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

The DMC 4002 is CMOS LSI chips developed for world-wide FM / MW / LW tuning with PLL frequency synthesizer system.
The DMC 4002 can make a compact and high performance FM / MW / LW tuner with clock function for high-end car stereo, home stereo and so on because these CMOS LSIs are in 64-pin QFP package with built-in PLL frequency synthesizer, controller, 200 MHz prescaler, LCD driver and IF counter.

☐ FUNCTIONS

RADIO FUNCTIONS

(1) Manual tuning

　　Manual tuning up/down ...... Stepped tuning and rapid tuning.

(2) Auto tuning

　　Seek up/down ...... Retaining the frequency of a station received.

　　Scan up/down ...... Receiving in intervals of 5 seconds.

(3) Preset memory scanning ..... Receiving the contents of preset memories on the FM, MW, and LW bands for 5 seconds each.

(4) VF auto – tuning

　　- SK seek up/down .... Retaining the frequency of a SK signal received.

　　SK scan up/down .... Receiving a station with SK signal in intervals of 5 seconds.

(5) Preset memories

　　FM band .... FM 1 : 6 stations, FW 2 : 6 stations, FM 3 : 6 stations

　　MW band ... MW 1 : 6 stations, MW 2 : 6 stations

　　LW band ... 6 stations

　　VF band .... 6 stations

　　MW2 cannot be used while the LW band is used.

(6) Last-preset memories ......1 station on the FM1, FM2, FM3, MW1, MW2, LW and VF bands each.

(7) LOC (local) control signal outputs and indications.

(8) FM MONO (monaural) control signal output and indication.(For VF bands, same as for FM)

(9) "ST " (stereo) indicator ...... Enabled on the FM and VF bands.

(10) Auto-preset memories

(11) DK stand-by and SK alarm function

TAPE FUNCTIONS

(1) Tape transport direction indicators .... Can flash at 2 Hz during fast forward.

(2) AMS (auto music search) control signal output and indication.

(3) MTL (metal) control signal output and indication.

(4) NR1 (noise reduction) and NR2 control outputs and indications.

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□ FUNCTIONS (continued)

CLOCK FUNCTIONS

(1) Selectable 12-hour(with AM and PM indicators) or 24-hour display.

(2) Selectable flashing colon(:) (1Hz).

(3) Low-power (400nA) backup available in the NOCLK(no-clock)mode.

OTHERS

(1) LOUD (loudness) control signal output and indication ...... common to radio, tape, and CD modes.

(2) Key acknowledge(beep) signal outputs (2.25 kHz, 40ms) ...... Enabled by valid momentary keys.

(3) Display selector and priority display function.

(4) "⌐⌐" (compact disk) indicator.

Table) Receiving frequency, channel spacing, reference frequency, intermediate frequency

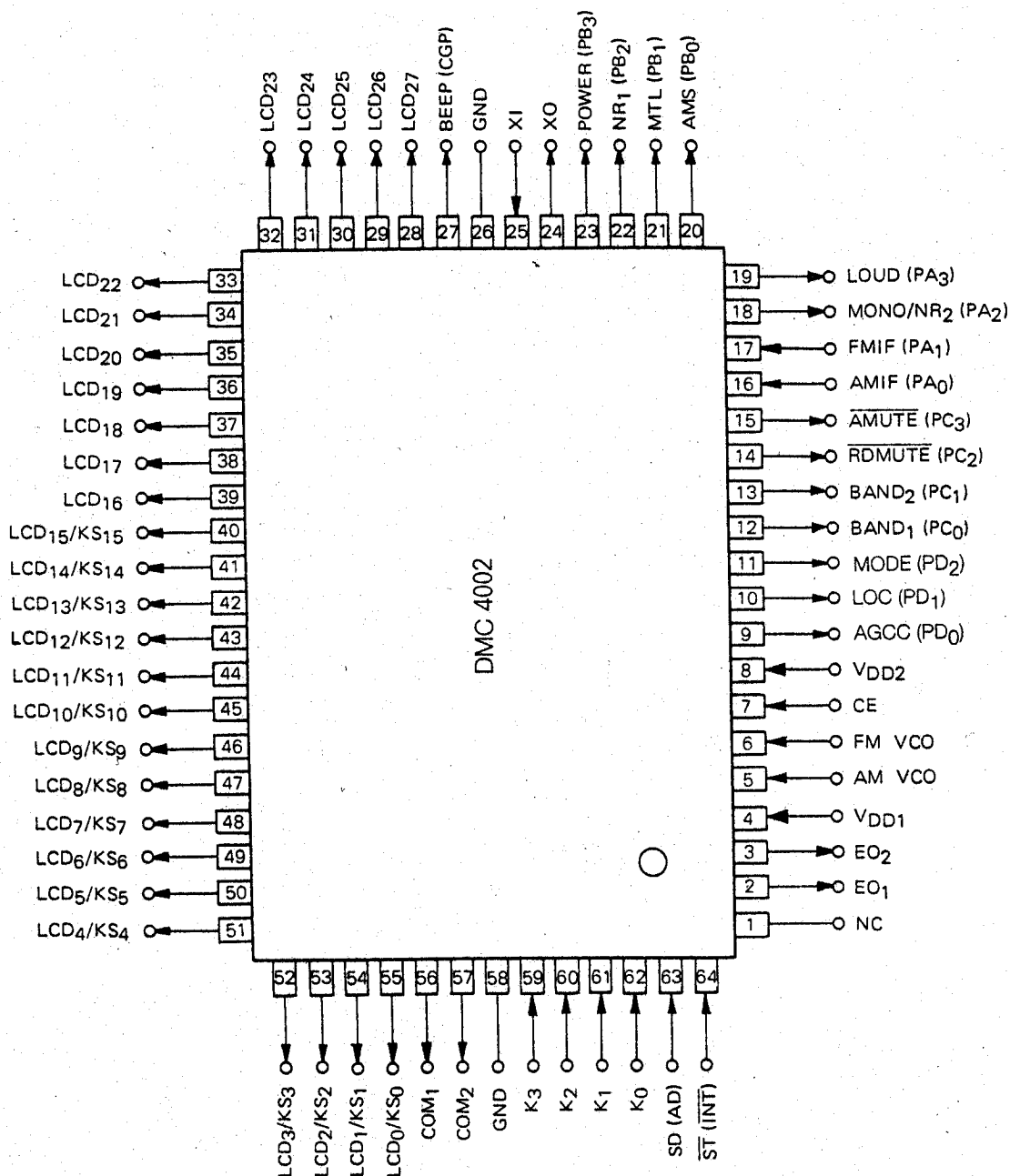| AREA	ITEM BAND	RECEIVING FREQUENCY	CHANNEL SPACE	REFERENCE FREQUENCY	INTERMEDIATE FREQUENCY
Europe 1	FM	87.5 to 108.0 MHz	50kHz	25kHz	10.7MHz
	MW	522 to 1620 kHz	9kHz	9kHz	450kHz
	LW	144 to 281kHz	1kHz	1kHz	450kHz
Europe 2	FW	87.5 to 108.0 MHz	50kHz	25kHz	10.7MHz
	MW	522 to 1620 kHz	9kHz	9kHz	459kHz
	LW	144 to 281kHz	1kHz	1kHz	459kHz
U.S.A 1	FM	87.5 to 108.0 MHz	100kHz	25kHz	10.7MHz
	MW	530 to 1620 kHz	10kHz	10kHz	450kHz
U.S.A 2	FM	87.5 to 107.9 MHz	200kHz	25kHz	10.7MHz
	MW	530 to 1620 kHz	10kHz	10kHz	450kHz
U.S.A 3	FM	87.5 to 107.9 MHz	200kHz	25kHz	10.7MHz
	MW	530 to 1710 kHz	10kHz	10kHz	450kHz
Australia and Middle and Near East	FM	87.5 to 108.0 MHz	100kHz	25kHz	10.7MHz
	MW	531 to 1602 kHz	9kHz	9kHz	450kHz
Japan	FM	76.0 to 90.0 MHz	100kHz	25kHz	−10.7MHz
	MW	522 to 1629 kHz	9kHz	9kHz	450kHz
Latin America	FM	87.5 to 108.0 MHz	100kHz	25kHz	10.7MHz
	MW	520 to 1620 kHz	5kHz	5kHz	450kHz

☐ FEATURES

Single power supply of 5V ± 10%

Built-in prescaler (200 MHz MAX. Vin = 0.3 V_{p-p}), IF counter and LCD driver (1/2 duty, 1/2 bias, frame frequency:100Hz)

Capable of receiving FM and MW in the whole world and LW in Europe.

Tuning function...... Manual tuning, auto-tuning (seek and scan) and preset memory scan.

Independent preset memory programming by six buttons for up to 18 FM stations (six FM1, FM2 and FM3 stations each), up to 12 MW stations (six MW1 and MW2 stations each), up to six LW stations and VF broadcasting stations.

Each last channel memory for FM : 3, MW : 1 and VF : 1

VF auto-tuning (SK signal search) with DK stand-by function.

Control output of MONO and LOC (LOCAL / DX) and its display.

Stereo display (ST)

Control output of MTL (METAL), NR1 (NOISE REDUCTION), NR2 and AMS (AUTO MUSIC SEARCH) and its display.

Automatic preset station memory function

Compact disc display (⌐d)

Loudness control output and its display

Built-in 12 hour/24 hour clock display function (possible to set no clock)

□ **PIN CONFIGURATION**

Top pins (left to right): 32 LCD23, 31 LCD24, 30 LCD25, 29 LCD26, 28 LCD27, 27 BEEP (CGP), 26 GND, 25 XI, 24 XO, 23 POWER (PB3), 22 NR1 (PB2), 21 MTL (PB1), 20 AMS (PB0)

Left pins (top to bottom):
- 33 LCD22
- 34 LCD21
- 35 LCD20
- 36 LCD19
- 37 LCD18
- 38 LCD17
- 39 LCD16
- 40 LCD15/KS15
- 41 LCD14/KS14
- 42 LCD13/KS13
- 43 LCD12/KS12
- 44 LCD11/KS11
- 45 LCD10/KS10
- 46 LCD9/KS9
- 47 LCD8/KS8
- 48 LCD7/KS7
- 49 LCD6/KS6
- 50 LCD5/KS5
- 51 LCD4/KS4

Center: DMC 4002

Right pins (top to bottom):
- 19 LOUD (PA3)
- 18 MONO/NR2 (PA2)
- 17 FMIF (PA1)
- 16 AMIF (PA0)
- 15 AMUTE (PC3)
- 14 RDMUTE (PC2)
- 13 BAND2 (PC1)
- 12 BAND1 (PC0)
- 11 MODE (PD2)
- 10 LOC (PD1)
- 9 AGCC (PD0)
- 8 VDD2
- 7 CE
- 6 FM VCO
- 5 AM VCO
- 4 VDD1
- 3 EO2
- 2 EO1
- 1 NC

Bottom pins (left to right): 52 LCD3/KS3, 53 LCD2/KS2, 54 LCD1/KS1, 55 LCD0/KS0, 56 COM1, 57 COM2, 58 GND, 59 K3, 60 K2, 61 K1, 62 K0, 63 SD (AD), 64 ST (INT)

☐ CONTENTS

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1. PIN DESCRIPTION

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
1	NC	No connection	This pin is not connected to the internal chip. Therefore, leave it open or connect it to GND, V_{DD}, etc.	—
2 3	EO_1 EO_2	Error out	PLL (Phase Locked Loop) error output pins. When the frequency obtained by dividing the local oscillation frequency (VCO output) is higher than the reference frequency. High level is output from these pins. When it is lower than the reference frequency. Low level is output from these pins . When the two frequencies are the same, these pins are floated. This output is input to an external LPF (Low Pass Filter) and is applied to a varactor diode through the LPF. EO1 and EO2 output the same waveform so that the pin to be used can be freely selected. When the radio is OFF, these pins are floated.	CMOS 3-state
4 - 8	V_{DD1} V_{DD2}	Power supply input	Device power supply input pin. This pin supplies $5V \pm 10\%$ power voltage during device operation (radio, tape, and CD modes). When the diode matrix NOCLK switch is 1(shorted by diode), when the CE pin (pin 7) is made Low level, this pin drops to 2.5V and data hold is enabled. When a voltage of $0 \rightarrow 4.5V$ is supplied to this pin, the data is initialized. Supply $0 \rightarrow 4.5V$ to this pin within 500 ms. Always connect pins 4 and 8 to the same potential. V_{DD1}(pin 4) is the analog system (PLL, A/D converter, INT, CE) power supply and V_{DD2}(pin 8) is the digital system (CPU, LCD driver, IF counter) power supply.	—
5	AM	AM local oscillation input	The AM (MW and LW band) local oscillation output (VCO output) is input to this pin. When the radio is turned on and the MW or LW band is received, this pin becomes active. Otherwise, it is pulled down internally. The input amplitude is $0.3 V_{P-P}$ MIN. Since there is an on-chip AC amplifier, block the DC component with a capacitor.	Input
6	FM	FM local oscillation input	The FM local oscillation output (VCO output) is input to this pin. When the radio is turned on and the FM band is received, this pin becomes active. Otherwise, it is pulled down internally. The input amplitude is $0.3 V_{P-P}$ MIN. Since there is an on-chip AC amplifier, block the DC component of the input signal with a capacitor.	Input

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
7	CE	Chip enable	Device select signal input pin. When the device is operated normally (radio, tape, CD, clock display, etc.), High level is input and when the device is not used, Low level is input. However, High and Low levels of 134μs or less are not accepted. When this pin is Low level, the radio, tape, CD and display are turned off and the device enters the data hold state. At this time, data hold at low consumption current (400nA or less) is possible by setting the NOCLK switch of the diode matrix to be described later to 1 (shorted by diode, no-clock mode.)	Input
9	AGCC	AGC cut output	Radio mode AGC(AUTOMATIC GAIN CONTROL) cut signal output pin. During autotuning, the High level shown below is output.	CMOS pushpull
10	LOC	Local output	This pin works as a LOCAL signal output pin when in the radio mode. The output is inverted each time `LOC` key is pressed. When the LOCAL state is enabled with `LOC` key, the "LOC" indicator on the LCD panel turns on, with an output high on this pin. The local state can be set in common on FM, VF, MW and LW bands. This pin is low at power-on time.	CMOS pushpull

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
11	MODE	Mode signal output	Mode switching signal output pin. Its output in each mode is shown below. Table: | Mode	MODE
------	------
CE = Low	0
CE = High ; radio, tape and CD OFF	0
Radio mode	1
Tape mode	0
CD mode	0
Tape DK standby / CD DK standby / DK ON	1
Radio monitor mode	1	 (0:Low level, 1:High level) That is, when the PLL is operated, High level is output from this pin. Therefore, use it to turn the tuner power on/off, etc.	CMOS pushpull
12 13	BAND₁, BAND₂	Band switching signal output	Radio mode band switching signal output pin. Its operation is described below. – Radio mode When the receiving band is switched by band switching key, the following is output on each band: Table: | BAND \ Pin	BAND1	BAND2
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MW	0	0
LW	0	1
FM	1	0
VF	1	1 | (0:Low level, 1:High level) – DK standby mode – DK ON mode | BAND \ Pin	BAND1	BAND2 /OPT.
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VF	1	1	 – Radio monitor mode Same as radio mode. – Tape mode – CD mode Low level output	CMOS pushpull

The content of the MODE pin description table:

Mode	MODE
CE = Low	0
CE = High ; radio, tape and CD OFF	0
Radio mode	1
Tape mode	0
CD mode	0
Tape DK standby / CD DK standby / DK ON	1
Radio monitor mode	1

The BAND switching tables:

BAND \ Pin	BAND₁	BAND₂
MW	0	0
LW	0	1
FM	1	0
VF	1	1

BAND \ Pin	BAND₁	BAND₂ /OPT.
VF	1	1

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
14	RDMUTE	Radio mute output	Radio mute signal output pin. This pin operates as follows: – Radio mode Low level is output at radio ON/OFF, band switching, and receiving frequency switching. – Tape and CD modes High level or Low level can be selected by MUTESEL switch of the diode matrix to be described later. However, when using the DK standby or radio monitor function, set the MUTESEL switch to 0 and select low level output. For more information, see "Mute Output Timing Chart".	CMOS pushpull
15	AMUTE	Audio mute output	Tape and CD mute signal output pin at DK ON and radio monitor ON. In the radio mode, Low level is output and in the tape and CD modes, High level is output. When DK is turned on during DK standby and in the radio monitor mode, Low level is output. For more information, see "Mute Output Timing Chart".	CMOS pushpull

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
16	AM IF	AM intermediate frequency input	AM (MW and LW bands) intermediate frequency (IF) input pin. The input amplitude is 0.1 Vp-p. Since there is an on-chip AC amplifier, block the DC component of the input signal with a capacitor. This pin is valid when the initialized diode matrix DISAMIF switch is 0. This pin is used for detecting the presence of a broadcast station during MW and LW band autotuning. The input frequency ranges and input conditions for determining the presence of a broadcast station are shown below. [table below] Input frequency range ① is the frequency that must be input within 20 ms after the PLL is locked. Input frequency range ② is the frequency that must be input within 40 ms after ① was input. When both input frequency ranges ① and ② are satisfied, a broadcast station is judged to be present and autotuning stops.	Input
17	FM IF	FM intermediate frequency input	FM band intermediate frequency (IF) input. The input amplitude is 0.1 Vp-p. Since there is an AC amplifier on the chip, block the DC component of the input signal with a capacitor. This pin is valid when the initialized diode matrix switch ENFMIF is 1. This pin is used for detecting the presence of a broadcast station during FM band autotuning. The input frequency ranges and input conditions for determining the presence of a broadcast station are shown below. [table below] Input frequency range ① is the frequency that must be input within 20 ms after the PLL is locked. Input frequency range ② is the frequency that must be input within 20 ms after ① was input. When both input frequency ranges ① and ② are satisfied, a broadcast station is judged to be present and autotuning stops.	Input

Table within pin 16 DESCRIPTION:

Area \ Item	Band	Input Frequency Range ①(kHz)	Input Frequency Range ②(kHz)
Europe 1	MW	450 ± 5	450 ± 2
Europe 1	LW	450 ± 5	450 ± 0.5
Europe 2	MW	459 ± 5	459 ± 2
Europe 2	LW	459 ± 5	459 ± 0.5
Others	MW	450 ± 5	450 ± 0.5

Table within pin 17 DESCRIPTION:

Area \ Item	Input Frequency Range ①	Input Frequency Range ②
All areas	10.7 MHz ± 50kHz	10.7 MHz ± 12.5kHz

PIN NO.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
18	MONO/NR₂	Monaural and noise reduction output	In the radio mode, this pin operates as the MONO signal output pin and in the tape mode, this pin operates as the NOISE REDUCTION signal output pin. – Radio mode Each time the ⌐MONO⌐ key is pressed on the FM and VF bands, the output is inverted. When the device is set to the MONO state by ⌐MONO⌐ key, the LCD panel "MONO" display lights and high level is output from this pin. On the MW and LW bands, this pin becomes low. When the power is turned on, this pin becomes low. – Tape mode This pin is valid when the diode matrix ENNR₂ switch to be described later is 1. When NOISE REDUCTION NR₂ is selected by pressing the ⌐NR⌐ key or NOISE REDUCTION function key (selected by diode matrix), high level is output. At this time, the LCD panel "NR₂" display lights. When the power is turned on, this pin becomes low.	CMOS pushpull
19	LOUD	LOUD output	LOUDNESS signal output pin. In the radio, tape and CD modes, the output is inverted each time the ⌐LOUD⌐ key is pressed. When the LOUDNESS state is selected by ⌐LOUD⌐ key, the LCD panel "LOUD" display lights and high level is output from this pin. When the power is turned on, this pin becomes low.	CMOS pushpull
20	AMS	AMS signal output	Tape mode AMS(AUTO MUSIC SEARCH) control signal output pin. Its output is inverted each time the ⌐AMS⌐ key is pressed. High level is output while the LCD panel "AMS" display is lit.	CMOS pushpull

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
21	MTL	Metal output	Tape mode metal signal output pin. Its output is inverted each time the [MTL] key and METAL function key (selected by diode matrix) is pressed. When the METAL state is selected with these keys, the LCD panel " MTL" display lights and high level is output from this pin. When the power is turned on, this pin becomes low.	CMOS pushpull
22	NR₁	Noise reduction output	Tape mode noise reduction (NR) signal output pin. When NR₁ is selected by the [NR] key or NOISE REDUCTION function key (selected by diode matrix), the LCD panel "NR₁" display lights and high level is output from this pin.	CMOS pushpull
23	POWER	Power output	When the CE pin is high level, the output of this pin is inverted each time the [POWER] key is pressed. When the power is turned on, low level is output. This pin can be used to turn the set power on and off, etc. See "Application Circuits".	CMOS pushpull
24 25	XO XI	Crystal oscillator	Crystal oscillator connection pin. It connects to a 4.5 MHz crystal oscillator. When the clock function is used, the accuracy of the clock is effected by the oscillation frequency accuracy only. Adjust the oscillation frequency while observing the LCD oscillation waveform and PLL local oscillation frequency.	CMOS (XO) Input(XI)
26 28	GND	Ground	Device ground pins. These pins connect to the internal chip. Therefore one of these two should be a ground. (Not all these two should not be.)	

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PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
27	BEEP	Beep output	Beep output pin when momentary key pressed. A 2.25 kHz and 50% duty square wave is output for approximately 40 ms. This time is equal to the premuting time. When a momentary key is pressed and the state of the LCD panel display or output port is changed (valid key) and at the end of 5 seconds hold during preset memory scan and scan operations, a beep is output. To disable the beep, float (leave open) this pin. The beep output is also used at SK alarm at DK standby.	CMOS pushpull
28 to 39 40 to 55	LCD_{27} to LCD_{16} LCD_{15}/KS_{15} to LCD_0/KS_0	LCD segment and key source output	LCD panel segment signal output (pins 28 to 55) and key matrix key source signal output (pins 40 to 55) pins. 56-dot display is performed at the LCD panel by matrix with the COM_1 pin(pin 56) and COM_2 pin (pin 57). Since LCD_{15} / KS_{15}(pin 40) to LCD_0 / KS_0(pin 55) share the key source signal and LCD segment signal, to use them as key source signals, a reverse current prevention diode is necessary. For the connection method, see "Key Matrix Connection" and "Application Circuits".	CMOS pushpull
56 57	COM_1 COM_2	LCD common signal output	Common signal output to LCD panel. 56-dot display is performed at the LCD panel by matrix with LCD_{27}(pin 28) to LCD_0/KS_0(pin 55)	CMOS pushpull
59 to 62	K_3 to K_0	Key return signal input	Key matrix key return signal input pin. Since the key source signal output is shared with the LCD segment signal, do not connect a pull-down resistor to this pin.	CMOS pushpull

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13

PIN No.	SYMBOL	FUNCTION	DESCRIPTION	OUTPUT TYPE
63	SD	SD input	Autotuning SD (Station Detector) signal input pin. When the voltage shown below is applied to this pin during the seek operation, a broadcast station is judged to be present. <table><tr><td>Band</td><td>LOCAL Mode</td><td colspan="2">SD Voltage</td></tr><tr><td></td><td></td><td></td><td>$V_{DD} = 5V$</td></tr><tr><td rowspan="2">FM</td><td>LOCAL</td><td>$\frac{28.5}{64} \times V_{DD}$ min</td><td>2.227V</td></tr><tr><td>DX</td><td>$\frac{12.5}{64} \times V_{DD}$ min</td><td>0.977V</td></tr><tr><td>MW</td><td>LOCAL</td><td>$\frac{15.5}{64} \times V_{DD}$ min</td><td>1.211V</td></tr><tr><td>LW</td><td>DX</td><td>$\frac{12.5}{64} \times V_{DD}$ min</td><td>0.977V</td></tr></table> In the auto preset memory mode, search is performed twice in the LOCAL mode and once in the DX mode. The voltage to determine the presence of a broadcast station at this time is shown below. <table><tr><td>Band</td><td>LOCAL Mode</td><td colspan="2">SD Voltage</td></tr><tr><td></td><td></td><td></td><td>$V_{DD} = 5V$</td></tr><tr><td rowspan="3">FM</td><td>LOCAL (1st time)</td><td>$\frac{44.5}{64} \times V_{DD}$ min</td><td>3.447V</td></tr><tr><td>LOCAL (2nd time)</td><td>$\frac{28.5}{64} \times V_{DD}$ min</td><td>2.227V</td></tr><tr><td>DX (3rd time)</td><td>$\frac{12.5}{64} \times V_{DD}$ min</td><td>0.977V</td></tr><tr><td rowspan="3">MW LW</td><td>LOCAL (1st time)</td><td>$\frac{18.5}{64} \times V_{DD}$ min</td><td>1.445V</td></tr><tr><td>LOCAL (2nd time)</td><td>$\frac{15.5}{16} \times V_{DD}$ min</td><td>1.211V</td></tr><tr><td>DX (3rd time)</td><td>$\frac{12.5}{64} \times V_{DD}$ min</td><td>0.977V</td></tr></table> When using the IF count, a broadcast station is detected when a broadcast station is judged to be present by both IF and SD pins	Input
64	$\overline{ST}$	Stereo signal input	Radio mode "ST" (STEREO) display input pin. When low level is input to this pin, the LCD panel "ST" display lights. This pin is valid only on the FM and VF bands. In the MONO mode, "ST" is not displayed.	Input

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2. KEY MATRIX

2.1 KEY MATRIX LAYOUT

Input Pin / Output Pin	K3 (59)	K2 (60)	K1 (61)	K0 (62)
LCD15 / KS15 (40)	M1 (TP1)	M2 (TP2)	M3 (TP3)	M4
LCD14 / KS14 (41)	M5	M6	VF	VF
LCD13 / KS13 (42)	SEEK DWN	SEEK UP	SCAN DWN	SCAN UP
LCD12 / KS12 (43)	BAND	—	—	—
LCD11 / KS11 (44)	ME(DISP)	MAN DWN	MAN UP	PSCAN AMEMO
LCD10 / KS10 (45)	LOUD	LOC(TP4)	MONO(TP5)	—
LCD9 / KS9 (46)	AMS	NR	MTL	RDMONI
LCD8 / KS8 (47)	—	—	—	DISP
LCD7 / KS7 (48)	CD SET	TP SET	RD SET	POWER
LCD6 / KS6 (49)	SK	DK	FF	RL
LCD5 / KS5 (50)	AUTO500	MUTESEL	AUTOSTP	ENNR2
LCD4 / KS4 (51)	KAMS	KNR	KMTL	ENTPK
LCD3 / KS3 (52)	NOCLK	CLK DISP	FLASH	DISAMEMO
LCD2 / KS2 (53)	ENFMIF	DISAMIF	PRIO2	PRIO1
LCD1 / KS1 (54)	DISFM3	ENMW2	DISLW	M2S
LCD0 / KS0 (55)	AREA3	AREA2	AREA1	RDON

( ) : Pin No

2.2 SWITCH CONNECTION

    : Momentary switch

    : Alternate or transistor switch

    : Diode matrix

—   : Open

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2.3 KEY MATRIX CONNECTION

⊕ Momentary switch

▽ Alternate or transistor switch

△ Diode matrix

LCD segment outputs

DMC 4002

Pin	Label
51	LCD4/KS4
50	LCD5/KS5
49	LCD6/KS6
48	LCD7/KS7
47	LCD8/KS8
46	LCD9/KS9
45	LCD10/KS10
44	LCD11/KS11
43	LCD12/KS12
42	LCD13/KS13
41	LCD14/KS14
40	LCD15/KS15
39	LCD16
32	LCD17
52	LCD3/KS3
53	LCD2/KS2
54	LCD1/KS1
55	LCD0/KS0
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57	
58	
59	K3
60	K2
61	K1
62	K0
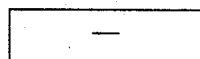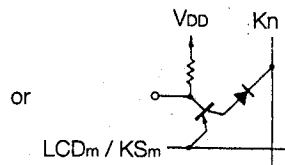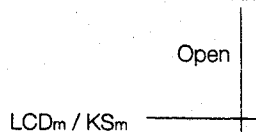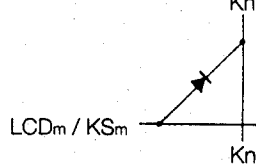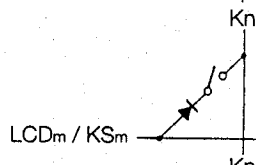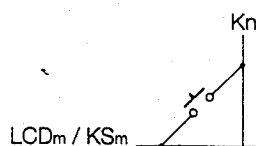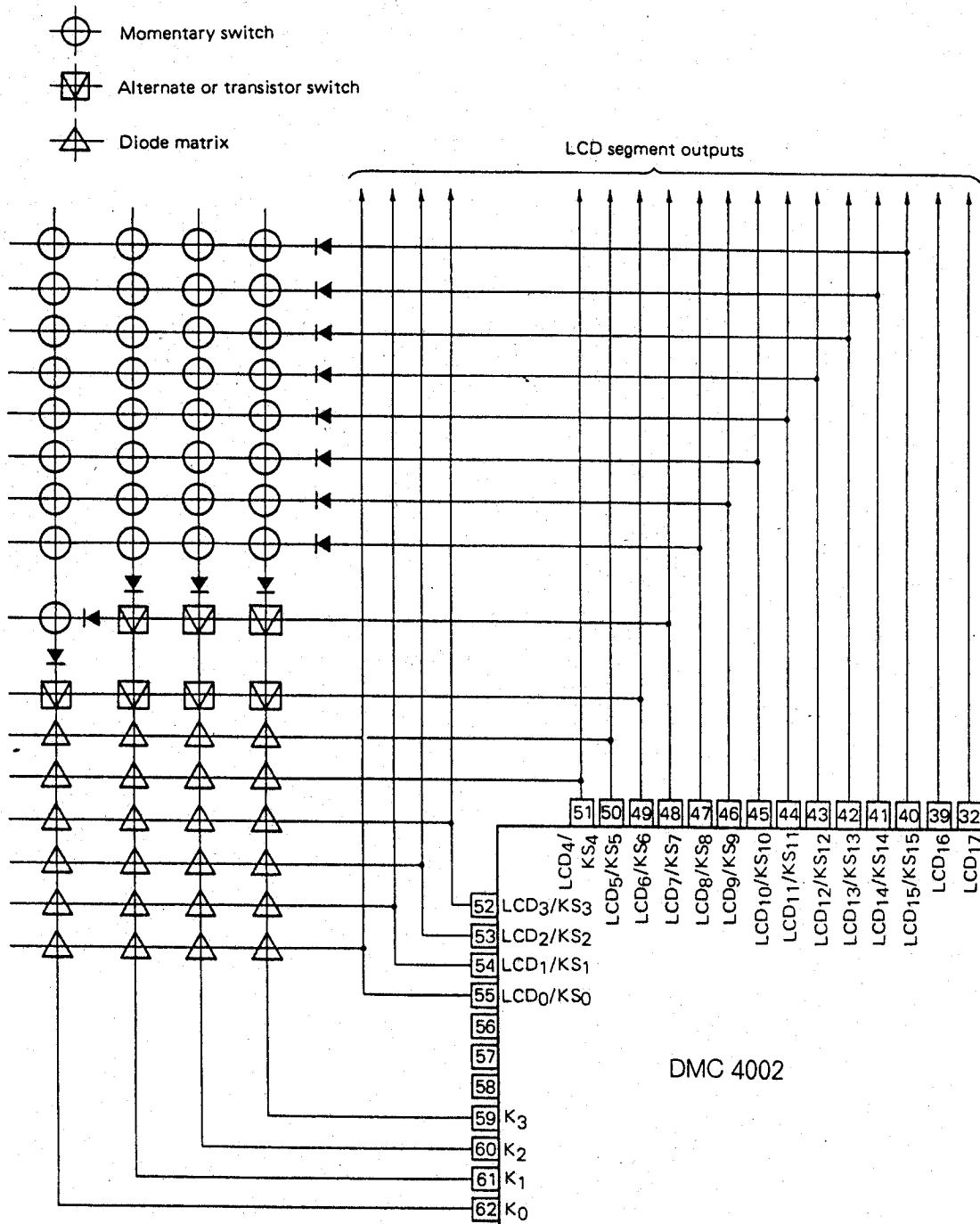
2.4 DESCRIPTION OF KEY MATRIX

2.4.1 Momentary Switch

Symbol	Function

	In the radio mode, these keys are used to call and write preset memory. In the tape mode, these are used as tape function keys by initialized diode (ENTPK, KAMS, KNR, KMTL).
	– Radio mode
	  Preset memory call and write keys.
	  One key can memorize the FM1, FM2, FM3, VF, MW1, MW2 and LW bands independently (max. 6 bands).
	  The following operations are performed according to the state of M2S of the initialized diodes :

	M2S	Description
M1(TP1) M2(TP2) M3(TP3) M4 M5 M6	W R I T E 0	The device is placed into the 5 seconds preset memory write mode by pressing the [ME] key during frequency display. When one of the keys [M1 (TP1)] to [M6] is pressed during this 5 seconds, the current receiving frequency is written to the preset memory corresponding to the pressed key. When the [ME] key is held down, writing is not performed. During writing, radio muting is not output. Example When the same preset memory key is pressed while the current preset memory contents are being received, the same operation is performed.
	C A L L	In the radio mode, when the device is in the memory unwritable state, when one of the [M1 (TP1)] to [M6] keys is pressed, the preset memory contents corresponding to the pressed key can be called. Example When the same preset memory key is pressed while the current preset memory contents are being received, no operation is performed. However, if the clock is being displayed. BEEP is output and the display switches to frequency display. Radio muting is not output.

Symbol	Function		
	M2S		Description

M1 (TP1)

M2 (TP2)

M3 (TP3)

*M4

M5

M6

1

W R I T E

When one of the key [M1 (TP1)] to [M6] is pressed for more than 2 seconds, the preset memory corresponding to the pressed key is writtten.

At the end of writing to the preset memory, radio muting is output as acknowlegment.

RDMUTE PIN Output | 50 ms | 2 sec | 40 ms | 250 to 375 ms

B E E P

Key Operation [M1 (TP1)] to [M6] key On

Display Frequency or Clock Display | Preset memory number of pressed key and frequency received last are displayed.

When the same preset memory key is pressed while the current preset memory contents are being received, nothing is performed. However, if the clock is being displayed, BEEP is output when the key is released or after 2 seconds and the display switches to frequency display. At this time, radio muting is not output.

If a key is pressed during the seek operation, the call operation is immediately performed (2 second count is ignored).

C A L L

When a [M1 (TP1)] to [M6] key is pressed and released within 2 seconds, the contents of the preset memory is called as soon as the key is released.

RDMUTE PIN Output | 50 ms | Within 2 sec | 40 ms | 375 to 500 ms

B E E P

Key OFF

Key Operation [M1 (TP1)] to [M6] key On

Display Frequency or Clock Display | Preset memory number of pressed key and frequency received last are displayed. | Preset memory number of pressed key and called frequency are displayed

When the same preset memory key is pressed while the current preset memory contents are being received, nothing is performed. However, if the clock is being displayed, Beep is output and the display switches to frequency display. Radio muting is not output.

If a key is pressed during the seek operation, the call operation is immediately performed.

Symbol	Function
M1 (TP1) M2 (TP2) M3 (TP3) M4 M5 M6	When the power is turned on, the frequency shown below are written to M1 to M6 to facilitate set adjustment.

Area \ Band	Memory Band	M1	M2	M3	M4	M5	M6
Europe 1 Europe 2	FM1	87.5	87.7	92.3	96.3	105.9	87.5
	MW1	522	603	954	1386	522	522
	MW2	522	621	1098	1530	522	522
	LW	144	155	208	256	144	144
U. S. A 1 U. S. A 2 U. S. A 3	FM1	87.5	87.9	97.1	105.1	87.5	87.5
	MW1	530	620	1010	1490	530	530
Australia, Middle East	FM1	87.5	87.9	97.1	105.1	87.5	87.5
	MW1	531	612	963	1395	531	531
Japan	FM1	76.0	76.4	85.6	76.0	76.0	76.0
	MW1	522	603	954	1386	522	522
Central and South America	FM1	87.5	87.9	97.1	105.1	87.5	87.5
	MW1	520	565	760	1000	1400	520

The lowest frequency of each area is M1 to M6 of the FM2, FM3, VF and MW2 bands of other than Europe 1 and 2.

– Tape mode

These keys can be used as tape function keys by means of initialized diode matrix switches ENTPK, KAMS and KMTL.

For the keys that can be used, see the diode matrix. For a description of each key operation, see the | AMS | , | NR | and | MTL | key items.

| VF | VF(traffic information) broadcast station search key. Its operation is described below.

When this key is pressed in the radio mode (FM, MW or LW band), the LCD panel "VF" display and Band₂ pin output are inverted.

When this key is pressed, the VF band is selected and 375 to 500 ms later, whether or not there is a broadcast station(IF count and SD check) and SK signal are detected. If no VF broadcast station is judged not to be present (The presence of a VF broadcast station is determined by the presence of an IF count , SD signal and SK signal),autotuning starts from that frequency.

When the first broadcast station is detected, that frequency is held until the autotuning key is pressed thereafter, even when there is no SK signal.

When the IF count and SD check are judged to be present, the autotuning operation is the same as normal autotuning, except that the SK signal is detected after 375 to 500 ms.

Autotuning(seek up) is performed automatically only when VF band is selected by   VF   key for the first time. Autotuning is not performed automatically even if another tuning key (other than autotuning) is pressed. |

Symbol	Function
VF	To reset the VF band, press the [VF] key or [BAND] key. The VF band has 6 independent memories. The last channel is also independent. When the device is set to the tape or CD mode by TPSET or CDSET switch while on the VF band, it switches to the DK standby mode. The device also switches to the DK standby mode when the [VF] key is pressed in the tape or CD mode. In the DK standby mode, all the keys, other than the [BAND] key, are valid. When the DK switch is set to ON in the DK standby mode, the device switches to the DK ON mode. In the DK ON mode, radio muting ($\overline{\text{RDMUTE}}$ pin) is turned off and audio muting ($\overline{\text{AMUTE}}$ pin) is turned on. When both the SD and SK signals or one of signals are lost during VF band reception(including TAPE or CD DK standby mode), BEEP is output. The SD and SK signals are checked 512 times once every 30 ms and if there are no SD and SK signals for 256 times or more, BEEP i s output. For BEEP, 120 ms ON and 120 ms OFF are output 5 times, respectively.
PSCAN AMEMO	Preset memory scan and auto store memory key. The auto store memory function is enabled when initialized diode DISAMEMO is 0. When the auto store memory is used (DISAMEMO = 0), when this key is pressed and released within 2 seconds, preset memory scanning is performed. When this key is held down for more than 2 seconds, operation switches to auto store memory operation. When the auto store memory is not used (DISAMEMO = 1), the preset memory scanning operation starts the moment the button is pressed. The preset memory scan and auto store memory operations are described below. (1) Preset memory scan operation The preset memory contents are called automatically every 5 seconds. If other than the current preset memory is being received, the preset memories are called from M1, and if a present memory is being received the preset memories are called from the next preset memory (for instance , from M4 if M3 is being received) sequentially every 5 seconds. This operation is shown below. Example When FM1 band being received. FM1 → M1 → M2 → M3 → M4 → M5 → M6 → Other than preset M3 being received memory being re- on FM1 band ceived on FM1 band This operation is the same for the MW bands (MW1, MW2) and LW band.

Symbol	Function
	When the next preset memory is called at the end of 5 second hold, BEEP is output.

When the next preset memory is called at the end of 5 second hold, BEEP is output.

During 5 second hold, the preset memory number display flashes at 1 Hz (duty 50%). The "ch" display does not flash.

To stop at that preset memory during 5 second hold, press this key again, or press the same preset memory key as the preset memory being received. Writing of preset memory (for example, writing to M5 during M1 hold) is also possible, but the preset memory scan operation ends when the preset memory was written.

The preset memory write operation during 5 second hold is described below.

M2S	Description
0	When the [ME] key is pressed, the device enters the 5 second memory write mode. Writing is performed by pressing a [M1 (TP1)] to [M6] key in the memory writable mode. At the end of writing, auto preset memory scanning stops. In the memory writable mode, the "ch" display flashes. If no operation is performed within 5 seconds, the next preset memory channel is called and auto preset scanning continues. If the [ME] key is pressed again in the memory writable mode, the memory writable mode is canceled and the next channel is called 5 seconds after the key was pressed.
1	When a [M1 (TP1)] to [M6] key is pressed for more than 2 seconds, the frequency currently being received is written to the preset memory corresponding to the pressed key. Auto preset scanning ends when the frequency was written to the preset memory (2 seconds after the key was pressed).

PSCAN
AMEMO

When one of the following keys is pressed during preset memory scanning, preset memory scanning stops and the operation of the pressed key is performed.

[MAN UP]   [MAN DWN]   [SEEK UP]   [SEEK DWN]

[SCAN UP]   [SCAN DWN]   [VF]

Memory call key other than memory being received (held)

Band switching key

When one of the following keys is pressed during preset memory scanning, after the operation of the pressed key is performed, preset memory scanning is continued.

[LOUD]   [LOC (TP4)]   [MONO (TP5)]

Symbol	Function
	Example) FM band (FM1, M1 = 89.1MHz, M2 = 91.9MHz, M3 = 93.1MHz, M4 = 95.1MHz) M2S = 0

(2) Auto store memory

This operation searches for a broadcast station and writes it to preset memory automatically.

Broadcast station search is performed in the up direction, starting from the frequency currently being received.

If the preset memory channel which is written is receiving the current preset memory, it is incremented from the preset memory channel being received (from M3 if M3 is being received). If a channel other than a preset memory channel is being received, the preset memory channel which is written is incremented from M1. When broadcast stations are stored up to M6, the auto store memory operation ends.

The auto store memory operation broadcast station search method in the LOCAL mode and DX mode differs as shown below.

– DX mode

The frequencies are searched in the up direction, starting from the frequency currently being received, and ends when the preset memories are written up to M6 or all the search frequencies were searched once.

Example 1) USA1, FM band 89.5MHz (M3) reception

Example 2) Japan, FM band 78.0 MHz reception

For auto store memory in the DX mode, the SD pin broadcast station detection level is :

Symbol	Function

Band	Lowest Voltage to Determine the Presence of Station
FM MW LW VF	$\dfrac{12.5}{64} \times V_{DD}$ 0.977 V at $V_{DD} = 5V$

– LOCAL mode

The frequencies are searched in the up direction, starting from the frequency currently being received.
In the LOCAL mode, the SD detection level is changed and the frequencies are searched twice.
In the DX mode, the freqencies are searched once. When the preset memories are written up to
M6 during this time or at the end of 3 searches, the auto store memory operation ends.
Example) Europe, AM band 1422 kHz reception

Frequency   1422   1531   Seek   1611   1620   522   1413

Display   ↑ ch1   ch1   ch2   ch2   ch2

Operation   [PSCAN AMEMO]   Station M1 Write

(LOCAL, 1st Time)

1422   1620   522   1413
ch2   ch2   ch2

(LOCAL, 2nd Time)

1422   1620   522   695   1413
ch2   ch2   ch2   ch2   ch3

Station M2 Write

(DX 1st Time)

1422

Auto Memory Stop

The SD detection level for LOCAL mode auto store memory is :

Symbol (left column): PSCAN AMEMO

Band	Mode	Lowest Voltage judged a Broadcast Station
FM VF	LOCAL 1st time	$\dfrac{44.5}{64} \times V_{DD}$ 3.447V at $V_{DD} = 5V$
	LOCAL 2nd time	$\dfrac{28.5}{64} \times V_{DD}$ 2.227V at $V_{DD} = 5V$
	DX 1st time	$\dfrac{12.5}{64} \times V_{DD}$ 0.977V at $V_{DD} = 5V$
MW LW	LOCAL 1st time	$\dfrac{18.5}{64} \times V_{DD}$ 1.445V at $V_{DD} = 5V$
	LOCAL 2nd time	$\dfrac{15.5}{64} \times V_{DD}$ 1.211V at $V_{DD} = 5V$
	DX 1st time	$\dfrac{12.5}{64} \times V_{DD}$ 0.997V at $V_{DD} = 5V$

Symbol	Function
PSCAN AMEMO	When the auto local function is used, each time the [PSCAN AMEMO] key is pressed, the local mode is switched as shown below. LOCAL1 → LOCAL2 → DX → auto memory stop When the local mode is switched, the auto memory operation is repeated from the frequency at which is started. When the auto memory operation was stopped, if even one broadcast station was written, operation shifts automatically from the preset memory when the auto memory operation started to preset scan operation.
SEEK UP SEEK DWN	Autotuning (seek operation) key. The frequencies are incremented ([SEEK UP] key) or decremented ([SEEK DWN] key) in 1 channel space and whether or not there is a broadcast station (IF count and SD signal) is detected at each receiving frequency and when there is a broadcast station, that frequency is held. On the VF band, when there is judged to be a broadcast station by IF count and SD signal the SK switch is checked 250 to 375 ms later and if there is an SK signal, that frequency is held. When seek up (seek down) reaches the highest (lowest) frequency, it returns to the lowest (highest) frequency and, that is, sawtooth wave mode tuning is performed. The channel seek up (seek down) operation is shown below: <table><tr><td>Seek Up</td><td>Seek Down</td></tr><tr><td></td><td></td></tr></table> For the S (slow) and F (fast) IF count conditions, see the FMIF pin and AMIF pin above. For the 1 channel space frequency width, see the receiving frequencies above.

Symbol	Function

AUTOSTP	Description
1	Even if the presence of a station is determined, tuning does not stop at its frequency when the keys are held down. Example:FM band $\overline{\text{RDMUTE}}$ pin

When the band selection is switched, then returned to the original band and when the radio is turned off(including a mode transition), then on, auto-tuning locks in the frequency with when the seek started.

All keys other than those shown in the table above are invalid(except for [POWER] key). The AUTO 500 switch(diode matrix) must be set to '0' when [SEEK UP] and [SEEK DWN] keys are used.

Key	Operation
SEEK UP SEEK DWN	- [SEEK UP] key during seek-up and [SEEK DWN] key during seek-down The seek stops and auto-tuning returns to the frequency with which the seek started. - [SEEK DWN] key during seek-up and [SEEK UP] key during seek-down The operation of the key pressed(seek-down if pressed during seek-up) is initiated, starting with the frequency tuned in when the key is pressed. The between-key operation is also enabled.
SCAN UP SCAN DWN	Scan-up (Scan-down) with the frequency tuned in when the key is pressed.
MAN UP MAN DWN	The seek stops and auto-tuning returns to the frequency with which the seek started.
BAND	The seek stops and the new band is selected in the following sequence. FM1 → FM2 → FM3 → MW1 → MW2 → LW The bands inhibited in the particular reception area and by DISFM3, ENMW2, DISLW switches are skipped. Tuning returns to the frequency with which the seek started when the original band is selected.
M1(TP1) to M6	Regardless of the setting of the M2S switch, the contents are called for the preset memory associated with any key pressed.
VF	The seek stops and the key operation starts.
PSCAN AMEMO	The seek stops and the preset-scan starts.
LOUD LOD(TP4) MONO(TP5)	The operations of the keys pressed are initiated. The seek continues.

Symbol column (left):
[SEEK UP]
[SEEK DWN]

Symbol	Function
SCAN UP SCAN DWN	Auto tuning (scan operation) key. The frequencies are searched up (SCAN UP key) or down (SCAN DWN key) in 1 channel steps and whether or not there is a broadcast station (IF count and SD signal) is detected at each receiving frequency and when a broadcast station is judged to be present, that frequency is held for 5 seconds. On the VF band, whether or not there is an SK signal is detected as well as seek operation. If no operation is performed during this 5 seconds, the seek operation is repeated and the next broadcast station is received sequentially every 5 seconds (scan operation). During this 5 seconds hold, the frequency display flashes at 1 Hz (duty 50%). At the end of the 5 seconds hold, BEEP is output. Seek operations (channel up/down method, AUTOSTP switch and IF count, SD detection, SK signal detection) are the same as the SEEK UP and SEEK DWN keys. When the radio is turned off (including mode switching) and then turned on, the frequency held last (when there is not even 1 broadcast station, the frequency when the scan operation started) is received. The operation of each key during seek operation (other than at 5 seconds hold) is shown below.

Key	Operation
SCAN UP SCAN DWN	− SCAN UP key during scan up and SCAN DWN key during scan down Scanning stops and returns to the frequency held last. However, when the auto local function is used, the local mode is switched. − SCAN DWN key during scan up and SCAN UP key during scan down Operation shifts to operation of the pressed key from the frequency when the key was pressed.
SEEK UP SEEK DWN	Scanning stops and seek operation starts from the frequency when the key was pressed.
MAN UP MAN DWN	Scanning stops and returns to the frequency held last (when a frequency was not held, returns to the frequency when scanning started). Scanning stops whenever any of these keys is pressed even though the AUTO500 switch is 1 (when the MAN UP or MAN DWN key is pressed for more than 0.5 seconds, seek is performed).
BAND	Scanning stops and the band is switched sequentially as shown below. ┌→ FM1 → FM2 → FM3 → MW1 → MW2 → LW ┐ However, bands disabled by receiving area and DISFM3, ENMW2 and DISLW switches are skipped. When switching returns to the same band, the frequency held last is received. When a frequency was not held, the frequency when scanning started is received.

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Symbol	Function

Key	Operation
M1 (TP1) to M6	When a key is pressed, scanning stops and the preset memory contents of the pressed key are called without regard to the state of the M2S switch.
VF	Scanning stops and operation of the key is performed.
PSCAN AMEMO	Scanning stops and preset scan is performed from M1.
LOUD / LOC (TP4) / MONO (TP5)	The operation of the pressed key is performed. Seek (scan operation) continues.

SCAN UP

SCAN DWN

Momentary keys other than those described above are invalid. (However, the POWER key is valid.)

Operation of each key during 5 second hold is shown below.

Key	Operation
SCAN UP / SCAN DWN	− SCAN UP key during scan up and SCAN DWN Key during scan down Scanning stops and the frequency being held is locked in. − SCAN DWN key during scan up and SCAN UP key during scan down And then the operation of the pressed key is performed.
SEEK UP / SEEK DWN	Scanning stops and a seek starts from the frequency being held.
MAN UP / MAN DWN	Scanning stops and operation of the MAN UP or MAN DWN key is performed from the frequency being held.
BAND	Scanning stops and the band is switched sequentially as shown below. → FM1 → FM2 → FM3 → MW1 → MW2 → LW However, bands disabled by receiving area and DISFM3, ENMW2 and DISLW switches are skipped. When switching returns to the same band, it returns to the held frequency.

Symbol	Function

	Key	Operation
		− When the M2S switch is 1, this key is invalid. − When M2S switch = 0 Each time the key is pressed, the memory write state is inverted as shown below.

(i)

	Less than 5 sec	5 sec	
Seek	Hold	Hold	Seek

Key Operation   Station   [ME] Key

Display 90.0 | 90.1 | Memory Writable 90.1 ch | 90.2

(ii)

	Less than 5 sec.	Less than 5 sec	5 sec	
Seek	Hold	Hold	Hold	Seek

Key Operation   Station   [ME]   [ME]

Display 90.0 | 90.1 | Memory Writable 90.1 ch | 90.1 | 90.2

SCAN UP

SCAN DWN

ME

When a [M1 (TP1)] to [M6] key is pressed in the memory writable state, data is written to the present memory corresponding to the pressed key.

VF	Scanning is canceled and the key operation is performed.
PSCAN AMEMO	Scanning is canceled and the key operation is performed.
LOUD	The operation of the pressed key is performed. Scanning continues.
LOC (TP4)	
MONO (TP5)	

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Symbol	Function

Key	Operation
	• When M2S switch = 0 – Memory unwritable state. The scanning operation is canceled and the preset memory contents corresponding to the pressed key is called. – Memory writable state (See the [ME] key below.) The held frequency is written to the preset memory corresponding to the pressed key and the memory writable state is canceled. Then, the hold state is held for 2 seconds. If an operation is not performed during this time, the next station is searched.

(Example)

Less than 5 sec   Less than 5 sec   2 sec

Seek | Hold | Hold | Hold | Seek

Key Operation   station   [ME]   [M1 (TP1)]

Memory Writable

Display 90.0 | 90.1 | 90.1 ch | 90.1 ch | 90.2

• When M2S switch = 1
– When key released within 2 seconds
  The preset memory contents corresponding to the pressed key are called and the scan operation is reset the moment the key is released.

(Example)

$\overline{RDMUTE}$ Pin

Less than 5 sec   Less than 2 sec

Seek | Hold | Hold | M1 Call

Station   [M1 (TP1)] Key   [M1 (TP1)] Key

ON   OFF

Display 90.0 | 90.1 | 90.1 ch | 92.0 ch

Contents of M1

– When key pressed for more than 2 seconds
  The held frequency is written to the preset memory corresponding to the pressed key 2 seconds after the key has been passed for 2 seconds. 2 seconds after the end of writing, hold ends and the next station is searched (seek operation).

(Example)

$\overline{RDMUTE}$ Pin

Less than 5 sec   2 sec   2 sec

Seek | Hold | Hold | Hold | Seek

Station   [M1 (TP1)] Key Pressed Continuously

90.0 | 90.1 | 90.1 ch | 90.1 ch | 90.2

Key symbols:

[M1 (TP1)]
[M2 (TP2)]
[M3 (TP3)]
[M4]
[M5]
[M6]

[SCAN UP]
[SCAN DWN]

Symbol	Function
BAND	Receiving band selection switch It is valid only in the radio mode. Each time this switch is pressed, the band is switched sequentially as shown below. FM1→ FM2 → FM3 → MW1 → MW2 → LW However, bands disabled by receiving area and DISFM3, ENMW2, and DISLW switches are skipped. When the band is switched (FM1→ FM2 → FM3 → MW1 → MW2) in the same band (FM, MW), the band display and last channel change. When the BAND key is pressed during VF band reception, the VF band is reset and the device returns to the band received last.
ME	In the radio mode, during frequency display, this key is used as the preset memory writable state setting key and during clock display (CE = High), this key is used with the MAN UP and MAN DWN keys as the clock adjustment key. When the M2S = 0, this key operates as the preset memory writable state and clock adjustment key. When M2S = 1, this key operates as the preset memory writable state and clock adjustment key. When M2S = 0, use the DISP key to switch the display. This key operation is described below. • Radio mode frequency display This key is used as the preset memory writable state setting key. It is valid ony when the initialized diode M2S switch is 0. When this key is pressed, the device enters the preset memory writable state for 5 seconds and the current receiving frequency is written to the preset memory corresponding to the pressed key by pressing the M1 (TP1) to M6 key. If the ME key is pressed continuously at this time, the write operation is not performed. During the preset memory writable state, the "ch" display flashes at 1 Hz (duty 50%). If preset memory is being received, the preset memory number flashes also. This key is invalid during the seek operation (including seek operation at scanning). However, it is valid at 5 seconds hold during the preset memory scan and scan operations. Each key operation in the preset memory writable state is shown below.

Key	Operation
M1 (TP1) to M6	The frequency being received when a key is pressed is written to the preset memory corresponding to the pressed key. Muting is not output.

Symbol	Function

Key	Operation
VF PSCAN AMEMO SEEK UP SEEK DWN SCAN UP SCAN DWN MAN UP MAN DWN DISP	Preset memory write mode is reset and each key operation is performed.
BAND	The preset memory writable state is reset and the band is switched sequentially as shown below. → FM1→ FM2 → FM3 → MW1 → MW2 → LW → However, bands disabled by receiving area and DISFM3, ENMW2 and DISLW switches are skipped.
ME	The preset memory writable state is reset.
LOUD LOC (TP4) MONO (TP5)	The preset memory writable state is held and each key operation is performed.

Symbol: **ME**

Keys other than those described above (except the **POWER** key) are invalid.

When the radio is turned off and then turned back on (including tape and CD mode switching) in the preset memory writable state, the writable state is released.

- Clock display

  This key is used as the time adjustment key.

  The minute and hour digits are adjusted as shown below by pressing the **MAN UP** and **MAN DWN** keys while pressing the **ME** key.

  – Hour adjustment

  The hour is advanced one hour each time the **MAN DWN** key is pressed. When the key is held down for more than 0.5 seconds, the hour changes continuously at a speed of 4 hours/ sec (1 hour in 250 ms) until the key is released.

  The minute digit and seconds count are not affected.

  – Minute digit adjustment

  The minute digit is advanced one minute each time the **MAN UP** key is pressed.

  When the key held down for more than 0.5 seconds, the minute digit changes at a speed of 8 minutes/sec (1 minute in 125 ms) until the key is released. Carry to the hour digit is not performed.

  Each time the minute-digit is adjusted, the seconds count is reset.

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Symbol	Function

MAN UP
 MAN DWN
	In the radio mode, these keys are used as the receiving frequency up/down keys. During clock display, these keys are used with the [ME] key as the clock adjustment keys.
	 Their operation is shown below.
	 • Radio mode
	   These keys operate as shown below, depending on the setting of the initialized diode matrix AUTO 500 switch.
	   – Operation by AUTO 500 switch

AUTO500	Description
0	Each time a key is pressed, the frequency is incremented ([MAN UP] key) or decremented ([MAN DWN] key) one step (1 channel space). When the key is held down for approx. 0.5 seconds, the frequency changes continuously at a speed of approx. 50 ms per step until the key is released. Example 1) When key released within 0.5 seconds RDMUTE Pin — Within 0.5 sec MAN UP Key OFF MAN UP Key OFF MAN UP Key OFF Frequency 87.5 87.6 87.7 87.8 Example 2) When key held down for more than 0.5 seconds RDMUTE Pin — Approx. 0.5 sec MAN UP Key OFF 87.5 87.6 87.7 87.8 87.9 88.0 88.1

Symbol	Function

	AUTO 500	Description

Each time a key is pressed, the frequency is incremented (MAN UP Key) or decremented (MAN DWN key) one step. When the key is held down for more than 0.5 seconds, the seek operation (seek up for MAN UP and seek down for MAN DWN) starts at the point after 0.5 seconds. This seek operation is the same as that of the SEEK UP and SEEK DWN keys. After the key was held down for more than 0.5 seconds, the seek operation continues even if the key is released.

Example 1) When key released within 0.5 seconds

RDMUTE Pin — Within 0.5 sec

MAN UP Key OFF   MAN UP Key OFF   MAN UP Key OFF

87.5   87.6   87.7   87.8

MAN UP

MAN DWN

1

Example 2) When key held down for more than 0.5 seconds

RDMUTE Pin — Approx. 0.5 sec

MAN UP   Key OFF

87.5   87.6   87.7   87.8   87.9   88.0

IF and SD check is not performed at the first 1 channel up.

SD, IF
No Station —————→ SD, IF Station

When the AUTO 500 switch was set to 1, do not use the SEEK UP and SEEK DWN keys.

· During clock display

When the clock is displayed and the ME key was pressed and held, the minute and hour digits are adjusted by pressing the MAN UP and MAN DWN keys.

For a description of the minute and hour digits adjustment method, see the ME key above.

LOUD	LOUD (LOUDNESS) control key. It is valid in the radio, tape and CD modes. Each time this key is pressed, the LCD panel "LOUD" display and the LOUD pin (pin 19) output are inverted. The LOUD state is held even when radio, tape and CD mode switching is performed. When the power is turned on, the OFF state is set ("LOUD" display OFF, LOUD pin Low level).

Symbol	Function

LOC (TP4)	The LOC(TP4)key is used as a LOCAL(LOCAL/DX) control key when in the radio mode and as a tape function key when in the tape mode in conjunction with initialization diode switches.
	- In the radio mode
	  The LCD panel "LOC" indicator and the output on the LOC pin(pin 10) are inverted each time the key is pressed.
	  A high is output on the LOC pin while the "LOC" indicator is on
	- In the tape mode
	  The LOC(TP4) key can be used as an AMS, NR(NOISE REDUCTION) or MTL(METAL) function key when the initialization diode switch ENTPK is "1". For the choice between AMS, NR and MTL functions, see the description of the initialization diode switches KAMS, KNR and KMTL.
	  When the AMS, MTL or NR function is selected, the LOC(TP4) key operates the same way as
	
	  AMS MTL or NR key.
	
	  See the description of these keys.

MONO (TP5)	In the radio mode, this key is used as the MONO control key. In the tape mode, this key is used as the tape function key by the initialized diode.
	– Radio mode
	  This key is valid only in FM and VF bands.
	  Each time this key is pressed, the LCD panel "MONO" display and the MONO/NR₂ pin (pin 18) output the inverted. High level is output from the MONO/NR₂ pin while "MONO" is displayed.
	  When the power is turned on, the OFF state is set ("MONO" display OFF, MONO/NR₂ pin Low level).
	– Tape mode
	  This key can be used as the AMS , MTL or NR function key by the initialized diode ENTPK, KAMS, KNR, and KMTL switches.
	  See the ENTPK, KAMS and KMTL switches items.
	When the AMS or MTL function is selected, this key operates the same as the MTL , AMS or NR key. See the description of each key.

MTL	MTL (METAL) contol key. This key is valid in the tape mode. Each time this key is pressed, the LCD panel "MTL" display and the MTL pin (pin 21) output are inverted. High level is output from the LOC/MTL pin while "MTL" is displayed. When the power is turned on, the OFF state is set (" MTL" display OFF, MTL pin Low level).

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Symbol	Function
NR	NR₁ (NOISE REDUCTION) and NR₂ control key. This key is valid in the tape mode. Its operation depends on the setting of the initialized diode ENNR₂ switch as shown below. | ENNR₂	Key Operation
0	Each time this key is pressed, the LCD panel "NR₁" display and the NR₁ pin (pin 22) output are inverted. High level is output from the NR₁ pin white "NR₁" is displayed. When the power is turned on, the OFF state is set ("NR₁" display OFF, NR₁ pin Low level).
1	Each time this key is pressed, the display and output are switched as shown below. "NR₁" display OFF / NR₁ pin Low / "NR₂" display OFF / MONO/NR₂ pin LOW → "NR₁" display ON / NR₁ pin High / "NR₂" display OFF / MONO/NR₂ pin LOW "NR₁" display OFF / NR₁ pin LOW / "NR₂" display ON / MONO/NR₂ pin HIGH When the power is turned on, NR₁ and NR₂ are both turned off.	
AMS	AMS (AUTO MUSIC SEARCH) control key. This key is valid in the tape mode. Each time this key is pressed, the LCD panel "AMS" display and the AMS pin (pin 20) output are inverted. High level is output from the AMS pin while "AMS" is displayed. When the AMS pin is high level (AMS mode), if the TPSET switch is ON, the AMS pin holds the high level output even if the mode is switched to the CD or radio mode. When the power is turned on, AMS is turned off ("AMS" display OFF, AMS pin Low level).
RDMONI	Radio monitor key. This key is valid in the tape and CD modes. Each time this key is pressed, the radio monitor mode is inverted. In the radio monitor mode, the LCD panel "RDMONI" display lights. In the radio monitor mode, all band tuning operations are possible and radio muting ($\overline{\text{RDMUTE}}$ pin) is turned off and audio muting ($\overline{\text{AMUTE}}$ pin) is turned on.

Symbol	Function
DISP	Display switching key. This key is valid when the initialized diode NOCLK = 0 (clock), M2S = 0 The display switching operation is shown below. ● Raido mode Each time this key is pressed, the frequency display and clock display are switched. This key is invalid at seek, scan and auto preset scan. Operation according to the setting of the initialized diode PRIO1 and PRIO 2 switches is shown below.

PRIO1	PRIO2	Priority Display	Description
0	0	None	Each time the DISP key is pressed, the frequency display and clock display are switched.
0	1	Frequency display	When the DISP key is pressed during frequency display, the clock is displayed for 5 seconds. When the DISP key is pressed during the 5 seconds clock display, the display returns to the frequency display.
1	0	Clock display	When the DISP key is pressed during clock display, the frequency display is displayed for 5 seconds. When the DISP key is pressed during the 5 seconds frequency display, the display returns to the clock display.

When the device is switched to the radio mode, display starts from frequency display.
● Tape mode
The DISP Key is invalid.
● CD mode
Each time this key is pressed, the "Cd" display and clock display are switched.
Operation according to the setting of the initialized diodes PRIO1 and PRIO2 is shown below.

PRIO1	PRIO2	Priority Display	Description
0	0	None	Each time the DISP key is pressed, the "Cd" display and clock display are switched.
0	1	"Cd" display	When the DISP key is pressed, during "Cd" display, the clock is displayed for 5 seconds. When the DISP key is pressed during the 5 seconds clock display, the display returns to the "Cd" display.
1	0	Clock	When the DISP key is pressed during clock display, the "Cd" display is displayed for 5 seconds. When the DISP key is pressed during the 5 seconds "Cd" display, the display returns to the "Cd" display.

When the device is switched to the CD mode, display starts from "Cd" display.

Symbol	Function
POWER	This key is used when turning the radio ON and OFF momentary key, controlling the illumination, etc. This key is valid only when the CE pin is High. The POWER pin (pin 23) output is inverted by pressing this key. When using this key, set the RDON switch (diode matrix) to 0. The radio is turned on and off by turning the transistor switch RDON ON and OFF with the output of the POWER pin. For details, see "Mode Transition" and "Application Circuits".

2.4.2 Alternate or Transistor Switch

Symbol	Function
CDSET	CD mode setting switch. This switch is valid only when the CE pin is high level. The CD mode can be set by setting this switch to ON. For details, see "Mode Transition".
TPSET	Tape mode setting switch. This switch is valid only when the CE pin is high level. When this switch is set to ON when the CDSET is OFF, the device is set to the tape mode. For details, see "Mode Transition".
RDSET	Radio mode setting switch. This switch is valid only when the CE pin is high level. When this switch is set to ON when the CDSET and TPSET switches are OFF, the device is set to the radio mode. For details, see "Mode Transition". When using this switch, set the RDON switch (diode matrix) to 0.
FF	Tape mode fast forward signal input switch. The tape fast forward display (◁ ▷) lights as shown below according to the state of the RL switch. | FF	RL	Display
---	---	---
0	0	◀
0	1	▶
1	0	◁
1	1	▷	 ◀ : Light ON, ◁ : Flash (2Hz) 0 : OFF, 1 : ON
SK	VF broadcast station SK signal input switch. When this switch is set to ON on the FM and VF bands, the LCD panel "SK" display lights. On the FM and VF bands this signal is also used as the auto tuning stop signal. At this time, 250 to 375 ms after the broadcast station is judged to be present by IF and SD pin, this switch is checked and if it is ON , a traffic information station is judged to be present and autotuning stops.
RL	Tape mode travel direction signal input switch. The tape display (◁ ▷) lights according to the state of the FF switch. For the lighting contents, see the FF switch above.
DK	VF broadcast station DK signal input switch. When this switch is set to ON in the tape DK standby and CD DK standby modes, the device enters the tape DK ON and CD DK ON mode.
ST	Switch used to enable "ST" display in the radio mode. "ST" display on the LCD panel lights by turning on this switch.

2.4.3 Diode Matrix

Symbol	Function
AREA1 AREA2 AREA3	Receiving area setting switch. Its setting is shown below. For the receiving frequencies, etc, at each area, see page 2. <table><tr><th>AREA3</th><th>AREA 2</th><th>AREA 1</th><th>MODE</th></tr><tr><td>0</td><td>0</td><td>0</td><td>Europe1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>Europe 2</td></tr><tr><td>0</td><td>1</td><td>0</td><td>U.S.A 1</td></tr><tr><td>0</td><td>1</td><td>1</td><td>U.S.A 2</td></tr><tr><td>1</td><td>0</td><td>0</td><td>U.S.A 3</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Australia, Middle East</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Japan</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Central and South America</td></tr></table>
DISFM3 ENMW2 DISLW	Receiving band setting switch. Its setting is shown below · DISFM3 .... FM3 band is disabled by setting to 1. · ENMW2......... MW2 band is enabled by setting to 1. · DISLW............ In Europe, the LW band is disabled by setting to 1. 　　　　　The DISLW switch is invalid in areas outside of Europe. The receiving bands for each area are set with these switches as shown below. <table><tr><th>AREA</th><th>DISFM3</th><th>ENMW2</th><th>DISLW</th><th>Receiving Bands</th></tr><tr><td rowspan="6">Europe1, Europe 2</td><td>0</td><td>0</td><td>0</td><td>FM1, FM2, FM3, MW1, LW</td></tr><tr><td>0</td><td>0</td><td>1</td><td>FM1, FM2, FM3, MW1</td></tr><tr><td>0</td><td>1</td><td>—</td><td>FM1, FM2, FM3,MW1, MW2</td></tr><tr><td>1</td><td>0</td><td>0</td><td>FM1, FM2, MW1,LW</td></tr><tr><td>1</td><td>0</td><td>1</td><td>FM1, FM2, MW1</td></tr><tr><td>1</td><td>1</td><td>—</td><td>FM1, FM2, MW1, MW2</td></tr><tr><td rowspan="4">Other areas</td><td>0</td><td>0</td><td>—</td><td>FM1, FM2, FM3, MW1</td></tr><tr><td>0</td><td>1</td><td>—</td><td>FM1, FM2, FM3, MW1, MW2</td></tr><tr><td>1</td><td>0</td><td>—</td><td>FM1, FM2,MW1</td></tr><tr><td>1</td><td>1</td><td>—</td><td>FM1, FM2, MW1, MW2</td></tr></table> — : Don't care

Symbol	Function
M2S	Preset memory write method setting switch. Its setting is shown below. **M2S / Write Method:** **0:** Preset memory is written by pressing a `M1 (TP1)` to `M6` key in the 5 seconds memory write state by `ME` key. **1:** Preset memory is written by holding down a `M1 (TP1)` to `M6` key for more than 2 seconds. The `ME` key is invalid. For more information, see the `ME` and `M1 (TP1)` to `M6` items.
AUTO 500	`MAN UP` and `MAN DWN` keys function setting switch. The `MAN UP` and `MAN DWN` keys can also be used as autotuning (seek operation) keys by means of this switch. The settings of this switch are shown below. **AUTO 500 / `MAN UP`, `MAN DWN` Key Function:** **0:** Manual tuning only. Each time the key is pressed, the channel is incremented or decremented by one. When the key is held down for more than 0.5 seconds, the channel is changed continuously and rapidly. **1:** Manual tuning and autotuning. Each time the key is pressed, the channel is incremented or decremented by one. When the key is held down for more than 0.5 seconds, autotuning (seek operation) is performed from the next channel.

Symbol	Function
AUTOSTP	Switch used to set the condition to stop auto-tuning. The switch also allows auto-tuning to continue further when the presence of a station is determined during auto-tuning. The switch sets the auto-tuning stop conditions as follows:

AUTOSTP	Auto-tuning stop conditions
0	Whenever the presence of a station is determined from the IF counter (along with an SK signal from the station when in the VF mode), tuning locks in that station even if auto-tuning keys are held down.
1	Auto-tuning stops when the presence of a station is determined from the IF counter (along with an SK signal from the station when in the VF mode.) and when auto-tuning keys are released ; that is, auto-tuning won't stop as long as an auto-tuning key is pressed even when the presence of a station is detected. This switch is operative with all the auto-tuning keys. During the first auto-tuning with ⌷ VF ⌷ key, however, tuning stops an detection of the presence of a station (along with an SK signal from the station) even while ⌷ VF ⌷ key is pressed.

Symbol	Function			

Priority display setting switch.

"Priority display" is display that returns to the previous display if no operation is performed within 5 seconds after the display was switched.

These switches are valid only when the NOCLK switch is set to 0 (clock mode) when the device is not in the DK standby mode and radio monitor is not used. Their settings are shown below.

PRIO1	PRIO2	Priority Display	Description
0	0	None	Display switching is performed when the [DISP] key and melody selection key (during clock display) was operated. – Radio mode The display switches between frequency display and clock display each time the [DISP] key is pressed. When the melody selection key is pressed during clock display, the display switches to frequency display. – Tape mode The [DISP] key is disabled. – CD mode The display is switched between "Cd" display and clock display each time the [DISP] key is pressed.
1	0	Frequency CD	When the display switched from frequency or "Cd" display to clock display by [DISP] key, if no operation is performed within 5 seconds, the display returns to the original display. – Radio mode Normally the frequency is displayed. The display is switched to 5 seconds clock display by pressing the [DISP] key. When the [DISP] key is pressed again, or the melody selection key is pressd., during 5 seconds clock display, the display returns to frequency display. – Tape mode Clock display. The [DISP] key is invalid. – CD mode Normally "Cd" is displayed. The display is switched to 5 seconds clock display by pressing the [DISP] key. When the [DISP] key is pressed again during 5 seconds clock display, the display returns to CD display.

Symbol: PRIO 1, PRIO 2

Symbol	Function

PRIO 1	PRIO 2	Priority Display	Description

0	1	Clock	In the radio and CE modes, clock display has priority.
			– Radio mode
			  Normally the clock is displayed.
			  The display is switched to 5 seconds frequency display by pressing the `DISP` key or melody selection key.
			  When the `DISP` key is pressed again during 5 seconds frequency display, the display returns to clock display.
			– Tape mode
			  The `DISP` key is invalid.
			– CD mode
			  Normally the clock is displayed.
			  The display is switched to 5 seconds "Cd" display by pressing the `DISP` key.
			  When the `DISP` key is pressed again during 5 seconds "Cd" display, the display returns to clock display.

1	1	—	Do not set to this mode.

Symbol column: PRIO 1, PRIO 2

"Frequency display" in the above means receiving frequency, receiving band, and preset memory display. Therefore, during radio reception, the "PSCAN", "SK", "VF", "ST", "MONO", "LOCAL" and "LOUD" displays light even at clock display.

In the tape mode, the "LOUD", "MTL", "NR1", "NR2", "AMS" and "▷", "◁" displays also light at clock display.

Symbol	Function			
	PRIO1	PRIO2	Priority Display	Description
PRIO 1 PRIO 2	0	0	None	– Tape DK standby – Radio monitor The display switches between frequency display and clock display each time the [DISP] key is pressed. When the melody selection key is pressed during clock display, the display switches to frequency display. When the device entered the tape DK standby and radio monitor standby mode, frequency is displayed first. – CD DK standby – Radio monitor The display switches between frequency display, "$\Box d$" display and clock display each time the [DISP] key is pressed. When the melody selection key is pressed during "$\Box d$" display and clock display, the display switches to frequency display. When the device entered the CD DK standby and radio monitor mode, frequency is displayed first. – DK ON Frequency displayed. The [DISP] key is invalid.
	1	0	Frequency CD	– Tape DK standby – Radio monitor Normally the frequency is displayed. The display is switched to 5 seconds clock display by pressing the [DISP] key. When the [DISP] key or the melody selection key is pressed during 5 seconds clock display, the display returns to frequency display. – CD DK standby – Radio Monitor Normally "$\Box d$" is displayed. When the [DISP] key is pressed, the display switches to 5 seconds frequency display. When the [DISP] key is pressed during frequency display, the display switches to 5 seconds clock display. When the [DISP] key is pressed during clock display, the display returns to "$\Box d$" display When the melody selection key is pressed during "$\Box d$" and clock display, the display switches to 5 seconds frequency display. – DK ON Frequency display The [DISP] key is invalid.

Symbol	Function

PRIO 1	PRIO 2	Priority Display	Description
0	1	Clock	– Tape DK standby – Radio monitor Normally the clock is displayed. When the [DISP] key or melody selection key is pressed, the display switches to 5 seconds frequency display. When the [DISP] key is pressed during 5 seconds frequency display the display returns to clock display. – CD DK standby – Radio monitor Normally the clock is displayed. When the [DISP] key is pressed, the display switches 5 seconds "Cd" display. When the [DISP] key is pressed during this "Cd" display, the display swtiches to 5 seconds frequency display. When the [DISP] key is pressed during frequency display, the display returns to clock display. When the melody selection key is pressed during clock display or "Cd" display, the display switches to 5 seconds frequency display. – DK ON Frequency display. The [DISP] key is invalid.
1	1	—	Do not set to this mode.

At no clock (NOCLK =1), the following is displayed and the [DISP] key becomes invalid without regard to the setting of the PRIO1 and PRIO2 switches.
And the [DISP] key is invalid.

Mode	Display
Radio	Frequency
Tape	None
CD	Cd
Tape DK standby CD DK standby DK ON Radio monitor	Frequency

RDON

Radio ON/OFF method setting switch.
Its setting is shown below.

RDON	Radio ON/OFF Method
0	Radio is turned on and off by RDSET switch
1	Radio is turned on by making the CE pin High.

When this switch was set to 1, do not use the RDSET switch.

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Symbol	Function
NOCLK	Clock specified setting switch. Its setting is shown below. | NOCLK	Clock | |---|---| | 0 | Yes | | 1 | No | In the no clock mode, low consumption current (400nA A max) backup is possible by making the CE pin Low.
CLKDISP	Clock time system setting switch. Its setting is shown below. | CLKDISP	Time System | |---|---| | 0 | 12-hour clock → AM 11:59 → PM 12:00 → ← AM 12:00 ← PM 11:59 ← | | 1 | 24-hour clock → 23:59 → 0:00 → |
FLASH	Clock colon(:) display setting switch. Its setting is shown below. | FLASH	Colon (:) Display | |---|---| | 0 | Steady light | | 1 | Flashing Frequency : 1Hz Duty → 6 (ON) : 4 (OFF) |

Symbol	Function

Switches for using the tape functions (AMS, NR, MTL) in common with the radio function keys. The keys that can be used in common can be selected as shown below.

ENTPK	Description
0	The M1 (TP1) , M2 (TP2) and M3 (TP3) keys can be used as the AMS , NR, MTL function keys. The keys that can be selected as shown below.

KAMS	KNR	KMTL	Dual Function Key		
			M1 (TP1)	M2 (TP2)	M3 (TP3)
1	1	1	AMS	NR	MTL
1	1	0	AMS	NR	—
1	0	1	AMS	MTL	—
1	0	0	AMS	—	—
0	1	1	NR	MTL	—
0	1	0	NR	—	—
0	0	1	MTL	—	—
0	0	0	—	—	—

That is, the functions selected by 1 are left-justified and used at the M1 (TP1) to M3 (TP3) keys.

Symbol column:
ENTPK
KAMS
KNR
KMTL

Of the AMS, NR and MTL function keys, two functions can be used at the LOC (TP4) and MONO (TP5) keys.
The following can be selected :

KAMS	KNR	KMTL	Dual Function Key	
			LOC (TP4)	MONO (TP5)
1	1	1	Do not set	
1	1	0	AMS	NR
1	0	1	AMS	MTL
1	0	0	AMS	—
0	1	1	NR	MTL
0	1	0	NR	—
0	0	1	MTL	—
0	0	0	—	—

(ENTPK = 1)

The functions selected by 1 are left-justified and used at the LOC (TP4) and MONO (TP5) keys.

Symbol	Function

The operation of each key is the same as that of the momentary keys AMS , NR and MTL Summarizing the above, the five keys M1 (TP1) to M3 (TP3) , LOC (TP4) and scan be used as MONO (TP5) tape function keys. Which functions used in common are determined by the ENTPK, KAMS, KNR and KMTL switches. This summarized below.

ENTPK	KAMS	KNR	KMTL	M1 (TP1)	M2 (TP2)	M3 (TP3)	LOC (TP4)	MONO (TP5)
	1	1	1	AMS	NR	MTL		
	1	1	0	AMS	NR			
	1	0	1	AMS	MTL			
0	1	0	0	AMS				
	0	1	1	NR	MTL			
	0	1	0	NR				
	0	0	1	MTL				
	0	0	0					
	1	1	1	Do not set.				
	1	1	0				AMS	NR
	1	0	1				AMS	MTL
1	1	0	0				AMS	
	0	1	1				NR	MTL
	0	1	0				NR	
	0	0	1				MTL	
	0	0	0					

When these functions are used, tuning operations in the tape DK standby, CD DK standby and radio monitor and DK ON modes are restricted as follows :

ENTPK	KAMS	KNR	KMTL	
0	0	0	0	Normal tuning possible.
0	When even switch is 1			Tuning by M1 (TP1) to M6 key is impossible
1	—	—	—	The LOC (TP4) and MONO (TP5) keys cannot be used as local and monaural keys.

Symbol:
ENTPK
KAMS
KNR
KMTL

Symbol	Function
ENNR2	Switch that enables the NR2 (Noise Reduction) function in the tape mode. Its setting is shown below. **ENNR2: 0** — Description: NR2 function cannot be used. When the [NR] key or NR function key (selected by KNR switch) is pressed, the LCD panel "NR1" display and NR1 pin output changes as follows : "NR1" display OFF → "NR1" display ON "NR1" pin Low output → "NR1" pin High output **ENNR2: 1** — Description: Both the NR1 and NR2 functions can be used. When the [NR] key or NR function key (selected by KNR switch) is pressed, the LCD panel "NR1" and "NR2" displays and NR1 and MONO/NR2 pins output change as follows : "NR1" display OFF / NR1 pin Low output / "NR2" display OFF / MONO/NR2 pin Low output → "NR1" display ON / NR1 pin High output / "NR2" display OFF / MONO/NR2 pin Low output → "NR1" display OFF / NR1 pin Low output / "NR2" display ON / MONO/NR2 pin High output
MUTESEL	Sets the $\overline{\text{RDMUTE}}$ pin output method in the tape and CD modes. Its setting is shown below. **MUTESEL: 1** — $\overline{\text{RDMUTE}}$ Pin Output: In the tape and CD modes, muting is turned off. $\overline{\text{RDMUTE}}$ Pin Output	MAX 20 ms	40 ms	625 to 750 ms MODE Pin LOW Mode switching by TPSET, CDSET switch When MUTESEL = 1 is set, do not use the DK standby and radio monitor functions. **MUTESEL: 0** — $\overline{\text{RDMUTE}}$ Pin Output: In the tape and CD modes, muting remains ON. $\overline{\text{RDMUTE}}$ Pin Output	MAX 20 ms	40 ms MODE Pin LOW Mode switching by TPSET, CDSET switch For details, see "Radio Mute Output Timing"

Symbol	Function
ENFMIF DISAMIF	IF counter use setting switch. Its setting is shown below. | ENFMIF	DISAMIF	BAND	Broadcast Station Detection Method
---	---	---	---
1	0	FM	IF counter and SD system
		MW, LW	IF counter and SD system
1	1	FM	IF counter and SD system
		MW, LW	SD system
0	0	FM	SD system
		MW, LW	IF counter and SD system
0	1	FM	SD system
		MW, LW	SD system	
DISAMEMO	Auto preset memory function disable switch. Its setting is shown below. 	DISAMEMO	Description
0	Enables the auto preset memory function. When the [PSCAN AMEMO] key is pressed for more than 2 seconds, auto preset memory operation begins.
1	Disables the auto preset memory function The [PSCAN AMEMO] key performs the preset scan function only.	

3. MODE TRANSITION

With the DMC 4002, the radio can be turned on and off by the following two methods:

(1) By CE pin when the initialized diode switch RDON = 1

(2) By turning the transistor or alternate switch RDSET on and off

The mode transition at each operation is described in 3.1, 3.2 and 3.3.

3.1 WHEN THE INITIALIZED DIODE RDON = 1 (RADIO ON/OFF BY CE PIN)

The radio mode is turned on and off by CE pin.

Switching to the tape and CD modes is performed by TPSET and CDSET switches, respectively.

When RDON = 1, do not use the RDSET switch.

When the CE pin is made Low level, clock display is not performed.

(1) CE : Low to High
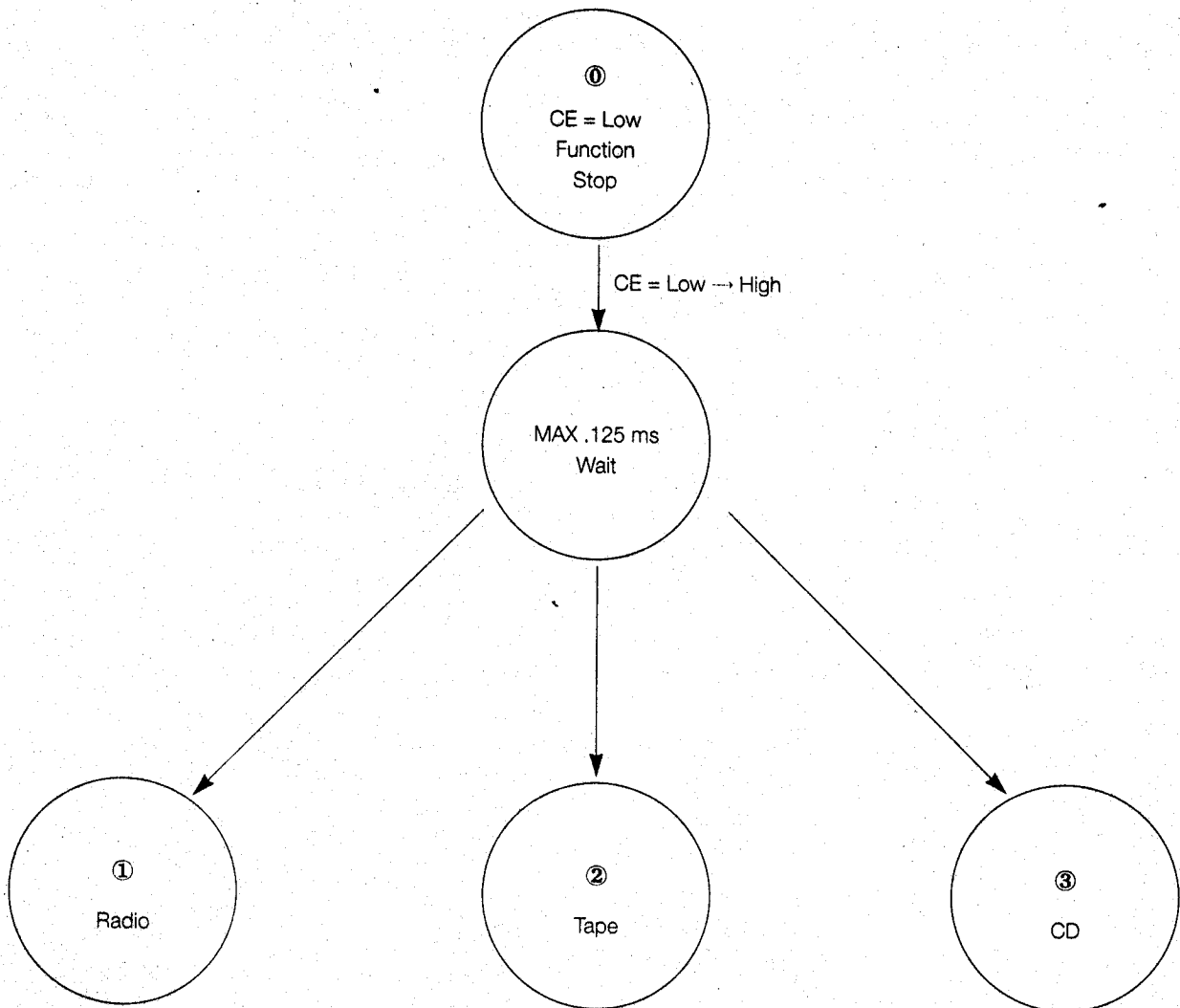
(2) CE : High Level
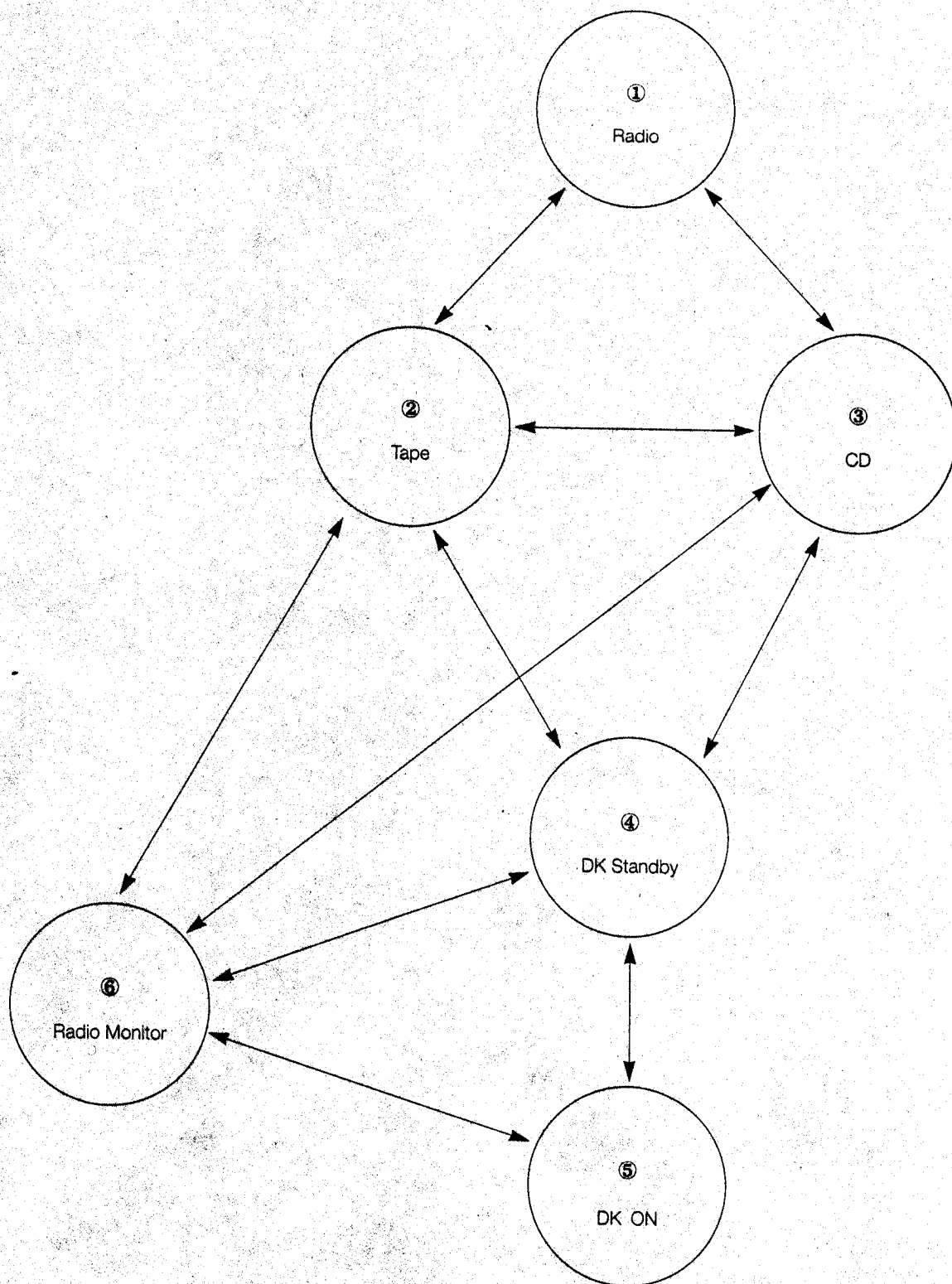
3. 2 RADIO ON/OFF BY RDSET SWITCH

The radio mode is turned on and off by RDSET switch.

Switching to the tape and CD mode is performed by TPSET and CDSET switch, respectively.

The difference from RDON=1 of 3.1 is that the clock is displayed even when the radio, tape and CD modes are OFF.

(1) CE : Low to high

⓪
CE = Low
Function
Stop

CE = Low → High

MAX .125 ms
Wait

① Radio

② Tape

③ CD

⑦ Clock

(2) CE : High Level

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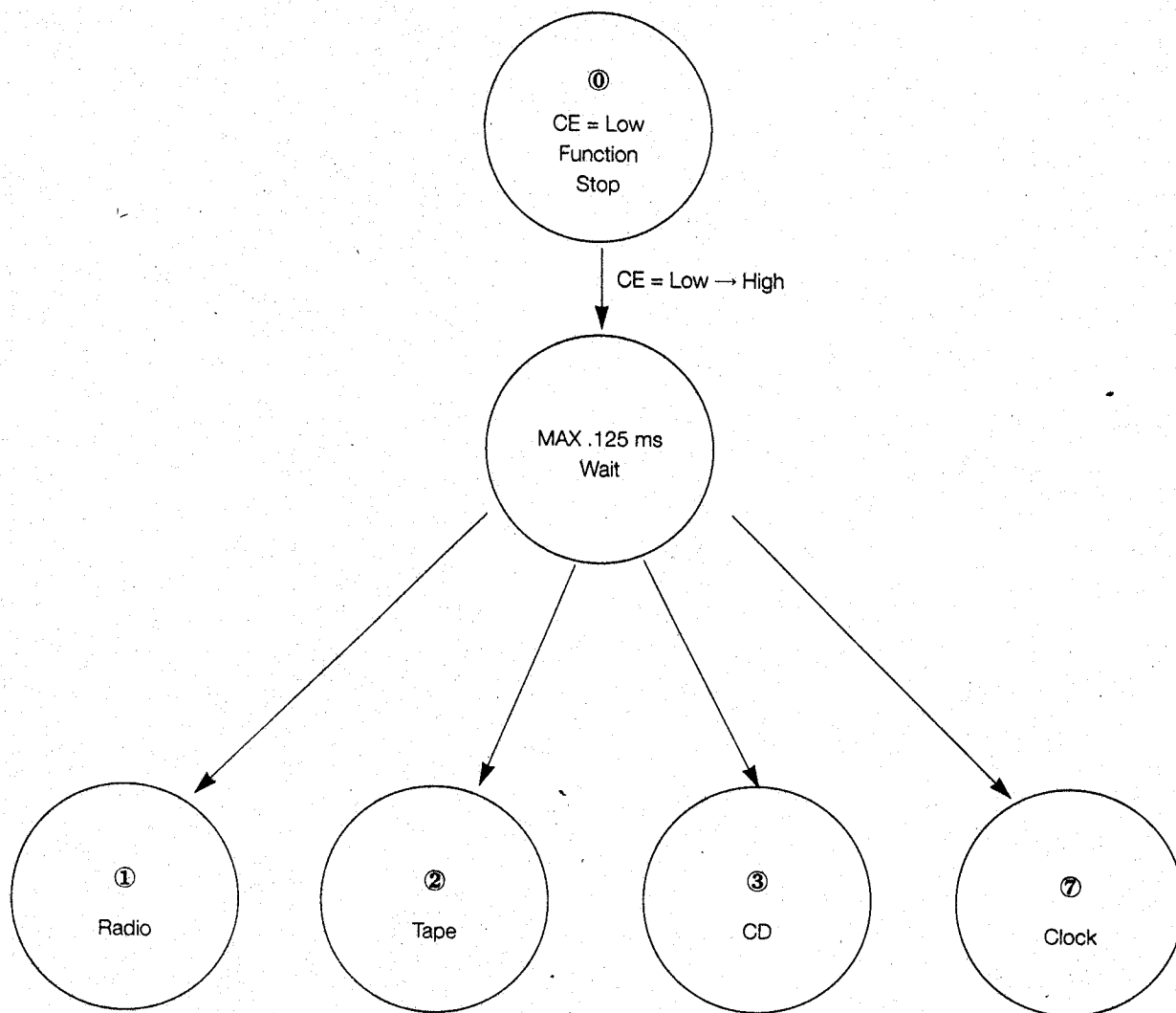
3.3 DESCRIPTION OF EACH MODE

Mode	Description
⓪ CE = Low	Backup mode. When the NOCLK switch is set to no clock, low consumption current(400nA Max.) backup is possible. When clock is selected, the device is set to the clock count mode. In the mode, the maximum consumption current is 500 μA.
① Radio	When the CE pin is high level and the TPSET and CDSET switches are OFF, the device is set to the radio mode.
② Tape	When the CE pin is high level and the TPSET switch is ON and the CDSET switch is OFF, the device is set to the tape mode.
③ CD	When the CE pin is high level and the CDSET switch is ON , the device is set to the CD mode.
④ DK Standby	When the VF band is received in the radio mode and the mode is switched to the tape or CD mode by TPSET or CDSET switch, the device is set to the DK standby mode. The device is also set to the DK standby mode by pressing the [VF] key in the tape or CD modes. In the DK standby mode, VF band tuning operation is enabled.
⑤ D·K	When the DK switch is set to ON in the DK standby mode, the device enters the DK ON mode. In the DK ON mode, radio muting ($\overline{\text{RDMUTE}}$ pin) is turned off and audio muting ($\overline{\text{AMUTE}}$ pin) is turned on.
⑥ Radio monitor	When the tape mode is set by TPSET switch when the radio monitor mode is ON by [RDMONI] in the radio mode, the device enters the radio monitor mode. The radio monitor mode is also set by pressing the [RDMONI] key in the tape and CD modes. In the radio monitor mode, normal tuning operation is possible. In the radio monitor mode, radio muting ($\overline{\text{RDMUTE}}$ pin) is turned off and audio muting ($\overline{\text{AMUTE}}$ pin) is turned on.
⑦ Clock	NOCLK = 0 Only clock display is performed. Clock adjustment is also possible. NOCLK = 1 Function is disabled. However, since the CE is high level, the consumption current is 500 μA Typ.

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55

3.4 RADIO ON/OFF BY POWER KEY

The POWER key valid when CE pin is high level.

Each time the key is pressed, the POWER pin (pin 23) output is inverted.

Therefore, a circuit is configured so that the radio is turned on and off by setting RDON = 0 and turning the RDSET switch on and off by POWER pin.

For details, see "Application Circuits".

4. DISPLAY

4.1 LCD PANEL
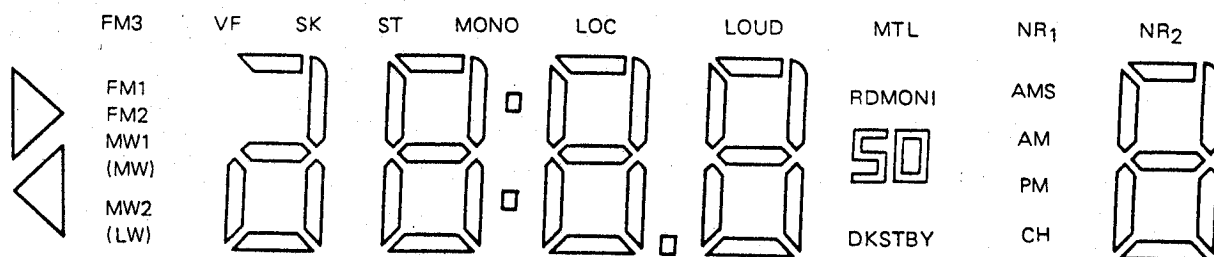
4.2 DISPLAY TYPE

4.3 SEGMENT LINES
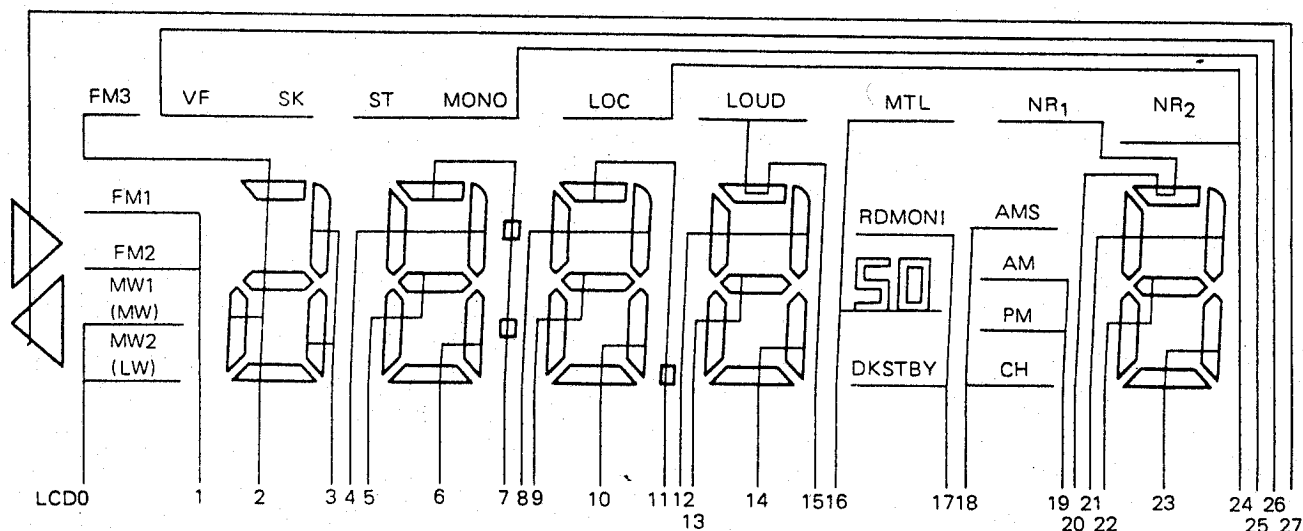
4.4 COMMON LINES
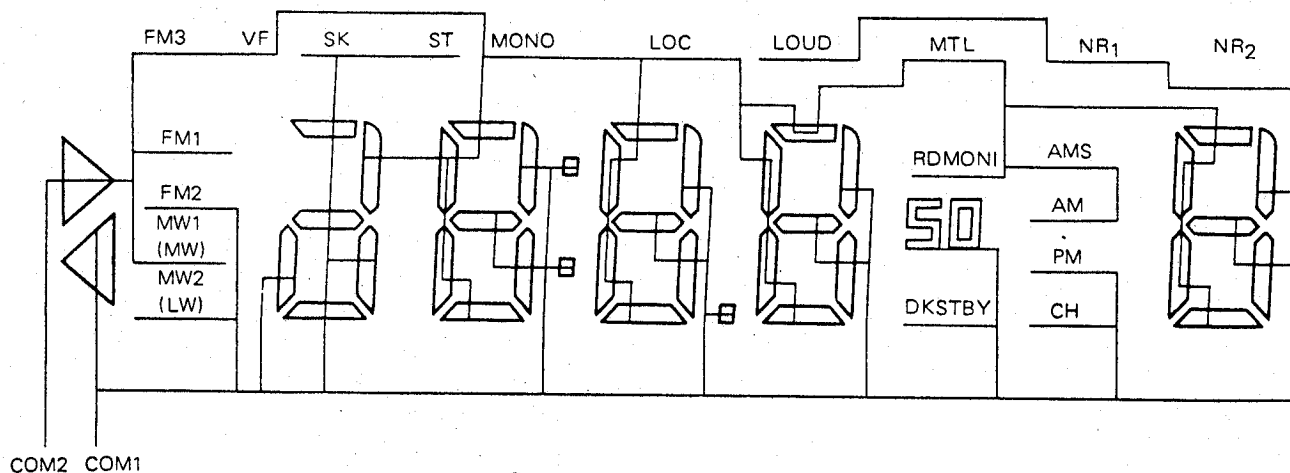
4.5 LCD ASSIGNMENT TABLE

LCD	COM1	COM2
0	MW2(LW)	MW1(MW)
1	FM2	FM1
2	4a, 4d. 4e, 4g	FM3
3	4c	4b
4	3b	3f
5	3g	3e
6	3c	3d
7	COLON(:)	3a
8	2b	2f
9	2g	2e
10	2c	2d
11	POINT(.)	2a
12	1b	1f
13	1g	1e
14	1c	1d
15	LOUD	1a
16	50	MTL
17	DKSTBY	RDMONI
18	CH	AMS
19	PM	AM
20	NR$_1$	Ca
21	Cb	Cf
22	Cg	Ce
23	Cc	Cd
24	NR$_2$	LOC
25	ST	MONO
26	SK	VF
27	◁	▷

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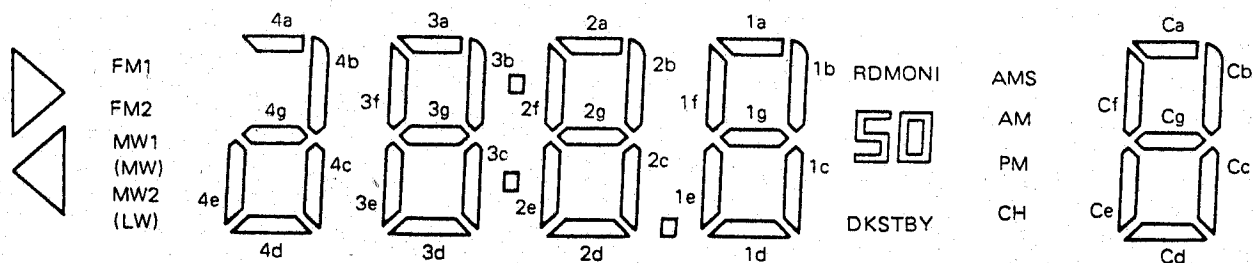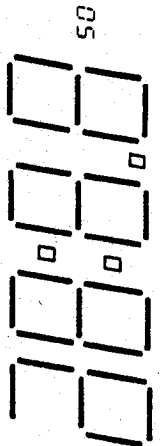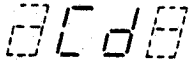
4. 6 DESCRIPTION OF DISPLAYS

Display	Description
VF	Indicates that the device is on the VF band.
SK	Indicates that the SK signal is input. It lights when the SK switch is turned on at the FM and VF bands.
ST	Indicates that a STEREO signal is input. It lights when the $\overline{ST}$ pin (pin 64) becomes Low on the FM and VF bands. However, it does not light in the MONO mode.
MONO	Indicates that the device is in the monaural mode. When the ⟨MONO⟩ key is pressed on the FM and VF bands, the display is inverted. High level is output from the MONO/NR2 pin(pin 18) while this display is lit. It is invalid on the MW and LW bands.
LOC	Indicates the LOCAL status. This display is reversed when ⟨LOC⟩ key is pressed in radio mode (FM, MW, LW bands). When the display flashes, High level is output from LOC pin(No. 10 pin).
LOUD	Indicates that the device is in the LOUDNESS state. When the ⟨LOUD⟩ key is pressed in the radio, tape or CD mode, this display is inverted. High level is output from the LOUD pin (pin 19) while this display is lit.
MTL	Indicates that the device is in the METAL state. When the ⟨METAL⟩ function key is pressed in the tape mode, this display is inverted. High level is output from the MTL pin (pin 21) while this display is lit.
NR1	Indicates that the device is in the NR1 (Noise Reduction) state. When the device is placed into the NR1 state by ⟨NR⟩ function key in the tape mode, this display lights. High level is output from the NR1 pin (pin 22) while this display is lit.
NR2	Indicates that the device is in the NR2 (Noise Reduction) state. The NR2 function can be used with the initialized diode ENNR2 switch. When the device was placed into the NR2 state by ⟨NR⟩ function key in the tape mode, this display lights. High level is output from the MONO / NR2 pin (pin 18) while this display is lit.
DKSTBY	Lights in the DK standby and DK ON modes in the tape/CD mode.
◁ ▷	Indicates the direction of tape travel. In the tape mode, this display indicates the tape direction according to the state of the RL switch. If the FF switch is ON, this display flashes. For more information, see the description of each pin.

Display	Description
FM1 FM2 FM3 MW1(MW) MW2(LW)	Indicates the receiving band in the radio mode. In Europe, when the device is switched to LW band, "MW2 (LW)" lights.
(7-segment display)	Displays the receiving frequency, CD and clock. – Receiving frequency display Displayed in the radio mode. "50" is displayed only on the Europe and South Africa FM bands. "." (D.P) is displayed as the decimal point on the FM bands. – CD display When the device enters the CD mode, the following is displayed. $0Cd0$ – Clock display 12 hour clock or 24 hour clock can be selected by the initialized diode CLKDSP switch. Flashing of the " : " (colon) display is possible by the initialized diode FLASH switch.
AMS	Indicates that the device is in the AMS (Auto Music Search) state. When the ⌐AMS⌐ function key is pressed in the tape mode, this display is inverted. High level is output from the AMS pin (pin 20) while this display is lit.
AM PM	12 hour clock AM and PM display.
(7-segment display) ch	Indicates the preset memory number and AMS selection number. – Preset memory number display. In the radio mode, when preset memory write and call are performed, the corresponding preset number and "ch" are displayed. In the memory write mode set by ⌐ME⌐ key, the "ch" display flashes at 1HZ. During preset memory scanning by ⌐PSCAN⌐ key, the preset memory number display (Ca to Cg) flashes at 1 Hz.
RDMONI	Lights in the radio monitor mode.

5. RADIO MUTE OUTPUT TIMING (RDMUTE)

① Key ON chattering prevention

② Premuting and BEEP output

③ Division ratio setting and display contents updating

④ Postmuting

⑤ Scan time

⑥ PLL lock wait time

5.1 RADIO MUTE (RDMUTE PIN) OUTPUT TIMING CHARTS

1) Manual up/down

    (1) 1 channel up/down

        (a) AUTO 500 switch = 0
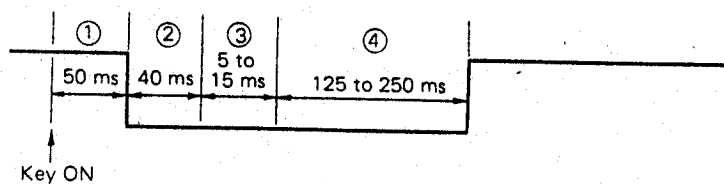
        (b) AUTO 500 switch = 1
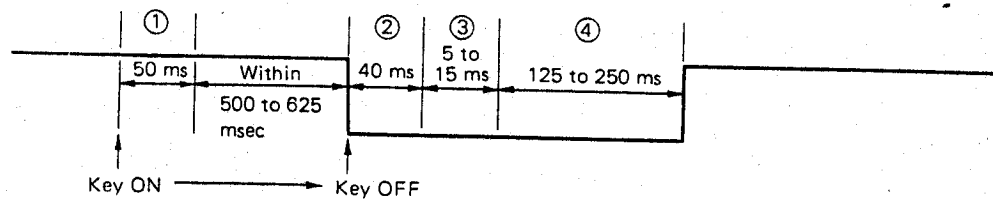
At the band edge (between lowest frequency and highest frequency) of both (a) and (b), time ④ is 625 to 750 ms.

    (2) Continuous up/down

        (a) AUTO 500 switch = 0
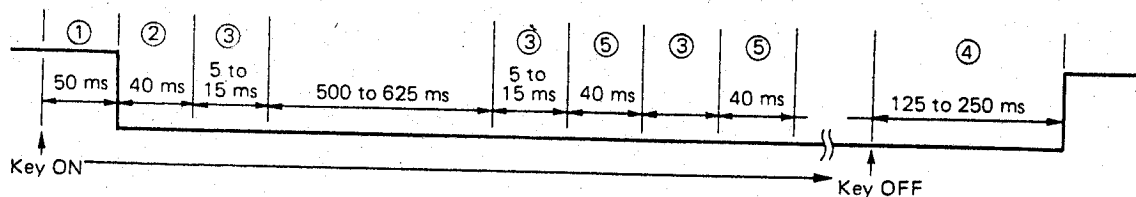
At the band edge, time ⑤ becomes 540 to 665 ms and time ④ becomes 625 to 750 ms.

        (b) When AUTO 500 switch = 1, continuous up/down is not performed because holding down the key for more than 0.5 seconds sets autotuning.

2) Auto up / down

(1) [SEEK UP] , [SEEK DWN] , [SCAN UP] , [SEEK DWN] keys
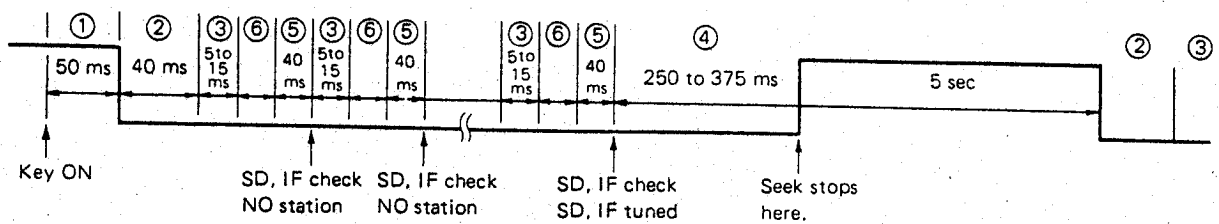
(2) [MAN UP] , [MAN DWN] key held down for more than 0.5 seconds when AUTO 500 switch = 1
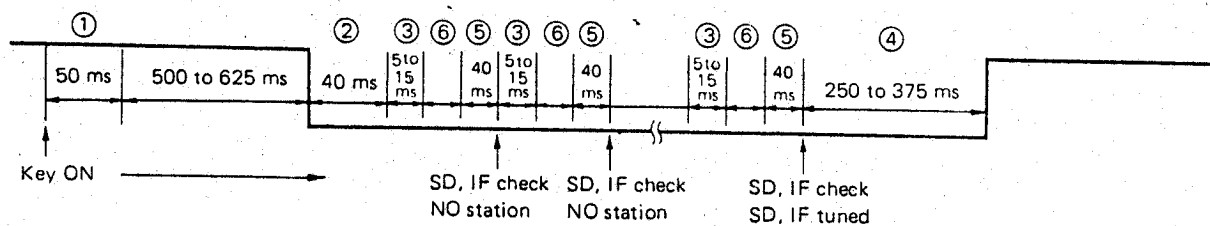
At both (1) and (2), at the band edge time ⑤ becomes 520 to 695 ms.

IF check is performed twice, once in the FAST mode and once in the SLOW mode.

FAST mode IF check takes approx. 6 ms on the FM, MW and LW bands and SLOW mode IF check takes approx. 15 ms on the FM band and approx. 25 ms on the MW and LW bands

3) Preset memory call

(1) M2S switch = 0

(2) M2S switch = 1

4) Preset memory write

(1) M2S switch = 0

Key ON

Preset-memory display

(2) When M2S switch = 1, muting is not output.

5) Preset memory scan
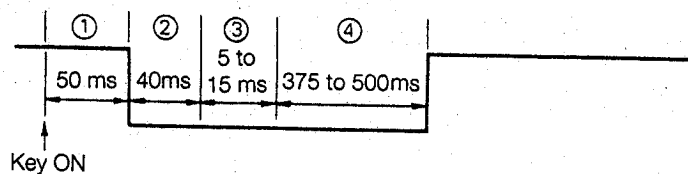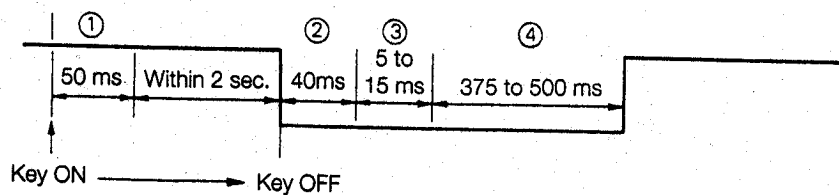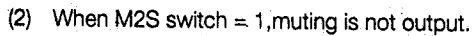
Key ON

6) VF mode

(1) When [VF] mode selected with VF key ON

Key ON

| SK Check | SD, IF Check | SD, IF Check | SK Check | SD, IF Check | SK Check |
| No SK | No SD, IF | SD, IF Tuned | No. SK | SD, IF Tuned | SK Tuned |

(2) Seek and scan operating in VF mode

Key ON

SD, IF check   SD, IF check   SK check   SD, IF check   SK check
NO SD, IF   SD, IF tuned   NO SK   SD, IF tuned   SK tuned
                                                              Seek stopped

7) Band switching

Key ON
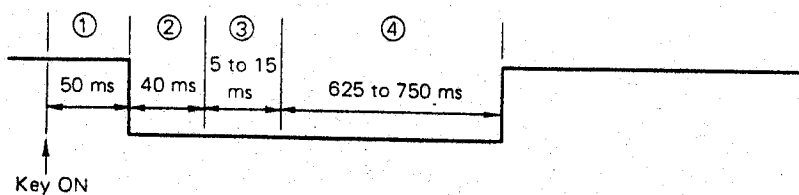
8) Radio OFF to ON

(1) RDSET switch

(Tape,CD)   ① ② ③ ④   (Radio)

0 to 20 ms 40 ms 5 to 15 ms 625 to 750 ms

RDSET switch ON
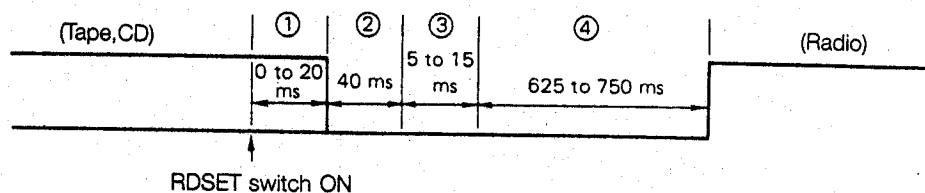
(2) CE : Low to High by RDON switch = 1

② ③ ④   (Radio)

0 to125 ms 40 ms 5 to 15 ms 625 to 750 ms

CE = HIGH

9) TAPE or CD OFF to ON

(Radio)   ① ② ④   (Tape,CD)   MUTESEL switch = 0

0 to 20ms 40 ms 625 to 750 ms

Clock Only   MUTESEL switch = 1

TPSET switch
CDSET switch ON

10) CE pin High to Low

(Radio, Tape, CD)

Clock Only   MAX. 5ms
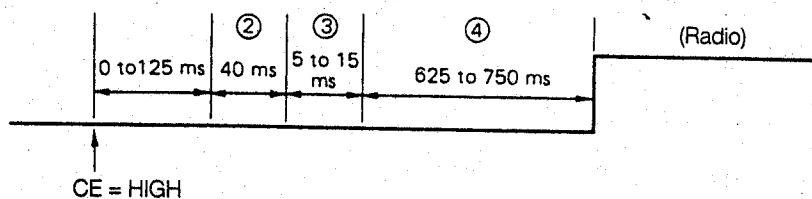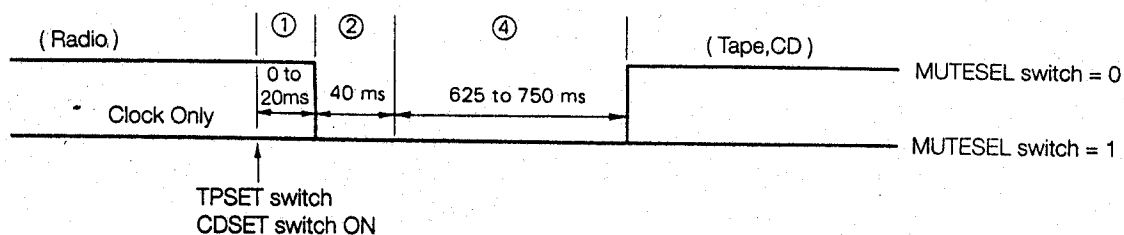
CE = High → Low
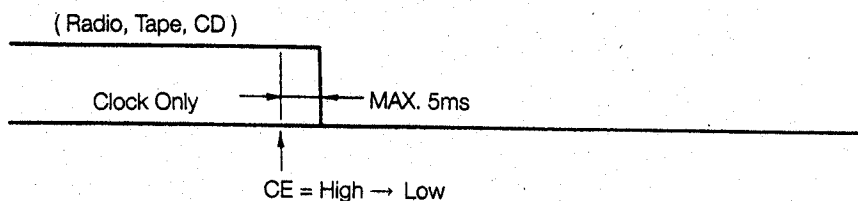
5.2 RADIO MUTE ($\overline{RDMUTE}$ PIN) AND AUDIO MUTE ($\overline{AMUTE}$ PIN) OUTPUT TIMING CHARTS

1) When switched from radio mode to tape or CD mode.

(Other than VF band, other than radio monitor mode)
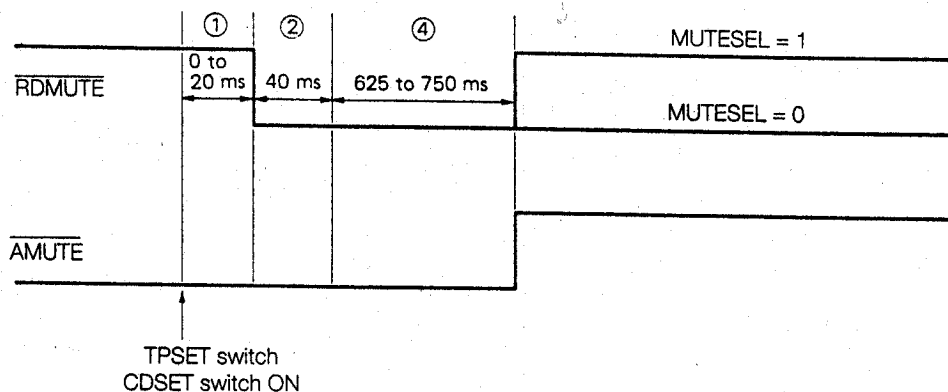
2) When switched from VF band to tape or CD mode (Set MUTESEL to 0)

(1) DK = OFF
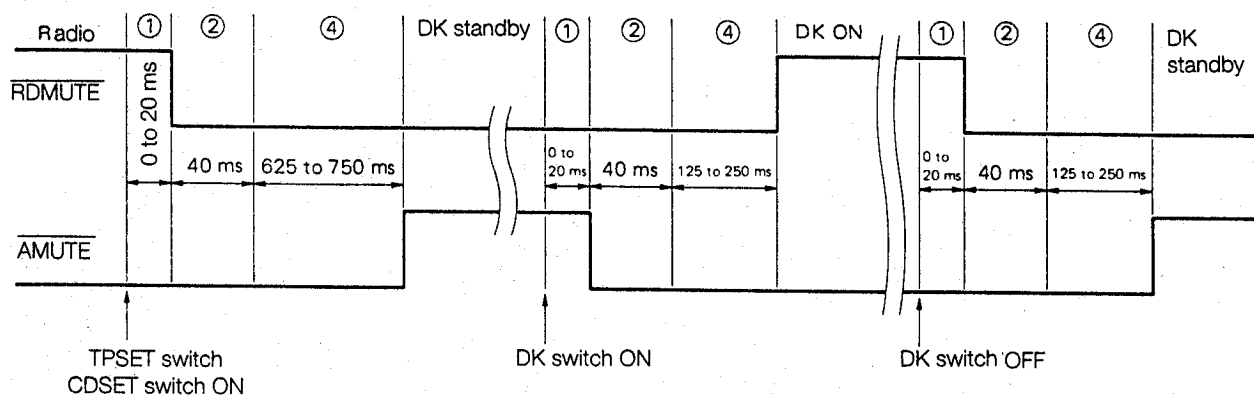
(2) DK = ON
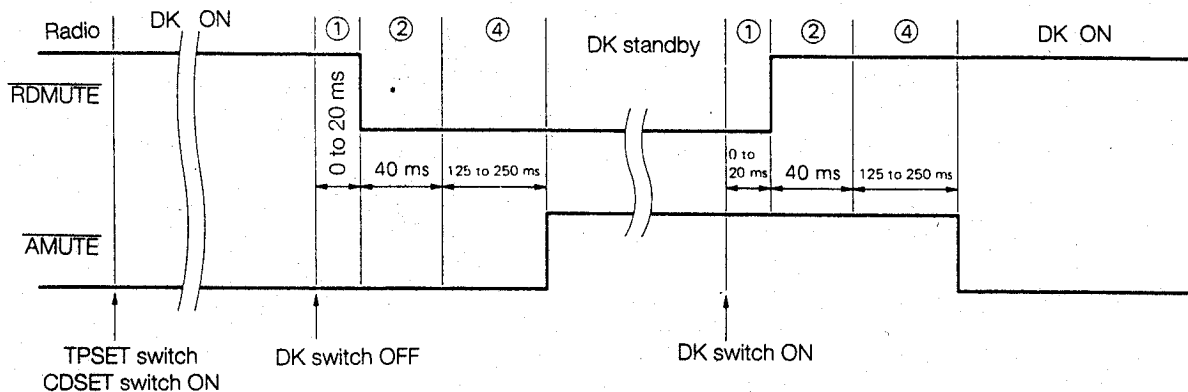
3) Radio monitor mode (Set MUTESEL to 0.)

(1) When switched from radio monitor OFF in the radio mode

| Radio | ① | ② | ④ | Tape, CD | ① | ② | ④ | Radio Monitor |

RDMUTE

0 to 20 ms | 40 ms | 625 to 750 ms | | 50 ms | 40 ms | 625 to 750 ms

AMUTE

↑ TPSET switch
CDSET switch ON

↑ RDMONI   Key ON
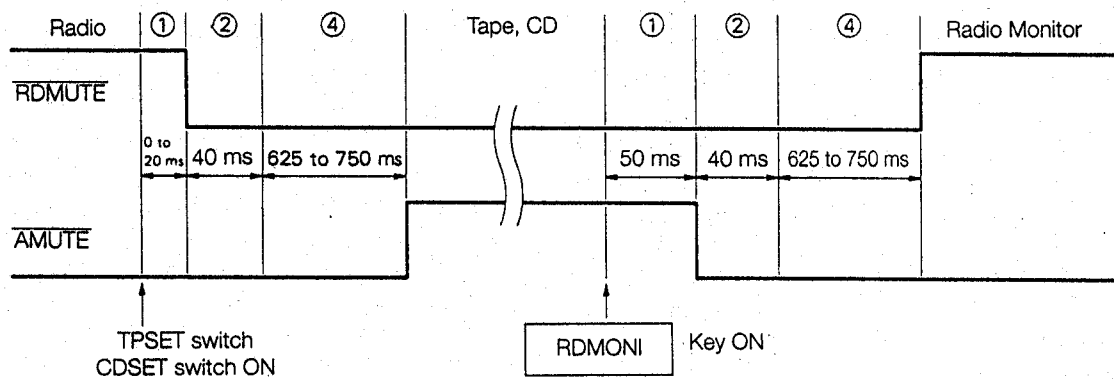
(2) When switched from radio monitor ON in radio mode

| Radio | Radio Monitor | | ① | ② | ④ | Tape, CD |

RDMUTE

50 ms | 40 ms | 625 to 750 ms

AMUTE

↑ TPSET switch
CDSET switch ON

↑ RDMONI   Key ON

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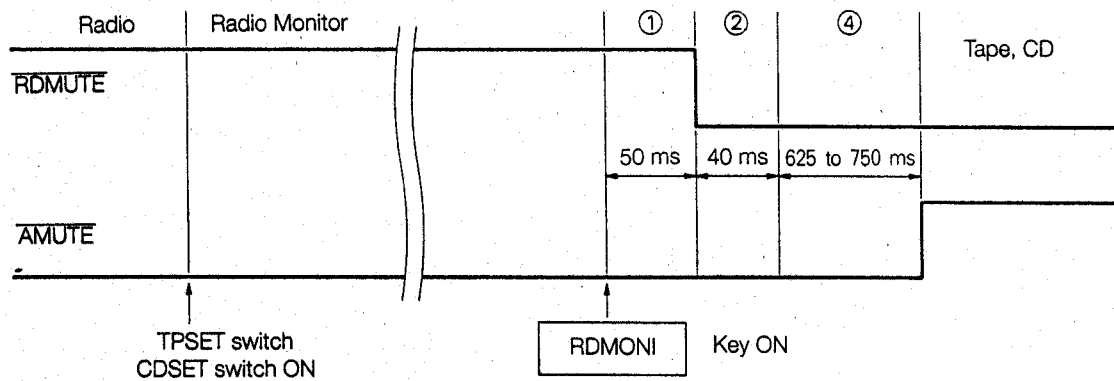
6. PIN I/O CIRCUITS

The I/O circuit of each pin of the DMC4002 is shown below in abbreviated form.

(1) LCD$_0$ / KS$_0$ to LCD$_{27}$, CGP, PB$_0$ to PB$_3$, PD$_0$ to PD$_2$, EO$_1$, EO$_2$
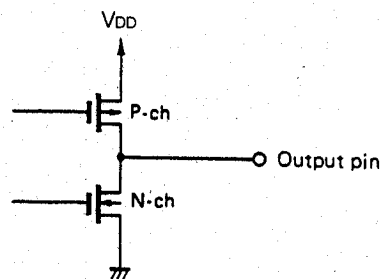
(2) $\overline{INT}$, AD
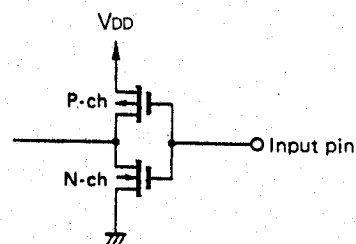
(3) PA$_0$ / AMIF, PA$_1$ / FMIF, PA$_2$, PA$_3$, PC$_0$ to PC$_3$

(4) COM$_1$, COM$_2$

V_{DD}

P-ch P-ch P-ch N-ch N-ch

Output pin

P-ch N-ch

(5) K$_0$ to K$_3$

V_{DD}

P-ch

N-ch

N-ch

Input pin

(High ON Resistnace)

(6) FM VCO, AM VCO

V_{DD}

P-ch N-ch

P-ch

N-ch

N-ch

Input pin

(High ON Resistnace)

(7) CE

Input Pin
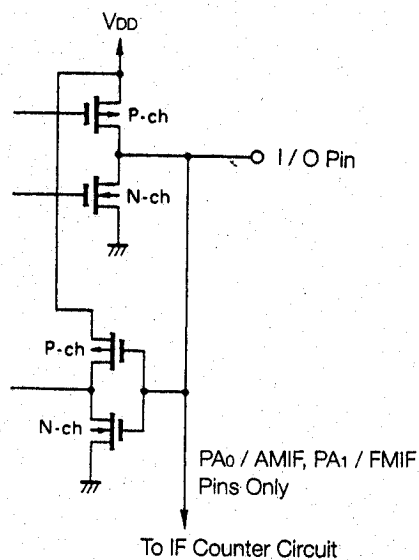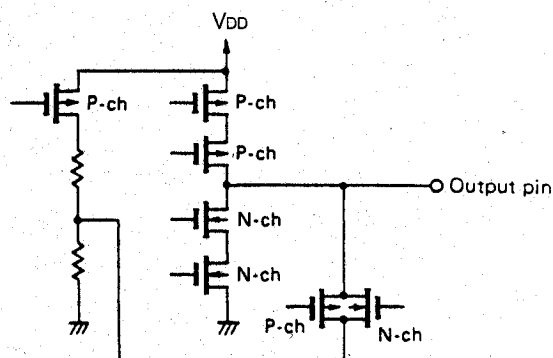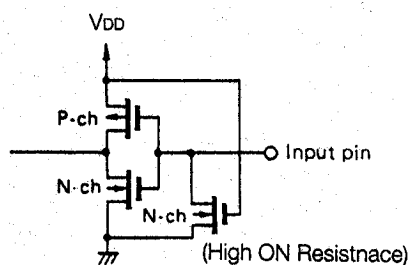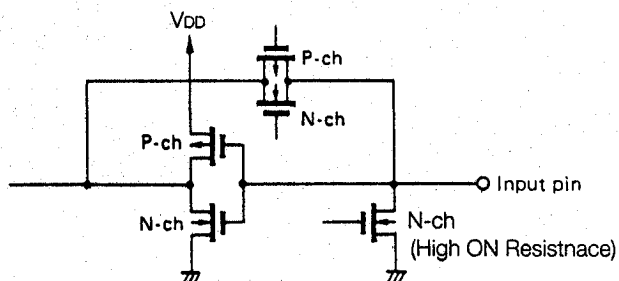
Schmitt Triggered input with Hysteresis Characteristics

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7. APPLICATION CIRCUITS

7.1 Power ON/OFF by alternate switch (o—o) (No clock display in power OFF time)

RDON SWITCH = 1
RADIO ON (CE: Low to High)
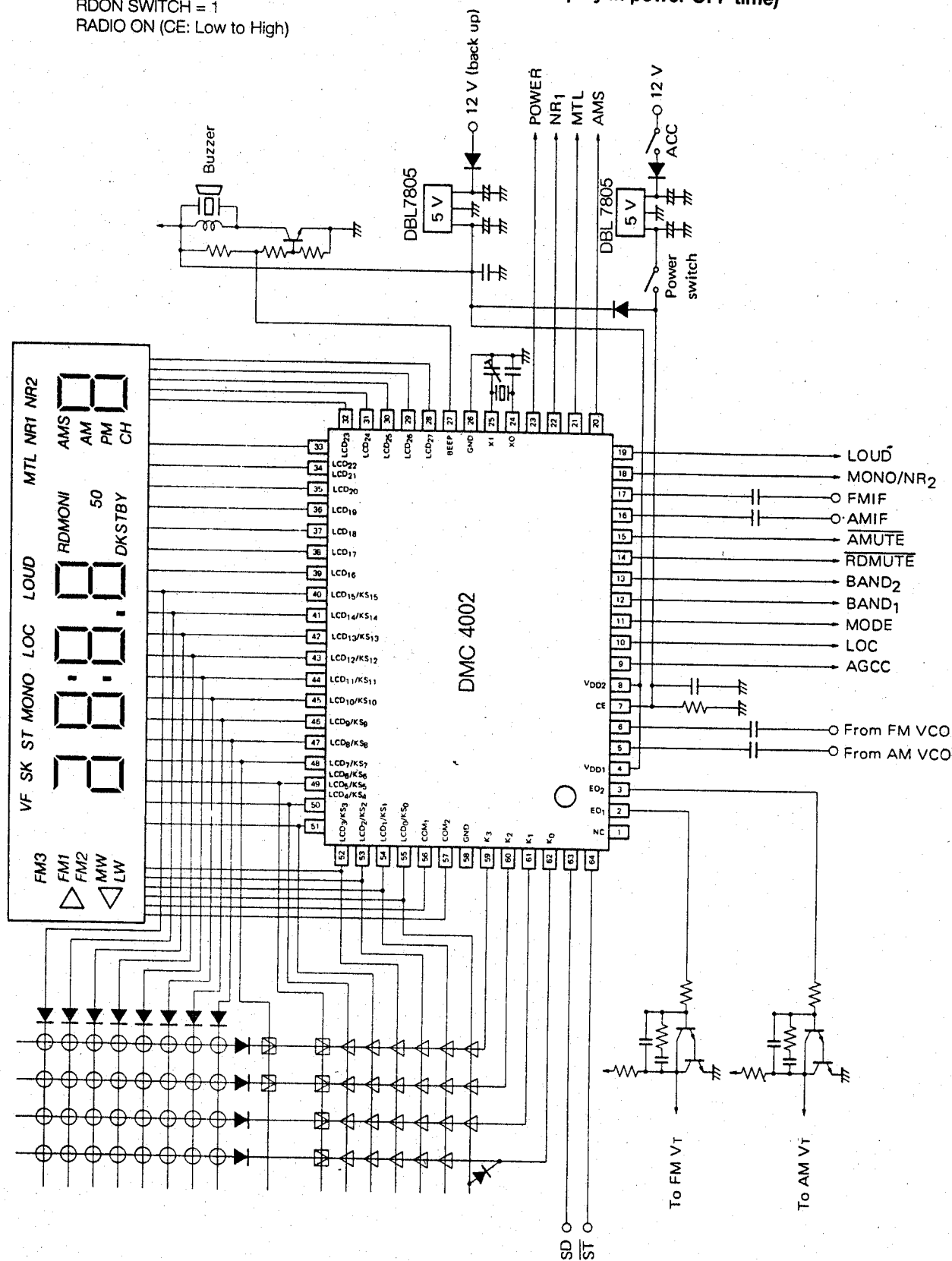
7.2 Power ON/OFF by alternate switch (o—o) (Clock display in power on time)

RDSET switch is used.

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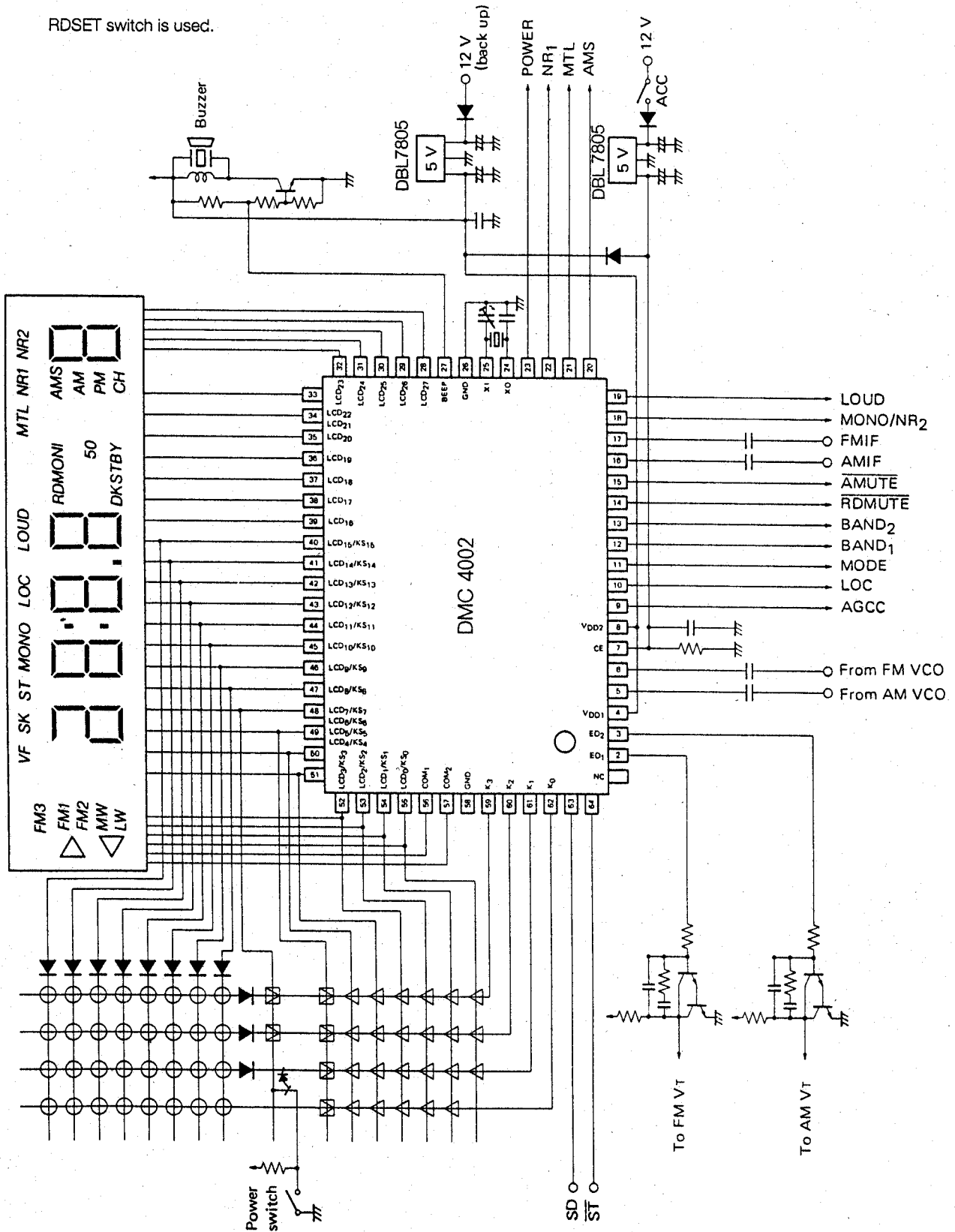
7.3 Power ON/OFF by momentary switch (⌒⌒) (Clock display in power Off time)
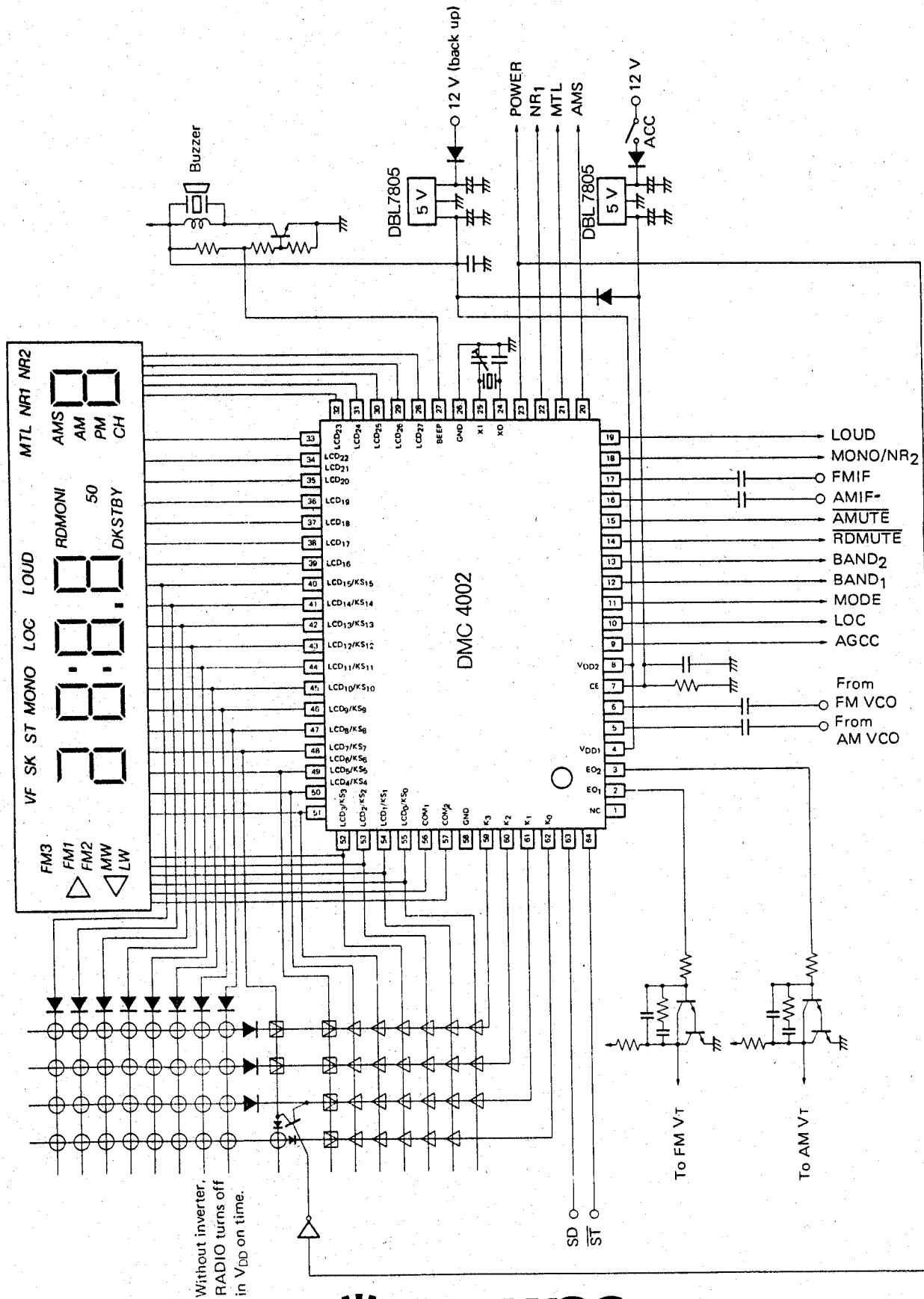
8. ELECTRICAL SPECIFICATIONS

□ MAXIMUM RATINGS

Characteristic	Symbol	Rating	Unit
Supply Voltage	V_{DD}	$-0.3 \sim 6.0$	V
Input Voltage	V_{IN}	$-0.3 \sim V_{DD}{}^{+0.3}$	V
Output Voltage	Vo	$-0.3 \sim V_{DD}{}^{+0.3}$	V
Output Sink Current	I SINK	10	mA
Operating Temperature	T_a	$-40 \sim 85$	°C
Storage Temperature	T_{stg}	$-55 \sim 125$	°C

□ RECOMMENDED OPERATING RANGE

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD1}	CPU, PLL operating	4.5	5	5.5	V
	V_{DD2}	PLL stopped	3.5	5	5.5	V
Date Hold Voltage	V_{DR}	X' tal oscillation stopped	2.5		5.5	V
Supply Voltage Rise Time	T_{rise}	V_{DD} = Low to High			500	ms
Input Amplitude	V_{in1}	FM VCO, AM VCO Pin	0.3		V_{DD}	V_{p-p}
	V_{in2}	AMIF, FMIF pin	0.1		V_{DD}	V_{p-p}

□ AC CHARACTERISTICS

(Unless otherwise specified, Ta = 25°C, V_{DD} = 4.5 to 5.5V)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operating Frequency	f_{in1}	FM VCO pin (positive sine wave input) $V_{in} = 0.3V_{P-P}$	10		200	MHz
	f_{in2}	AM VCO pin (positive sine wave input) $V_{in} = 0.3V_{P-P}$	0.50		30	MHz
	f_{in3}	FMIF pin (positive sine wave input) $V_{in} = 0.1V_{P-P}$	1		20	MHz
	f_{in4}	AMIF pin (positive sine wave input) $V_{in} = 0.1V_{P-P}$	0.3		5	MHz

□ DC CHARACTERISTICS

(Unless otherwise specified, Ta = 25° C, VDD = 4.5 to 5.5V)

| Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input Voltage High	V_{IH1}	PORT A / C	$0.7 V_{DD}$			V
	V_{IH2}	CE, $\overline{INT}$	$0.8 V_{DD}$			V
	V_{IH3}	K3 to K0	$0.6 V_{DD}$			V
Input Voltage Low	V_{IL1}	PORT A / C, CE, $\overline{INT}$			$0.2 V_{DD}$	V
	V_{IL2}	K3 to K0			$0.15 V_{DD}$	V
Output Current High	I_{OH1}	PORT A / B / C / D $\qquad V_{OH} = V_{DD} - 0.4V$	−0.4			mA
	I_{OH2}	EO1, EO2, CGP, LCD27 to LCD24 $\qquad V_{OH} = V_{DD} - 1V$	−0.5			mA
	I_{OH3}	LCD0 to LCD23 $\qquad V_{OL} = V_{DD} - 1V$	−200	−280		μA
Output Current Low	I_{OL1}	PORT A / B / C / D, CGP, LCD27 to LCD24 $\qquad V_{OH} = 0.4V$	0.6			mA
	I_{OL2}	EO1, EO2 $\qquad V_{OL}=1V$	0.5			mA
	I_{OL3}	LCD0 to LCD23 $\qquad V_{OL}=1V$	200	300		μA
Input Current High	I_{IH1}	K3 to K0 $\qquad V_1 = V_{DD} = 4.5V$	15	120	200	μA
	I_{IH2}	FM / AM VCO, XI $\qquad V_1 = V_{DD} = 4.5V$	100			μA
Output Voltage	V_{COM1}	COM1, COM2 $\qquad V_{DD} = 5V$, output open	4.8	5.0		V
	V_{COM2}	COM1, COM2 $\qquad V_{DD} = 5V$, output open	2.3	2.5	2.7	V
	V_{COM3}	COM1, COM2 $\qquad V_{DD} = 5V$, output open	0	0.2		V
Output off Leakage Current	I_{LEAK}	EO1, EO2 $\qquad V_0 = V_{DD}$, Ta = 25° C		10^{-3}	1	μA
A/D Converter Resolution					6	bit
A/D Converter Absolute Accuracy		Ta = −10 to + 50° C		1	1.5	LSB
Supply Current	I_{DD1}	CPU and PLL operating (fin = 150 MHz) $\qquad V_{DD} = 5V$, Ta = 25° C		20		mA
	I_{DD2}	PLL stopped, CPU operating $\qquad V_{DD} = 5V$, Ta = 25° C		0.5		mA
Data Hold Current	I_{DR}	X'tal oscillation stopped, Ta = 25° C $\qquad V_{DD} = 5V$		20	400	nA
A/D Input Resistance	R_1		1			$M\Omega$

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9. PACKAGE DIMENSION

detail of lead end
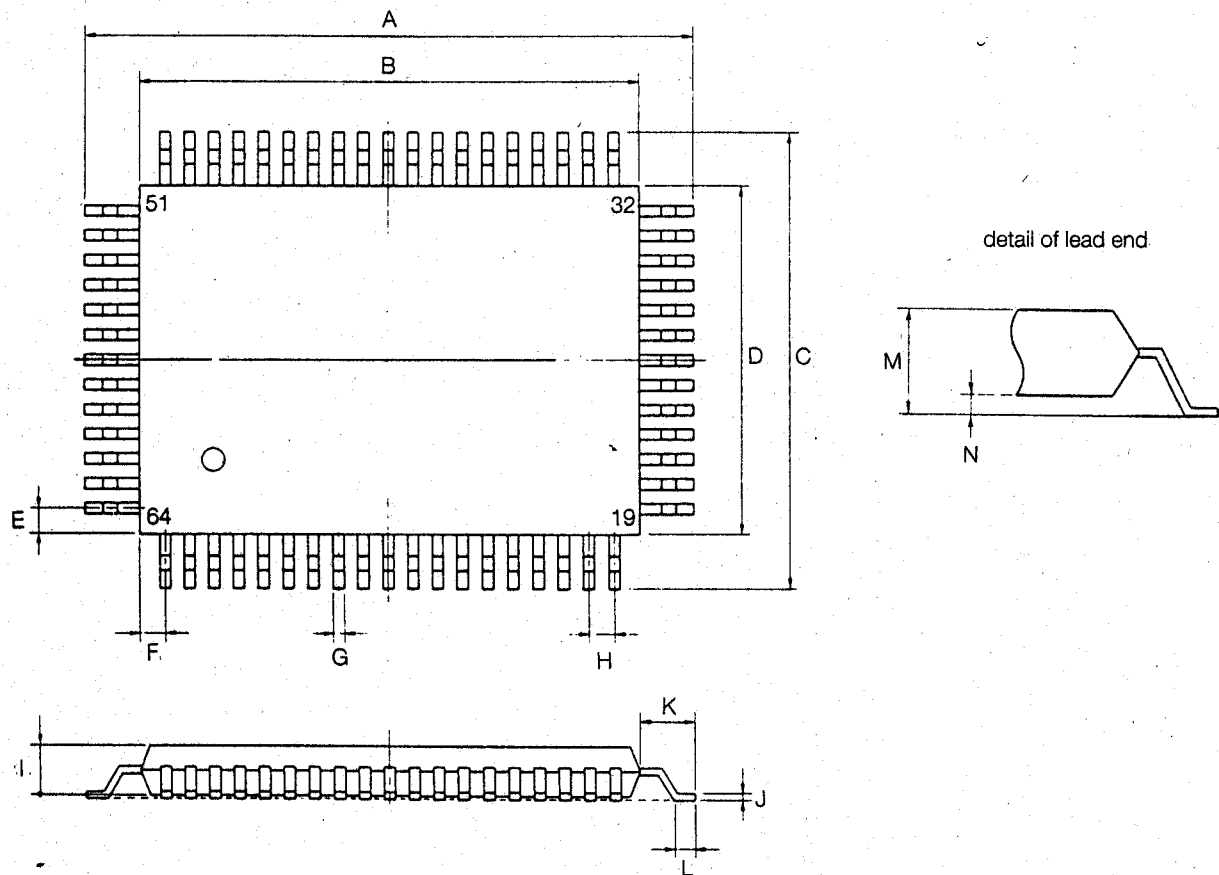
	MILLIMETER			INCHE			MILLIMETER			INCHE
	Min.	Typ.	Max.	Typ.		Min.	Typ.	Max.	Typ.
A	23.4	23.86	24.2	.939	H	—	1.0	—	.039
B	19.85	20.0	20.15	.787	I	2.6	2.71	2.8	.107
C	17.4	17.86	18.2	.703	J	0.13	0.15	0.2	.006
D	13.85	14.0	14.15	.551	K	1.7	1.93	2.1	.076
E	—	1.0	—	.039	L	0.4	0.51	0.7	.02
F	—	1.0	—	.039	M	—	2.91	3.15	.115
G	0.3	0.4	0.5	.016	N	0.0	0.2	0.35	.008

Note : Its specification is subject to change at any time without notice.