | $0.40^{+0.10}$ | $0.016^{+0.004}_{-0.005}$ |
| I | 0.20 | 0.008 |
| J | 1.0 (T.P.) | 0.039 (T.P.) |
| K | $3.5^{+0.2}$ | $0.138^{+0.008}_{-0.009}$ |
| L | $2.2^{+0.2}$ | $0.087^{+0.008}_{-0.009}$ |
| M | $0.15^{+0.10}_{-0.05}$ | $0.006^{+0.004}_{-0.003}$ |
| N | 0.15 | 0.006 |
| P | $2.6^{+0.2}_{-0.1}$ | $0.102^{+0.009}_{-0.004}$ |
| Q | $0.1^{+0.1}$ | $0.004^{+0.004}$ |

**μPD1708AG-211-03**



P52G-100-03

**NOTE**

Each lead centerline is located within 0.20 mm (0.008 inch) of its true position (T.P.) at maximum material condition.

| ITEM | MILLIMETERS | INCHES |
|------|-------------|--------|
| A | 19.8 +0.4 | 0.780 +0.016 -0.017 |
| B | 14 +0.2 | 0.551 +0.009 -0.008 |
| C | 14 +0.2 | 0.551 +0.009 -0.008 |
| D | 19.8 +0.4 | 0.780 +0.016 -0.017 |
| F | 1.0 | 0.039 |
| G | 1.0 | 0.039 |
| H | 0.40 +0.10 | 0.016 +0.004 -0.005 |
| I | 0.20 | 0.008 |
| J | 1.0 (T.P.) | 0.039 (T.P.) |
| K | 2.9 +0.2 | 0.114 +0.009 -0.008 |
| M | 0.15 +0.10 -0.05 | 0.006 +0.004 -0.003 |
| P | 2.6 +0.2 -0.1 | 0.102 +0.009 -0.004 |
| T | 1.0 | 0.039 |
| U | 1.45 | 0.057 |