DATA SHEET

NEC

MOS INTEGRATED CIRCUIT

μPD178024GC-051

8-BIT SINGLE-CHIP MICROCONTROLLER WITH ON-CHIP PRESCALER, PLL FREQUENCY SYNTHESIZER, AND IF COUNTER FOR AUTOMOTIVE FM/MW/LW RADIO WITH CD PLAYER

The μPD178024GC-051 is an 8-bit CMOS microcontroller for use in digital tuners designed to receive the European and USA FM, MW, and LW bands. It incorporates a prescaler, PLL frequency synthesizer, and IF counter.

The device has various CD player control functions and enables the configuration of a high-performance, multi-function FM/MW/LW tuner with CD player, such as an automotive stereo system, using a single chip.

FEATURES

- Preset memory
  Stores six stations in each of the FM1, FM2, FM3, AM1 (shared by MW), and AM2 (shared between MW and LW) bands, giving a total of 30 stations
- Last channel memory
  One station per band, totaling 5 stations
- Tuning functions
  - Manual seek/auto-seek
  - Auto-storage
  - Preset scan
  - Auto-retuning
- LCD controller/driver (μPD16431A)
- Single power supply (V_{DD} = 5 V ±10%)
- CD player control functions
  - 8 cm/12 cm disc detection
  - Track repeat
  - Intro playback
  - Random play
  - Program playback
    (with CD player (CDC-01KG) connected)
- Electronic volume control (TDA7313)
- Equalizer function (TA2078P)
- Remote-controller signal reception function (μPD6121G is used for sending the remote-controller signal)
- Rotary commander
- Front panel control

ORDERING INFORMATION

Part Number	Package
μPD178024GC-051-8BT	80-pin plastic QFP (14 × 14 mm, 0.65 mm pitch)

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Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

Document No. U14608EJ1V0DS00 (1st edition)
Date Published January 2000 N CP(K)
Printed in Japan

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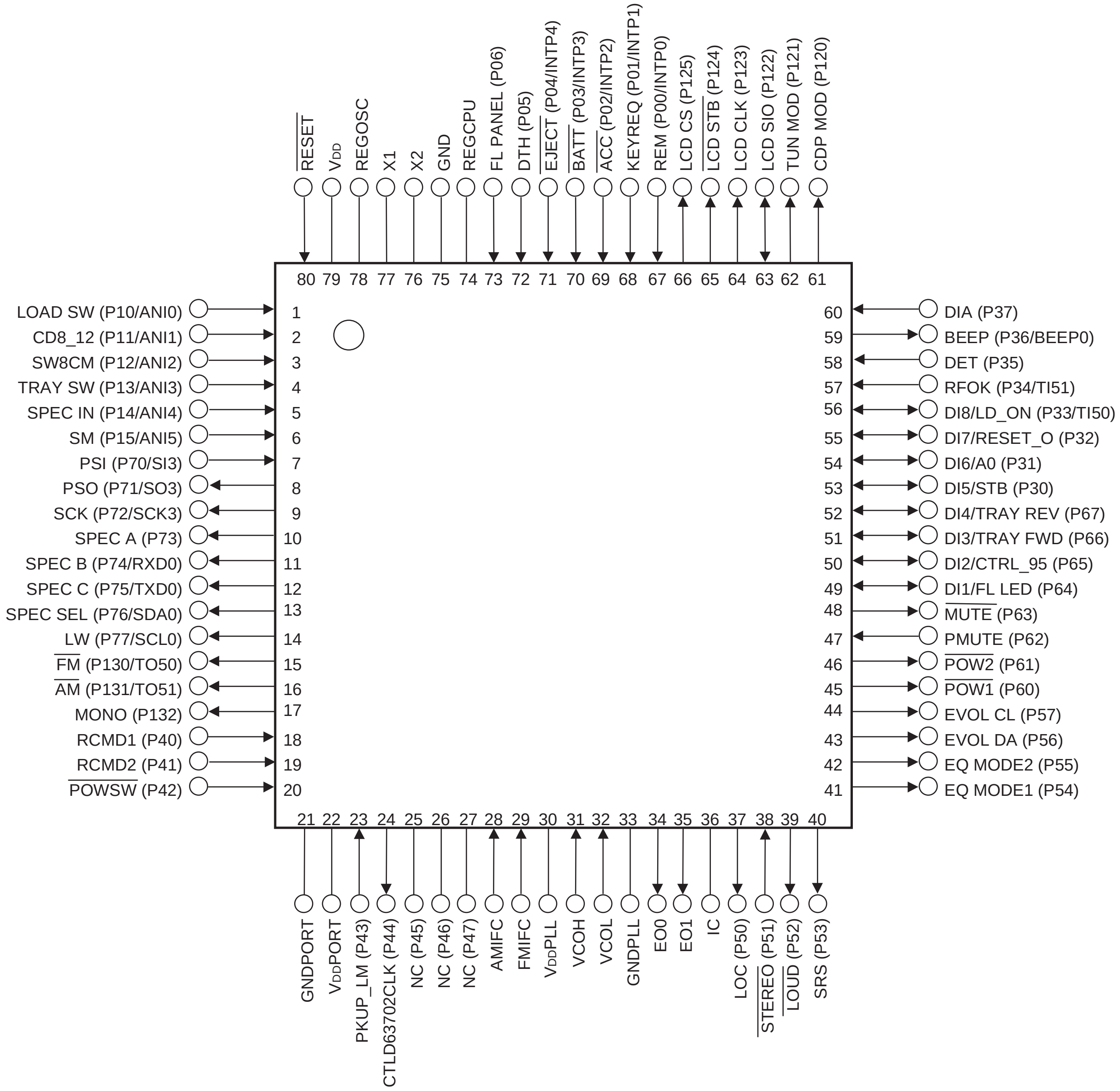
PIN CONFIGURATION (TOP VIEW)

80-pin plastic QFP (14 × 14 mm, 0.65 mm pitch)
μPD178024GC-051-8BT


RESET
VDD
REGOSC
X1
X2
GND
REGCPU
FL PANEL (P06)
DTH (P05)
EJECT (P04/INTP4)
BATT (P03/INTP3)
ACC (P02/INTP2)
KEYREQ (P01/INTP1)
REM (P00/INTP0)
LCD CS (P125)
LCD STB (P124)
LCD CLK (P123)
LCD SIO (P122)
TUN MOD (P121)
CDP MOD (P120)
LOAD SW (P10/ANI0)
CD8_12 (P11/ANI1)
SW8CM (P12/ANI2)
TRAY SW (P13/ANI3)
SPEC IN (P14/ANI4)
SM (P15/ANI5)
PSI (P70/SI3)
PSO (P71/SO3)
SCK (P72/SCK3)
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DI4/TRAY REV (P67)
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NC (P46)
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VDDPLL
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VCOL
GNDPLL
EO0
EO1
IC
LOC (P50)
STEREO (P51)
LOUD (P52)
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Remarks **1.** ( ): μPD178024-XXX-8BT
2. IC: Internally connected
3. NC: No connection

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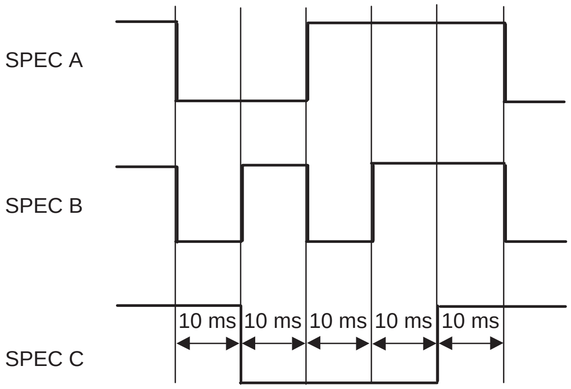
1. PIN FUNCTIONS

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>1</td><td>LOAD SW</td><td>Disc insertion detection signal</td><td>This pin inputs the disc insertion detection signal from the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Detects insertion of a disc.</td></tr>
<tr><td>1</td><td>Does not detect insertion of a disc.</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>2</td><td>CD8_12</td><td>8 cm/12 cm disc detection signal</td><td>This pin inputs the 8 cm/12 cm disc detection signal from the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Detects an 8 cm/12 cm disc.</td></tr>
<tr><td>1</td><td>Does not detect an 8 cm/12 cm disc.</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>3</td><td>SW8CM</td><td>12 cm disc detection signal</td><td>This pin inputs the 12 cm disc detection signal from the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Detects a 12 cm disc.</td></tr>
<tr><td>1</td><td>Does not detect a 12 cm disc.</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>4</td><td>TRAY SW</td><td>Chucking signal input</td><td>This pin inputs the chucking signal from the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>TRAY SW Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Tray opens.</td></tr>
<tr><td>1</td><td>Tray closes (chucking status).</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>5</td><td>SPEC IN</td><td>Spectrum analyzer signal input</td><td>This pin inputs an analog signal indicating the audio level in each audio frequency band from a bandpass filter IC (BA3835F).
Connect this pin to the AOUT pin (pin 17) of the bandpass filter IC (BA3835F) and input an analog signal to the device in accordance with a given audio level.
This pin is used to identify the audio level in each audio frequency band to be displayed by the spectrum analyzer.
The audio level varies, depending on the input voltage, as follows, regardless of the audio frequency band:
<table>
<tr><th>Input voltage (V_{DD} = 5.0 V)</th><th>Audio Level</th></tr>
<tr><td>239.5 ÷ 256 × V_{DD} or more (4.7 V or more)</td><td>10</td></tr>
<tr><td>Less than 239.5 ÷ 256 × V_{DD} (less than 4.7 V)
219.5 ÷ 256 × V_{DD} or more (4.3 V or more)</td><td>9</td></tr>
<tr><td>Less than 219.5 ÷ 256 × V_{DD} (less than 4.3 V)
199.5 ÷ 256 × V_{DD} or more (3.9 V or more)</td><td>8</td></tr>
<tr><td>Less than 199.5 ÷ 256 × V_{DD} (less than 3.9 V)
179.5 ÷ 256 × V_{DD} or more (3.5 V or more)</td><td>7</td></tr>
<tr><td>Less than 179.5 ÷ 256 × V_{DD} (less than 3.5 V)
149.5 ÷ 256 × V_{DD} or more (2.9 V or more)</td><td>6</td></tr>
<tr><td>Less than 149.5 ÷ 256 × V_{DD} (less than 2.9 V)
119.5 ÷ 256 × V_{DD} or more (2.3 V or more)</td><td>5</td></tr>
<tr><td>Less than 119.5 ÷ 256 × V_{DD} (less than 2.3 V)
89.5 ÷ 256 × V_{DD} or more (1.7 V or more)</td><td>4</td></tr>
<tr><td>Less than 89.5 ÷ 256 × V_{DD} (less than 1.7 V)
59.5 ÷ 256 × V_{DD} or more (1.1 V or more)</td><td>3</td></tr>
<tr><td>Less than 59.5 ÷ 256 × V_{DD} (less than 1.1 V)
29.5 ÷ 256 × V_{DD} or more (0.6 V or more)</td><td>2</td></tr>
<tr><td>Less than 29.5 ÷ 256 × V_{DD} (less than 0.6 V)
4.5 ÷ 256 × V_{DD} or more (0.1 V or more)</td><td>1</td></tr>
<tr><td>Less than 4.5 ÷ 256 × V_{DD} (less than 0.1 V)</td><td>0</td></tr>
</table>
For spectrum analyzer display, refer to “6. LCD PANEL”.</td><td>Analog input</td></tr>
<tr><td>6</td><td>SM</td><td>Signal meter signal input</td><td>This pin inputs a signal meter signal from a tuner pack.
Input an analog signal in accordance with the intensity of the received electric field to this pin.
This pin is used to detect a broadcasting station during auto tuning of the radio.
A station is detected by the signal meter signal as follows, depending on the input voltage but regardless of the received band and received sensitivity (local/DX):
<table>
<tr><th>Input Voltage (V_{DD} = 5.0 V)</th><th>Station Detection</th></tr>
<tr><td>128.5 ÷ 256 × V_{DD} or more (2.49 V or more)</td><td>Station detected</td></tr>
<tr><td>Less than 128.5 ÷ 256 × V_{DD} (less than 2.49 V)</td><td>Station not detected</td></tr>
</table>
For station detection, refer to “3.4 Station Detection”.</td><td>Analog input</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>7</td><td>PSI</td><td>Servo IC serial data signal input</td><td>This pin inputs a serial data signal from the servo IC (μPD63702) of the CD player (CDC-01KG).
Pull up this pin externally.</td><td>Input</td></tr>
<tr><td>8</td><td>PSO</td><td>Servo IC serial data signal output</td><td>This pin outputs a serial data signal to the servo IC (μPD63702) of the CD player (CDC-01KG).</td><td>CMOS push-pull output</td></tr>
<tr><td>9</td><td>SCK</td><td>Servo IC serial clock signal output</td><td>This pin outputs a serial clock signal to the servo IC (μPD63702) of the CD player (CDC-01KG).</td><td>CMOS push-pull output</td></tr>
<tr><td>10
11
12</td><td>SPEC A
SPEC B
SPEC C</td><td>Spectrum analyzer band select signal output</td><td>These pins output spectrum analyzer band select signals to a bandpass filter IC (BA3835F).
Connect these pins to the A to C pins (pins 10 to 12) of the bandpass filter IC (BA3835F).
These pins are used to select the audio frequency band to be input to the SPEC IN pin.
The correspondence between these pins, the audio frequency band to be selected, and spectrum analyzer display segment are as follows:
<table>
<tr><th>SPEC A</th><th>SPEC B</th><th>SPEC C</th><th>Audio Frequency Band</th><th>Spectrum Analyzer Display Segment</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>105 Hz</td><td>A1 to A10</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>340 Hz</td><td>B1 to B10</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1 kHz</td><td>C1 to C10</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>3.4 kHz</td><td>D1 to D10</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>10.5 kHz</td><td>E1 to E10</td></tr>
</table>
(0: Low level, 1: High level)
In the power-on status, the audio frequency band to be selected is changed every 10 ms and output as illustrated below.


At all other times, each of these pins outputs a low level.
For spectrum analyzer display, refer to “6. LCD PANEL”.</td><td>CMOS push-pull output</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>13</td><td>SPEC SEL</td><td>Spectrum analyzer SEL signal output</td><td>This pin outputs a spectrum analyzer SEL signal to a bandpass filter IC (BA3835F).
Connect this pin to the SEL pin (pin 14) of the bandpass filter IC (BA3835F) and externally pull up the connection line between the pin.
In the power-on status, this pin outputs a high level.
At all other times, it outputs a low level.</td><td>N-ch open-drain output</td></tr>
<tr><td>14</td><td>LW</td><td>LW band select signal output</td><td>This pin outputs the LW band select signal of the radio.
Externally pull up this pin.
When the LW band is selected in the power-on status, this pin outputs a high level regardless of the audio source mode.
In the CD mode, it holds output in the radio mode.
At all other times, this pin outputs a low level.</td><td>N-ch open-drain output</td></tr>
<tr><td>15</td><td>$\overline{\text{FM}}$</td><td>FM band select signal output</td><td>This pin outputs the FM band select signal of the radio.
When the FM band is selected in the power-on status, this pin outputs a low level regardless of the audio source mode.
In the CD mode, it holds output in the radio mode.
At all other times, this pin outputs a high level.</td><td>N-ch open-drain output</td></tr>
<tr><td>16</td><td>$\overline{\text{AM}}$</td><td>AM band select signal output</td><td>This pin outputs the AM band select signal of the radio.
When the AM band (MW, LW) is selected in the power-on status, this pin outputs a low level regardless of the audio source mode.
In the CD mode, it holds output in the radio mode.
At all other times, this pin outputs a high level.</td><td>N-ch open-drain output</td></tr>
<tr><td>17</td><td>MONO</td><td>Monaural signal output</td><td>This pin outputs a forced monaural signal.
In the power-on status, this pin outputs the following signal in the forced monaural status, regardless of the audio source band and received band.
<table>
<tr><th>MONO Pin</th><th>Forced Monaural</th></tr>
<tr><td>0</td><td>Forced monaural OFF</td></tr>
<tr><td>1</td><td>Forced monaural ON</td></tr>
</table>
(0: Low level, 1: High level)
In the CD mode, this pin holds the output in the radio mode.
At all other times, it outputs a high level.</td><td>N-ch open-drain output</td></tr>
<tr><td>18
19</td><td>RCMD1
RCMD2</td><td>Rotary encoder phase signal input</td><td>These pins input the phase signal of a rotary encoder.
They are used to detect input from a rotary commander.
For details, refer to “8. ROTARY COMMANDER”.</td><td>Input</td></tr>
<tr><td>20</td><td>$\overline{\text{POWSW}}$</td><td>$\boxed{\text{POWER}}$ key signal input</td><td>This pin inputs the $\boxed{\text{POWER}}$ key signal.
Connect a momentary key to this pin.
Input a signal to this pin as follows:
<table>
<tr><th>$\overline{\text{POWSW}}$ Pin</th><th>Description</th></tr>
<tr><td>0</td><td>$\boxed{\text{POWER}}$ key ON</td></tr>
<tr><td>1</td><td>$\boxed{\text{POWER}}$ key OFF</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>21</td><td>GNDPORT</td><td>Port ground</td><td>This is the ground pin for ports.
Connect this pin to the GND pin.</td><td>–</td></tr>
<tr><td>22</td><td>V_{DD}PORT</td><td>Power supply</td><td>This is the positive power supply pin for ports.
Connect this pin to the V_{DD} pin.</td><td>–</td></tr>
<tr><td>23</td><td>PKUP_LM</td><td>Pickup position error signal input</td><td>This pin inputs the pickup position error signal from the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>PKUP_LM Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Pickup position error detected</td></tr>
<tr><td>1</td><td>Normal pickup position</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>24</td><td>CTLD63702
CLK</td><td>Servo IC clock oscillation control signal output</td><td>This pin outputs a servo IC clock oscillation control signal to the CD player (CDC-01KG).
This pin outputs the following signal depending on the oscillation control status of the servo IC clock.
<table>
<tr><th>CTLD63702CLK Pin</th><th>Oscillation Control of Servo IC Clock</th></tr>
<tr><td>0</td><td>Oscillation enabled</td></tr>
<tr><td>1</td><td>Oscillation disabled</td></tr>
</table>
(0: Low level, 1: High level)</td><td>CMOS push-pull output</td></tr>
<tr><td>25
26
27</td><td>NC</td><td>No connection</td><td>These pins are not connected.
Connect each of these pins to the V_{DD} pin or GND pin via resistor.</td><td>–</td></tr>
<tr><td>28</td><td>AMIFC</td><td>AM band intermediate frequency input</td><td>This pin inputs the intermediate frequency of the AM band (MW, LW) of the radio.
Because it is connected to an internal AC amplifier, connect a capacitor to this pin in series to cut off the DC component.
This pin is used to detect a station during auto tuning of the AM band (MW, LW) of the radio.
For how to detect a station, refer to “3.4 Station Detection”.
The voltage on this pin is at the intermediate level (about 1/2V_{DD}) during auto tuning of the AM band (MW, LW), but at all other times the pin goes into a high-impedance state.</td><td>Input</td></tr>
<tr><td>29</td><td>FMIFC</td><td>FM band intermediate frequency input</td><td>This pin inputs the intermediate frequency of the FM band of the radio.
Because it is connected to an internal AC amplifier, connect a capacitor to this pin in series to cut off the DC component.
This pin is used to detect a station during auto tuning of the FM band of the radio.
For how to detect a station, refer to “3.4 Station Detection”.
The voltage on this pin is at the intermediate level (about 1/2V_{DD}) during auto tuning of the FM band, but at all other times the pin goes into a high-impedance state.</td><td>Input</td></tr>
<tr><td>30</td><td>V_{DD}PLL</td><td>PLL power supply</td><td>Positive power supply pin for PLL.
Connect this pin to the V_{DD} pin.
Insert a 100 pF capacitor between the V_{DD}PLL and GNDPLL pins.</td><td>–</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>31</td><td>VCOH</td><td>FM local oscillation input</td><td>This pin inputs the local oscillation output (VCO) of the FM band.
Because it is connected to an internal AC amplifier, connect a capacitor to this pin in series to cut off the DC component.
The voltage on this pin is at the intermediate level (about 1/2V_{DD}) during auto tuning of the FM band, but at all other times the pin goes into a high-impedance state.</td><td>Input</td></tr>
<tr><td>32</td><td>VCOL</td><td>AM local oscillation input</td><td>This pin inputs the local oscillation output (VCO) of the AM band (MW, LW).
Because it is connected to an internal AC amplifier, connect a capacitor to this pin in series to cut off the DC component.
The voltage on this pin is at the intermediate level (about 1/2V_{DD}) during auto tuning of the AM band (MW, LW), but at all other times the pin goes into a high-impedance state.</td><td>Input</td></tr>
<tr><td>33</td><td>GNDPLL</td><td>PLL ground</td><td>Ground pin for PLL.
Connect this pin to the GND pin.</td><td>–</td></tr>
<tr><td>34
35</td><td>EO0
EO1</td><td>Error out</td><td>These pins are the output pins of the charge pump of the phase comparator that constitutes the PLL.
Input the output signals from these pins to an external LPF (Low Pass Filter), and apply them to a varacter diode via the LPF.
If the divided local oscillation frequency (VCO output) is higher than the reference frequency, these pins output a high level; if this frequency is lower than the reference frequency, they output a low level.
If the frequency matches, these pins are floated.</td><td>CMOS 3-state output</td></tr>
<tr><td>36</td><td>IC</td><td>Internally connected</td><td>This pin is internally connected.
Directly connect this pin to the GND pin with as short a wiring length as possible.
If noise is superimposed on this pin, it may cause the device to malfunction.</td><td>–</td></tr>
<tr><td>37</td><td>LOC</td><td>Local signal output</td><td>This pin outputs the local signal of the radio.
This pin outputs a high level during auto tuning in the local mode.
At all other times, it outputs a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>38</td><td>$\overline{\text{STEREO}}$</td><td>Stereo signal input</td><td>This pin inputs a stereo signal.
Input a signal to this pin as follows:
<table>
<tr><th>$\overline{\text{STEREO}}$ Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Stereo broadcasting being received</td></tr>
<tr><td>1</td><td>Stereo broadcasting not received</td></tr>
</table>
(0: Low level, 1: High level)
The stereo signal is ignored unless the FM band is being received.</td><td>Input</td></tr>
<tr><td>39</td><td>$\overline{\text{LOUD}}$</td><td>Loudness signal output</td><td>Outputs a loudness signal.
This pin outputs a signal as follows in the power-on status, depending on the loudness status.
<table>
<tr><th>$\overline{\text{LOUD}}$ Pin</th><th>Loudness Status</th></tr>
<tr><td>0</td><td>Loudness on</td></tr>
<tr><td>1</td><td>Loudness off</td></tr>
</table>
(0: Low level, 1: High level)
At all other times, this pin outputs a high level.</td><td>CMOS push-pull output</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>40</td><td>SRS</td><td>SRS signal output</td><td>This pin outputs an SRS signal.
This pin outputs a signal as follows in the power-on status, depending on the SRS status.
<table>
<tr><th>SRS Pin</th><th>SRS Status</th></tr>
<tr><td>0</td><td>SRS off</td></tr>
<tr><td>1</td><td>SRS on</td></tr>
</table>
(0: Low level, 1: High level)
At all other times, it outputs a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>41
42</td><td>EQ MODE1
EQ MODE2</td><td>Equalizer mode signal output</td><td>These pins output an equalizer mode signal.
If it is specified by the initialization switch “EQICSEL” that an equalizer IC is used, these pins output a signal as follows in the power-on status, depending on the equalizer mode.
<table>
<tr><th>EQ MODE1 Pin</th><th>EQ MODE2 Pin</th><th>Equalizer Mode</th></tr>
<tr><td>0</td><td>0</td><td>FLAT</td></tr>
<tr><td>1</td><td>0</td><td>ROCK</td></tr>
<tr><td>0</td><td>1</td><td>CLASSIC</td></tr>
<tr><td>1</td><td>1</td><td>POP</td></tr>
</table>
(0: Low level, 1: High level)
At all other times, both the “EQ MODE1” and “EQ MODE2” pins output a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>43</td><td>EVOL DA</td><td>Electronic volume data signal output</td><td>This pin outputs a serial data signal (IIC bus format) to an electronic volume IC (TDA7313).
Connect this pin to the SDA pin (pin 27) of the electronic volume IC (TDA7313) and externally pull up the connection line between the pins.
In the power-off status, stop the pull-up power supply.
This pin outputs data at the falling edge of the EVOL CL pin.
In the power-off status and in the standby mode, it outputs a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>44</td><td>EVOL CL</td><td>Electronic volume clock signal output</td><td>This pin outputs a serial clock signal (IIC bus format) to an electronic volume IC (TDA7313).
Connect this pin to the SCL pin (pin 28) of the electronic volume IC (TDA7313) and externally pull up the connection line between the pins.
In the power-off status, stop the pull-up power supply.
In the power-off status and in the standby mode, this pin outputs a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>45
46</td><td>$\overline{\text{POW1}}$
$\overline{\text{POW2}}$</td><td>Power signal output</td><td>These pins output a power signal to the peripheral circuit.
Both the $\overline{\text{POW1}}$ and $\overline{\text{POW2}}$ pins output a low level in the power-on status, and a high level in the power-off status.
For the output timing of the power signal, refer to “12. MUTE OUTPUT TIMING CHART”.</td><td>CMOS push-pull output</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>47</td><td>PMUTE</td><td>Telephone mute signal input</td><td>This pin inputs a telephone mute signal.
Input a signal to this pin as follows:
<table>
<tr><th>PMUTE Pin</th><th>Telephone Mute</th></tr>
<tr><td>0</td><td>Telephone mute off</td></tr>
<tr><td>1</td><td>Telephone mute on</td></tr>
</table>
(0: Low level, 1: High level)
Mute is on if telephone mute is on.</td><td>Input</td></tr>
<tr><td>48</td><td>$\overline{\text{MUTE}}$</td><td>Mute signal output</td><td>This pin outputs a mute signal.
This pin outputs a signal as follows, depending on the mute status.
<table>
<tr><th>$\overline{\text{MUTE}}$ Pin</th><th>Mute</th></tr>
<tr><td>0</td><td>Mute on</td></tr>
<tr><td>1</td><td>Mute off</td></tr>
</table>
(0: Low level, 1: High level)
For the output timing of the mute signal, refer to “12. MUTE OUTPUT TIMING CHART”.</td><td>CMOS push-pull output</td></tr>
<tr><td>49</td><td>DI1/
FL LED</td><td>Initialization switch signal input/front panel detachment LED lighting signal output</td><td>This is a bi-directional pin that inputs an initialization switch signal and outputs a signal that lights an LED indicating that the front panel is detached.
If the front panel is detached, this pin outputs square wave of 1 Hz with a duty factor of 50%.
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.
At all other times, this pin outputs a low level.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>50</td><td>DI2/
CTRL_95</td><td>Initialization switch signal input/loading signal output</td><td>This is a bi-directional pin that inputs an initialization switch signal and outputs a loading signal to the CD player (CDC-01KG).
It outputs a high level when a disc is loaded or ejected.
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.
At all other times, this pin outputs a low level.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>51</td><td>DI3/
TRAY FWD</td><td>Initialization switch signal input/loading forward signal output</td><td>This is a bi-directional pin that inputs an initialization switch signal and outputs a loading forward signal to the CD player (CDC-01KG).
It outputs a high level when a disc is loaded or ejected.
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.
At all other times, this pin outputs a low level.</td><td>CMOS push-pull I/O</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>52</td><td>DI4/
TRAY REV</td><td>Initialization switch signal input/loading reverse signal output</td><td>This is a bi-directional pin that inputs an initialization switch signal and outputs a loading reverse signal to the CD player (CDC-01KG).
It outputs a high level when a disc is loaded or ejected.
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.
At all other times, this pin outputs a low level.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>53</td><td>DI5/
STB</td><td>Initialization switch signal input/servo IC strobe signal output</td><td>This is a bidirectional pin that inputs an initialization switch signal and outputs a strobe signal to the servo IC (μPD63702) of the CD player (CDC-01KG).
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>54</td><td>DI6/
A0</td><td>Initialization switch signal input/servo IC A0 signal output</td><td>This is a bidirectional pin that inputs an initialization switch signal and outputs an A0 signal to the servo IC (μPD63702) of the CD player (CDC-01KG).
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>55</td><td>DI7/
RESET_O</td><td>Initialization switch signal input/servo IC reset signal output</td><td>This is a bidirectional pin that inputs an initialization switch signal and outputs an IC reset signal to the servo IC of the CD player (CDC-01KG).
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>56</td><td>DI8/
LD_ON</td><td>Initialization switch signal input/laser diode lighting signal output</td><td>This is a bidirectional pin that inputs an initialization switch signal and outputs a laser diode lighting signal to the RF amplifier of the CD player (CDC-01KG).
This pin outputs a high level when the laser diode lights.
This pin functions as an input pin when the initialization switch is read.
For the initialization switch, refer to “2. KEY MATRIX CONFIGURATION”.
At all other times, this pin outputs a low level.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>57</td><td>RFOK</td><td>RFOK signal input</td><td>This pin inputs an RFOK signal from the RF amplifier of the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>RFOK Pin</th><th>Description</th></tr>
<tr><td>0</td><td>RFOK not detected</td></tr>
<tr><td>1</td><td>RFOK detected</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>58</td><td>DET</td><td>Vibration detection signal input</td><td>This pin inputs a vibration detection signal from the RF amplifier of the CD player (CDC-01KG).
Pull up this pin externally.
Input a signal to this pin as follows:
<table>
<tr><th>DET Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Vibration not detected</td></tr>
<tr><td>1</td><td>Vibration detected</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>59</td><td>BEEP</td><td>Beep output</td><td>Outputs a beep.
This pin outputs a square wave of 1.5 kHz with a duty factor of 50% as a beep in the following cases:
(1) When a momentary key is pressed and a key operation is performed.
(2) When the received preset memory is changed by the preset memory scan operation of the radio
At all other times, this pin outputs a high level.
However, in the standby mode, it goes into a high-impedance state.</td><td>CMOS push-pull output</td></tr>
<tr><td>60</td><td>DIA</td><td>Hardware diagnosis signal input</td><td>This pin inputs a hardware diagnosis signal.
If a high level is input to this pin in the power-on status, “!!!” is displayed.</td><td>Input</td></tr>
<tr><td>61</td><td>CDP MOD</td><td>CD mode signal output</td><td>This pin outputs a CD mode signal.
This pin outputs a high level in the CD mode.
In other modes, it outputs a low level.
For the output timing of the CD mode signal, refer to “12. MUTE OUTPUT TIMING CHART”.</td><td>CMOS push-pull output</td></tr>
<tr><td>62</td><td>TUN MOD</td><td>Radio mode signal output</td><td>This pin outputs a radio mode signal.
This pin outputs a high level in the radio mode.
In other modes, it outputs a low level.
For the output timing of the radio mode signal, refer to “12. MUTE OUTPUT TIMING CHART”.</td><td>CMOS push-pull output</td></tr>
<tr><td>63</td><td>LCD SIO</td><td>LCD driver data signal I/O</td><td>This pin inputs or outputs a serial data signal to or from an LCD driver IC (μPD16431A).
Connect this pin to the DATA pin (pin 8) of the LCD driver IC (μPD16431A) and externally pull up the connection line between the pins.
Communication with the LCD driver IC (μPD16431A) is carried out in the 2-wire serial mode.
This pin reads data at the rising edge of the LCD CLK pin and outputs data at the falling edge.
It outputs a high level in the standby mode.</td><td>CMOS push-pull I/O</td></tr>
<tr><td>64</td><td>LCD CLK</td><td>LCD driver clock signal output</td><td>This pin outputs a serial clock signal to the LCD driver IC (μPD16431A).
Connect this pin to the SCK pin (pin 7) of the LCD driver IC (μPD16431A) and externally pull up the connection line between the pins.
Communication with the LCD driver IC (μPD16431A) is carried out in the 2-wire serial mode.
This pin outputs a high level in the standby mode.</td><td>CMOS push-pull output</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>65</td><td>$\overline{\text{LCD STB}}$</td><td>LCD driver strobe signal output</td><td>This pin outputs a strobe signal to the LCD driver IC (μPD16431A).
Connect this pin to the STB pin (pin 9) of the LCD driver IC (μPD16431A).
Data is transferred or received while this pin is low.
Usually, this pin outputs a high level, but in the standby mode, it outputs a low level.</td><td>CMOS push-pull output</td></tr>
<tr><td>66</td><td>LCD CS</td><td>LCD driver chip select signal output</td><td>This pin outputs a chip select signal to the LCD driver IC (μPD16431A).
Connect this pin to the OE pin (pin 11) of the LCD driver IC (μPD16431A).
This pin outputs a signal as follows:
<table>
<tr><th>LCDCS Pin</th><th>LCD Display</th></tr>
<tr><td>0</td><td>LCD display off</td></tr>
<tr><td>1</td><td>LCD display on</td></tr>
</table>
(0: Low level, 1: High level)</td><td>CMOS push-pull output</td></tr>
<tr><td>67</td><td>REM</td><td>Remote controller signal input</td><td>This pin inputs a remote controller signal.
This pin supports the μPD6121G remote controller signal transmitter IC.</td><td>Input</td></tr>
<tr><td>68</td><td>KEYREQ</td><td>LCD driver key request signal input</td><td>This pin inputs a key request signal from the LCD driver IC (μPD16431A).
Connect this pin to the KEYREQ pin (pin 6) of the LCD driver IC (μPD16431A).
When this pin inputs a high level, it is assumed that a key is pressed, and key data is read.</td><td>Input</td></tr>
<tr><td>69</td><td>$\overline{\text{ACC}}$</td><td>Accessory power signal input</td><td>This pin inputs an accessory power signal.
Input a signal to this pin as follows:
<table>
<tr><th>$\overline{\text{ACC}}$ Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Normal operation</td></tr>
<tr><td>1</td><td>Standby (low current consumption) operation</td></tr>
</table>
(0: Low level, 1: High level)
For the standby operation, refer to “5. STANDBY FUNCTION”.</td><td>Input</td></tr>
<tr><td>70</td><td>$\overline{\text{BATT}}$</td><td>Battery power signal input</td><td>This pin inputs a battery power signal.
Input a signal to this pin as follows:
<table>
<tr><th>$\overline{\text{BATT}}$ Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Normal operation</td></tr>
<tr><td>1</td><td>Standby (low power consumption) operation</td></tr>
</table>
(0: Low level, 1: High level)
For the standby operation, refer to “5. STANDBY FUNCTION”.</td><td>Input</td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Pin Name</th><th>Description</th><th>I/O Type</th></tr>
<tr><td>71</td><td>$\overline{\text{EJECT}}$</td><td>$\boxed{\text{EJECT}}$ key signal input</td><td>This pin inputs an $\boxed{\text{EJECT}}$ key signal.
Connect a momentary key to this pin.
Input a signal to this pin as follows:
<table>
<tr><th>$\overline{\text{EJECT}}$ Pin</th><th>Description</th></tr>
<tr><td>0</td><td>$\boxed{\text{EJECT}}$ key on</td></tr>
<tr><td>1</td><td>$\boxed{\text{EJECT}}$ key off</td></tr>
</table>
(0: Low level, 1: High level)</td><td>Input</td></tr>
<tr><td>72</td><td>DTH</td><td>Front panel detachment signal input</td><td>This pin inputs a signal indicating that the front panel is attached/detached.
Input a signal to this pin as follows:
<table>
<tr><th>DTH Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Front panel is correctly attached.</td></tr>
<tr><td>1</td><td>Front panel is detached.</td></tr>
</table>
(0: Low level, 1: High level)
If the front panel is detached, the power is forcibly turned off.</td><td>Input</td></tr>
<tr><td>73</td><td>FL PANEL</td><td>Front panel open signal input</td><td>This pin inputs a signal that indicates whether the front panel is open or closed.
Input a signal to this pin as follows:
<table>
<tr><th>FL PANEL Pin</th><th>Description</th></tr>
<tr><td>0</td><td>Front panel is closed.</td></tr>
<tr><td>1</td><td>Front panel is open.</td></tr>
</table>
(0: Low level, 1: High level)
The disc cannot be ejected when the front panel is closed.</td><td>Input</td></tr>
<tr><td>74</td><td>REGCPU</td><td>CPU power supply regulator</td><td>CPU power supply regulator pin.
Connect this pin to the GND pin via a 0.1 μF capacitor.</td><td>–</td></tr>
<tr><td>75</td><td>GND</td><td>Ground</td><td>Ground pin of the device.
Ground this pin.</td><td>–</td></tr>
<tr><td>76
77</td><td>X2
X1</td><td>Crystal resonator</td><td>This pin connects a crystal resonator.
Connect a 4.5 MHz crystal resonator to this pin.</td><td>–</td></tr>
<tr><td>78</td><td>REGOSC</td><td>Oscillator regulator</td><td>Oscillator regulator pin.
Connect this pin to the GND pin via a 0.1 μF capacitor.</td><td>–</td></tr>
<tr><td>79</td><td>V_{DD}</td><td>Power supply</td><td>Positive power supply pin of the device.
Supply 5 V ±10% to this pin when the device is operating.</td><td>–</td></tr>
<tr><td>80</td><td>$\overline{\text{RESET}}$</td><td>Reset input</td><td>Reset input pin of the device.
Input a high level to this pin when the device is operating.
If a low-level pulse is input to this pin for 10 μs or longer, the device is reset.</td><td>Input</td></tr>
</table>

2. KEY MATRIX CONFIGURATION

2.1 Location of Initialization Switches

Input Pin	Initialization Switch
DI1/FL LED (49)	AREA1
DI2/CTRL_95 (50)	AREA2
DI3/TRAY FWD (51)	FADSEL
DI4/TRAY REV (52)	EQICSEL
DI5/STB (53)	AMIF
DI6/A0 (54)	DISAMIFC
DI7/RESET_O (55)	NOCLK
DI8/LD_ON (56)	CLK12

Remark ( ): Pin numbers of μPD178024GC-XXX

2.2 Location of Momentary Key Matrix

Input Pin / Output Pin	KEY1 (2)	KEY2 (3)	KEY3 (4)	KEY4 (5)
KS1 (25)	M1	MAN DWN/SEEK DWN	VOL DWN	–
	REPEAT	PREV/REW	VOL DWN	–
	–	–	–	–
KS2 (26)	M2	MAN UP/SEEK UP	VOL UP	–
	SCAN	NEXT/FF	VOL UP	–
	–	–	–	–
KS3 (27)	M3	PSCAN/ASM	MUTE	–
	RANDOM	PGM CLR	MUTE	–
	–	–	–	–
KS4 (28)	M4	MONO	LOUD	–
	TOP	PROGRAM	LOUD	–
	–	–	–	–
KS5 (29)	M5	LOCAL	DSP	–
	–	–	DSP	–
	–	–	–	–
KS6 (30)	M6	DISP	VOL SEL/VOL CLR	–
	–	DISP	VOL SEL/VOL CLR	–
	–	–	–	–
KS7 (31)	BAND	CD	SRS	–
	TUNER	PLAY/PAUSE	SRS	–
	TUNER	CD	–	–
KS8 (32)	POWER	EJECT	–	–
	POWER	EJECT	–	–
	POWER	EJECT	–	–

Remarks **1.** ( ): Pin numbers of μPD16431A

2. Each row in the above table indicates a key name in the following modes:

Key name in radio mode
Key name in CD mode
Key name at power off

3. – indicates that the key is invalid.

2.3 Description of Key Matrix

2.3.1 Initialization switches

The initialization switches determine the functions of the μPD178024GC-051. Be sure to set these switches.

The following 15 types of initialization switches are available. All these switches are read on power application to the device, on releasing the standby mode, and on resetting the μPD178024GC-051; they are ignored at all other times.

To read an initialization switch, the corresponding initialization switch input pin (pin 49 to 56) is tested every 10 ms, and if a specific status of the pin is detected three times, the status of the initialization switch is read. In this way, chattering is eliminated.

(1) Switches specifying the intended region of the set

AREA1, AREA2

(2) Switch specifying whether the intermediate frequency is used for broadcasting station detection during auto tuning of the AM band (MW, LW) of the radio

DISAMIFC

(3) Switch setting the intermediate frequency of the AM band (MW, LW) of the radio

AMIF

(4) Switch specifying whether the clock function is used

NOCLK

(5) Switch setting the 12-hour/24-hour mode of the clock

CLK12

(6) Switch specifying whether an equalizer IC (TA2078P) is used or not

EQICSEL

(7) Switch specifying whether the fader adjustment function by an electronic volume IC (TDA7313) is used or not

FADSEL

These switches are set by pulling up or down the corresponding pins.

The functions of the initialization switches are explained next in alphabetical order.

<table>
<tr><th>Initialization Switch</th><th>Function</th></tr>
<tr><td>AMIF</td><td>This switch sets the intermediate frequency range in which a station is detected in the AM band (MW, LW) of the radio.
Set this switch as follows:
<table>
<tr><th>AMIF</th><th>Band</th><th>Intermediate Frequency</th></tr>
<tr><td rowspan="2">0</td><td>MW</td><td>+450 kHz ±3 kHz</td></tr>
<tr><td>LW</td><td>+450 kHz ±0.5 kHz</td></tr>
<tr><td rowspan="2">1</td><td>MW</td><td rowspan="2">+10.7 MHz ±20 kHz</td></tr>
<tr><td>LW</td></tr>
</table>
(0: Pull down, 1: Pull up)
Regardless of the setting of AMIF, convert the frequency into 450 kHz and input this frequency to the FMIFC and AMIFC pins.</td></tr>
<tr><td>AREA1
AREA2</td><td>These switches specify the region for which the set is intended.
Set these switches as follows:
<table>
<tr><th>AREA2</th><th>AREA1</th><th>Region</th></tr>
<tr><td>0</td><td>0</td><td>Western Europe</td></tr>
<tr><td>0</td><td>1</td><td>Eastern Europe</td></tr>
<tr><td>1</td><td>1</td><td>USA 1</td></tr>
<tr><td>1</td><td>0</td><td>USA 2</td></tr>
</table>
(0: Pull down, 1: Pull up)
Depending on the region specified, the reception band of the radio, reception frequency, and initial value of the preset memory differ. For details, refer to “3. RADIO FUNCTIONS”.</td></tr>
<tr><td>CLK12</td><td>This switch specifies the 12-hour or 24-hour mode of the clock.
Set this switch as follows:
<table>
<tr><th>CLK12</th><th>Display Mode of Clock</th></tr>
<tr><td>0</td><td>24-hour mode</td></tr>
<tr><td>1</td><td>12-hour mode (with “AM” and “PM” indication)</td></tr>
</table>
(0: Pull down, 1: Pull up)</td></tr>
<tr><td>DISAMIFC</td><td>This switch is used to specify whether an intermediate frequency is used for detection of a broadcasting station during auto tuning of the AM band (MW, LW) of the radio.
Set this switch as follows:
<table>
<tr><th>DISAMIFC</th><th>AM Band Station Detection Mode</th></tr>
<tr><td>0</td><td>Intermediate frequency is identified (identification by S meter and intermediate frequency).</td></tr>
<tr><td>1</td><td>Intermediate frequency is not identified (identification by S meter).</td></tr>
</table>
(0: Pull down, 1: Pull up)</td></tr>
<tr><td>EQICSEL</td><td>This switch specifies whether an equalizer IC (TA2078P) is used or not.
Set this switch as follows:
<table>
<tr><th>EQICSEL</th><th>Equalizer IC</th></tr>
<tr><td>0</td><td>Equalizer IC is not used (equalizer processing by electronic volume).</td></tr>
<tr><td>1</td><td>Equalizer IC is used (equalizer processing by equalizer IC).</td></tr>
</table>
(0: Pull down, 1: Pull up)</td></tr>
</table>

<table>
<tr><th>Initialization Switch</th><th>Function</th></tr>
<tr><td>FADSEL</td><td>This switch specifies whether the fader adjustment function of the electronic volume IC (TDA7313) is used.
Set this switch as follows:
<table>
<tr><th>FADSEL</th><th>Fader Adjustment Function</th></tr>
<tr><td>0</td><td>Fader adjustment function is not used.</td></tr>
<tr><td>1</td><td>Fader adjustment function is used.</td></tr>
</table>
(0: Pull down, 1: Pull up)</td></tr>
<tr><td>NOCLK</td><td>This switch specifies whether the clock function is used or not.
Set this switch as follows:
<table>
<tr><th>NOCLK</th><th>Clock Function</th></tr>
<tr><td>0</td><td>Clock function is used.</td></tr>
<tr><td>1</td><td>Clock function is not used.</td></tr>
</table>
(0: Pull down, 1: Pull up)</td></tr>
</table>

2.3.2 Momentary keys

Rollover of momentary keys including the POWER key is valid, and the operation of the R key is performed.
The clock can be adjusted by pressing the MAN UP/SEEK UP (NEXT/FF) key or MAN DWN/SEEK DWN (PREV/REW) key while holding down the DISP key during clock display.
Rollover of momentary keys other than above is invalid (no key operates).

The functions of the momentary keys are explained next in alphabetical order.

Momentary Key	Function
BAND	This key selects the reception band of the radio. It is valid in the radio mode. Each time this key is pressed, the reception band is changed as follows: FM1 → FM2 → FM3 → AM1 (MW1, MW) → AM2 (MW2, LW) When the radio mode is selected for the first time after power application, the FM1 band is received. The MW or LW band is assigned to the AM2 band depending on the region for which the set is intended. For assignment of the reception band, refer to “3.1 Reception Bands”.
CD	This key selects the CD mode. It is valid if a disc is inserted in the power-off status and radio mode. If this key is pressed when no disc is inserted in the radio mode, a message indicating that no disc is inserted is displayed for 3 seconds. When this key is pressed, power is turned on, the CD mode is selected, and the CD is played from the position on the disc that was played last. The “repeat”, “intro”, “random”, and “program” playback modes are all off when the CD mode is selected. If the CD mode is selected for the first time after power application, the first track of the disc is played.

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>DISP</td><td>This key selects a display mode and adjusts the clock.
It is valid in the radio mode and CD mode.

(1) Selecting display mode
If this key is pressed and released without pressing any other keys, it functions as a display mode selector key.
A display mode is selected as follows, depending on the telephone mute status and forced mute status.
<table>
<tr><th>Mute</th><th>Operation</th></tr>
<tr><td>Off</td><td>Selects an audio source display mode and clock display mode.
The operation of the key is as follows, depending on whether the clock function is used or not, as specified by the initialization switch “NOCLK”.

(1) When clock function is used
If use of the clock function is specified, and if the volume is being displayed, display of the volume ends, and the display is changed as follows:

In radio mode
Radio display ↔ Clock display

In CD mode
CD display ↔ Clock display

If nothing is done for 5 seconds after the clock display mode is selected, the audio source display mode is restored.

(2) When clock function is not used
If use of the clock function is not specified, a switchover between the audio source display mode and clock display mode is not made, and the volume display mode is simply canceled.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>DISP</td><td>
<table>
<tr><th>Mute</th><th>Operation</th></tr>
<tr><td>On</td><td>This key is also used to temporarily select the audio source display mode during mute display.
The display mode is changed as follows:

In radio mode
Mute display → Radio display

In CD mode
Mute display → CD display

If nothing is done for 5 seconds after the display mode has been changed, the mute display mode is restored.
The mute display is in the telephone mute display mode if telephone mute is on and in the forced mute display mode if forced mute is on.
If both telephone mute and forced mute are on at the same time, the telephone mute display mode is selected.</td></tr>
</table>

(2) Adjusting the clock
If the MAN UP/SEEK UP (NEXT/FF) key or MAN DWN/SEEK DWN (PREV/REW) key is pressed while holding down the DISP key during clock display in the power-on status, the hour digit and minute digit of the clock can be adjusted as follows:

Adjusting the hour digit
Each time the MAN DWN/SEEK DWN (PREV/REW) key is pressed while holding down the DISP key, the hour digit is incremented by one hour.
At this time, the minute digit and second digit are not affected.
If the MAN DWN/SEEK DWN (PREV/REW) key is held down for about 250 ms, the hour digit is incremented by 4 hours per second (1 hour every 250 ms), until the key is released.

Adjusting the minute digit
Each time the MAN UP/SEEK UP (NEXT/FF) key is pressed while the DISP key is held down, the minute digit is incremented by 1 minute.
At this time, no carry occurs from the minute digit to the hour digit.
Each time the minute digit is adjusted, the second digit is reset to 0 seconds.
If the MAN UP/SEEK UP (NEXT/FF) key is held down for 250 ms, the minute digit is incremented by 4 minutes per second (1 minute every 250 ms), until the key is released.
</td></tr>
</table>

Momentary Key	Function
DSP	This key selects an equalizer mode. It is valid in the power-on status. Each time this key is pressed, the equalizer mode is changed as follows: FLAT → ROCK → CLASSIC → POP On power application, the equalizer mode used when power was turned off last is restored. The default equalizer mode is “FLAT”.
EJECT	This key is used to eject a disc. It is valid when a disc is inserted. Two EJECT keys are available. One is connected to the $\overline{\text{EJECT}}$ pin and the other is connected to the momentary key matrix. These keys are the same in terms of function and can be used at the same time. However, the EJECT key connected to the momentary key matrix is invalid in the standby mode. When the EJECT key is pressed, the disc is ejected. If the disc is ejected in the CD mode, the radio mode is set. However, the disc is not ejected if the front panel is closed. If the CD mode is set at this time, playing is stopped and the radio mode is selected.

Momentary Key	Function
LOCAL	This key selects whether the local mode is used or not during auto tuning of the radio. It is valid in the radio mode. Each time this key is pressed, the local mode is turned on or off. The auto tuning operation is performed as follows, depending on whether the local mode is on or off. <table><tr><th>Local Mode</th><th>Operation</th></tr><tr><td>On</td><td>Auto tuning in local mode and DX mode</td></tr><tr><td>Off</td><td>Auto tuning in DX mode only</td></tr></table>The on/off status of the local mode selected during an auto tuning operation is not reflected in the auto tuning operation in progress, and will be valid when the next auto tuning operation is started.
LOUD	This key selects a loudness status. It is valid in the power-on status. Each time this key is pressed, loudness is turned on/off. On power application, the loudness status selected when the power was turned off last is restored. The default loudness status is off.
M1 M2 M3 M4 M5 M6	These are call and write keys of the preset memory of the radio. They are valid in the radio mode. A frequency in each band of FM1, FM2, FM3, AM1 (MW1, MW), and AM2 (MW2, LW) can be recorded by using each key. The operation of these keys is as follows, depending on the time for which a key is pressed. <table><tr><th>Key Pressed for:</th><th>Operation</th></tr><tr><td>Less than 0.7 seconds</td><td>These keys function as preset memory calling keys. When one of the keys is pressed, the preset memory number corresponding to the key is displayed. If the key is pressed and released within 0.7 seconds, the frequency written to the corresponding preset memory is received.</td></tr><tr><td>0.7 seconds or longer</td><td>The keys function as preset memory writing keys. When one of the keys is pressed, the preset memory number corresponding to the key is displayed. If the key is held down for 0.7 seconds or longer, the frequency currently displayed is written to the preset memory corresponding to the key. At this time, the displayed preset memory number blinks only once (i.e. goes off for about 500 ms). After that, the preset memory number is displayed again. The “CH” indication does not blink. After the preset memory has been written, the frequency written to that preset memory is received.</td></tr></table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>MAN UP/SEEK UP
MAN DWN/SEEK DWN</td><td>These keys increment or decrement the received frequency of the radio, or are auto seek up/down keys.
They are valid in the radio mode.
Even in the radio mode, these keys can be also used to adjust the clock by pressing the DISP key at the same time during clock display.
For how to adjust the clock, refer to the description of the DISP key.
The operation of these keys is as follows, depending on how long each key is held down.
<table>
<tr><th>Key Pressed for:</th><th>Operation</th></tr>
<tr><td>Less than 0.7 seconds</td><td>Each time the key is pressed, the received frequency is incremented (MAN UP/SEEK UP key) or decremented (MAN DWN/SEEK DWN key) by 1 channel space.</td></tr>
<tr><td>0.7 seconds or longer</td><td>If the key is held down for 0.7 seconds, an auto seek operation is started in the up (MAN UP/SEEK UP key) or down (MAN DWN/SEEK DWN key) direction.</td></tr>
</table>
The auto seek operation is performed as follows, depending on the on/off status of the local mode when the operation is started.
<table>
<tr><th>Local Mode</th><th>Operation</th></tr>
<tr><td>On</td><td>The reception frequency is incremented or decremented by 1 channel space in the local mode, starting from the frequency when the operation was started, while detection of a station at each frequency is identified.
If the frequency is incremented/decremented to the original reception frequency, the reception frequency in the DX mode is incremented/decremented by 1 channel space while detection of a station at each frequency is identified, until a station is detected.
If a station has been detected, the auto seek operation ends, and the frequency at that time is received.</td></tr>
<tr><td>Off</td><td>The reception frequency when the operation is started is incremented or decremented by 1 channel space in the DX mode while detection of a station at each frequency is identified, until a station is detected.
If a station has been detected, the auto seek operation ends, and the frequency at that time is received.</td></tr>
</table>
For how to identify detection of a station, refer to “3. RADIO FUNCTIONS”.</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>MAN UP/SEEK UP
MAN DWN/SEEK DWN</td><td>During the auto seek operation, the operation of each key is as follows:
<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>MAN UP/SEEK UP</td><td>The operation of the key is as follows depending on the seek direction.
<table>
<tr><th>Seek Direction</th><th>Operation</th></tr>
<tr><td>Up</td><td>The auto seek operation is stopped and the frequency when the key was pressed is received.</td></tr>
<tr><td>Down</td><td>The seek direction is changed upward from the frequency received when the key was pressed.</td></tr>
</table></td></tr>
<tr><td>MAN DWN/SEEK DWN</td><td>The operation of the key is as follows depending on the seek direction.
<table>
<tr><th>Seek Direction</th><th>Operation</th></tr>
<tr><td>Up</td><td>The seek direction is changed downward from the frequency received when the key was pressed.</td></tr>
<tr><td>Down</td><td>The auto seek operation is stopped and the frequency when the key was pressed is received.</td></tr>
</table></td></tr>
<tr><td>LOCAL</td><td>The auto seek operation continues.
The operation of the pressed key is performed.
The on/off status of the selected local mode is not reflected in the auto seek operation in progress, and will become valid when the next auto seek or auto store memory operation is started.</td></tr>
<tr><td>M1 to M6</td><td>The auto seek operation is stopped.
The preset memory corresponding to the pressed key is called.</td></tr>
<tr><td>PSCAN/ASM
MONO
POWER
BAND
CD</td><td>The auto seek operation is stopped.
The operation of the pressed key is performed from the frequency received when the key was pressed.</td></tr>
<tr><td>EJECT
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>The auto seek operation continues.
The operation of the pressed key is performed.</td></tr>
</table>
Keys other than above are invalid.</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>MONO</td><td>This key controls the forced monaural status of the radio.
It is valid when the FM band is being received in the radio mode.
Each time this key is pressed, the forced monaural status is turned on or off.
The forced monaural status and the output of the MONO pin (forced monaural signal), as well as the "ST" display, which indicates the forced monaural off status, and the "◎" display, which indicates reception of stereo broadcasting are as follows:
<table>
<tr><th>Forced Monaural</th><th>MONO Pin</th><th>"ST" Display</th><th>"◎" Display</th></tr>
<tr><td>On</td><td>1</td><td>Goes off</td><td>Goes off regardless of stereo broadcasting reception status</td></tr>
<tr><td>Off</td><td>0</td><td>Lights while FM band is being received, and goes off at all other times</td><td>Depends on reception band and stereo broadcasting reception status.
For details, refer to "6.3 Display on LCD Panel".</td></tr>
</table>
(0: Low level, 1: High level)</td></tr>
<tr><td>MUTE</td><td>This key controls the forced mute status.
It is valid in the power-on status.
However, it is invalid if telephone mute is turned on by the PMUTE pin (pin 47).
Each time this key is pressed, the forced mute status is turned on or off.
The forced mute status is also cleared by operating another valid key.
When power is turned on, this key restores the forced mute status when power was turned OFF last.
The default forced mute status is off on power application.</td></tr>
<tr><td>NEXT/FF
PREV/REW</td><td>These keys increment/decrement and fast-forward/rewind the tracks of the CD, and increment/decrement the selection of the program.
They are valid in the CD mode.
Even in the CD mode, these keys are also used to adjust the clock if the DISP key is also pressed at the same time during clock display. For how to adjust the clock, refer to the description of the DISP key.

The operation of these keys differs as follows, depending on the status of the program.

(1) While program is being edited
If these keys are pressed while a program is being edited, the music to be selected as the program contents is incremented (NEXT/FF key) or decremented (PREV/REW key) by one.
The operation does not differ regardless of the time for which the key is pressed. While the program is being edited, fast-forward/rewind cannot be performed.
For program playback, refer to "4.2 Program Playback".</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>NEXT/FF
PREV/REW</td><td>(2) While program is not being edited
The operation of these keys is as follows, depending on the time for which the key is pressed.
<table>
<tr><th>Key Pressed for:</th><th>Key</th><th>Operation</th></tr>
<tr><td>Less than 0.7 seconds</td><td>NEXT/FF</td><td>Increments the track to be played.
If the track repeat mode is selected at this time, the mode is cleared.
However, the other playback modes, “intro”, “random”, and “program”, will continue.
How the tracks are incremented differs depending on the playback mode.
For details, refer to the description of the SCAN key and RANDOM key, and “4.2 Program Playback”.
If all the play modes are off, the track after the one currently playing is played from the beginning.</td></tr>
<tr><td></td><td>PREV/REW</td><td>Decrements the track to be played.
If the track repeat mode is selected at this time, the mode is cleared.
However, the other playback modes, “intro”, “random”, and “program”, will continue.
How the tracks are decremented differs depending on the playback mode.
For details, refer to the description of the SCAN key and RANDOM key, and “4.2 Program Playback”.
If all the playback modes are off, one of the following operations is performed, depending on the playback time when the key is pressed.
<table>
<tr><th>Playback Time</th><th>Operation</th></tr>
<tr><td>Less than 1 second from beginning of track</td><td>Decrements the track to be played by one and the track before the one currently playing is played from the beginning.</td></tr>
<tr><td>1 second or longer from beginning of track</td><td>Replays the track being played from the beginning.</td></tr>
</table></td></tr>
<tr><td>0.7 seconds or longer</td><td>NEXT/FF</td><td>Clears the playback modes, “repeat”, “intro”, “random”, and “program”.
Fast-forward continues until the key is released.</td></tr>
<tr><td></td><td>PREV/REW</td><td>Clears the playback modes, “repeat”, “intro”, “random”, and “program”.
Rewind continues until the key is released.</td></tr>
</table></td></tr>
</table>

Momentary Key	Function
PGM CLR	This key is used to clear the CD program or delete tracks from the program. It is valid in the CD mode while the program is playing or while a program to be played is being edited. The operation of this key is as follows, depending on the program status. **(1) While program is being edited** When this key is pressed, the music selected as the play program is deleted from the program contents. At this time, the playback status and playback mode are not affected. **(2) While program is being played** When this key is pressed, the program playback mode is cleared. Playing continues, however. For the program playback, refer to “4.2 Program Playback”.
PLAY/PAUSE	This key temporarily stops the CD player playing. It is valid in the CD mode. Each time this key is pressed, the CD starts or stops playing. This key is also used to start a program while the program is being edited. For the program playback, refer to “4.2 Program Playback”.
POWER	This key changes the power status of the set. Each time this key is pressed, the power to the set is turned on or off. When power is turned on by using this key, the audio source mode selected when power was turned off last time is restored. If no disc is inserted, however, the radio mode is selected when power is turned on. On power application, power to the set is off, and the default audio source mode is the radio mode.

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>PROGRAM</td><td>This key is used to edit the program to be played by the CD player.
It is valid in the CD mode.
The operation of the key differs as follows depending on how the program is edited.

(1) While program is being edited
When this key is pressed, the music selected for editing is set as the program contents.
At this time, the playback status and playback mode are not affected.

(2) While program is not being edited
When this key is pressed, the program editing status is set.
If a program is playing at this time, the program playback mode is cleared.
The playback modes, “repeat”, “intro”, and “random” continue.

For the program playback, refer to “4.2 Program Playback”.</td></tr>
<tr><td>PSCAN/ASM</td><td>This key is used to scan the preset memory or for automatic storing to memory.
It is valid in the radio mode.
The operation of the key differs, as follows, depending on the time for which the key is pressed.
<table>
<tr><th>Key Pressed for:</th><th>Operation</th></tr>
<tr><td>Less than 0.7 seconds</td><td>If the key is pressed and released within 0.7 seconds, a preset memory scan operation is started.</td></tr>
<tr><td>Longer than 0.7 seconds</td><td>If the key is pressed for 0.7 seconds or longer, an auto store memory operation is started.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>PSCAN/ASM</td><td>

(1) Preset memory scan operation

The contents of each preset memory of the band being received is automatically received for 6 seconds.

If a source other than the preset memory is received when the operation is started, the contents of the preset memories are sequentially received, starting from M1, for 6 seconds each. If a preset memory is received, the contents of next preset memory is received for 6 seconds, followed by the preset memory after next, and so on (for example, while M3 is being received, M4 is received for 6 seconds, followed by M5, M6, and so on), as illustrated below.

M1 → M2 → M3 → M4 → M5 → M6

While the contents of a preset memory are being received for 6 seconds, the preset memory number is displayed blinking at a frequency of 1 Hz and with a duty factor of 50%. The “CH” indication does not blink.

When the contents of the next preset memory are received after the lapse of 6 seconds, a beep sound is output.

To stop at the preset memory currently being received, either press the PSCAN/ASM key or press the preset memory key identical to the preset memory currently being received.

The operation of each key during a preset memory scan operation is as follows.

<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>PSCAN/ASM</td><td>Stops the preset memory scan operation.
The frequency received when the key was pressed is received as is.</td></tr>
<tr><td>M1 to M6
MAN UP/SEEK UP
MAN DWN/SEEK DWN
POWER
BAND
CD</td><td>Stops the preset memory scan operation.
The operation of the pressed key is started at the frequency received when the key was pressed.</td></tr>
<tr><td>MONO
LOCAL
EJECT
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>Continues the preset memory scan operation.
The operation of the key pressed is performed.</td></tr>
</table>

Keys other than those above are invalid.

</td></tr>
</table>

Momentary Key	Function
PSCAN/ASM	**(2) Auto store memory** This operation is to search a broadcasting station automatically and write it to a preset memory. A station is searched in the upward direction starting from the frequency incremented by 1 channel space from the frequency received when the auto store memory operation was started. If the auto store memory operation is started while a preset memory is being received, the preset memory reception status is cleared. When a station is detected, the frequency of that station is written to a preset memory. For how to identify detection of a station, refer to “3. RADIO FUNCTIONS”. During the auto store memory operation, the number of the preset memory to which the frequency of the station detected last is displayed blinking at a frequency of 1 Hz and with a duty factor of 50%. If nothing is written to a preset memory, the preset memory number is not displayed. The auto store memory operation is performed as follows, depending on the on/off status of the local mode when the operation was started.

Local Mode	Operation
On	Searches a station in the local mode in the upward direction from the frequency incremented by 1 channel space from the frequency currently received. If six stations or more have not been detected by the time all the frequencies have been searched once, the DX mode is selected and the search operation continues. If six or more stations have been detected in the local mode, or if all the frequencies have been searched in the DX mode, the auto store memory operation is finished. If the PSCAN/ASM key is pressed during a search, the auto store memory operation ends, and the frequency received when the operation was started is received. If even one station is detected when the auto store memory operation ends because six or more stations were detected in the local mode or all the frequencies were searched in the DX mode, a preset memory scan operation is started from preset memory M1.

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>PSCAN/ASM</td><td>
<table>
<tr><th>Local Mode</th><th>Operation</th></tr>
<tr><td>On</td><td>How the contents of a preset memory are updated differs depending on the number of stations detected.

(1) If six or more stations were detected in local mode
If six or more stations were detected in local mode, six stations are selected starting from the highest input level of the S meter, and the frequencies of the stations are written to the preset memories, starting from the station with the highest input level and from the lowest preset memory number.

(2) If less than six stations were detected in the local mode and stations were later detected in the DX mode, totaling six or more stations
The stations detected in the DX mode with a high input level of the S meter are selected so as to total six stations when added to, the stations detected in the local mode.
However, the stations detected in the local mode are not included in the stations selected in the DX mode.
The six stations are first written to the preset memories, starting from the lowest preset memory number and starting from the station with the highest input level detected in the local mode.
Next, the stations detected in the DX mode but not written to the preset memories in the local mode are written to the remaining preset memories, starting from the lowest preset memory number and from the station with the highest input level.

(3) If less than six stations were detected in the local mode and stations were later detected in the DX mode, totaling less than six stations
If the stations detected in the local mode and DX mode are at the same frequencies, the stations detected in the DX mode are deleted so that the same frequency is not written to two memories.
Of the six stations, those detected in the local mode are first written to the preset memories starting from the station with the highest input level and from the lowest preset memory number.
Next, the stations detected in the DX mode are written to the remaining preset memories starting from the station with the highest input level and from the lowest preset memory number.
At this time, the contents of a preset memory to which nothing is written remain unchanged.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>PSCAN/ASM</td><td>
<table>
<tr><th>Local Mode</th><th>Operation</th></tr>
<tr><td>Off</td><td>Searches a station in the DX mode in the upward direction from the frequency incremented by 1 channel space from the frequency currently being received, and the operation ends when all the frequencies have been searched.
If the PSCAN/ASM key is pressed during a search, the auto store memory operation ends, and the frequency received when the operation was started is received.
How the contents of a preset memory are updated differs depending on the number of stations detected.

(1) If six or more stations were detected
If six or more stations were detected, six stations are selected starting from the highest input level of the S meter, and the frequencies of the stations are written to the preset memories, starting from the station with the highest input level and from the lowest preset memory number.

(2) If less than six stations were detected
If less than six stations were detected, their frequencies are written to the preset memories starting from the station with the highest input level and from the lowest preset memory number.
At this time, the contents of a preset memory to which nothing is written remain unchanged.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>PSCAN/ASM</td><td>The operation of each key is as follows during the auto store memory operation.
<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>PSCAN/ASM</td><td>Stops the auto store memory operation.
Receives the frequency selected when the operation was started.</td></tr>
<tr><td>M1 to M6</td><td>Stops the auto store memory operation.
Calls the preset memory corresponding to the pressed key.</td></tr>
<tr><td>MAN UP/SEEK UP
MAN DWN/SEEK DWN
POWER
BAND
CD</td><td>Stops the auto store memory operation.
The operation of the pressed key is performed starting from the frequency received when the auto store memory operation was started.</td></tr>
<tr><td>LOCAL</td><td>The auto store memory operation continues.
The operation of the pressed key is performed.
The on/off status of the local mode selected is not reflected in the auto store memory operation in progress, but will become valid when the next auto seek or auto store memory operation is started.</td></tr>
<tr><td>MONO
EJECT
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>The auto store memory operation continues.
The operation of the pressed key is performed.</td></tr>
</table>
Keys other than those above are invalid.</td></tr>
<tr><td>RANDOM</td><td>This key changes the random play status of the CD player.
It is valid in the CD mode.
Each time this key is pressed, the on/off status of the random play mode is changed.
At this time, the playback modes “repeat”, “intro”, and “program” are cleared.

If the random play mode is turned on, a track is selected at random from the disc and played from the beginning.
When the track currently being played is finished, another track is selected from the disc at random again, and is played from the beginning.
However, a track that has been already played is not selected.
After all the tracks on the disc have been played, a track is selected at random again. These operations are repeated until the random play mode is cleared.</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>RANDOM</td><td>The operation of each key is as follows during random play.
<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>RANDOM</td><td>Clears the random play mode.
Playback continues.</td></tr>
<tr><td>REPEAT
SCAN
TOP
EJECT
POWER
TUNER</td><td>Clears the random play mode.
The operation of the key pressed is performed.</td></tr>
<tr><td>PLAY/PAUSE
PROGRAM
PGM CLR
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>Clears the random play mode.
The operation of the key pressed is performed.</td></tr>
<tr><td>NEXT/FF</td><td>The operation of the key is as follows, depending on how long the key is pressed.
<table>
<tr><th>Key Pressed for:</th><th>Operation</th></tr>
<tr><td>Less than 0.7 seconds</td><td>The random play mode continues.
The track currently being played is played from the beginning.</td></tr>
<tr><td>0.7 seconds or longer</td><td>The random play mode is cleared.
The operation of the pressed key is performed.</td></tr>
</table></td></tr>
<tr><td>PREV/REW</td><td>The operation of the key is as follows, depending on how long the key is pressed.
<table>
<tr><th>Key Pressed for:</th><th>Operation</th></tr>
<tr><td>Less than 0.7 seconds</td><td>The random play mode continues.
Tracks are shuffled again and the track selected is played from the beginning.</td></tr>
<tr><td>0.7 seconds or longer</td><td>The random play mode is cleared.
The operation of the pressed key is performed.</td></tr>
</table></td></tr>
</table>
Keys other than those above are invalid.</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>REPEAT</td><td>This key controls the track repeat mode of the CD player.
It is valid in the CD mode.
Each time this key is pressed, the track repeat mode is turned on or off.
At this time, the playback modes, “intro”, “random”, and “program” are cleared.

When one track has been played to the end in the track repeat mode, it is played again from the beginning, until the track repeat mode is cleared.
The operation of each key is as follows in the track repeat mode:
<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>REPEAT</td><td>Clears the track repeat mode.
Play continues.</td></tr>
<tr><td>SCAN
RANDOM
TOP
NEXT/FF
PREV/REW
EJECT
POWER
TUNER</td><td>Clears the track repeat mode.
The operation of the pressed key is performed.</td></tr>
<tr><td>PLAY/PAUSE
PROGRAM
PGM CLR
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>The track repeat mode continues.
The operation of the pressed key is performed.</td></tr>
</table>
Keys other than those above are invalid.</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>SCAN</td><td>This key controls the intro playback mode of the CD player.
It is valid in the CD mode.
Each time this key is pressed, the intro playback mode is turned on or off.
At this time, the playback modes, “repeat”, “random”, and “program” are cleared.

When the intro playback mode is turned on, the beginning of the next track to the one currently being played is played.
The selected track is played for 10 seconds, and then the next track is played for 10 seconds, and so on, until the intro playback mode is cleared.
The operation of each key is as follows in the intro playback mode:
<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>SCAN</td><td>Clears the intro playback mode.
Playback continues.</td></tr>
<tr><td>REPEAT
RANDOM
TOP
EJECT
POWER
TUNER</td><td>Clears the intro playback mode.
The operation of the pressed key is performed.</td></tr>
<tr><td>PLAY/PAUSE
PROGRAM
PGM CLR
DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>The intro playback mode continues.
The operation of the pressed key is performed.</td></tr>
<tr><td>NEXT/FF
PREV/REW</td><td>The operation of the key is as follows depending on how long the key is pressed.
If the key is released within 0.7 seconds:
The intro playback mode continues.
The operation of the pressed key is performed.
If the key is held down for longer than 0.7 seconds:
The intro playback mode is cleared.
The operation of the pressed key is performed.</td></tr>
</table>
Keys other than those above are invalid.</td></tr>
</table>

Momentary Key	Function
SRS	This key controls the SRS status. It is valid in the power-on status. Each time this key is pressed, SRS is turned on or off. When power is turned on, the SRS status when power was turned off last is restored. The default SRS status is off on power application.
TOP	This key is used to play the first track on the disc in the CD mode. It is valid in the CD mode. When this key is pressed, the playback modes, “repeat”, “intro”, “random”, and “program” are cleared, and the first track on the disc is played.
TUNER	This key selects the radio mode. It is valid in the power-off status and in the CD mode. If this key is pressed and released within 4 seconds, power is turned on and the radio mode is set. When the radio mode is set, the reception band of the radio, reception frequency, received preset memory number, forced monaural status, and the on/off status of the local mode are the same as those selected when the radio mode was selected the last time. If the radio mode is selected for the first time after power application, the lowest frequency of the FM1 band is received, and no preset memory is selected. At this time, both the forced monaural status and local mode are turned off.

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>VOL SEL/VOL CLR</td><td>
<p>This key selects an adjustment mode of the electronic volume or initializes the status of the electronic volume.
It is valid in the power-on status.
However, this key is invalid if telephone mute is turned on by the PMUTE pin (pin 47).
This key has two functions, as the VOL SEL key and the VOL CLR key. Which function is selected depends on how long the key is pressed.</p>
<table>
<tr><th>Key Pressed for:</th><th>Operation</th></tr>
<tr><td>Less than 4 seconds</td><td>Functions as VOL SEL key.</td></tr>
<tr><td>4 seconds or longer</td><td>Functions as VOL CLR key.</td></tr>
</table>
<p>(1) Operation of VOL SEL key</p>
<p>This key is used to select the adjustment mode of the electronic volume.
The electronic volume can be adjusted in the following modes:</p>
<table>
<tr><th>Mode</th><th>Function</th></tr>
<tr><td>Volume</td><td>Adjusts the volume of the main volume.</td></tr>
<tr><td>Bass</td><td>Adjusts the volume of the bass (low-frequency region).</td></tr>
<tr><td>Treble</td><td>Adjusts the volume of the treble (high-frequency region).</td></tr>
<tr><td>Balance</td><td>Adjusts the volume balance between the left and the right.</td></tr>
<tr><td>Fader</td><td>Adjusts the volume balance between the front and the rear.</td></tr>
</table>
<p>However, the fader adjustment mode cannot be used if it is specified that the fader adjustment function is not used by using the initialization switch “FADSEL”.
To perform equalizer processing by electronic volume, the bass adjustment mode and treble adjustment mode cannot be selected if the equalizer mode is other than FLAT.
For equalizer processing by electronic volume, refer to “11.1 Electronic Volume Functions.”</p>
<p>If this key is pressed and released within 4 seconds while the electronic volume is not displayed, the main volume is displayed.
While the electronic volume is being displayed, the adjustment mode is changed as follows each time this key is pressed and released within 4 seconds.</p>
<p>→ Volume → (Bass → Treble) → Balance → (Fader)</p>
<p>The modes in parentheses ( ) are skipped if they cannot be selected because of the setting, and the next adjustment mode is selected.</p>
<p>If an operation other than that to adjust the volume is performed or if no key is pressed for 5 seconds while the electronic volume is displayed, the electronic volume display terminates.</p>
</td></tr>
</table>

<table>
<tr><th>Momentary Key</th><th>Function</th></tr>
<tr><td>VOL SEL/VOL CLR</td><td>(2) Operation of VOL CLR key
This key returns the set values in all the modes of the electronic volume, loudness status, and SRS status to the original conditions.
If this key is pressed for 4 seconds or longer, the set value of each mode of the electronic volume is returned to the default value at power application, and the loudness status and SRS status are turned off.</td></tr>
<tr><td>VOL UP
VOL DWN</td><td>These keys increase or decrease the volume in each adjustment mode of the electronic volume.
They are valid in the power-on status.
However, they are invalid if telephone mute is turned on by using the PMUTE pin (pin 47).
When the VOL UP key is pressed, the volume in an adjustment mode is increased.
When the VOL DWN key is pressed, the volume is decreased.
If either of these keys is held down for 500 ms or longer, the operation is repeatedly performed every 125 ms, until the key is released.

If either of these keys is pressed while the electronic volume is not being displayed, the main volume is displayed and, at the same time, the volume of the main volume is increased or decreased.
The operation of these keys is as follows in each adjustment mode of the electronic volume.
<table>
<tr><th>Mode</th><th>Operation</th></tr>
<tr><td>Volume</td><td>Increments or decrements the volume of the main volume.</td></tr>
<tr><td>Bass</td><td>Increments or decrements the volume of bass (low-frequency region).</td></tr>
<tr><td>Treble</td><td>Increments or decrements the volume of treble (high-frequency region).</td></tr>
<tr><td>Balance</td><td>Increments (moves to the right) or decrements (moves to the left) the volume balance between the left and the right.</td></tr>
<tr><td>Fader</td><td>Increments (moves forward) or decrements (moves backward) the volume balance between front and rear.</td></tr>
</table>
On power application, the volume value in each mode is set to the default value.
For the default value in each mode, refer to “11.1 Electronic Volume Functions”.
When the power is turned on or when the standby mode is released, the main volume value is returned to the default value if it is greater than the default value. If the main volume value is less than the default value, it is retained.
At this time, the volume value in each of the bass, treble, balance, and fader modes is retained, regardless of whether the value is greater or less than the default value.
For the correspondence between the displayed volume value and the set values of the electronic volume IC, refer to “11.2 Electronic Volume IC (TDA7313) Set Values”.
If an operation other than that to adjust the volume is performed or if no key is pressed for 5 seconds while the electronic volume is being displayed, the electronic volume display terminates.</td></tr>
</table>

3. RADIO FUNCTIONS

3.1 Reception Bands

The bands receivable in the radio mode are as follows depending on the region for which the application set is intended and are specified by initialization switches “AREA1” and “AREA2”.

AREA2	AREA1	Region	Reception Bands
0	0	Western Europe	FM1, FM2, FM3, AM1 (MW), AM2 (LW)
0	1	Eastern Europe	FM1, FM2, FM3, AM1 (MW), AM2 (LW)
1	1	USA 1	FM1, FM2, FM3, AM1 (MW1), AM2 (MW2)
1	0	USA 2	FM1, FM2, FM3, AM1 (MW1), AM2 (MW2)

(0: Pull down, 1: Pull up)

3.2 Reception Frequency, Channel Space, Reference Frequency, and Intermediate Frequency

The frequencies receivable in each band in the radio mode, channel space, reference frequency, and a range of intermediate frequencies in which broadcasting stations are detected differ as follows depending on the region for which the application set is intended and are specified by initialization switches “AREA1” and “AREA2”.

The range of the intermediate frequencies in which stations are detected during auto tuning of the AM band (MW or LW) can be selected by using initialization switch “AMIF”.

The reception frequencies, channel space, reference frequency, and intermediate frequencies are as follows:

Region	Band	Reception Frequency	Channel Space	Reference Frequency	AMIF	Intermediate Frequency
Western Europe	FM1, FM2, FM3	87.5 to 108.0 MHz	50 kHz	25 kHz	×	+10.7 MHz ±20 kHz
	AM1 (MW)	522 to 1,620 kHz	9 kHz	9 kHz	0	+450 kHz ±3 kHz
					1	+10.7 MHz ±20 kHz
	AM2 (LW)	144 to 290 kHz	1 kHz	1 kHz	0	+450 kHz ±0.5 kHz
					1	+10.7 MHz ±20 kHz
Eastern Europe	FM1	65.0 to 74.0 MHz	50 kHz	25 kHz	×	+10.7 MHz ±20 kHz
	FM2, 3	87.5 to 108.0 MHz	50 kHz	25 kHz	×	+10.7 MHz ±20 kHz
	AM1 (MW)	522 to 1,620 kHz	9 kHz	9 kHz	0	+450 kHz ±3 kHz
					1	+10.7 MHz ±20 kHz
	AM2 (LW)	144 to 290 kHz	1 kHz	1 kHz	0	+450 kHz ±0.5 kHz
					1	+10.7 MHz ±20 kHz
USA 1	FM1, FM2, FM3	87.5 to 108.0 MHz	100 kHz	25 kHz	×	+10.7 MHz ±20 kHz
	AM1 (MW1) AM2 (MW2)	530 to 1,620 kHz	10 kHz	10 kHz	0	+450 kHz ±3 kHz
					1	+10.7 MHz ±20 kHz
USA 2	FM1, FM2, FM3	87.5 to 107.9 MHz	200 kHz	25 kHz	×	+10.7 MHz ±20 kHz
	AM1 (MW1) AM2 (MW2)	530 to 1,710 kHz	10 kHz	10 kHz	0	+450 kHz ±3 kHz
					1	+10.7 MHz ±20 kHz

(0: Pull down, 1: Pull up, ×: don’t care)

3.3 Default Values of Preset Memories

On power application, the following frequencies are written to preset memories M1 to M6 to facilitate adjustment of the set.

Region	Band	M1	M2	M3	M4	M5	M6
Western Europe	FM1	87.50 MHz	89.90 MHz	97.90 MHz	105.90 MHz	108.00 MHz	87.50 MHz
	FM2, FM3	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz
	AM1 (MW)	522 kHz	603 kHz	999 kHz	1,404 kHz	1,620 kHz	522 kHz
	AM2 (LW)	144 kHz	180 kHz	216 kHz	252 kHz	290 kHz	144 kHz
Eastern Europe	FM1	65.00 MHz	67.00 MHz	68.50 MHz	70.50 MHz	72.50 MHz	74.00 MHz
	FM2, FM3	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz
	AM1 (MW)	522 kHz	603 kHz	999 kHz	1,404 kHz	1,620 kHz	522 kHz
	AM2 (LW)	144 kHz	180 kHz	216 kHz	252 kHz	290 kHz	144 kHz
USA 1	FM1	87.50 MHz	89.90 MHz	97.90 MHz	105.90 MHz	108.00 MHz	87.50 MHz
	FM2, FM3	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz
	AM1 (MW1)	530 kHz	600 kHz	1,000 kHz	1,500 kHz	1,620 kHz	530 kHz
	AM2 (MW2)	530 kHz	530 kHz	530 kHz	530 kHz	530 kHz	530 kHz
USA 2	FM1	87.50 MHz	89.90 MHz	97.90 MHz	105.90 MHz	107.90 MHz	87.50 MHz
	FM2, FM3	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz	87.50 MHz
	AM1 (MW1)	530 kHz	600 kHz	1,000 kHz	1,500 kHz	1,710 kHz	530 kHz
	AM2 (MW2)	530 kHz	530 kHz	530 kHz	530 kHz	530 kHz	530 kHz

3.4 Station Detection

A station is detected during auto tuning (auto seek and auto store memory) if the following two conditions of receivable frequencies are satisfied:

(1) Station is detected by the S meter signal.
(2) Station is detected by an intermediate frequency.

If detection of an intermediate frequency in the AM band is not selected by initialization switch “DISAMIFC”, the condition “(2) intermediate frequency” is ignored in detecting stations in the AM band (MW or LW), and only the condition “(1) S meter signal” is used.

(1) Station detection by S meter signal

Stations are detected or not detected depending on the signal intensity (input voltage) of the S meter signal input to the SM pin (pin 6) as follows, regardless of the reception bands and reception sensitivity (local/DX).

Input Voltage (V_{DD} = 5.0 V)	Station Detection
128.5 ÷ 256 × V_{DD} or more (2.49 V or more)	Station detected
Less than 128.5 ÷ 256 × V_{DD} (less than 2.49 V)	Station not detected

The S meter signal is identified after the PLL is locked and 20 to 30 ms after the S meter signal has been stabilized.
For the identification timing of the S meter signal, refer to “12. MUTE OUTPUT TIMING CHART”.

(2) Station detection by intermediate frequency

Stations are detected by measuring the intermediate frequency input to the FMIFC pin (pin 29) while the FM band is being received, or the intermediate frequency input to the AMIFC pin (pin 28) while the AM band (MW or LW) is being received.
The input intermediate frequency is measured three times by the internal frequency counter of the μPD178024-051 for a gate open time of 4 ms. If the result of measurement is in the specific frequency range more than two times out of three times, a station is detected.
For the range of the intermediate frequencies in which a station is detected, refer to “3.2 Reception Frequency, Channel Space, Reference Frequency, and Intermediate Frequency”.
For the identification timing of the intermediate frequency, refer to “12. MUTE OUTPUT TIMING CHART”.

4. CD PLAYER CONTROL FUNCTIONS

The μPD178024GC-051 can control a CD player (CDC-01KG).

4.1 CD Player Control

The following CD player control functions are available:

(1) Starting/stopping playback
(2) Temporarily stopping playback
(3) Selecting tracks in upward or downward direction
(4) Fast-forward/rewind
(5) Track repeat
(6) Intro playback
(7) Random play
(8) Program playback
(9) Loading/ejecting disc

For the details of each control function, refer to “2. KEY MATRIX CONFIGURATION”.

4.2 Program Playback

(1) Editing program

If the PROGRAM key is pressed in the CD mode, a program to be played in the program playback mode can be edited.

While a program is being edited, the message indicating the program editing mode is displayed, but play continues.

A program is edited in the following steps:

Step	Operation/Status	Program Number Display	Music Number Display
1	No tracks are programmed. In this status, the first attempt to edit a program is made.	01	– – – – indicates no candidate track for programming is selected.
2	Select the tracks to be programmed by using the NEXT/FF and PREV/REW keys. Any track on the disc can be selected.	01	04 (Blinks) Blinking indicates that a candidate track is available for selection.
3	After selecting the track to be programmed, set it by the PROGRAM key. If a new track is selected by following step 2 again after the track has been set, the track selected first is given up. In the display example on the right, track number 4 is set as program number 1.	01	04 The set track number does not blink.
4	Press the PROGRAM key again to increment the program number by one.	02	– – – – indicates that no candidate track for programming is selected.
5	Repeat steps 2 through 4 for programming. Up to 30 tracks can be programmed. Each time the PGM CLR key is pressed, the program number is decremented by one, so that you can reselect tracks for the program. In this case, however, the contents of the previous program number are erased and no track is selected for this program number. **(Example)** If tracks have been programmed up to program number 30 and then the program number is decremented to 20, the contents of program numbers 20 through 30 are erased and nothing is programmed for these numbers.	: :	: :
6	To start program playback with the contents programmed up to that point, press the PLAY/PAUSE key. The program candidate track that is still under selection (blinking) when the key is pressed is not included in the program contents. In the example on the right, program playback starts with the contents of program numbers 1 through 27 because a track number for program number 28 has not been set yet.	28	06 (Blinking) Blinking indicates that a candidate track is being selected.

The operation of each key is as follows while a program is being edited.

Key	Operation
NEXT/FF	Selects the next track to the one whose program number is displayed. While the last track on the disc is under selection, the first track on the disc is selected.
PREV/REW	Selects the previous track to the one whose program number is displayed. While the first track on the disc is under selection, the last track on the disc is selected.
PROGRAM	The operation of this key is as follows depending on the selection status of the program tracks. (1) If no program candidate track is selected (when "−−" is displayed as the track number) This key is invalid. (2) When program candidate track is selected (when a track number is displayed blinking) The track number displayed for the displayed program number is set as a program track. (3) When program track has been set (when a track number is displayed) The program number to be edited is incremented by one. However, this key is invalid if program number 30 has already been reached.
PGM CLR	Decrements the program number to be edited by one. The contents of the decremented program number are erased, and no program track is selected for this number.
PLAY/PAUSE	The operation of this key is as follows, depending on the number of tracks programmed. (1) If one or more track has been programmed Program editing ends, and program play is started. (2) If no track is determined Program editing ends and play is temporarily stopped or resumed.
REPEAT, SCAN RANDOM, TOP EJECT, POWER TUNER	Program editing ends, and the operation of the pressed key is performed.
DISP VOL SEL/VOL CLR VOL UP, VOL DWN MUTE, LOUD DSP, SRS	Editing the program continues. The operation of the pressed key is performed.

Keys other than those above are invalid.

(2) Operation of program playback

When program playback is started, tracks are sequentially started from program number 1 to the last program number specified while editing the program.

When all the programmed tracks have been played, program play is repeated again starting from program number 1.

The operation of each key is as follows during program playback.

<table>
<tr><th>Key</th><th>Operation</th></tr>
<tr><td>NEXT/FF</td><td>Increments by one from the program number currently being played and plays the track from the beginning.
If the track of the last program number is being played, the track of the first program number (number 1) is played from the beginning.</td></tr>
<tr><td>PREV/REW</td><td>The operation of this key differs depending on the playback time when the key was pressed.
<table>
<tr><th>Playback Time</th><th>Operation</th></tr>
<tr><td>Less than 1 second from the beginning of the track</td><td>Decrements by one from the program number currently being played and plays the track from the beginning.
If the track of program number 1 is being played, the track of the last program number is played from the beginning.</td></tr>
<tr><td>1 second or longer from the beginning of the track</td><td>Replays the track being played from the beginning.</td></tr>
</table></td></tr>
<tr><td>PROGRAM</td><td>Sets the playback program editing mode.
Clears the program playback mode.
Playback continues.</td></tr>
<tr><td>PGM CLR</td><td>Clears the program playback mode.
Playback continues.</td></tr>
<tr><td>PLAY/PAUSE</td><td>The program playback mode continues.
The operation of the pressed key is performed.</td></tr>
<tr><td>REPEAT, SCAN
RANDOM, TOP
EJECT, POWER
TUNER</td><td>Clears the program playback mode.
The operation of the pressed key is performed.</td></tr>
<tr><td>DISP
VOL SEL/VOL CLR
VOL UP, VOL DWN
MUTE, LOUD
DSP, SRS</td><td>The program playback mode continues.
The operation of the pressed key is performed.</td></tr>
</table>

Keys other than those above are invalid.

5. STANDBY FUNCTIONS

The μPD178024GC-051 can perform a standby operation to reduce the power consumption.

In the standby mode, however, none of the functions, except ejecting the disc, can be used.

The mode is switched between the normal operation mode and standby mode by using the $\overline{\text{ACC}}$ pin (pin 69) and $\overline{\text{BATT}}$ pin (pin 70).

For the switching timing, refer to “12. MUTE OUTPUT TIMING CHART”.

(1) Standby operation

The $\overline{\text{ACC}}$ and $\overline{\text{BATT}}$ pins are tested every 2 ms five times to suppress chattering.

After chattering has been suppressed, the mode is changed from the normal operation mode to the standby mode when the $\overline{\text{ACC}}$ or $\overline{\text{BATT}}$ pin goes high.

If the $\overline{\text{ACC}}$ or $\overline{\text{BATT}}$ pin is high since power application, the standby mode is selected on completion of chattering suppression.

In the standby mode, none of the functions, except ejecting the disc, can be used.

In addition, the LCD panel displays nothing.

The clock is not displayed in the standby mode even if the clock function is specified by using the initialization switch “NOCLK”.

Internally, however, the clock count continues in the same manner as in the normal operation mode.

In the standby mode, the μPD178024GC-051 performs an intermittent operation by oscillating and stopping the CPU clock to reduce its own current consumption.

If the clock function is not specified, oscillation of the CPU clock and system clock is completely stopped in the standby mode. Consequently, the current consumption of the μPD178024GC-051 is substantially reduced.

In the standby mode, each pin is placed in the status that lowers the current consumption.

For the pin statuses at this time, refer to “1. PIN FUNCTIONS”.

(2) Operation after releasing standby mode

If the internal falling edge detector of the μPD178024GC-051 detects negative transition of the $\overline{\text{ACC}}$ pin (pin 69) or $\overline{\text{BATT}}$ pin (pin 70), the standby mode is temporarily released, and the $\overline{\text{ACC}}$ and $\overline{\text{BATT}}$ pins are tested.

If both the $\overline{\text{ACC}}$ and $\overline{\text{BATT}}$ pins are high, the standby mode is immediately resumed.

If either of the pins is low, the standby mode is released, and the normal operation mode is set.

When the standby mode has been released, the previous power status and audio source mode selected before the standby mode was set are restored.

Similarly, the reception frequency of the radio, the contents of the preset memories, the volume values of the electronic volume, and other functions are restored to the status before the standby mode was set.

If the contents of the internal memory could not be retained because the supply voltage dropped and if the result of reading the initialization switches differs from before, all the statuses are returned to the default statuses in the same manner as on power application.

(3) Ejecting disc in standby mode

If the internal falling edge detector of the μPD178024GC-051 detects the negative transition of the $\overline{\text{EJECT}}$ pin (pin 71), the standby mode is temporarily released and the disc is ejected in the normal mode.

At this time, eject indication is not made on the display.

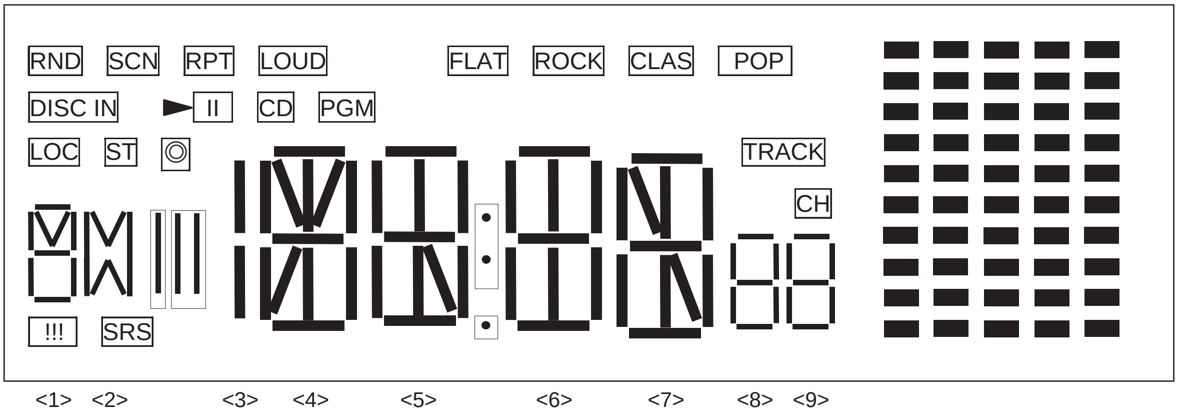
As soon as the disc has been ejected, the standby mode is resumed.

6. LCD PANEL

6.1 Configuration of LCD Panel

(1) Example of LCD panel configuration

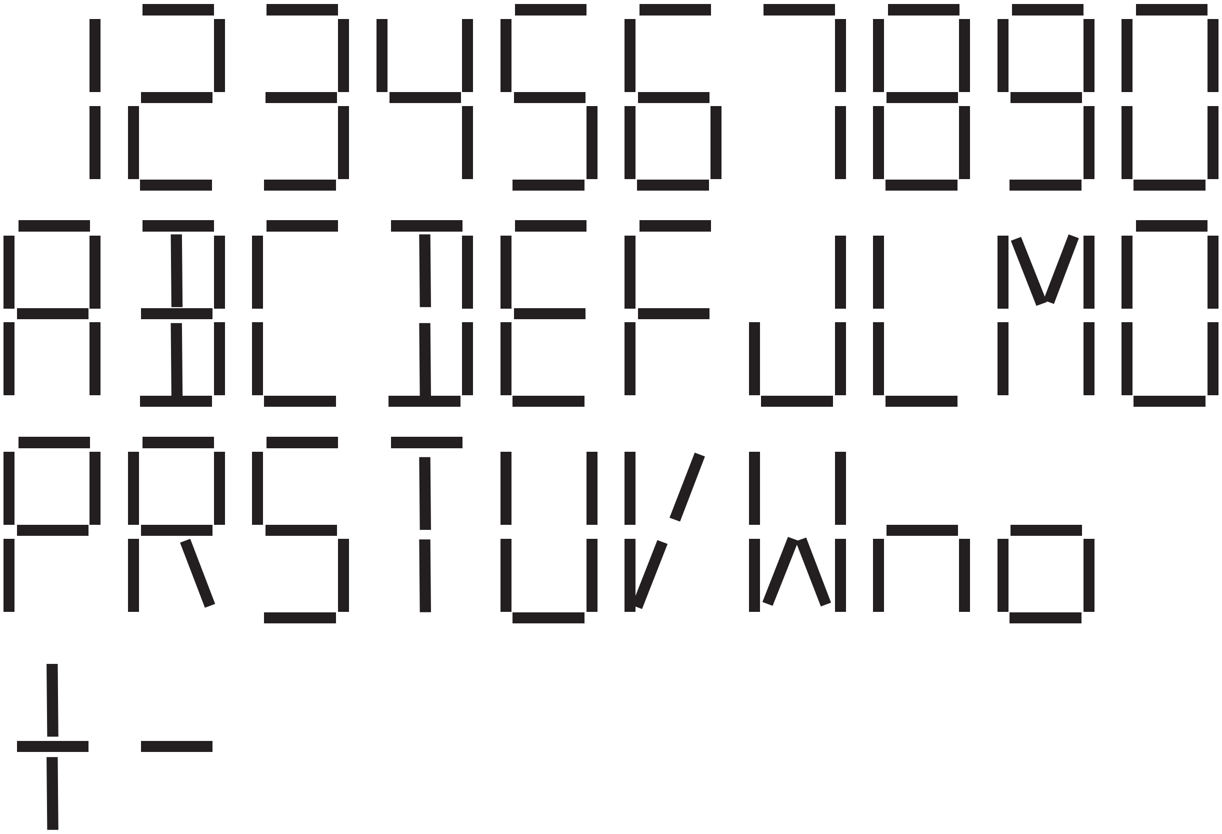
Here is an example of the configuration of the LCD panel.


RND
SCN
RPT
LOUD
FLAT
ROCK
CLAS
POP
DISC IN
II
CD
PGM
LOC
ST
TRACK
CH
!!!
SRS
<1>
<2>
<3>
<4>
<5>
<6>
<7>
<8>
<9>

Remarks 1. <1> through <9> indicate the position of digit display.

2. ☐ indicates a segment.

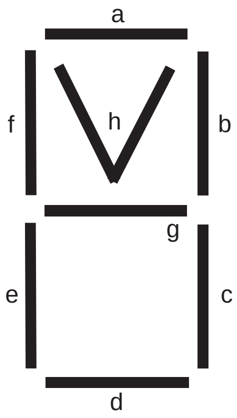
(2) Font



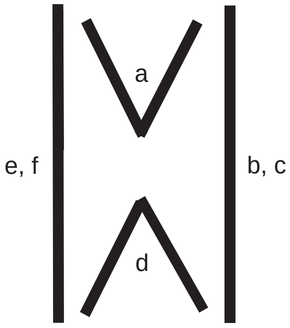
6.2 LCD Pin Assignment

The assignment of the LCD pins of the LCD driver IC (µPD16431A) is as shown below.

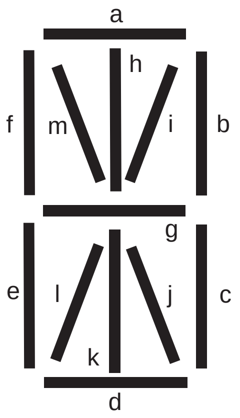
Segments “a” through “m” indicate each segment of digit display as follows:



Digit <1>



Digit <2>



Digits <3> through <9>

Segments “A1” through “E10” indicate each segment of spectrum analyzer display as follows:

A10	B10	C10	D10	E10
A 9	B 9	C 9	D 9	E 9
A 8	B 8	C 8	D 8	E 8
A 7	B 7	C 7	D 7	E 7
A 6	B 6	C 6	D 6	E 6
A 5	B 5	C 5	D 5	E 5
A 4	B 4	C 4	D 4	E 4
A 3	B 3	C 3	D 3	E 3
A 2	B 2	C 2	D 2	E 2
A 1	B 1	C 1	D 1	E 1

Common Segment	COM1 (21)	COM2 (22)	COM3 (23)
SEG1 (25)	▶	||	DISC IN
SEG2 (26)	SCN	RPT	RND
SEG3 (27)	ST	◎	LOC
SEG4 (28)	<1> h	<1> a	<1> e, f
SEG5 (29)	<1> g	<1> b	<1> d
SEG6 (30)	<1> c	<2> e, f	<2> a
SEG7 (31)	!!!	<2> b, c	<2> d
SEG8 (32)	SRS	II	<3> b, c
SEG9 (33)	–	I	<4> i
SEG10 (34)	<4> d	<4> f	<4> e
SEG11 (35)	<4> l	<4> m	<4> k
SEG12 (36)	–	<4> h	<4> g
SEG13 (37)	<4> c	<4> a	<4> b
SEG14 (38)	LOUD	CD	–
SEG15 (39)	–	PGM	–
SEG16 (40)	<5> d	<5> f	<5> e
SEG17 (41)	<5> j	FLAT	<5> k
SEG18 (42)	–	<5> h	<5> g
SEG19 (43)	<5> c	<5> a	<5> b
SEG20 (44)	ROCK	:	.
SEG21 (45)	<6> d	<6> f	<6> e
SEG22 (46)	–	CLAS	<6> k
SEG23 (47)	–	<6> h	<6> g
SEG24 (48)	<6> c	<6> a	<6> b
SEG25 (49)	<7> d	<7> f	<7> e
SEG26 (50)	<7> j	<7> m	<7> k
SEG27 (51)	<7> g	POP	<7> h
SEG28 (52)	<7> c	<7> a	<7> b
SEG29 (53)	<8> d	<8> f	<8> e
SEG30 (54)	–	TRACK	<8> g
SEG31 (55)	<8> c	<8> a	<8> b
SEG32 (56)	<9> d	<9> f	<9> e
SEG33 (57)	–	CH	<9> g
SEG34 (58)	<9> c	<9> a	<9> b
SEG35 (59)	C10	A10	B10
SEG36 (60)	C9	A9	B9
SEG37 (61)	C8	A8	B8
SEG38 (62)	C7	A7	B7
SEG39 (63)	C6	A6	B6
SEG40 (64)	C5	A5	B5
SEG41 (65)	C4	A4	B4
SEG42 (66)	C3	A3	B3
SEG43 (67)	C2	A2	B2
SEG44 (68)	C1	A1	B1
SEG45 (69)	E10	–	D10
SEG46 (70)	E9	–	D9
SEG47 (71)	E8	–	D8
SEG48 (72)	E7	–	D7
SEG49 (73)	E6	–	D6
SEG50 (74)	E5	–	D5
SEG51 (75)	E4	–	D4
SEG52 (76)	E3	–	D3
SEG53 (77)	E2	–	D2
SEG54 (78)	E1	–	D1

Remarks 1. Numbers in parentheses ( ) are the pin numbers of the μPD16431A.

2. $\boxed{–}$ indicates an unused segment.

6.3 Indicators on LCD Panel

Indicator	Description
RND SCN RPT	Each of these indicators indicate the playback modes of the CD player as follows: RND: Random play mode SCN: Intro playback mode RPT: Track repeat mode These indicators light in the corresponding playback mode in the CD mode. At all other times, they remain dark.
LOUD	This indicator indicates the loudness-on status. It lights in the power-on status and loudness-on status. At all other times, it remains dark.
DISC IN	This indicator indicates that a disc is inserted. It lights when a disk is inserted, regardless of the power status and audio source mode. At all other times, it remains dark.
▶ ||	These indicators indicate that the CD player has been temporarily stopped. Both “▶” and “||” light simultaneously when playback is temporarily stopped in the CD mode. At all other times, both remain dark.
CD	This indicator indicates the CD mode. It lights in the CD mode. At all other times, it remains dark.
PGM	This indicator indicates that the CD player is playing a program or that a program is being edited. It lights when the program playback mode is set or while a program is being edited in the CD mode. At all other times, it remains dark.
FLAT ROCK CLAS POP	The following indicators indicate an equalizer mode: FLAT: “FLAT” mode ROCK: “ROCK” mode CLAS: “CLASSIC” mode POP: “POP” mode These indicators light in the corresponding equalizer mode in the power-on status. At all other times, they remain dark.
LOC	This indicator indicates the on status of the local mode of the radio. It lights when the local mode is on in the radio mode, regardless of the status of the reception sensitivity (local/DX) of the auto tuning in progress. At all other times, it remains dark.
ST	This indicator indicates the forced monaural off status of the radio. It lights while the FM band is being received in the radio mode and in the forced monaural off status. At all other times, it remains dark.
◎	This indicator indicates the stereo broadcasting reception status of the radio. It lights while stereo broadcasting in the FM band is being received in the radio mode and in the forced monaural off status (when the “ST” indicator lights). At all other times, it remains dark.
!!!	This indicator indicates the hardware diagnosis status. It lights when a hardware diagnosis signal is input (when the DIA pin is high) in the power-on status. At all other times, it remains dark.

Indicator	Description
SRS	This indicator indicates the SRS status. It lights when SRS is on in the power-on status. At all other times, it remains dark.
I II	These indicators indicate the reception band of the radio, with digits <1> and <2>. They light when the corresponding band is being received in the radio mode. At all other times, they remain dark. For display of a reception band, refer to the description of digits <1> and <2>.
:	This is the colon for clock display. It blinks at a frequency of 1 Hz and with a duty factor of 50% when digits <4> through <7> display the time. At all other times, it remains dark. For the clock display, refer to the description of digits <4> through <7>.
.	This is a decimal point for frequency display of the radio. It lights when digits <3> through <7> indicate a frequency of the FM band in the radio mode. At all other times, it remains dark. For the frequency display, refer to the description of digits <4> through <7>.
TRACK	This indicates that digits <8> and <9> indicate a track number of the CD player. It lights when digits <8> and <9> indicate a track number in the CD mode. At all other times, it remains dark. For the track number display, refer to the description of digits <8> and <9>.
CH	This indicates that digit <9> indicates a preset memory number of the radio. It lights when digit <9> indicates a preset memory number in the radio mode. At all other times, it remains dark. For the preset memory number display, refer to the description of digits <8> and <9>.
Digits <1> and <2>	These digits indicate the following: (1) Reception band of radio (2) a.m./p.m. of the clock At all other times, they remain dark. **(1) Reception band of radio** Digits <1> and <2> indicate the reception band of the radio in the radio mode, in accordance with the “I” and “II” indicators, as follows: “ F M I ”: FM1 band is received. “ F M II ”: FM2 band is received. “ F M III ”: FM3 band is received. “ M W ”: MW band is received. “ L W ”: LW band is received. “ A M I ”: If the intended region is USA 1 or USA 2 and AM1 band is received “ A M II ”: If the intended region is USA 1 or USA 2 and AM2 band is received For the assignment of the MW and LW bands to the AM1 and AM2 bands, refer to “3.1 Receivable Bands”. **(2) a.m./p.m. of clock** In the 12-hour mode of the clock, a.m. and p.m. are indicated as follows: “ A M ”: a.m. “ P M ”: p.m. For the clock display, refer to the description of digits <3> through <7>.

Indicator	Description
Digits <3> through <7>	These digits indicate the following: (1) Reception frequency of radio (2) Auto store memory indication of radio (3) Playback time of CD player (4) Program number of playback program of CD player (5) Error status of CD player (6) Indication of loading disc (7) Indication of ejecting disc (8) Indication of no disc (9) Telephone mute indication (10) Forced mute indication (11) Adjustment mode of electronic volume (12) Clock (13) Power-on indication At all other times, these digits remain dark. **(1) Reception frequency of radio** These digits display the frequency currently being received as follows when the frequency is displayed in the radio mode. Note that the first digit is not prefixed with 0 when a frequency is displayed. Example of displaying frequency of FM band To display the frequency of the FM band, a decimal point is displayed as “. ”. “ 8 7 . 5 0 ”: The frequency received is 87.50 MHz. “ 1 0 8 . 0 0 ”: The frequency received is 108.00 MHz. Example of displaying frequency of MW band “ 5 2 2 ”: The frequency received is 522 kHz. “ 1 6 2 0 ”: The frequency received is 1620 kHz. Example of displaying frequency of LW band “ 1 4 4 ”: The frequency received is 144 kHz. **(2) Auto store memory indication of radio** While the auto store memory operation is in progress in the radio mode, digits <4> through <6> show the following blinking message indicating that the auto store memory operation is in progress, at a frequency of 1 Hz and with a duty factor of 50%. “ A T P ”: Auto store memory display (blinks at a frequency of 1 Hz and with a duty factor of 50%) At this time, digits <3> and <7> remain dark.

Indicator	Description
Digits <3> through <7>	**(3) Playback time of CD player** In the CD mode, digits <4> through <7>, with indicator “:”, indicate the playback time (minute: second) from the beginning of the music being played. At this time, digit <3> remains dark. When the playback time is displayed and if the minute digits indicate 9 minutes or less, the minute digit is prefixed with 0. Similarly, if the second digits indicate 9 seconds or less, the second digit is prefixed with 0. While the playback time is being displayed, the number of the track currently being played is indicated by digits <8> and <9>. To jump to another track during playback, “00:00” is displayed blinking at a frequency of 1 Hz and with a duty factor of 50% as the playback time, until the jump is completed and the new track starts playing. At this time, the number of the track to be jumped to is displayed with digits <8> and <9>. Similarly, “00:00” is displayed blinking at a frequency of 1 Hz and with a duty factor of 50% as the play back time, until the load is complete and playback starts. At this time, “– –” is displayed on digits <8> and <9> as the track number. The playback time is displayed as follows along with the “:” indicator and the track number displayed with digits <8> and <9>: Example of displaying playback time “ 0 1 : 0 3 0 9 ”: 1 minute and 3 seconds have passed since track number 9 started playing. (Lights) (Lights) “ 1 4 : 5 9 1 2 ”: 14 minutes and 59 seconds have passed since track number 12 started (Lights) (Lights) playing. “ 0 0 : 0 0 0 7 ”: Play jumps to track number 7. (Blinks) (Lights) “ 0 0 : 0 0 – – ” : Display from when the disc was loaded until play starts. (Blinks) (Lights)

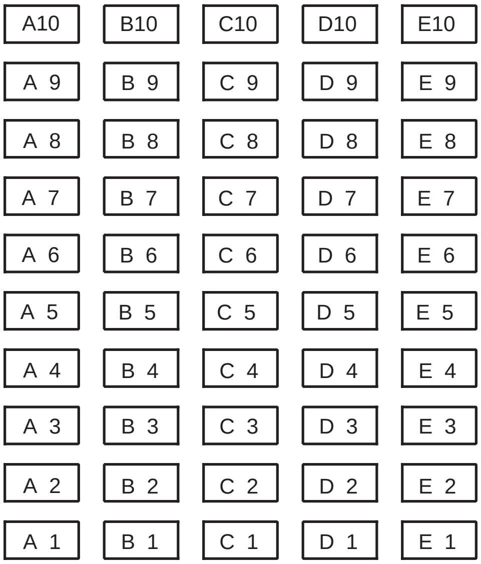
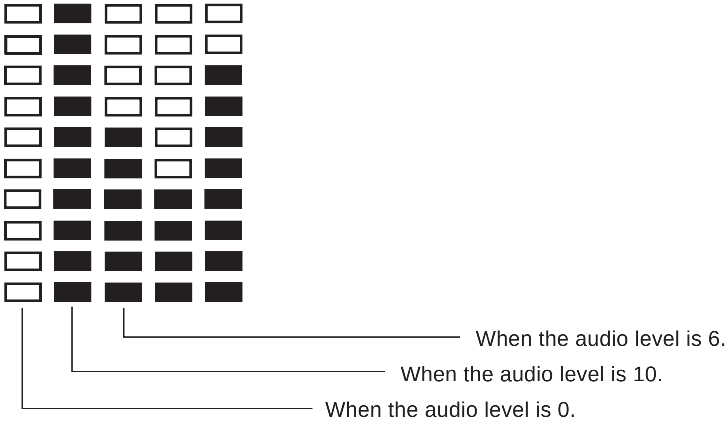
Indicator	Description
Digits <3> through <7>	**(4) Program number of playback program of CD player** While a program is being edited, digits <6> and <7> indicate the program number (“01” to “30”) being edited. At this time, digits <3> through <5> remain dark. When a program number is displayed and the program number is 9 or less, the digit is prefixed with 0. The status of editing a program is indicated as follows, along with the selected track number indicated with digits <8> and <9>. Example of displaying program editing status “ 0 7 – – ”: Candidate track has not been selected for program number 7. (Lights) (Lights) “ 0 7 0 4 ”: Track number 4 has been selected as a candidate for program number 7. (Lights) (Blinks) “ 2 1 1 3 ”: Track number 13 has been set as program number 21. (Lights) (Lights) For how to edit a program, refer to “4.2 Program Playback”. **(5) Error status of CD player** If an error occurs in the CD player, digits <4> through <7> and “:” indicate the error as follows: CD player error indication (only the error number blinks, at a frequency of 1 Hz with a duty factor of 50%.) “ E R : 0 1 ”: Focus error “ E R : 0 2 ”: Disc load or eject error “ E R : 0 3 ”: Other errors At this time, only the error number indicated with digits <6> and <7> blinks, at a frequency of 1 Hz and with a duty factor of 50%. “ER” on digits <4> and <5>, and “:” do not blink. Digit <3> remains dark.

Indicator	Description
Digits <3> through <7>	**(6) Indication of loading disc** While a disc is being loaded, digits <4> through <7> display the following message, which blinks at a frequency of 1 Hz and with a duty factor of 50%. " LO AD ": Disc is being loaded. (Blinks at a frequency of 1 Hz and with a duty factor of 50%.) At this time, digit <3> remains dark. **(7) Indication of ejecting disc** While the disc is being ejected, digits <4> through <7> display the following message, which blinks at a frequency of 1 Hz and with a duty factor of 50%. " EJ CT ": Disc is being ejected. (Blinks at a frequency of 1 Hz and with a duty factor of 50%.) At this time, digit <3> remains dark. **(8) Indication of no disc** If the CD mode is selected while no disc is inserted, digits <4> through <7> show the following message for three seconds, which blinks at a frequency of 1 Hz and with a duty factor of 50%. " no CD ": No disc is inserted. (Blinks at a frequency of 1 Hz and with a duty factor of 50%.) At this time digit <3> remains dark. **(9) Telephone mute display** If telephone mute by the PMUTE pin (pin 47) is turned on in the power-on status, digits <4> through <6> display the following message, which blinks at a frequency of 1 Hz and with a duty factor of 50%. " TEL ": Telephone mute display. (Blinks at a frequency of 1 Hz and with a duty factor of 50%.) At this time, digits <3> and <7> remain dark. **(10) Forced mute display** If forced mute is turned on by the MUTE key in the power-on status, digits <4> through <7> display the following message, which blinks at a frequency of 1 Hz and with a duty factor of 50%. " MU TE ": Forced mute display. (Blinks at a frequency of 1 Hz and with a duty factor of 50%.) At this time, digit <3> remains dark. If both forced mute and telephone mute are turned on at the same time, the telephone mute display takes precedence.

Indicator	Description
Digits <3> through <7>	**(11) Adjustment mode of electronic volume** If the electronic volume is adjusted, digits <8> and <9> display a volume value (“00” to “63”). At this time, digits <4> through <6> display the mode of the adjustment currently selected. At this time, digit <3> remains dark. Digit <7> shows a sign indicating whether the volume value is positive or negative (“+” or “–”), a balance adjustment direction (“R” or “L”), or fader adjustment direction (“F” or “R”). The electronic volume is displayed as follows, with the volume value indication (“00” to “63”) on digits <8> and <9>. Example of display in master volume adjustment mode “ V O L 0 3 ”: When the master volume value is 3 “ V O L 2 8 ”: When the master volume value is 28 Example of display in bass adjustment mode “ B A S 0 0 ”: When the bus compensation value is 0 (no compensation) “ B A S + 0 1 ”: When the bus compensation value is +1 “ B A S – 0 6 ”: When the bus compensation value is –6 Example of display in treble adjustment mode “ T R E 0 0 ”: When the treble compensation value is 0 (no compensation) “ T R E + 0 6 ”: When the treble compensation value is +6 “ T R E – 0 1 ”: When the treble compensation value is –1 Example of display in balance adjustment mode “ B A 0 0 ”: When the balance position is at the center between the left and the right “ B A R 0 1 ”: When the balance position is +1 to the right “ B A L 3 1 ”: When the balance position is +31 to the left Example of display in fader adjustment mode “ F A 0 0 ”: When the fader position is at the center between front and rear “ F A F 0 1 ”: When the fader position is +1 toward the front “ F A R 3 1 ”: When the fader position is +31 toward the rear

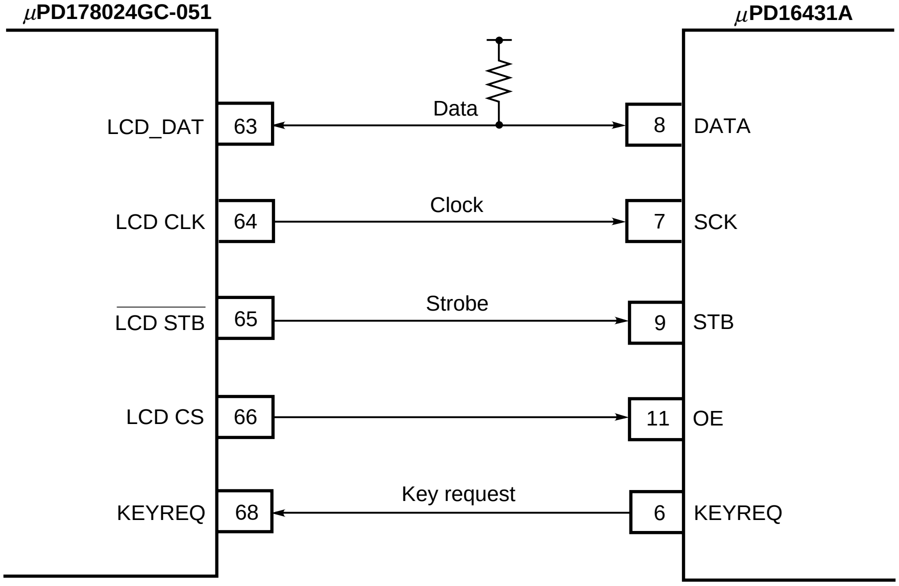
Indicator	Description
Digits <3> through <7>	**(12) Clock** If use of the clock function is specified by the initialization switch “NOCLK”, the clock is displayed with “:” when the clock function is selected in the power-off status and power-on status. The clock is not displayed in the standby mode. If the minute digits of the clock display 9 minutes or less, the minute digit is prefixed with 0. However, the hour digit is not prefixed with 0. “:” is displayed blinking at a frequency of 1 Hz and with a duty factor of 50%. The clock is displayed as follows, depending on the setting of the initialization switch “CLK12”. Example of clock in 24-hour mode “ 0 : 0 0 ”: 12 o’clock midnight “ 8 : 0 7 ”: 8 o’clock 7 minutes in the morning “ 1 2 : 0 0 ”: 12 o’clock midday “ 2 1 : 5 9 ”: 9 o’clock 59 minutes in the evening Example of 12-hour mode In the 12-hour mode, digits <1> and <2> indicates the morning (AM) or afternoon (PM). “ A M 1 2 : 0 0 ”: 12 o’clock midnight “ A M 8 : 0 7 ”: 8 o’clock 7 minutes in the morning “ P M 1 2 : 0 0 ”: 12 o’clock midday “ P M 9 : 5 9 ”: 9 o’clock 59 minutes in the evening **(13) Power-on indication** On power application, the following message is displayed. “ P O N ” : Power-on indication At this time, digits <3> and <5> remain dark. The power-on indication lasts until mute output on power application ends. For mute output on power application, refer to “12. MUTE OUTPUT TIMING CHART”.

Indicator	Description
Digits <8> and <9>	These digits display the following: (1) Preset memory number of radio (2) Track number of CD player (3) Volume value of electronic volume At all other times, they remain dark. **(1) Preset memory number of radio** Digit <9> displays a preset memory number ("1" to "6"). At this time, digit <8> remains dark. While the station of a preset memory is being received, the preset memory number is displayed. When a station is written to a preset memory, the number of the preset memory to which the station is written is displayed and blinks only once (i.e. goes off for 500 ms). After that, the number of the preset memory whose station is being received (i.e., to which a station has been written) is displayed again. While the preset memory is being scanned, the number of the preset memory whose station is being received is displayed blinking at a frequency of 1 Hz and with a duty factor of 50%. During an auto store memory operation, the preset memory that has been written by the operation is displayed blinking at a frequency of 1 Hz and with a duty factor of 50%. If no station is written to the preset memory, digit <9> remains dark. A preset memory number is not displayed during forced mute display and telephone mute display. **(2) Track number of CD** Digits <8> and <9> display the track number of the CD ("01" to "99", or "−−"). If the track number to be displayed is 9 or less, the first digit is prefixed with 0. While the playback time of the CD player is being displayed, the number of the track being played is displayed. To jump to another track during playback, the number of the jump destination is displayed blinking at a frequency of 1 Hz and with a duty factor of 50% until the jump is completed and the track starts playing. After a disc has been loaded and until playing starts, "−−" is displayed as the track number, blinking at a frequency of 1 Hz and with a duty factor of 50%. While a program is being edited, the number of the set track is displayed as the contents of the program. While a track number is being selected (not yet set), the track number is displayed, blinking at a frequency of 1 Hz and with a duty factor of 50%. When no track number is selected, "−−" is displayed. For how the playback time and the status of editing a program is displayed, refer to the description of digits <3> through <7> and "4.2 Program Playback". **(3) Volume value of electronic volume** While the electronic volume is displayed, the volume value ("00" to "63") in each adjustment mode of the electronic volume is displayed with digit <7>. At this time, digit <7> shows the sign of the volume value ("+" or "–"), the balance adjustment direction ("R" or "L"), or the fader adjustment direction ("F" or "R"). If the volume value to be displayed is 9 or less, the digit is prefixed with 0. For details of electronic volume display, refer to the description of digits <3> through <7>.

Indicator	Description
A1 to E10	Segments “A1” through “E10” indicate the segments of the spectrum analyzer display as follows:  A10 B10 C10 D10 E10 A 9 B 9 C 9 D 9 E 9 A 8 B 8 C 8 D 8 E 8 A 7 B 7 C 7 D 7 E 7 A 6 B 6 C 6 D 6 E 6 A 5 B 5 C 5 D 5 E 5 A 4 B 4 C 4 D 4 E 4 A 3 B 3 C 3 D 3 E 3 A 2 B 2 C 2 D 2 E 2 A 1 B 1 C 1 D 1 E 1 The spectrum analyzer is displayed as follows in the power-on status. Spectrum analyzer display is to display the audio level in the audio frequency band corresponding to each row of the five columns of spectrum analyzer segments “A1 to A10” through “E1 to E10”. For the assignment of an audio frequency band to each column, refer to the description of the SPEC A, SPEC B, and SPEC C pins. Of all the 10 levels of segments “1” to “10” constituting one column, all the levels of segments, except those falling below a given audio level, light to display an audio level.  When the audio level is 6. When the audio level is 10. When the audio level is 0. For how an audio level is identified, refer to the description of the SPEC IN pin. An audio level the same as the audio level input to the SPEC IN pin is displayed regardless of the mute status. During spectrum analyzer display, the displayed contents are updated every 50 ms. When the spectrum analyzer is not displayed, all segments, “A1” through “E10”, remain dark.

7. DESCRIPTION OF LCD DRIVER IC (μPD16431A) CONTROL

The μPD178024GC-051 uses the μPD16431A to control the LCD display.
The connection of the μPD178024GC-051 to the μPD16431A is illustrated below.


μPD178024GC-051
μPD16431A
LCD_DAT
63
Data
8
DATA
LCD CLK
64
Clock
7
SCK
$\overline{\text{LCD STB}}$
65
Strobe
9
STB
LCD CS
66
11
OE
KEYREQ
68
Key request
6
KEYREQ

7.1 Key Scan

Key scan using the μPD16431A is performed as follows:

(1) Detecting a pressed key

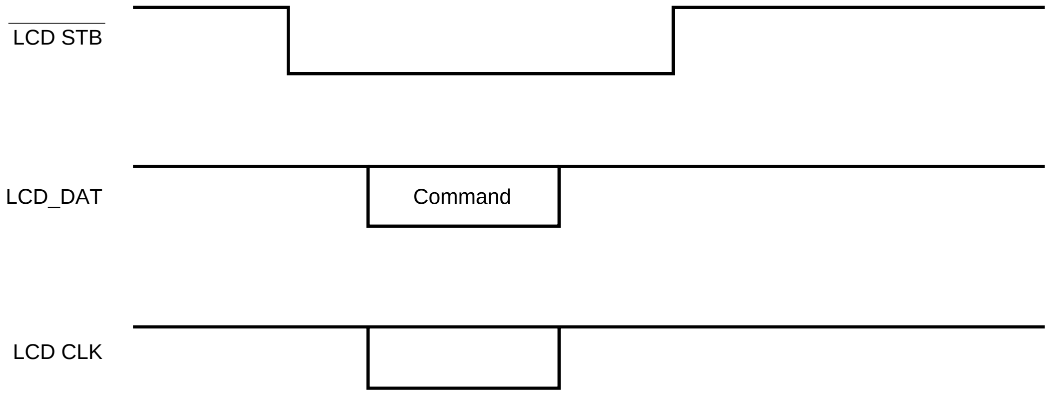
The controller judges the state of the KEYREQ pin (pin 6) of the μPD16431A every 20 ms.
When the KEYREQ pin is high, it is assumed that a key is being pressed. Noise elimination (chattering elimination) based on two consecutive matches is applied.
When noise elimination is performed correctly, the key code is read with serial reception.
Key data is received within 20 ms while a key is held down (the KEYREQ pin is high).

(2) Detecting the release of a key

When a key is released, the level of the KEYREQ pin of the μPD16431A goes from high to low. The pin is scanned every 20 ms and, if the low level is detected two times in a row, it is judged that the key has been released.

7.2 Initial Data Output

The μPD178024GC-051 transfers the next initialization data to the μPD16431A about 500 ms after the level of LCDCS pin (pin 66) changes from low to high on power application to the device, on releasing the standby mode, and on detecting the attachment of the front panel.

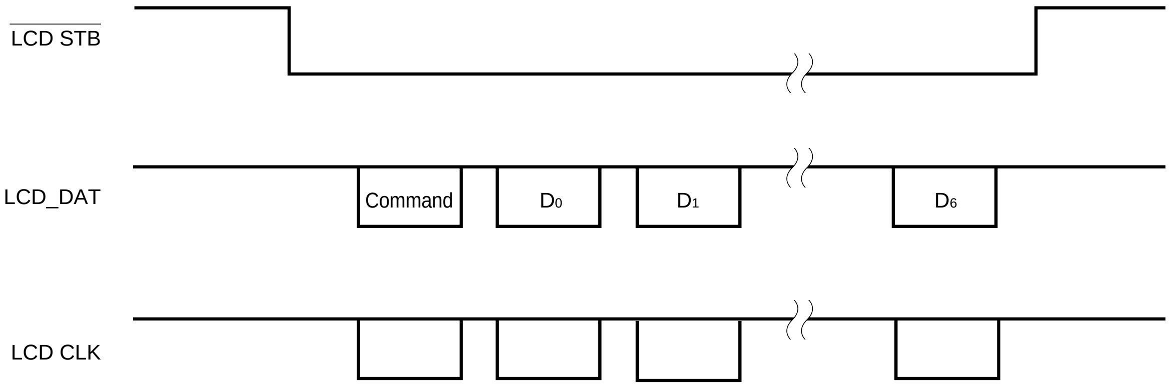


Command: 00001000 (initialization command)

1/3 duty, (f_{OSC}/512) /3, internal drive voltage, master, and normal operation are initialized.

7.3 Display Data Output

The output of display data to the μPD16431A is shown below.

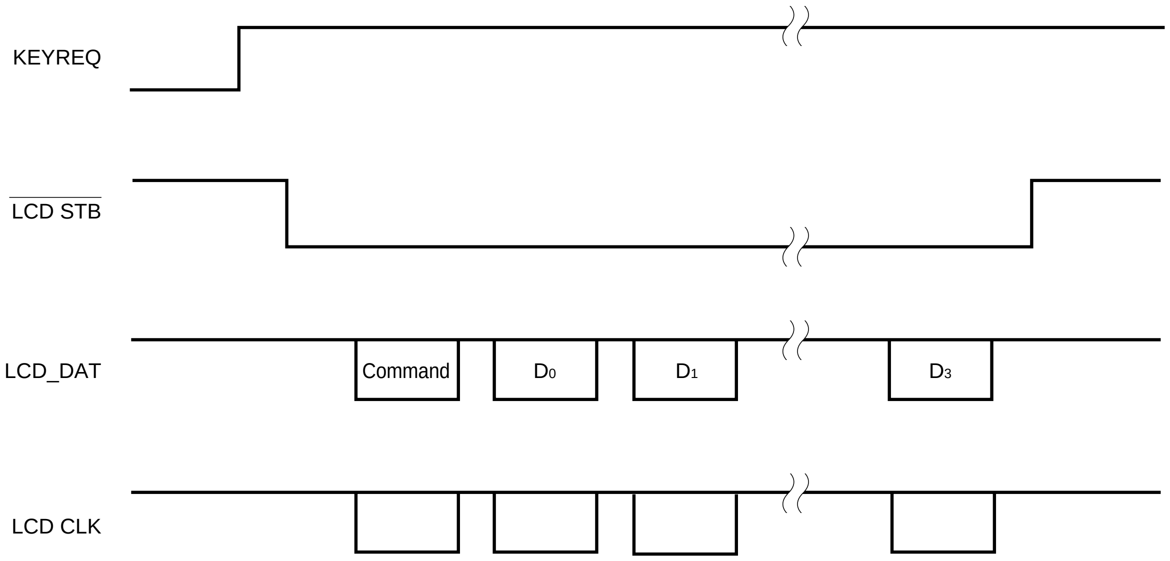

$\overline{\text{LCD STB}}$
LCD_DAT
Command
D_0
D_1
D_6
LCD CLK

Command: 10000100 (status command (at COM1 output))
: 10001100 (status command (at COM2 output))
: 10010100 (status command (at COM3 output))
D_0 to D_6: 00000000 (display data)
|
11111111

The above display output is repeated three times when sending display data.

7.4 Key Data Input/Output

The input and output of key data to and from the μPD16431A are shown below.


KEYREQ
LCD STB
LCD_DAT
Command
D0
D1
D3
LCD CLK

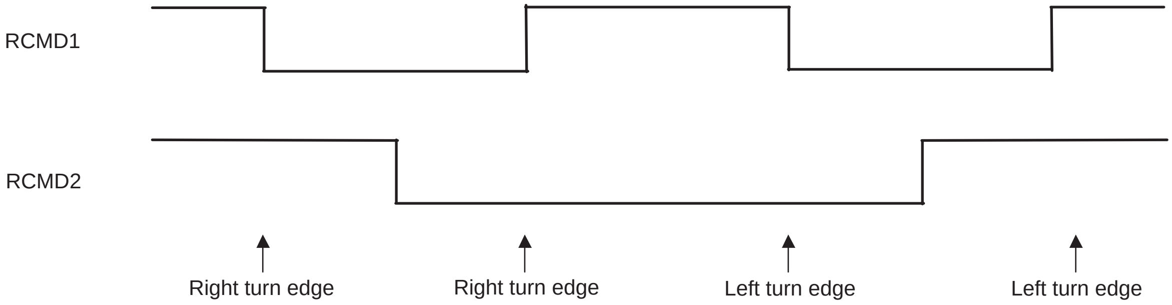
Command: 10000101 (status command (key data readout))
D_0 to D_3: 00000000 (display data)
|
11111111

After the status command is send, key data is read from the LCD_DAT pin.

8. ROTARY COMMANDER

(1) Input detection timing of rotary commander

Input to the rotary commander is detected as follows:
The RCMD1 (pin 18) and RCMD2 (pin 19) pins are tested every 2 ms two times to suppress chattering. After chattering has been suppressed, the turn edges are detected as follows:



However, only the first turn edge of successive turn edges that are within 200 ms is valid.

(2) Function of rotary commander

The rotary commander functions in the same manner as the VOL UP key when it turns clockwise, and as the VOL DOWN key when it turns counterclockwise. In either case, one turn edge operates the same as one key input.
However, the operation cannot be repeated as is the case with holding down the VOL UP and VOL DOWN keys.

9. FRONT PANEL

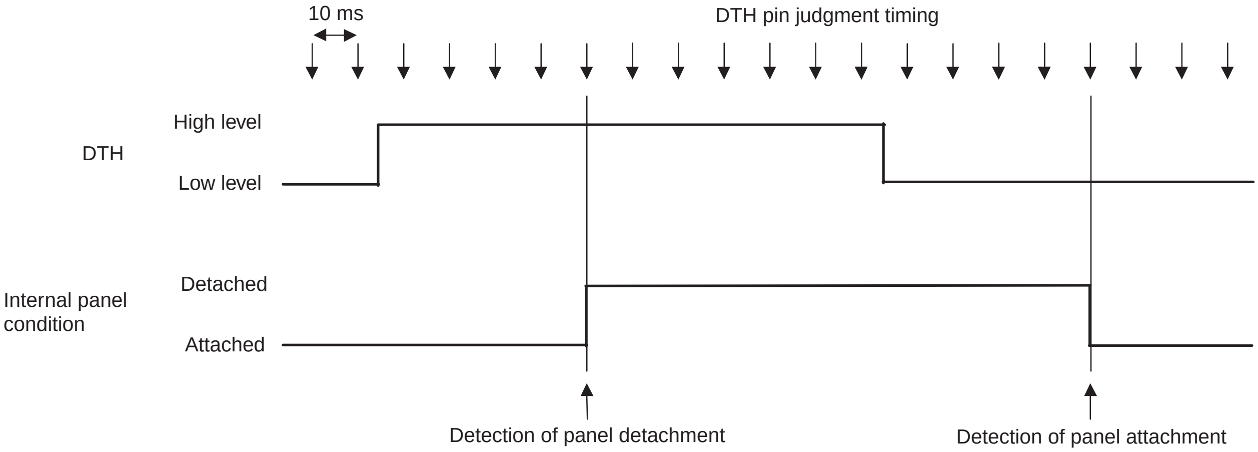
9.1 Attached/Detached Front Panel

Power is turned on/off by detecting the attachment or detachment of the front panel using the DTH pin (pin 72).

(1) Timing of detecting attachment/detachment of front panel

The DTH pin (pin 72) is judged every 10 ms. If the pin is high five times in a row, it is assumed that the front panel is detached. If the pin is low five times in a row, it is assumed that the front panel is attached.

If the DTH pin is not high or low five times in a row, the previous status of the front panel is retained.


10 ms
DTH pin judgment timing
DTH
High level
Low level
Internal panel condition
Detached
Attached
Detection of panel detachment
Detection of panel attachment

(2) Operation based on attachment/detachment of front panel

If the front panel is detached, the power is turned off. It is not turned on until the front panel is attached (forced power off status).

While the front panel is detached, the FL LED pin (pin 49) outputs a square wave with a frequency of 1 Hz and a duty factor of 50% to blink an externally connected LED.

In the standby mode, however, this pin always outputs a low level, regardless of the status of the front panel. Therefore, the LED remains dark.

If the front panel is reattached, the power can be turned on, however the power status immediately after the front panel has been reattached is always off, regardless of the power status before the panel was detached.

9.2 Opening/Closing Front Panel

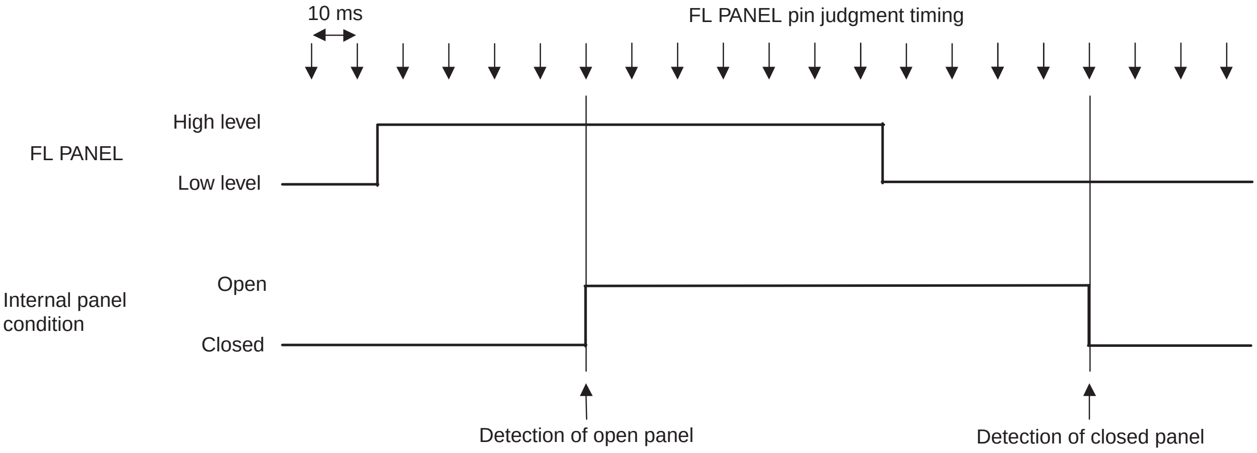
The FL PANEL pin (pin 73) detects the opening or closing of the front panel, which and enables or disables the ejection of the disc.

(1) Timing of detecting opening/closing of front panel

The FL PANEL pin (pin 73) is judged every 10 ms. If it is high five times in a row, it is assumed that the front panel is open.

If the pin is low five times in a row, it is assumed that the front panel is closed.

If the pin is not high or low five times in a row, the previous status of the front panel is retained.


10 ms
FL PANEL pin judgment timing
High level
FL PANEL
Low level
Open
Internal panel condition
Closed
Detection of open panel
Detection of closed panel

(2) Operation based on open/closed front panel

When the front panel is closed, the disc cannot be ejected.

10. REMOTE CONTROL

The remote controller signal transmitter IC μPD6121G is supported. The μPD6121G has a custom code. Unless this custom code is correctly set, the μPD178024GC-051 cannot be controlled by a remote controller.

The custom code that operates the μPD178024GC-051 is 8604H. This code is set on the key matrix of the μPD6121G by connecting a diode and a pull-up resistor to the matrix.

10.1 Location of Remote Controller Keys (When μPD6121G Is Used)

Input Pin Output Pin	KI0 (1)	KI1 (2)	KI2 (3)	KI3 (4)
KI/O0 (19)	M1	M2	M3	M4
KI/O1 (18)	M5	M6	MAN UP/SEEK UP	MAN DWN/SEEK DWN
KI/O2 (17)	PSCAN/ASM	BAND	LOCAL	–
KI/O3 (16)	POWER	DISP	LOUD	EJECT
KI/O4 (15)	CD	DSP	VOL SEL/VOL CLR	MUTE
KI/O5 (14)	VOL UP	VOL DWN	–	–
KI/O6 (13)	–	–	–	–
KI/O7 (12)	–	–	–	–

Remarks 1. Numbers in parentheses ( ) are the pin numbers of the μPD6121G.

2. The key names are those in the radio mode.

3. – indicates an undefined key.

10.2 Remote Controller Keys

The remote controller keys operate in the same manner as the momentary keys of the μPD178024GC-051.

However, rollover of remote controller keys, including the POWER key, is invalid (no key input is detected).

The clock cannot be adjusted by remote controller keys by pressing the MAN UP/SEEK UP (NEXT/FF) or MAN DWN/SEEK DWN (PREV/REW) key after the DISP key.

10.3 Remote Controller Data Codes

Remote Controller Keys	Data Codes							
	D0	D1	D2	D3	D4	D5	D6	D7
M1	0	0	0	0	0	0	0	0
M2	1	0	0	0	0	0	0	0
M3	0	1	0	0	0	0	0	0
M4	1	1	0	0	0	0	0	0
M5	0	0	1	0	0	0	0	0
M6	1	0	1	0	0	0	0	0
MAN UP/SEEK UP	0	1	1	0	0	0	0	0
MAN DWN/SEEK DWN	1	1	1	0	0	0	0	0
PSCAN/ASM	0	0	0	1	0	0	0	0
BAND	1	0	0	1	0	0	0	0
LOCAL	0	1	0	1	0	0	0	0
–	1	1	0	1	0	0	0	0
POWER	0	0	1	1	0	0	0	0
DISP	1	0	1	1	0	0	0	0
LOUD	0	1	1	1	0	0	0	0
EJECT	1	1	1	1	0	0	0	0
CD	0	0	0	0	1	0	0	0
DSP	1	0	0	0	1	0	0	0
VOL SEL/VOL CLR	0	1	0	0	1	0	0	0
MUTE	1	1	0	0	1	0	0	0
VOL UP	0	0	1	0	1	0	0	0
VOL DWN	1	0	1	0	1	0	0	0
–	0	1	1	0	1	0	0	0
–	1	1	1	0	1	0	0	0
–	0	0	0	1	1	0	0	0
–	1	0	0	1	1	0	0	0
–	0	1	0	1	1	0	0	0
–	1	1	0	1	1	0	0	0
–	0	0	1	1	1	0	0	0
–	1	0	1	1	1	0	0	0
–	0	1	1	1	1	0	0	0
–	1	1	1	1	1	0	0	0

Remarks 1. The key names are those in the radio mode.

2. – indicates an undefined key.

11. ELECTRONIC VOLUME CONTROL

11.1 Electronic Volume Functions

The μPD178024GC-051 uses an electronic volume IC (TDA7313) to control audio output and for audio selection. The following electronic volume functions are available.

(1) Setting gain of electronic volume IC

The gain of the electronic volume IC is set to 0 dB.

(2) Adjusting volume

The volume can be adjusted in each of the following modes:

Mode	Function	Adjustment Range	Default Value on Power Application
Volume	Adjusts volume of main volume.	00 to 63	28
Bass	Adjusts volume of bass (low-frequency region).	–6 to +6	00 (no bass compensation)
Treble	Adjusts volume of treble (high-frequency region).	–6 to +6	00 (no treble compensation)
Balance	Adjusts volume balance between left and right.	R31 to L31	00 (center position between left and right)
Fader	Adjusts volume balance between front and rear	F31 to R31	00 (center position between front and rear)

However, the fader cannot be adjusted if the fader adjustment function is not specified by the initialization switch “FADSEL”.

When equalize processing is performed by the electronic volume and when the equalizer mode is other than “FLAT”, bass and treble cannot be adjusted.

For equalizer processing by the electronic volume, refer to “(4) Equalizer processing by electronic volume”.

To adjust the volume, select an adjustment mode by using the VOL SEL/VOL CLR key, and make an adjustment by using the VOL UP and VOL DWN keys.

For the specific adjustment method, refer to the description of each of the above keys.

On power application, the volume value in each mode is set to the default value.

On power application and on releasing the standby mode, the main volume value set at that time is returned to the default value if it is greater than the default value, or is retained if it is less than the default value.

At this time, the volume values in the bass, treble, balance, and fader modes are retained regardless of their values.

For the correspondence between the displayed volume values and the set values of the electronic volume IC, refer to “11.2 Electronic Volume IC (TDA7313) Set Values”.

(3) Loudness control

Each time the $\boxed{\text{LOUD}}$ key is pressed, loudness is turned on or off.

When loudness is on, the $\overline{\text{LOUD}}$ pin (pin 39) outputs a low level, and the loudness of the electronic volume IC is turned on.

If the loudness of the electronic volume IC is on, the gain of the electronic volume IC is amplified by +7.5 dB.

(4) Equalizer processing by electronic volume IC

If it is specified by the initialization switch “EQICSEL” that the equalizer is not used, equalizer processing by the electronic volume IC is performed.

Equalizer processing by electronic volume IC is performed by setting the gain of the bass and treble in an equalizer mode.

At this time, the bass adjustment mode and treble adjustment mode are skipped when an electronic volume mode is selected by using the $\boxed{\text{VOL SEL}}$ key in an equalizer mode other than “FLAT”. Therefore, bass and treble cannot be adjusted.

Bass and treble are adjusted as follows in each equalizer mode.

Equalizer Mode	Range	Gain
FLAT	Bass	Adjustable by bass adjustment operation
	Treble	Adjustable by treble adjustment operation
ROCK	Bass	Fixed to +6 dB (cannot be adjusted)
	Treble	Fixed to +2 dB (cannot be adjusted)
CLASSIC	Bass	Fixed to +2 dB (cannot be adjusted)
	Treble	Fixed to +2 dB (cannot be adjusted)
POP	Bass	Fixed to –4 dB (cannot be adjusted)
	Treble	Fixed to –2 dB (cannot be adjusted)

(5) Mute setting of electronic volume

In the mute-on status, the $\overline{\text{MUTE}}$ pin outputs a low level, and the electronic volume IC is muted.

For the mute value of the electronic volume IC, refer to “11.2 Electronic Volume IC (TDA7313) Set Values”.

11.2 Electronic Volume IC (TDA7313) Set Values

The correspondence between the display values and the set values of the electronic volume IC in each mode of volume adjustment is as follows:

(1) Main volume set values

Display Value	Set Value (dB)	Display Value	Set Value (dB)	Display Value	Set Value (dB)	Display Value	Set Value (dB)
00	–78.75	16	–58.75	32	–38.75	48	–18.75
01	–77.50	17	–57.50	33	–37.50	49	–17.50
02	–76.25	18	–56.25	34	–36.25	50	–16.25
03	–75.00	19	–55.00	35	–35.00	51	–15.00
04	–73.75	20	–53.75	36	–33.75	52	–13.75
05	–72.50	21	–52.50	37	–32.50	53	–12.50
06	–71.25	22	–51.25	38	–31.25	54	–11.25
07	–70.00	23	–50.00	39	–30.00	55	–10.00
08	–68.75	24	–48.75	40	–28.75	56	–8.75
09	–67.50	25	–47.50	41	–27.50	57	–7.50
10	–66.25	26	–46.25	42	–26.25	58	–6.25
11	–65.00	27	–45.00	43	–25.00	59	–5.00
12	–63.75	28	–43.75	44	–23.75	60	–3.75
13	–62.50	29	–42.50	45	–22.50	61	–2.50
14	–61.25	30	–41.25	46	–21.25	62	–1.25
15	–60.00	31	–40.00	47	–20.00	63	0.00

(2) Bass/treble set values

Display Value	Set Value (dB)	Display Value	Set Value (dB)
00	0	–	–
+01	+2	–01	–2
+02	+4	–02	–4
+03	+6	–03	–6
+04	+8	–04	–8
+05	+10	–05	–10
+06	+12	–06	–12

(3) Speaker attenuator set values by balance/fader adjustment

Balance/fader adjustment attenuates the speaker attenuator of a channel in a direction opposite to the moving direction.

Display Value	Set Value (dB)	Display Value	Set Value (dB)	Display Value	Set Value (dB)	Display Value	Set Value (dB)
00	0	08	–10.00	16	–20.00	24	–30.00
01	–1.25	09	–11.25	17	–21.25	25	–31.25
02	–2.50	10	–12.50	18	–22.50	26	–32.50
03	–3.75	11	–13.75	19	–23.75	27	–33.75
04	–5.00	12	–15.00	20	–25.00	28	–35.00
05	–6.25	13	–16.25	21	–26.25	29	–36.25
06	–7.50	14	–17.50	22	–27.50	30	–37.50
07	–8.75	15	–18.75	23	–28.75	31	–38.75

(4) Mute set values

Parameter	Set Values (dB)
Main volume	–78.75
Speaker attenuator	All channels: –38.75

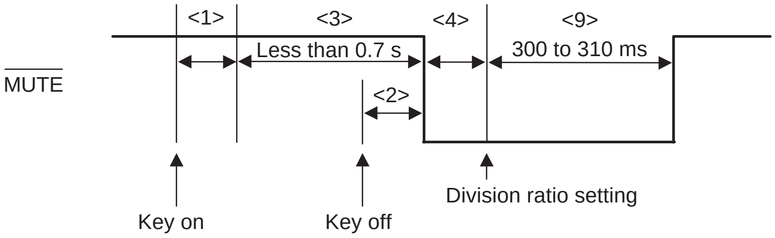
12. MUTE OUTPUT TIMING CHART

Timing charts illustrating the mute output timing are shown below.

Charts <1> through <11> show the time required for each of the following processing, which is the value shown in parentheses ( ) unless otherwise specified.

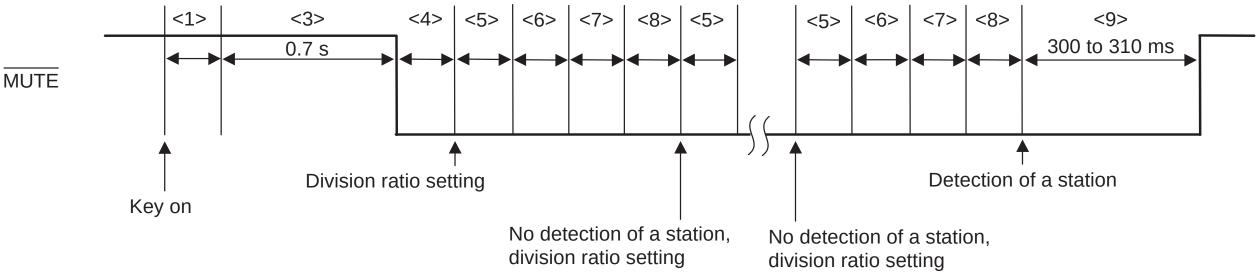
<1> Key ON chattering suppression time (20 to 40 ms)
<2> Key OFF chattering suppression time (20 ms MAX.)
<3> Key OFF wait time
<4> Mute leading time (40 to 50 ms)
<5> Division ratio setup time (500 to 510 ms at band edge, 0 ms at other edges)
<6> PLL lock wait time
<7> S meter stabilization wait time (20 to 30 ms)
<8> IF measurement time (12 to 30 ms, IF counter gate open time: 4 ms × 3 times)
<9> Mute trailing time
<10> Preset hold time (6.0 to 6.1 seconds)
<11> Chattering suppression time of $\overline{\text{ACC}}$ and $\overline{\text{BATT}}$ pins (10 to 12 ms)

12.1 Manual Up/Down


MUTE
<1>
<3>
Less than 0.7 s
<4>
<9>
300 to 310 ms
<2>
Key on
Key off
Division ratio setting

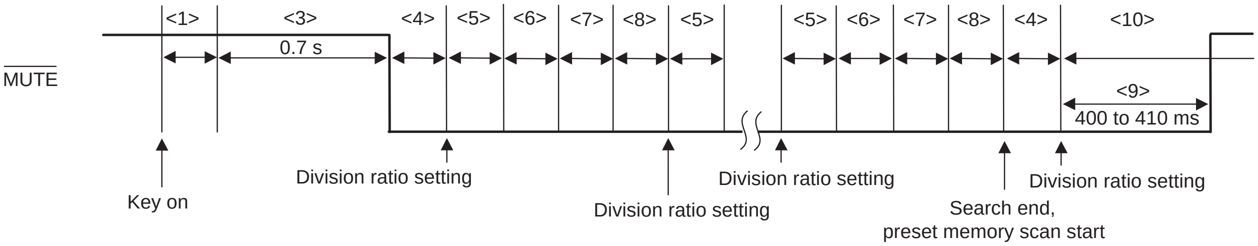
Time <9> is 600 to 610 ms in the case of a band edge.

12.2 Auto Seek Up/Down

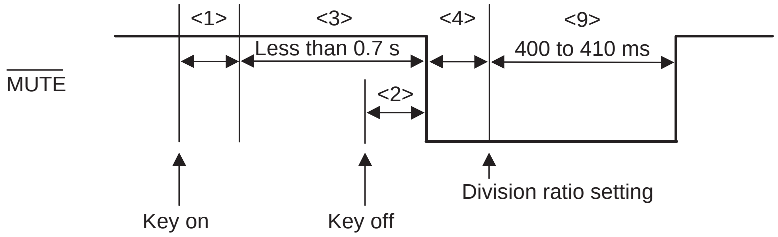

MUTE
<1>
<3>
0.7 s
<4>
<5>
<6>
<7>
<8>
<5>
<5>
<6>
<7>
<8>
<9>
300 to 310 ms
Key on
Division ratio setting
No detection of a station,
division ratio setting
No detection of a station,
division ratio setting
Detection of a station

Time <9> is 600 to 610 ms in the case of a band edge.

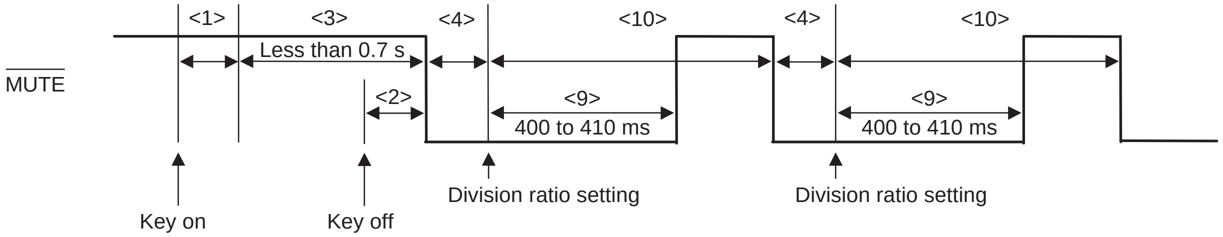
12.3 Auto Store Memory


MUTE
<1>
<3>
0.7 s
<4>
<5>
<6>
<7>
<8>
<5>
<5>
<6>
<7>
<8>
<4>
<10>
<9>
400 to 410 ms
Key on
Division ratio setting
Division ratio setting
Division ratio setting
Search end,
preset memory scan start
Division ratio setting

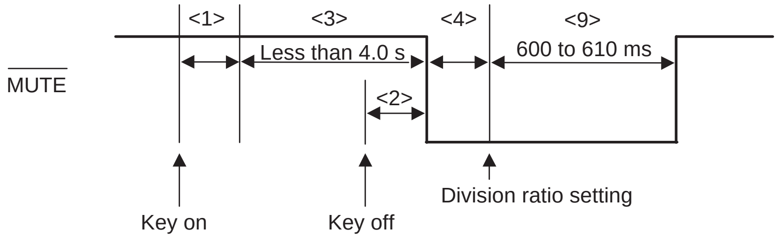
12.4 Preset Memory Calling


MUTE
<1>
<3>
Less than 0.7 s
<4>
<9>
400 to 410 ms
<2>
Key on
Key off
Division ratio setting

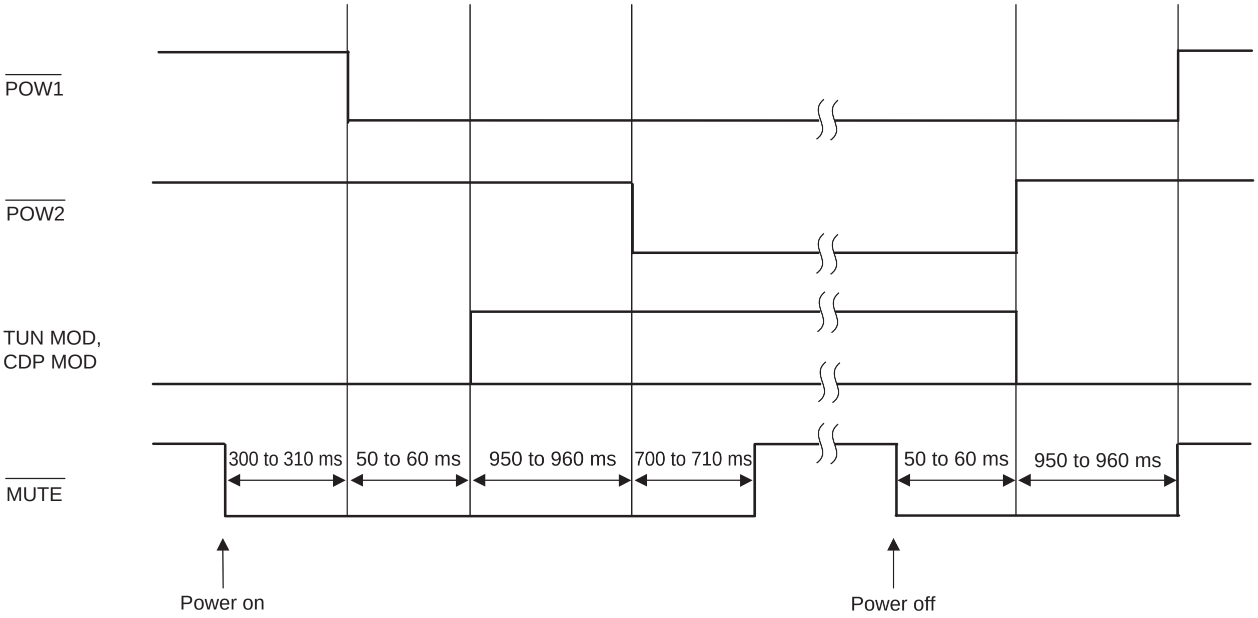
12.5 Preset Memory Scan


MUTE
<1>
<3>
Less than 0.7 s
<4>
<10>
<4>
<10>
<2>
<9>
400 to 410 ms
<9>
400 to 410 ms
Key on
Key off
Division ratio setting
Division ratio setting

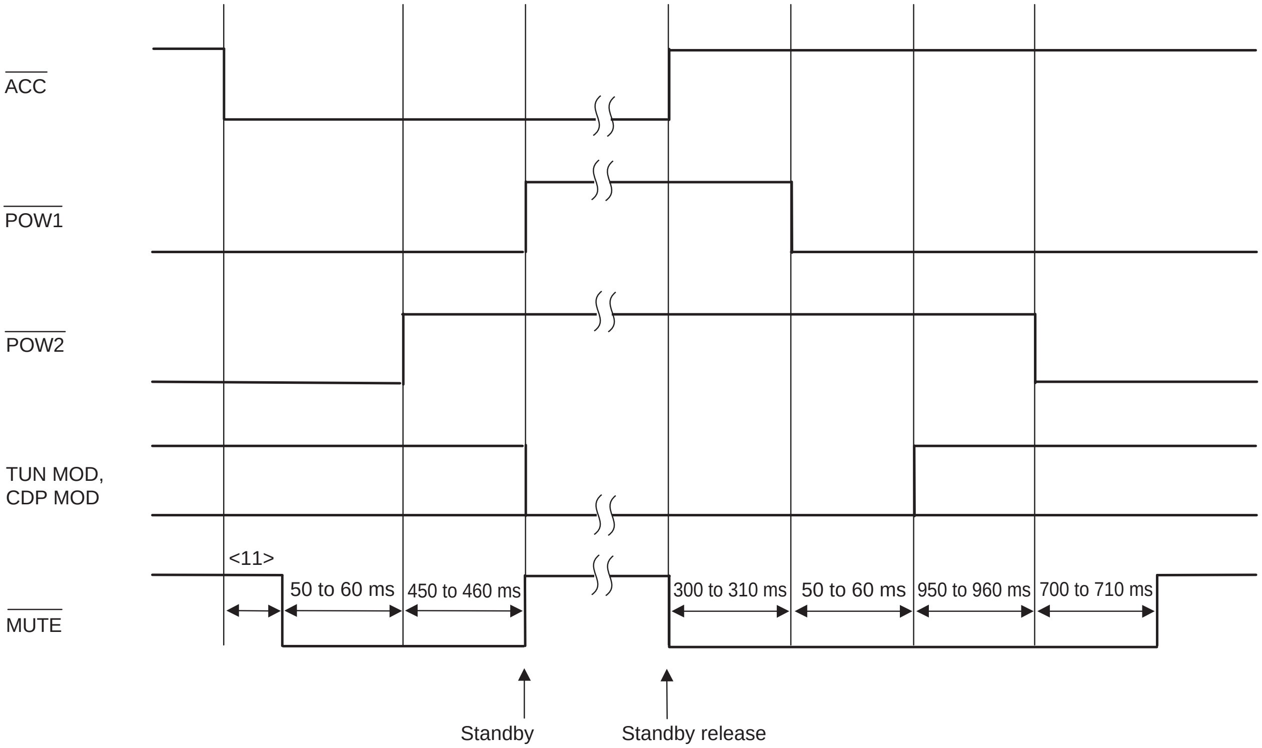
12.6 Band Selection


MUTE
<1>
<3>
Less than 4.0 s
<4>
<9>
600 to 610 ms
<2>
Key on
Key off
Division ratio setting

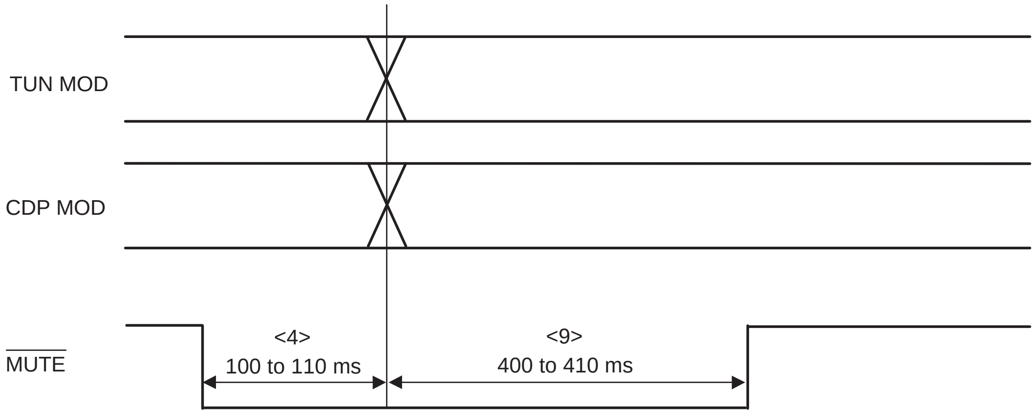
12.7 Power On/Off


$\overline{\text{POW1}}$
$\overline{\text{POW2}}$
TUN MOD,
CDP MOD
$\overline{\text{MUTE}}$
300 to 310 ms
50 to 60 ms
950 to 960 ms
700 to 710 ms
50 to 60 ms
950 to 960 ms
Power on
Power off

12.8 Setting/Releasing Standby Mode


$\overline{\text{ACC}}$
$\overline{\text{POW1}}$
$\overline{\text{POW2}}$
TUN MOD,
CDP MOD
$\overline{\text{MUTE}}$
<11>
50 to 60 ms
450 to 460 ms
300 to 310 ms
50 to 60 ms
950 to 960 ms
700 to 710 ms
Standby
Standby release

12.9 Mode Selection


TUN MOD
CDP MOD
$\overline{\text{MUTE}}$
<4>
100 to 110 ms
<9>
400 to 410 ms

13. ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings (T_A = 25°C)

Parameter	Symbol	Conditions		Rating	Unit
Supply voltage	V_{DD}			–0.3 to +6.0	V
	V_{DD}PORT			–0.3 to V_{DD} + 0.3	V
	V_{DD}PLL			–0.3 to V_{DD} + 0.3	V
Input voltage	V_I			–0.3 to +11.0	V
Output voltage	V_O	Excluding P130 to P132		–0.3 to V_{DD} + 0.3	V
Output breakdown voltage	V_{BDS}	P130 to P132	N-ch open drain	16	V
Analog input voltage	V_{AN}	P10 to P15	Analog input pin	–0.3 to V_{DD} + 0.3	V
Output current, high	I_{OH}	Per pin		–8	mA
		Total for P00 to P06, P30 to P37, P54 to P57, P60 to P67, and P120 toP125		–15	mA
		Total for P40 to P47, P50 to P53, and P70 to P77		–15	mA
Output current, low	I_{OL} Note	Per pin	Peak value	16	mA
			rms value	8	mA
		Total for P00 to P06, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P120 to P125, and P130 to P132	Peak value	30	mA
			rms value	15	mA
Operating ambient temperature	T_A			–40 to +85	°C
Storage temperature	T_{stg}			–55 to +125	°C

Note The rms value should be calculated as follows: [rms value] = [Peak value] × $\sqrt{\text{Duty}}$

Caution **Product quality may suffer if the absolute maximum rating is exceeded even momentarily for any parameter. That is, the absolute maximum ratings are rated values at which the product is on the verge of suffering physical damage, and therefore the product must be used under conditions that ensure that the absolute maximum ratings are not exceeded.**

Remark Unless specified otherwise, the characteristics of alternate-function pins are the same as those of port pins.

Recommended Supply Voltage Ranges (T_A = –40 to +85°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply voltage	V_{DD1}	When CPU and PLL are operating	4.5	5.0	5.5	V
	V_{DD2}	When CPU is operating and PLL is stopped	3.5	5.0	5.5	V
Data retention voltage	V_{DDR}	When crystal oscillation stops	2.3		5.5	V
Output breakdown voltage	V_{BDS}	P130 to P132 (N-ch open drain)			15	V

DC Characteristics (T_A = –40 to +85°C, V_{DD} = 3.5 to 5.5 V) (1/2)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Input voltage, high	V_{IH1}	P10 to P15, P30 to P32, P35 to P37, P40 to P47, P50 to P57, P60 to P67, P71, P73, P120 to P125		0.7 V_{DD}		V_{DD}	V
	V_{IH2}	P00 to P06, P33, P34, P70, P72, P74, P75, $\overline{\text{RESET}}$		0.8 V_{DD}		V_{DD}	V
	V_{IH3}	P76, P77 (N-ch open-drain I/O)	4.5 V $\le V_{DD} \le$ 5.5 V	0.7 V_{DD}		V_{DD}	V
Input voltage, low	V_{IL1}	P10 to P15, P30 to P32, P35 to P37, P40 to P47, P50 to P57, P60 to P67, P71, P73, P120 to P125		0		0.3 V_{DD}	V
	V_{IL2}	P00 to P06, P33, P34, P70, P72, P74 to P75, $\overline{\text{RESET}}$		0		0.2 V_{DD}	V
	V_{IL3}	P76, P77 (N-ch open-drain I/O)	4.5 V $\le V_{DD} \le$ 5.5 V	0		0.3 V_{DD}	V
Output voltage, high	V_{OH1}	P00 to P06, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P120 to P125	4.5 V $\le V_{DD} \le$ 5.5 V, I_{OH} = –1 mA	V_{DD} – 1.0			V
			3.5 V $\le V_{DD} <$ 4.5 V, I_{OH} = –100 μA	V_{DD} – 0.5			V
	V_{OH2}	EO0, EO1	V_{DD} = 4.5 to 5.5 V, I_{OH} = –3 mA	V_{DD} – 1.0			V
Output voltage, low	V_{OL1}	P00 to P06, P30 to P37, P40 to 47, P50 to 57, P60 to P67, P70 to P75, P120 to P125	4.5 V $\le V_{DD} \le$ 5.5 V, I_{OL} = 1 mA			1.0	V
			3.5 V $\le V_{DD} <$ 4.5 V, I_{OL} = 100 μA			0.5	V
	V_{OL2}	EO0, EO1	V_{DD} = 4.5 to 5.5 V, I_{OL} = 3 mA			1.0	V
	V_{OL3}	P76, P77 (N-ch open-drain I/O)	4.5 V $\le V_{DD} \le$ 5.5 V, I_{OL} = 3 mA			0.4	V
			4.5 V $\le V_{DD} \le$ 5.5 V, I_{OL} = 6 mA			0.6	V
Input leakage current, high	I_{LH}	P00 to P06, P10 to P15, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P120 to P125, $\overline{\text{RESET}}$	$V_{IN} = V_{DD}$			3	μA

Remark Unless specified otherwise, the characteristics of alternate-function pins are the same as those of port pins.

DC Characteristics (T_A = –40 to +85°C, V_{DD} = 3.5 to 5.5 V) (2/2)

Parameter	Symbol	Test Conditions		MIN.	TYP.	MAX.	Unit
Input leakage current, low	I_{LIL}	P00 to P06, P10 to P15, P30 to P37, P40 to P47, P50 to P57, P60 to P67, P70 to P77, P120 to P125, $\overline{\text{RESET}}$	V_{IN} = 0 V			–3	µA
Output off leakage current	I_{LOH1}	P130 to P132	V_{OUT} = 15 V			–3	µA
	I_{LOL1}	P130 to P132	V_{OUT} = 0 V			3	µA
	I_{LOH2}	P76, P77 (at N-ch open drain I/O)	V_{OUT} = V_{DD}			–3	µA
	I_{LOL2}	P76, P77 (at N-ch open drain I/O)	V_{OUT} = 0 V			3	µA
	I_{LOH3}	EO0, EO1	V_{OUT} = V_{DD}			–3	µA
	I_{LOL3}	EO0, EO1	V_{OUT} = 0 V			3	µA
Supply current**Note**	I_{DD1}	When CPU is operating and PLL is stopped. Sine wave input to X1 pin At f_X = 4.5 MHz V_{IN} = V_{DD}			4.0	20	mA
	I_{DD2}	In HALT mode with PLL stopped. Sine wave input to X1 pin At f_X = 4.5 MHz V_{IN} = V_{DD}			0.35	0.70	mA
Data retention voltage	V_{DDR1}	When crystal oscillation is operating		3.5		5.5	V
	V_{DDR2}	When crystal oscillation is stopped	Power-failure detection function	2.2			V
	V_{DDR3}		Data memory retained	2.0			V
Data retention current	I_{DDR1}	When crystal oscillation is stopped	T_A = 25°C, V_{DD} = 5 V		2.0	4.0	µA
	I_{DDR2}				2.0	20	µA

Note Excluding AV_{DD} current and V_{DD}PLL current.

Remarks **1.** f_X: System clock oscillation frequency

2. Unless specified otherwise, the characteristics of alternate-function pins are the same as those of port pins.

Reference Characteristics (T_A = –40 to +85°C, V_{DD} = 4.5 to 5.5 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Supply current	I_{DD3}	When CPU and PLL are operating. Sine wave input to VCOH pin At f_{IN} = 160 MHz V_{IN} = 0.15 V_{P-P}		8		mA

AC Characteristics

(1) Basic operation (T_A = –40 to +85°C, V_{DD} = 3.5 to 5.5 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Cycle time (minimum instruction execution time)	T_{CY}	f_X = 4.5 MHz	0.44		7.11	μs
TI50, TI51 input frequency	f_{TI5}				2	MHz
TI50, TI51 input high-/low-level widths	t_{TIH5} t_{TIL5}		200			ns
Interrupt input high-/low-level widths	t_{INTH} t_{INTL}	INTP0 to INTP4	1			μs
$\overline{\text{RESET}}$ pin low-level width	t_{RSL}		10			μs

(2) Serial interface (T_A = –40 to +85°C, V_{DD} = 3.5 to 5.5 V)

(a) Serial interface (IIC0)

I^{2}C bus mode

Parameter		Symbol	Standard Mode		High-Speed Mode		Unit
			MIN.	MAX.	MIN.	MAX.	
SCL0 clock frequency		f_{CLK}	0	100	0	400	kHz
Bus free time (between stop and start conditions)		t_{BUF}	4.7	–	1.3	–	μs
Hold time[Note 1]		$t_{HD:STA}$	4.0	–	0.6	–	μs
SCL0 clock low-level width		t_{LOW}	4.7	–	1.3	–	μs
SCL0 clock high-level width		t_{HIGH}	4.0		0.6	–	μs
Start/restart condition setup time		$t_{SU:STA}$	4.7	–	0.6	–	μs
Data hold time	CBUS compatible master	$t_{HD:DAT}$	5.0	–	–	–	μs
	I^{2}C bus		0[Note2]	–	0[Note 2]	0.9[Note 3]	μs
Data setup time		$t_{SU:DAT}$	250	–	100[Note 4]	–	ns
SDA0 and SCL0 signal rise time		t_R	–	1,000	20+0.1Cb[Note 5]	300	ns
SDA0 and SCL0 signal fall time		t_F	–	300	20+0.1Cb[Note 5]	300	ns
Stop condition setup time		$t_{SU:STO}$	4.0	–	0.6	–	μs
Pulse width of spike restrained by input filter		t_{SP}	–	–	0	50	ns
Each bus line capacitative load		Cb	–	400	–	400	pF

Notes
1. The first clock pulse is generated at the start condition after this period.
2. The device needs to internally supply a hold time of at least 300 ns for the SDA0 signal to fill the undefined area at the falling edge of the SCL0 ($V_{IHmin.}$ of the SCL0 signal).
3. Unless the device extends the low hold time (t_{LOW}) of the SCL0 signal, it is necessary to fill only the maximum data hold time ($t_{HD:DAT}$).
4. The high-speed mode I^{2}C bus can be used in the standard mode I^{2}C bus system. In this case, satisfy the following conditions:
   - When the device does not extend the low hold time of the SCL0 signal
     $t_{SU:DAT} \geq 250$ ns
   - When the device extends the low hold time of the SCL0 signal
     Send the next data bit to the SDA line before releasing the SCL0 line ($t_{Rmax.} + t_{SU:DAT}$ = 1,000 + 250 = 1,250 ns : in the standard mode I^{2}C bus specification)
5. Cb: Total capacitance of one bus line (unit: pF)

(b) Serial interface (SIO3)

(i) 3-wire serial I/O mode ($\overline{\text{SCK3}}$ ... internal clock output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
$\overline{\text{SCK3}}$ cycle time	t_{KCY1}		800			ns
$\overline{\text{SCK3}}$ high-/low-level width	t_{KH1}, t_{KL1}		$t_{KCY1}/2 - 50$			ns
SI3 setup time (to $\overline{\text{SCK3}}$↑)	t_{SIK1}		100			ns
SI3 hold time (from $\overline{\text{SCK3}}$↑)	t_{KSI1}		400			ns
SO3 output delay time from $\overline{\text{SCK3}}$↓	t_{KSO1}	C = 100 pF**Note**			300	ns

Note C is the load capacitance of SCK3 and SO3 output lines.

(ii) 3-wire serial I/O mode ($\overline{\text{SCK3}}$ ... external clock input)

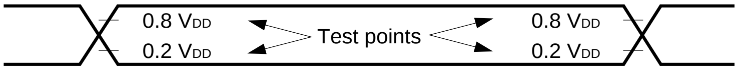
Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
$\overline{\text{SCK3}}$ cycle time	t_{KCY}		800			ns
$\overline{\text{SCK3}}$ high-/low-level width	t_{KH2}, t_{KL2}		400			ns
SI3 setup time (to $\overline{\text{SCK3}}$↑)	t_{SIK2}		100			ns
SI3 hold time (from $\overline{\text{SCK3}}$↑)	t_{KSI2}		400			ns
SO3 output delay time from $\overline{\text{SCK3}}$↓	t_{KSO2}	C = 100 pF**Note**			300	ns
$\overline{\text{SCK3}}$ rise/fall time	t_{R2}, t_{F2}				1,000	

Note C is the load capacitance of SO3 output line.

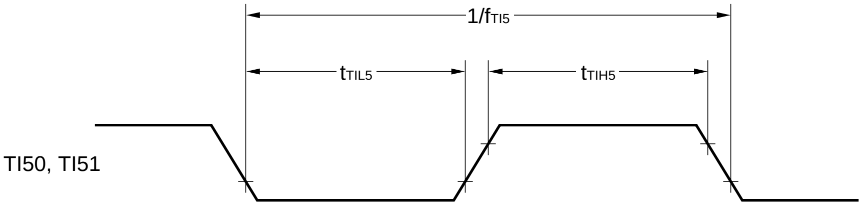
(c) Serial interface (UART0: Dedicated baud rate generator output)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Transfer rate					38,400	bps

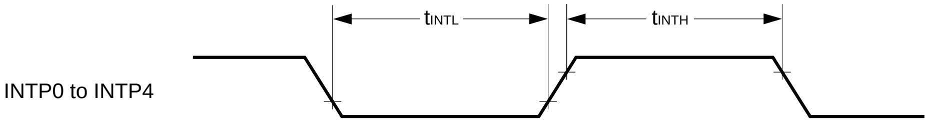
AC Timing Test Point (Excluding X1 Input)


0.8 V_{DD}
0.2 V_{DD}
Test points
0.8 V_{DD}
0.2 V_{DD}

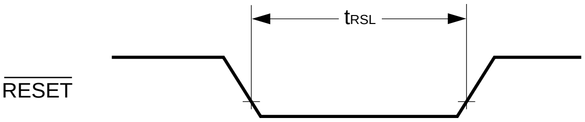
TI Timing


$1/f_{TI5}$
t_{TIL5}
t_{TIH5}
TI50, TI51

Interrupt Input Timing

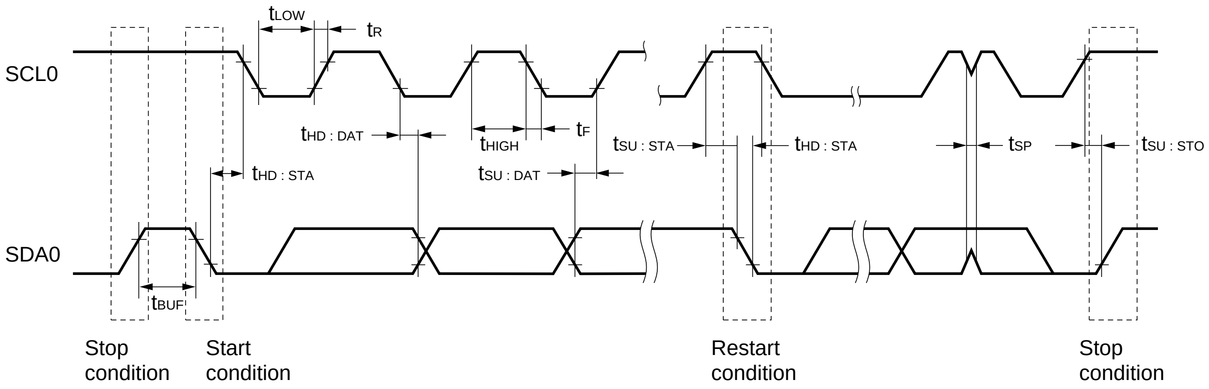

t_{INTL}
t_{INTH}
INTP0 to INTP4

$\overline{\text{RESET}}$ Input Timing

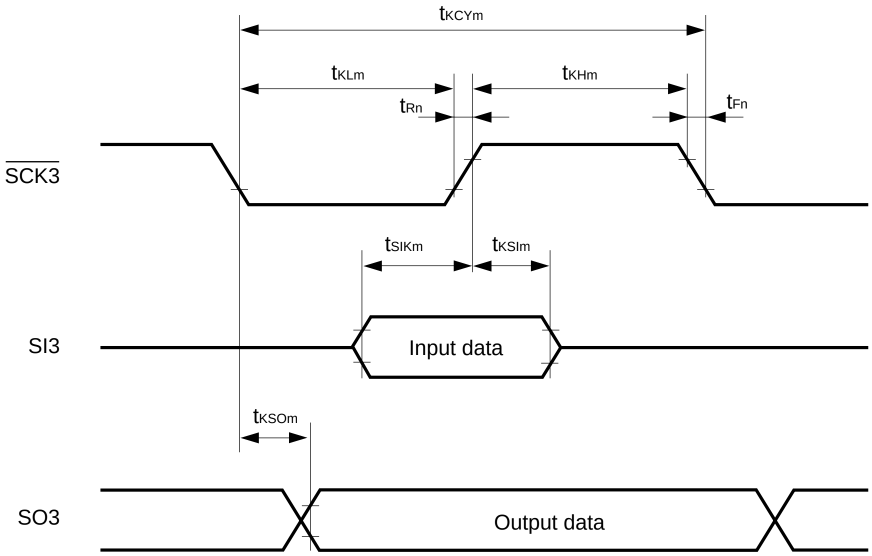

t_{RSL}
$\overline{\text{RESET}}$

Serial Transfer Timing

I^{2}C bus mode:


tLOW
tR
SCL0
tHD : DAT
tHIGH
tF
tSU : STA
tHD : STA
tSP
tSU : STO
tHD : STA
tSU : DAT
SDA0
tBUF
Stop condition
Start condition
Restart condition
Stop condition

3-wire serial I/O mode:


tKCYm
tKLm
tKHm
tRn
tFn
SCK3
tSIKm
tKSIm
SI3
Input data
tKSOm
SO3
Output data

Remark m = 1, 2
n = 2

A/D Converter Characteristics (T_A = –40 to +85°C, V_{DD} = 4.5 to 5.5 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Resolution			8	8	8	bit
Overall error[Note]					0.8	%
Conversion time	t_{CONV}		15.2		45.7	μs
Analog input voltage	V_{IAN}		0		V_{DD}	V

Note Excludes quantization error (±1/2LSB).

PLL Characteristics (T_A = –40 to +85°C, V_{DD} = 4.5 to 5.5 V)

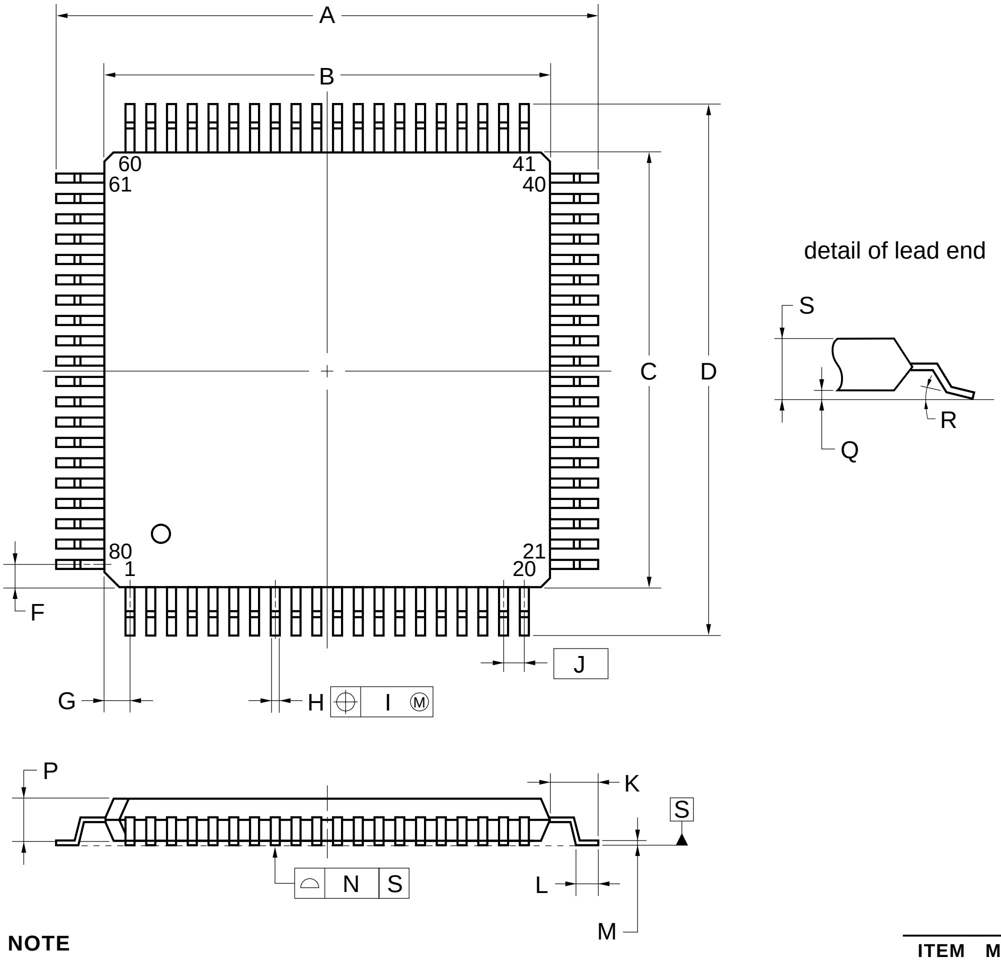
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating frequency	f_{IN1}	VCOL pin, MF mode, sine wave input, V_{IN} = 0.15 V_{P-P}	0.5		3.0	MHz
	f_{IN2}	VCOL pin, HF mode, sine wave input, V_{IN} = 0.15 V_{P-P}	10		40	MHz
	f_{IN3}	VCOH pin, VHF mode, sine wave input, V_{IN} = 0.15 V_{P-P}	60		130	MHz
	f_{IN4}	VCOH pin, VHF mode, sine wave input, V_{IN} = 0.3 V_{P-P}	40		160	MHz

IFC Characteristics (T_A = –40 to +85°C, V_{DD} = 4.5 to 5.5 V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Operating frequency	f_{IN5}	AMIFC pin, AMIF count mode, sine wave input, V_{IN} = 0.15 V_{P-P}	0.4		0.5	MHz
	f_{IN6}	FMIFC pin, FMIF count mode, sine wave input, V_{IN} = 0.15 V_{P-P}	10		11	MHz
	f_{IN7}	FMIFC pin, AMIF count mode, sine wave input, V_{IN} = 0.15 V_{P-P}	0.4		0.5	MHz

14. PACKAGE DRAWING

80-PIN PLASTIC QFP (14x14)


A
B
60
41
61
40
C
D
80
21
1
20
F
J
G
H
I
Ⓜ
detail of lead end
S
R
Q
P
K
S
N
S
L
M

NOTE

Each lead centerline is located within 0.13 mm of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS
A	17.20±0.20
B	14.00±0.20
C	14.00±0.20
D	17.20±0.20
F	0.825
G	0.825
H	0.32±0.06
I	0.13
J	0.65 (T.P.)
K	1.60±0.20
L	0.80±0.20
M	$0.17^{+0.03}_{-0.07}$
N	0.10
P	1.40±0.10
Q	0.125±0.075
R	$3°^{+7°}_{-3°}$
S	1.70 MAX.

P80GC-65-8BT-1

15. RECOMMENDED SOLDERING CONDITIONS

The μPD178024GC-051 should be soldered and mounted under the following recommended conditions.

For the details of the recommended soldering conditions, refer to the document **Semiconductor Device Mounting Technology Manual (C10535E)**.

For soldering methods and conditions other than those recommended below, consult your NEC sales representative.

Table 10-1. Surface Mounting Type Soldering Conditions

μPD178024GC-051-8BT: 80-pin plastic QFP (14 × 14 mm, 0.65 mm pitch)

Soldering Method	Soldering Conditions	Recommended Conditions Symbol
Infrared reflow	Package peak temperature: 235°C, Time: 30 seconds max. (at 210°C or higher), Count: two times or less	IR35-00-2
VPS	Package peak temperature: 215°C, Time: 40 seconds max. (at 200°C or higher), Count: two times or less	VP15-00-2
Wave soldering	Solder bath temperature: 260°C max., Time: 10 seconds max., Count: once, Preheating temperature: 120°C max., (Package surface temperature)	WS60-00-1
Partial heating	Pin temperature: 300°C max., Time: 3 seconds max. (per pin row)	–

Caution Do not use different soldering methods together (except partial heating).

NOTES FOR CMOS DEVICES

① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note:

No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to V_{DD} or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note:

Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

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- Product release schedule
- Availability of related technical literature
- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)
- Network requirements

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