CMOS IC

LC7234-8460

Single-chip PLL and Microcontroller with LCD Driver

Preliminary

Overview

The LC7234-8460 is a single-chip microcontroller that incorporates a phase-locked loop (PLL) and a liquid crystal display driver.

The LC7234-8460 operates over the American, European, Chinese, Middle Eastern, Canadian and Australian LW, MW, SW and FM bands, and incorporates preset-channel memory, automatic or manual tuning, high-speed station search, and clock and timer functions.

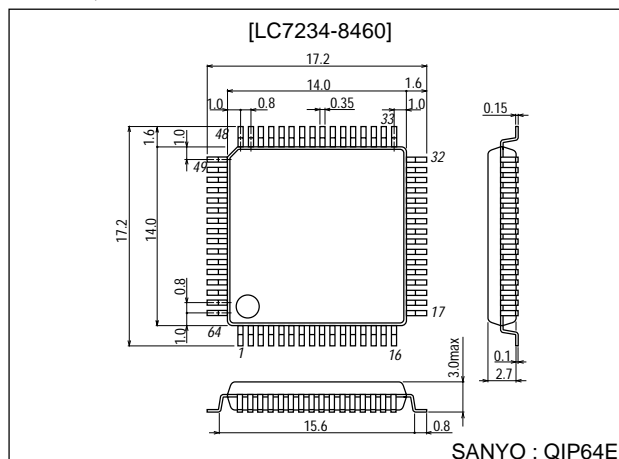The LC7234-8460 operates from a 5 V supply and is available in 64-pin QIPs.

Features

• Operates over the LW, MW, SW1, SW2 and FM bands.
• Three selectable preset memory configurations.
• Automatic tuning or manual preset memory scan.
• High-speed station search.
    FM band: 60 ms per step.
    AM band: 70 ms per step.
• Clock function.
• ON, OFF and SLEEP timer functions.
• Logic-level and momentary switch band select inputs.
• LCD display with wide viewing angle and high contrast over a wide operating temperature range.
• On-chip amplifier for external lowpass filter.
• External RC network for reset not required.
• Forced mono mode.
• High signal-to-noise ratio.
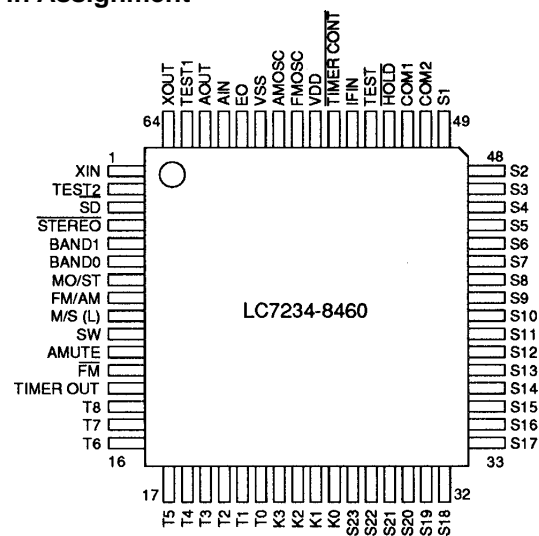• Single 5 V supply.
• 64-pin QIPs.

Package Dimensions

unit:mm

3159-QIP64E

[LC7234-8460]

SANYO : QIP64E

Pin Assignment

LC7234-8460

Top view

LC7234-8460

Pin Function

Number	Name	Description
1	XIN	4.5MHz crystal oscillator input connection.
2	TEST2	Test input. Normally connected to GND.
3	$\overline{SD}$	Active-LOW station detect input. During autotuning, this input is active when a station is detected. Connect to V_{SS} when not in use.
4	$\overline{STEREO}$	Active-LOW stereo detect input. When LOW during FM mode, the STEREO display LED is ON. Connect to V_{DD} when not in use.
5	BAND1	Band select inputs. Active when SELBND is 0. See the band select tables.
6	BAND0	
7	MO/ST	Active-HIGH mono/stereo indicator output. Mono when LOW and stereo when HIGH. LOW level after reset. Leave open when not in use.
8	FM/AM	Active-HIGH FM/AM band select output. AM when LOW and FM when HIGH. HIGH level after reset. Leave open when not in use.
9	M/S (L)	Active-LOW medium/short wave band select output. MW when HIGH and SW(LW) when LOW. LOW level after reset. Leave open when not in use.
10	SW	Active-HIGH short wave band select output. SW1 when LOW and SW2 when HIGH. LOW level after reset. Leave open when not in use.
11	AMUTE	Active-HIGH audio mute control output. Cuts the audio output when changing receiver frequency. HIGH level after reset. Leave open when not in use.
12	$\overline{FM}$	Active-HIGH AM/FM select output. FM when LOW and AM when HIGH. LOW level after reset. Leave open when not in use.
13	TIMER OUT	Active-HIGH timer control output. HIGH during timer and sleep mode operation. LOW level after reset. Leave open when not in use.
14 to 17	T8 to T5	Active-HIGH diode matrix scan outputs.The matrix is scanned when a LOW-to-HIGH transition occurs on $\overline{HOLD}$. Device is initialized if data has changed. LOW level after reset. Leave open when not in use.
18 to 22	T4 to T0	Active-HIGH key matrix scan outputs.The key matrix is scanned only when the corresponding key is pressed. Goes HIGH after each scan. HIGH level after reset. Leave open when not in use.
23 to 26	K3 to K0	Active-HIGH key scan inputs. Connect to V_{SS} when not is use.
27 to 49	S23 to S1	Segment driver outputs. Leave open when not in use.
50, 51	COM2, COM1	Common driver outputs. Leave open when not in use.
52	$\overline{HOLD}$	Active-LOW hold mode control input. When a HIGH-to-LOW transition occurs and the clock is operating, hold mode is selected (I_{DD} = 0.7mA typ.). When a HIGH-to-LOW transition occurs and the clock is not operating, backup mode is selected (I_{DD} = 5μA max.).
53	TEST	Active-HIGH test input. See the Test key description for further information.
54	IFIN	AM/FM IF signal input. Connect to V_{SS} when not in use.
55	$\overline{TIMER\ CONT}$	Active-LOW timer control input. Timer operating when LOW and not operating when HIGH. Connect to V_{DD} when not in use.
56	V_{DD}	5V supply
57	FMOSC	FM local oscillator input. Connect to V_{SS} when not in use.
58	AMOSC	AM local oscillator input. Connect to V_{SS} when not in use.
59	V_{SS}	Ground
60	EO	Phase comparator output.
61	AIN	Lowpass filter amplifier input connection. Connect to V_{SS} when not in use.
62	AOUT	Lowpass filter amplifier output connection. Connect to V_{SS} when not in use.
63	TEST1	Test input. Normally connected to GND.
64	XOUT	4.5MHz crystal oscillator output connection.

Specifications

Absolute Maximum Ratings at Ta = 25°C, V_{SS} = 0V

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}		−0.3 to +6.5	V
Input voltage	V_{IN1}	$\overline{HOLD}$, TEST, $\overline{SD}$, $\overline{STEREO}$, $\overline{TIMER\ CONT}$, BAND0, BAND1	−0.3 to +13	V
	V_{IN2}	All other inputs	−0.3 to V_{DD}+0.3	
Output voltage	V_{OUT1}	MO/ST, FM/AM, AOUT	−0.3 to +15	V
	V_{OUT2}	All other outputs	−0.3 to V_{DD}+0.3	
Output current	I_{OUT1}	MO/ST, FM/AM	0 to 5	mA
	I_{OUT2}	M/S(L), SW, AMUTE, $\overline{FM}$, TIMER OUT, T6 to T8	0 to 3	
	I_{OUT3}	T0 to T5	0 to 1	
	I_{OUT4}	AOUT	0 to 2	
Allowable power dissipation	Pd max	Ta=−40 to +85°C	400	mW
Operating temperature	Topr		−40 to +85	°C
Storage temperature	Tstg		−45 to +125	°C

Reommended Operating Conditions at Ta = –40 to +85˚C, V_{DD} = 3.5 to 5.5V

Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
Supply voltage	V_{DD1}	CPU, PLL operating	4.5		5.5	V
	V_{DD2}	CPU operating	3.5		5.5	
	V_{DD3}	Data retention	1.3		5.5	
Input high-level voltage	V_{IH1}	$\overline{SD}$, $\overline{STEREO}$, BAND0, BAND1, $\overline{TIMER\ CONT}$	$0.7V_{DD}$		8.0	V
	V_{IH2}	K0 to K3, TEST	$0.6V_{DD}$		V_{DD}	
	V_{IH3}	$\overline{HOLD}$	$0.8V_{DD}$		8.0	
Input low-level voltage	V_{IL1}	$\overline{SD}$, $\overline{STEREO}$, BAND0, BAND1, $\overline{TIMER\ CONT}$	0		$0.3V_{DD}$	V
	V_{IL2}	$\overline{HOLD}$	0		$0.4V_{DD}$	
	V_{IL3}	K0 to K3, TEST	0		$0.2V_{DD}$	
Input frequency	f_{IN1}	XIN	4.0	4.5	5.0	MHz
	f_{IN2}	FMOSC, V_{IN2}, V_{DD1}	10		130	
	f_{IN3}	AMOSC (LW, MW), V_{IN3}, V_{DD1}	0.5		10	
	f_{IN4}	AMOSC (SW), V_{IN4}, V_{DD1}	2.0		40	
	f_{IN5}	IFIN, V_{IN5}, V_{DD1}	0.4		12	
Input amplitude	V_{IN1}	XIN	0.50		1.5	Vrms
	V_{IN2}	FMOSC	0.10		1.5	
	$V_{IN3,4}$	AMOSC	0.10		1.5	
	V_{IN5}	IFIN	0.10		1.5	

Electrical Characteristics Under recommended operating conditions

Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
Power-down detection voltage	V_{DET}		2.7	3.0	3.3	V
Input high-level curret	I_{IH1}	$\overline{HOLD}$, $\overline{SD}$, $\overline{STEREO}$, $\overline{TIMER\ CONT}$, TEST, BAND0, BAND1: V_I=5.5V			3.0	μA
	I_{IH2}	XIN: V_I=V_{DD}=5.0V	2.0	5.0	15	
	I_{IH3}	FMIN, AMIN, IFIN: V_I=V_{DD}=5.0V	4	10	30	
	I_{IH4}	K0 to K3: V_I=V_{DD}=5.0V		50		
	I_{IH5}	AIN: V_I=V_{DD}		0.1	10	nA
Input low-level curret	I_{IL1}	V_I=V_{SS}, $\overline{HOLD}$, $\overline{SD}$, $\overline{STEREO}$, $\overline{TIMER\ CONT}$, TEST, BAND0, BAND1			3.0	μA
	I_{IL2}	V_I=V_{SS}, XIN	2.0	5.0	15	
	I_{IL3}	V_I=V_{SS}, FM OSC, AM OSC, IFIN	4.0	10	30	
	I_{IL4}	AIN: V_I=V_{SS}		0.01	10	nA
Input floating voltage	V_{IF}	K0 to K3			$0.05V_{DD}$	V
Pull-down resistance	R_{PD}	K0 to K3, V_{DD}=5.0V	75	100	200	kΩ
Output OFF leakage current	I_{OFFH1}	EO: V_O=V_{DD}		0.1	10	nA
	I_{OFFH2}	T0 to T8, TIMER OUT, $\overline{FM}$, AMUTE, SW, M/S(L): V_O=V_{DD}			3.0	μA
	I_{OFFH3}	FM/AM, MO/ST: V_O=13V			5.0	
	I_{OFFH4}	AOUT: V_O=13V			1.0	
	I_{OFFL1}	EO: V_O=V_{SS}		0.01	10	nA
	I_{OFFL2}	T0 to T8, TIMER OUT, $\overline{FM}$, AMUTE, SW, M/S(L): V_O=V_{SS}			3.0	μA
Output high-level voltage	V_{OH1}	T0 to T5: I_O=1mA	V_{DD}−2.0	V_{DD}−1.0	V_{DD}−0.5	V
	V_{OH2}	T6 to T8, TIMER OUT, $\overline{FM}$, AMUTE, SW, M/S(L): I_O=1mA	V_{DD}−1.0			
	V_{OH3}	EO: I_O=500μA	V_{DD}−1.0			
	V_{OH4}	XOUT: I_O=200μA	V_{DD}−1.0			
	V_{OH5}	S1 to S23: I_O=− 0.1mA	V_{DD}−1.0			
	V_{OH6}	COM1, COM2: I_O=25μA	V_{DD}−0.75	V_{DD}−0.5	V_{DD}−0.3	
Output low-level voltage	V_{OL1}	T1 to T5: I_O=50μA	0.5	1.0	2.0	V
	V_{OL2}	T6 to T8, TIMER OUT, FM, $\overline{AMUTE}$, SW, M/S(L): I_O=1mA			1.0	
	V_{OL3}	EO: I_O=50μA			1.0	
	V_{OL4}	XOUT: I_O=200μA			1.0	
	V_{OL5}	S1 to S23: I_O=0.1mA			1.0	
	V_{OL6}	AOUT: I_O=5mA, AIN=1.3V			0.5	
	V_{OL7}	COM1, COM2: I_O=25μA	0.3	0.5	0.75	
	V_{OL8}	FM/AM, MO/ST: I_O=5mA	0.75 (150Ω)		2.0 (400Ω)	

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
MID-level output voltage	V_M	COM1, COM2, V_{DD}=5V, I_O=20μA	2.0	2.5	3.0	V
Supply current	I_{DD1}	V_{DD1}, f_{IN2}=130MHz		15	20	mA
	I_{DD2}	V_{DD2}, PLL operating, Hold mode measurement circuit		0.7		
	I_{DD3}	V_{DD}=5.5V, Oscillator operating, Ta=25°C, Backup mode measurement circuit			5	μA
	I_{DD4}	V_{DD}=2.2V, Oscillator stopped, Ta=25°C, Backup mode measurement circuit			1	

Measurement Circuits

Hold mode I_{DD2}
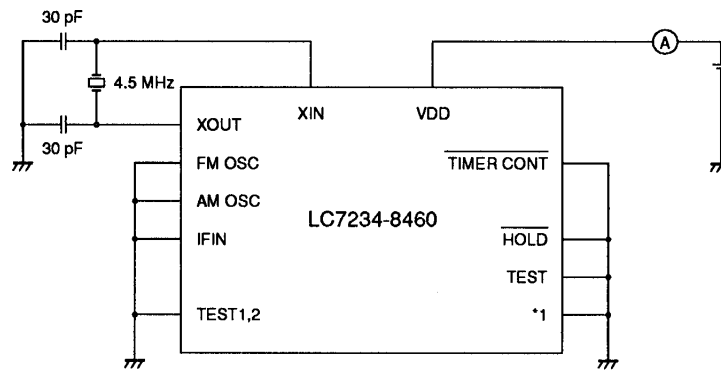
Note
*1 = pins K0 to K3, $\overline{SD}$, $\overline{STEREO}$, BAND0 and BAND1
Pins T0 to T8, TIMER OUT, FM, AMUTE, SW, M/S(L), FM/AM, MO/ST = open

Backup mode I_{DD3}
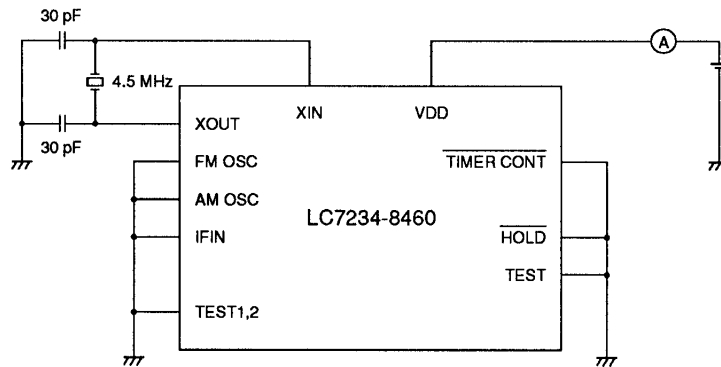
Note
Pins K0 to K4, $\overline{SD}$, $\overline{STEREO}$, BAND0, BAND1, T0 to T8, TIMER OUT, FM, AMUTE, SW, M/S(L), FM/AM, MO/ST, S1 to S23, COM1, COM2 = open

Functional Description

Band Coverage

Region	Band	Frequency range [FM, SW (MHz) AM (kHz)]	Frequency step (kHz)	Comparison frequency (kHz)	Center frequency [FM (MHz) AM (kHz)]	B2	B1	B0
China	FM	87.0 to 108.0	100/50	25	10.7	0	0	0
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
	SW1	2.28 to 6.23	5	5	450			
	SW2	7.1 to 21.85	5	5	450			
United States 1	FM	87.5 to 107.9	200	50	10.7	0	0	1
	MWa	531 to 1602	9	9	450/468			
	MWb	530 to 1710	10	10	450			
United States 2	FM	87.5 to 108.0	100	50	10.7	0	1	0
	MWa	531 to 1602	9	9	450/468			
	MWb	530 to 1710	10	10	450			
Europe	FM	87.5 to 108.0	100/50	25	10.7	1	0	0
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
	LW	146 to 281	1	1	450/468			
Middle East	FM	87.5 to 108.0	100/50	25	10.7	0	1	1
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
	SW1	2.28 to 6.23	5	5	450			
	SW2	7.1 to 21.85	5	5	450			
Common 1	FM	87.5 to 108.0	100/50	25	10.7	1	0	1
	MWa	531 to 1602	9	9	450/468			
	MWb	531 to 1602	9	9	450/468			
	SWA	5.95 to 15.6	5	5	450			
Common 2	FM	87.5 to 108.0	100/50	25	10.7	1	1	0
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
	SWB	3.8 to 12.5	5	5	450			
Canada, Australia	FM	87.5 to 108.0	100/50	25	10.7	1	1	1
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
World	FM	87.5 to 108.0	100/50	25	10.7	WORLD = 1		
	MWa	531 to 1602	9	9	450/468			
	MWb	522 to 1611	9	9	450/468			
	LW	146 to 281	1	1	450/468			
	SWB	3.8 to 12.5	5	5	450			

Band Selection

When SELBND is 0, BAND0 and BAND1 select the frequency band as shown in the following table. When SELBND is 1, the BAND, FM, MW, LW and SW keys select the frequency band.

BAND1	BAND0	U.S.A., Canada, Australia	Europe	Middle East, China	Common 1	Common 2	World
0	0	FM	FM	FM	FM	FM	FM
0	1	(FM)	LW	SW1	(FM)	(FM)	LW
1	0	AM	MW	MW	MW	MW	MW
1	1	(FM)	(FM)	SW2	SWA	SWB	SWB

The frequency band selection determines the logic levels of FM/AM, M/S(L), SW and $\overline{FM}$ as shown in the following table.

BAND	Pin name			
	FM/AM	M/S(L)	SW	$\overline{FM}$
FM	HIGH	LOW	LOW	LOW
MW	LOW	HIGH	LOW	HIGH
SW1(LW)	LOW	LOW	LOW	HIGH
SW2	LOW	LOW	HIGH	HIGH

Preset Memory Channels

Preset memory values		Number of frequency bands			
PSCH2	PSCH1	FM	MW	SW1/LW	SW2
0	0	8	8	8	8
0	1	5	5	5	5
1	0	16	8	8	8
1	1	Illegal			

SW band search ranges

BAND	Frequency range (MHz)
SW1	2.28 to 2.495
	3.2 to 3.4
	3.8 to 4.0
	4.75 to 5.06
	5.95 to 6.23
SW2	7.1 to 7.3
	9.5 to 9.9
	11.65 to 12.5
	13.6 to 13.8
	15.1 to 15.6
	17.55 to 17.9
	21.45 to 21.85
SWA	5.95 to 6.23
	7.1 to 7.3
	9.5 to 9.9
	11.65 to 12.5
	13.6 to 13.8
	15.1 to 15.6
SWB	3.8 to 4.0
	4.75 to 5.06
	5.95 to 6.23
	7.1 to 7.3
	9.5 to 9.9
	11.65 to 12.5

Key/diode Matrix
Diode matrix functions

Diode matrix name	ON/OFF	Function
CLOCK	0	Without clock functions
	1	With clock functions
12/24H	0	12-hour clock
	1	24-hour clock
COLON	0	Flashing. ON for 500 ms, OFF for 500 ms
	1	ON
IFCNT	0	No
	1	Yes
SELIF	0	450 kHz
	1	468 kHz
SELFM	0	100 kHz
	1	50 kHz
SELMW	0	MWa frequency range select
	1	MWb frequency range select
SELTMR	0	Without timer
	1	With timer
SELBAND	0	Logic-level input band select
	1	Momentary switch band select
WORLD	0	Band select using B0, B1 and B2
	1	Selects WORLD band

Function positions

Output	Input			
	K0	K1	K2	K3
T0	CH1/TIMER ON	CH2/TIMER OFF	CH3	CH4
T1	CH5	CH6	CH7	CH8
T2	UP	DOWN	PS	ME
T3	BAND	MO/ST	SLEEP	DISPLAY
T4	FM	MW	LW (SW1)	SW, (SW2) (SWA), (SWB)
T5	B0 ▲	B1 ▲	B2 ▲	
T6	CLOCK ▲	12/24H ▲	COLON ▲	IFCNT ▲
T7	SELIF ▲	SELFM ▲	SELMW ▲	SELTMR ▲
T8	SELBND ▲	PSCH1 ▲	PSCH2 ▲	WORLD ▲

Notes

1. A ▲ indicates that the diode matrix element has either of the following configuations.
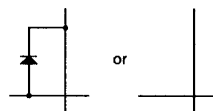
2. No ▲ indicates that the diode matrix element has a momentary switch configuation.

LCD Display Driver

China and the Middel East

The configuation of the LCD panel used in China and the Middle East only is shown in the following figure, and the pin-to-segment relationship, in the following table.

Segment output	Common driver output		Segment output	Common driver output	
	COM1	COM2		COM1	COM2
S1	1	MW· kHz	S13	4f	4a
S2	SW· dp1· MHz	FM· dp2· MHz	S14	4b	4g
S3	1a	2	S15	4e	4c
S4	1c	1b	S16	4d	TIMER
S5	2f	2a	S17	ON	OFF
S6	2b	2g	S18	5	AM
S7	2e	2c	S19	7f	7a
S8	2d	STEREO	S20	7b	7g
S9	3f	3a	S21	7e	7c
S10	3b	3g	S22	7d	SLEEP
S11	3e	3c	S23	6b, c	PM
S12	3d	COLON			

All other regions

The configuration of the LCD panel used in all regions other than China and the Middle East is shown in the following figure, and the pin-to-segment relationship, in the following table.

Segment output	Common driver output		Segment output	Common driver output	
	COM1	COM2		COM1	COM2
S1	kHz	MW	S13	4f	4a
S2	SW1· dp1· MHz	FM· dp2· MHz	S14	4b	4g
S3	1a	LW	S15	4e	4c
S4	1c	1b	S16	4d	TIMER
S5	2f	2a	S17	ON	OFF
S6	2b	2g	S18	5	AM
S7	2e	2c	S19	7f	7a
S8	2d	STEREO	S20	7b	7g
S9	3f	3a	S21	7e	7c
S10	3b	3g	S22	7d	SLEEP
S11	3e	3c	S23	6b, c	PM
S12	3d	COLON			

Hold Mode

When the clock is enabled and $\overline{\text{HOLD}}$ makes a HIGH-to-LOW transition, the FMOSC, AMOSC, IFIN and TEST inputs are disabled and only the clock operates. In this mode, the supply current is reduced to 0.7 mA (typ).

Backup Mode

When the clock is disabled and $\overline{\text{HOLD}}$ makes a HIGH-to-LOW transition, the FMOSC, AMOSC, IFIN and TEST inputs are disabled and the 4.5MHz crystal oscillator is halted. In this mode, the supply current is reduced to 5 μA (max).

As AMUTE becomes high impedance in backup mode, a pull-down resistor should be connected between AMUTE and ground.

Key Functions
Frequency display
PSCH2 and PSCH1 = LOW

Write mode

When **ME** is pressed, the flashing preset number 'P' appears and the system enters write mode for 5 seconds. If one of the preset memory keys **CH1** to **CH8** is pressed within 5 seconds, the presently selected frequency and status are written to the corresponding channel. If **ME** is pressed while 'P' is displayed, write mode is extended.

When the same preset memory key is pressed twice, AMUTE goes HIGH.

If any other key is pressed or if HOLD makes a HIGH-to-LOW transition, write mode is canceled.

Read mode

When one of the preset memory keys **CH1** to **CH8** is pressed, the corresponding frequency and status are displayed.

PSCH2 = LOW and PSCH1 = HIGH

Write mode

When **ME** is pressed, the flashing preset number 'P' appears and the system enters write mode for 5 seconds. If one of the preset memory keys **CH1** to **CH5** is pressed within 5 seconds, the presently selected frequency and status are written to the corresponding channel.

If **ME** is pressed while 'P' is displayed, write mode is extended. When the same preset memory key is pressed twice, AMUTE goes HIGH.

If any other key is pressed or if $\overline{\text{HOLD}}$ makes a HIGH-to-LOW transition, write mode is canceled.

Read mode

When one of the preset memory keys **CH1** to **CH5** is pressed, the corresponding frequency and status are displayed.

PSCH2 = HIGH and PSCH1 = LOW

Write mode

When **ME** is pressed, a flashing 'P1' appears in the frequency display area and the system enters write mode for 5 seconds.

If one of the preset memory keys **CH1** to **CH8** is pressed within 5 seconds, the frequency and status are written to the corresponding channel of channels 1 to 8.

When the FM band is selected, pressing **ME** while 'P1' is flashing changes the display to a flashing 'P2'. If one of the preset memory keys **CH1** to **CH8** is then pressed within 5 seconds, the frequency and status are written to the corresponding channel of channels 9 to 16.

If **ME** is pressed while 'P2' is flashing, write mode is canceled.

When the AM band is selected, pressing **ME** while 'P1' is flashing cancels the write mode.

Read mode

When the FM band is selected and one of the preset memory keys **CH1** to **CH8** is pressed once, the frequency and status are read from the corresponding channel of channels 1 to 8.

If one of the preset memory keys is pressed twice, the frequency and status are read from the corresponding channel of channels 9 to 16.

When the AM band is selected and one of the preset memory keys **CH1** to **CH8** is pressed, the corresponding frequency is read out.

UP and DOWN

When HOLD is HIGH, each time UP or DOWN is pressed, the frequency will go up or down by one step, respectively. If you hold down one of these keys for more than 500 ms, autosearch mode will start, and the next broadcasting station in the corresponding direction will be searched for. The search speed is 60 ms/step for the FM band and 70 ms/step for the AM band.

Autosearch pauses for 500 ms when either key is pressed, regardless of whether a station has been detected, and then resumes. Autosearch searches from one edge of the band to the other, pauses for 500 ms and then resumes searching.

BAND

When HOLD is HIGH, BAND is used to select the frequency band. Each time BAND is pressed, the frequency band will change as shown in figures 1 and 2. The band select keys are shown in figure 3.
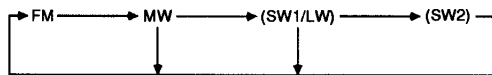
Figure 1. Band selection (WORLD = 0)

Figure 2. Band selection (WORLD = 1)

Figure 3. Band select keys

PS

When PS is pressed, the channel number changes to the next highest channel number than the one currently selected. If no channel number is currently selected, then channel number 1 is selected. In this case, AMUTE will go LOW for 5 s if a signal is received.

During PS mode, the channel number flashes at 1 Hz (500 ms ON and 500 ms OFF).

PS mode is canceled if any of PS, UP, DOWN, CH1 to CH8, or BAND are pressed, or if HOLD makes a HIGH-to-LOW transition.

MO/ST

MO/ST is used when receiving in the FM band. When MO/ST is pressed, the MO/ST port output will toggle between mono and stereo.

Clock display

When the clock or timer setting is displayed, CH3 to CH8 function in the same way as when the frequency is displayed.

When ME is pressed, the hour and minute digits and the separating colon start flashing and the system enters set mode. In this mode, use UP to alter the minute and DOWN to after the hour. The segments continue flashing between UP and DOWN key operations.

UP

Each time UP is pressed, the minute setting increases by 1. If UP is held down for more than 500 ms, the minute setting increases at a rate of 8 min/s.

When adjusting the minute setting, the second setting is reset to 0 s. The second setting cannot be adjusted independently from the minute setting.

DOWN

Each time DOWN is pressed, the hour setting increases by 1. If DOWN is held down for more than 500 ms, the hour setting increases at a rate of 4 hr/s.
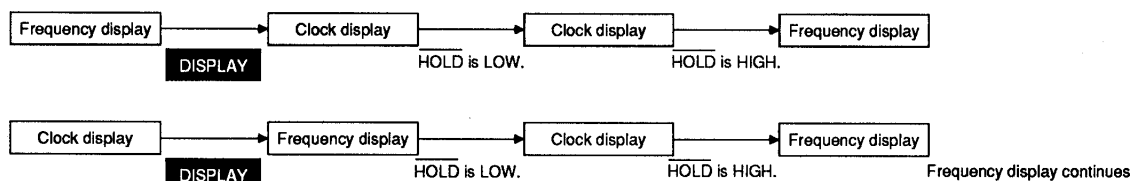
The second setting is not changed when adjusting the hour setting.

Canceling set mode

If no key is pressed for 5 s or ME is pressed twice, set mode is canceled automatically.

If any other key is pressed, set mode is canceled and the key operation is executed.

Timer display

When CH1/TIMER ON is pressed, the ON time is selected, 'TIMER' and 'ON' are displayed, the hour and minute digits and the separating colon start flashing (500 ms ON and 500 ms OFF), and the system enters set mode. In this mode, use UP to alter the minute and DOWN to alter the hour.

When CH2/TIMER OFF is pressed, the OFF time is selected, 'TIMER' and 'OFF' are displayed, the hour and minute digits and the separating colon start flashing (500 ms ON and 500 ms OFF), and the system enters set mode. In this mode, use UP to alter the minute and DOWN to alter the hour.
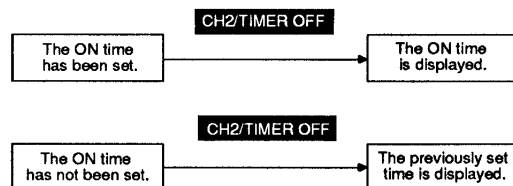
Figure 4. Timer setting

The timer setting mode is canceled by pressing the same key twice or by pressing a mode cancel input key. If no key is pressed, the timer setting mode is canceled automatically after five seconds.

UP

Each time UP is pressed, the minute setting increases by 1. If UP is held down for more than 500 ms, the minute setting increases at a rate of 8 min/s.

DOWN

Each time **DOWN** is pressed, the hour setting increases by 1. If **DOWN** is held down for more than 500 ms, the hour setting increases at a rate of 4 hr/s.

UP or DOWN

When you press either key, the hour and minute digits and the separating colon stop flashing and remain ON.

Other keys
DISPLAY

When $\overline{\text{HOLD}}$ is HIGH and the clock is enabled (DIMRX CLOCK =1), use **DISPLAY** to change what is displayed. Each time **DISPLAY** is pressed, the display toggles between the frequency display and clock displays as shown in the following figure.

Frequency display	→	Clock display	→	Clock display	→	Frequency display
DISPLAY		HOLD is LOW.		HOLD is HIGH.		

Clock display	→	Frequency display	→	Clock display	→	Frequency display
DISPLAY		HOLD is LOW.		HOLD is HIGH.		Frequency display continues

SLEEP

SLEEP is used to set the sleep time. If **SLEEP** is pressed while 'SLEEP' is not displayed, 'SLEEP' and '90' appear on the display. Each time **SLEEP** is pressed while the sleep time is displayed, the sleep time decreases by 10 minutes. Five seconds after setting the sleep time, the previous display is restored. If the sleep time is set to 0, the 'SLEEP' display disappears and the sleep mode setting is canceled.

If the sleep time has already been set, **SLEEP** can be pressed to check the remaining sleep time even while the frequency or clock is displayed. After 5 s, the previous display is restored.

When in sleep mode, TIMER OUT is HIGH.

TEST

When **TEST** is pressed and $\overline{\text{HOLD}}$ makes a LOW-to-HIGH transition, all segments of the LCD turn ON. If **TEST** is pressed again, the clock display turns ON, assuming there is a clock, and starts counting at a rate of 1 min/s. If there is no clock, pressing **TEST** a second time cancels the test.

Tracking Point Frequency

Region	Band	Channel					
		CH1	CH2	CH3	CH4	CH5 to CH8	Last channel
China	FM	87.0	90.1	98.1	106.1	87.0	87.0
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	SW1	2.28	2.495	4.0	6.0	2.28	2.28
	SW2	7.1	9.5	15.1	21.45	7.1	7.1
United States 1	FM	87.5	90.1	98.1	106.1	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	530	600	1000	1400	530	530
United States 2	FM	87.5	90.1	98.1	106.1	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	530	600	1000	1400	530	530
Europe	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	LW	146	164	209	263	146	146
Middle East	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	SW1	2.28	2.495	4.0	6.0	2.28	2.28
	SW2	7.1	9.5	15.1	21.45	7.1	7.1

Continued from preceding page.

Region	Band	Channel					
		CH1	CH2	CH3	CH4	CH5 to CH8	Last channel
Common 1	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	SWA	5.95	6.2	9.9	13.8	5.95	5.95
Common 2	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	SWB	3.8	5.00	7.1	11.65	3.8	3.8
Canada, Australia	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
World	FM	87.5	90.0	98.0	106.0	87.5	87.5
	MWa	531	603	999	1404	531	531
	MWb	522	603	999	1404	522	522
	LW	146	164	209	263	146	146
	SWB	3.8	5.00	7.1	11.65	3.8	3.8

Power-up Status

If momentary switches are connected to the band select inputs, the lower edge of the FM band is selected on power-up. If rocker switches are connected, the band is determined by the input states of BAND1 and BAND0.

On power-up, the MO/ST status is set to mono, the display indicates the tuning frequency, the clock is set to 12:00 and the timer is set to 10:00.

Timing Diagrams

Automatic Up/down Scanning
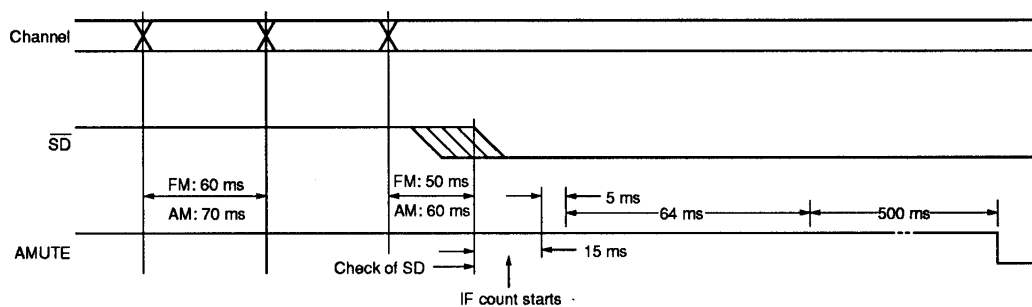
Table 1. IF count tolerance

FM	10.7 MHz ±10 kHz
MW	450/468 ±3 kHz
SW	450 ±1.5 kHz
LW	450/468 ±0.6 kHz

Notes
1. When using an IF count, $\overline{SD}$ is checked twice at 5 ms intervals. If both checks are successful, $\overline{SD}$ is recognized.
2. When not using an IF count, $\overline{SD}$ is checked three times at 5 ms intervals. If all three checks are successful, $\overline{SD}$ is recognized.

Scanning with UP and DOWN
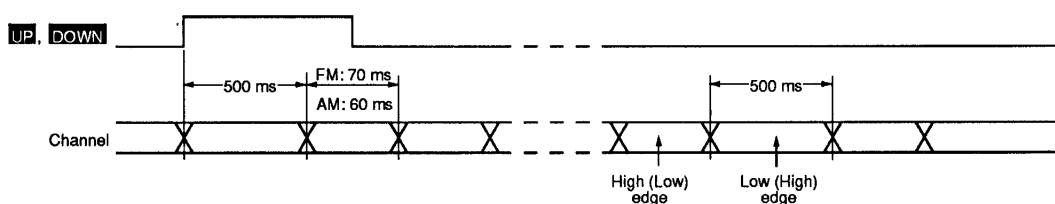
Timer Functions
Timer example 1
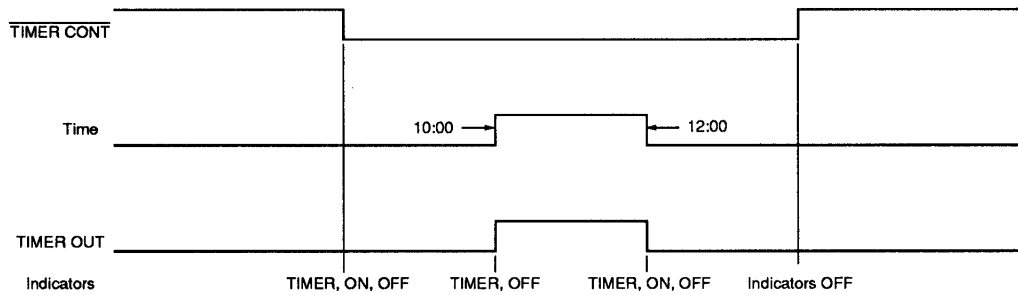
Notes
1. Timer ON time is 10:00.
2. Timer OFF time is 12:00.

Timer example 2
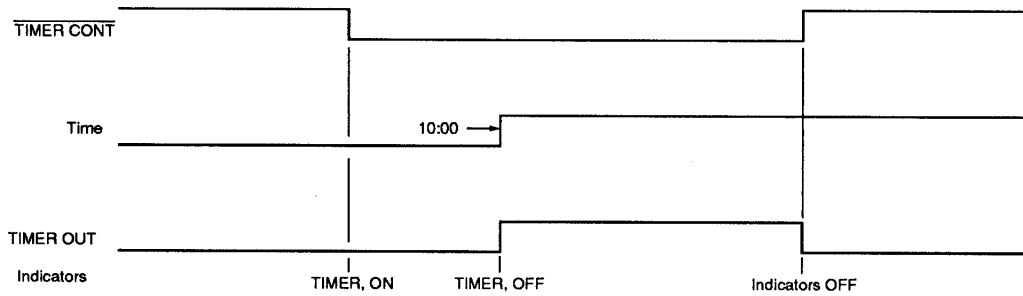
Note
Timer ON and OFF times are both 10:00.

Simultaneous sleep and timer operation
If the following figures, the timer ON time is 10:00 and the timer OFF time is 12:00.
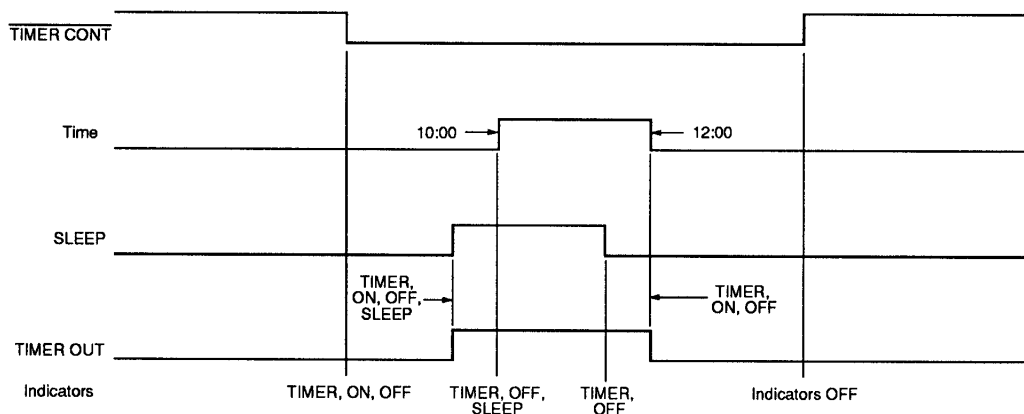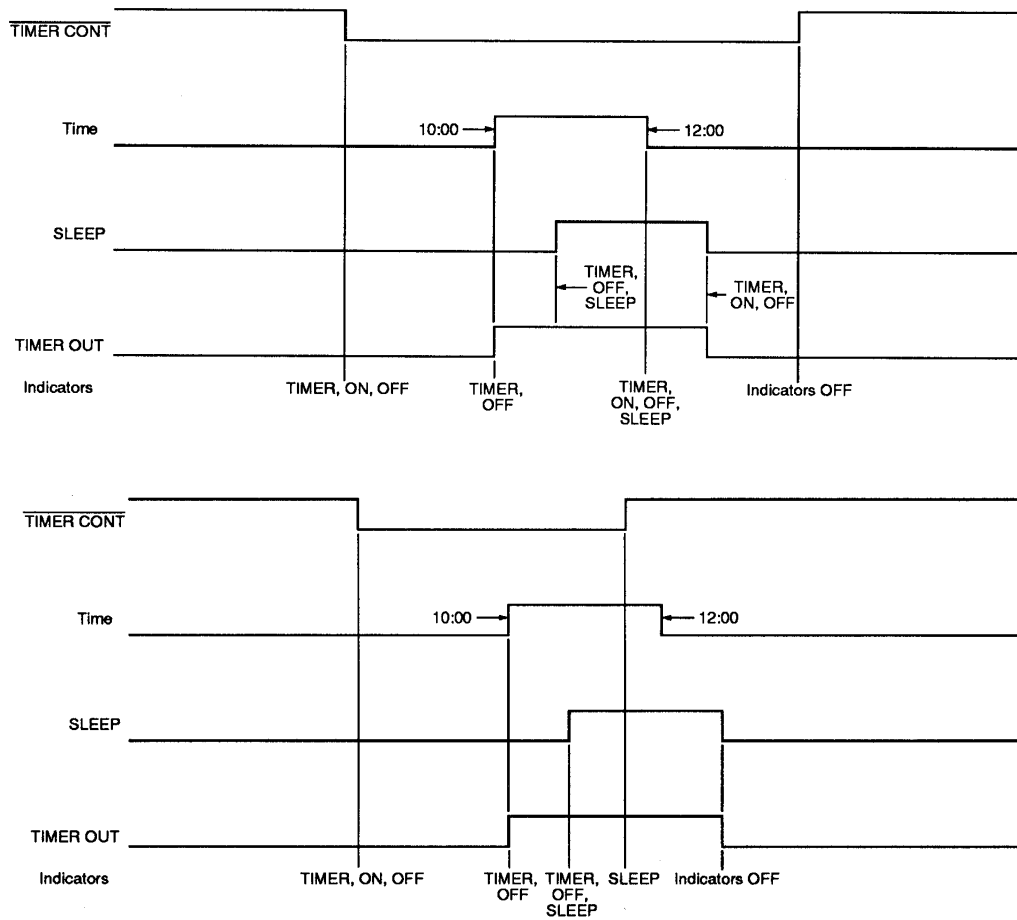
Audio Mute

The timing periods shown in the following diagram represent the following times.

1. Key debounce reject time (40 ms)
2. Audio mute lead time and EDO output delay (50 ms)
3. PLL data and display processing time (30 to 50 ms)
4. Audio mute trailing time

BAND and CH1 to CH8 initiated muting
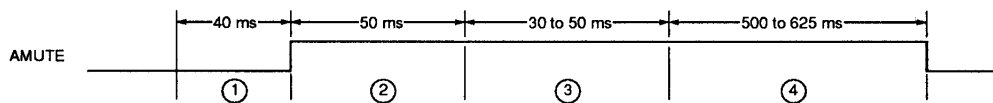
UP and DOWN initiated muting
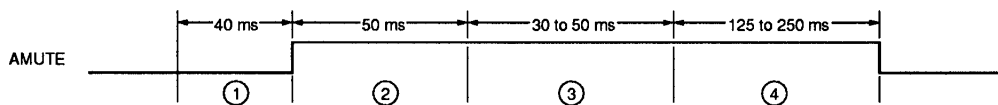
Note

If a band edge is encountered during period 4, the length of period 4 changes to 500 to 625 ms.

PS initiated muting

AMUTE

40 ms ← 50 ms → ← 30 to 50 ms → ← 1 s wait → ← 1 s wait → ← 5 s → ← 1 s wait

① ② ③ ③ ② ③

SD is LOW. SD is HIGH.
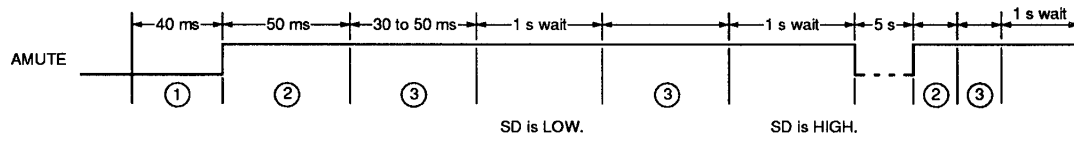
Auto up/down function initiated muting

AMUTE

← 40 ms → ← 50 ms → ← 30 to 50 ms → ← 500 to 625 ms →

① ② ③ ③ ③ ④

SD is LOW. SD is LOW. SD is HIGH.

Hold Mode

LOW-to-HIGH transition of HOLD

ON, HIGH   OFF, LOW

Hold mode

AMUTE

← 500 to 625 ms → ← 500 to 625 ms →

Backup Mode

LOW-to-HIGH transition of HOLD

ON, HIGH   OFF, LOW

30 ms

AMUTE   LOW

← 500 to 625 ms →   10 ms PLL stop   Backup mode (Crystal oscillator stopped)
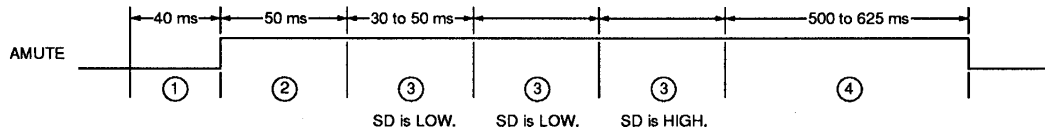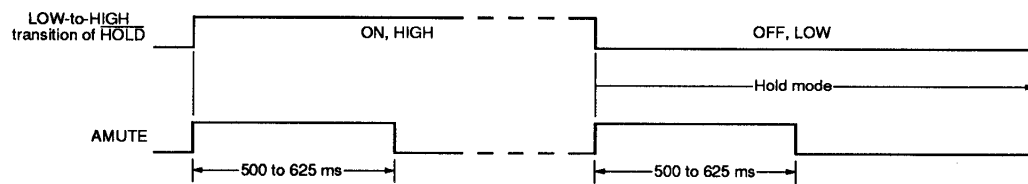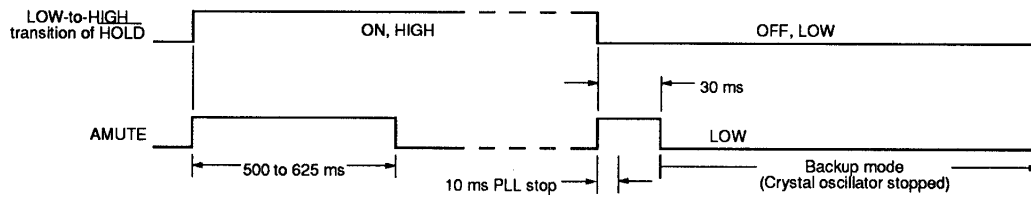
Note

A pull-down resistor should be connected to AMUTE.

Typical Applications

Without Clock (Clock = 0), Momentary Switch Band Select
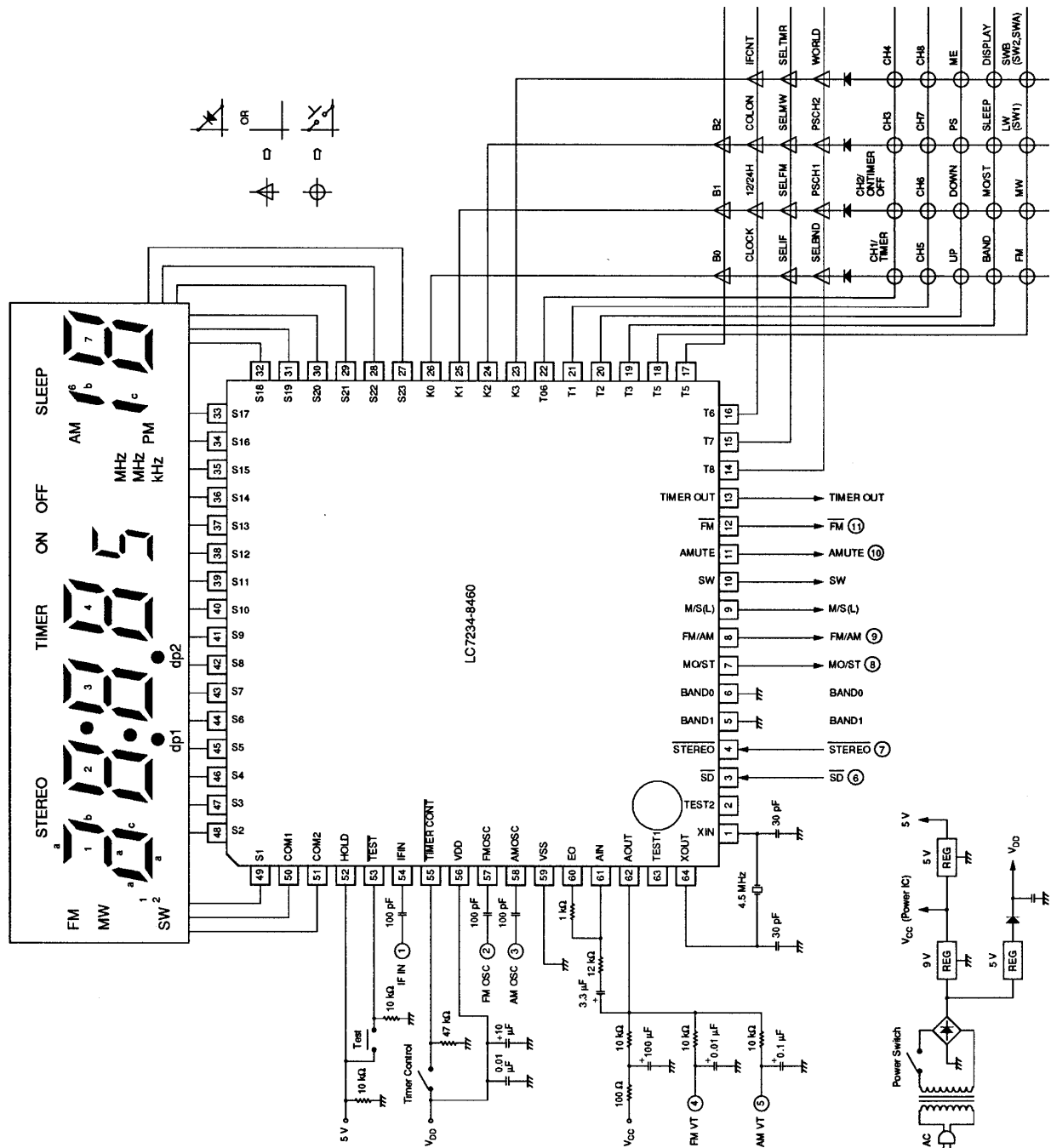
With Clock (Clock = 1), Momentary Switch Band Select
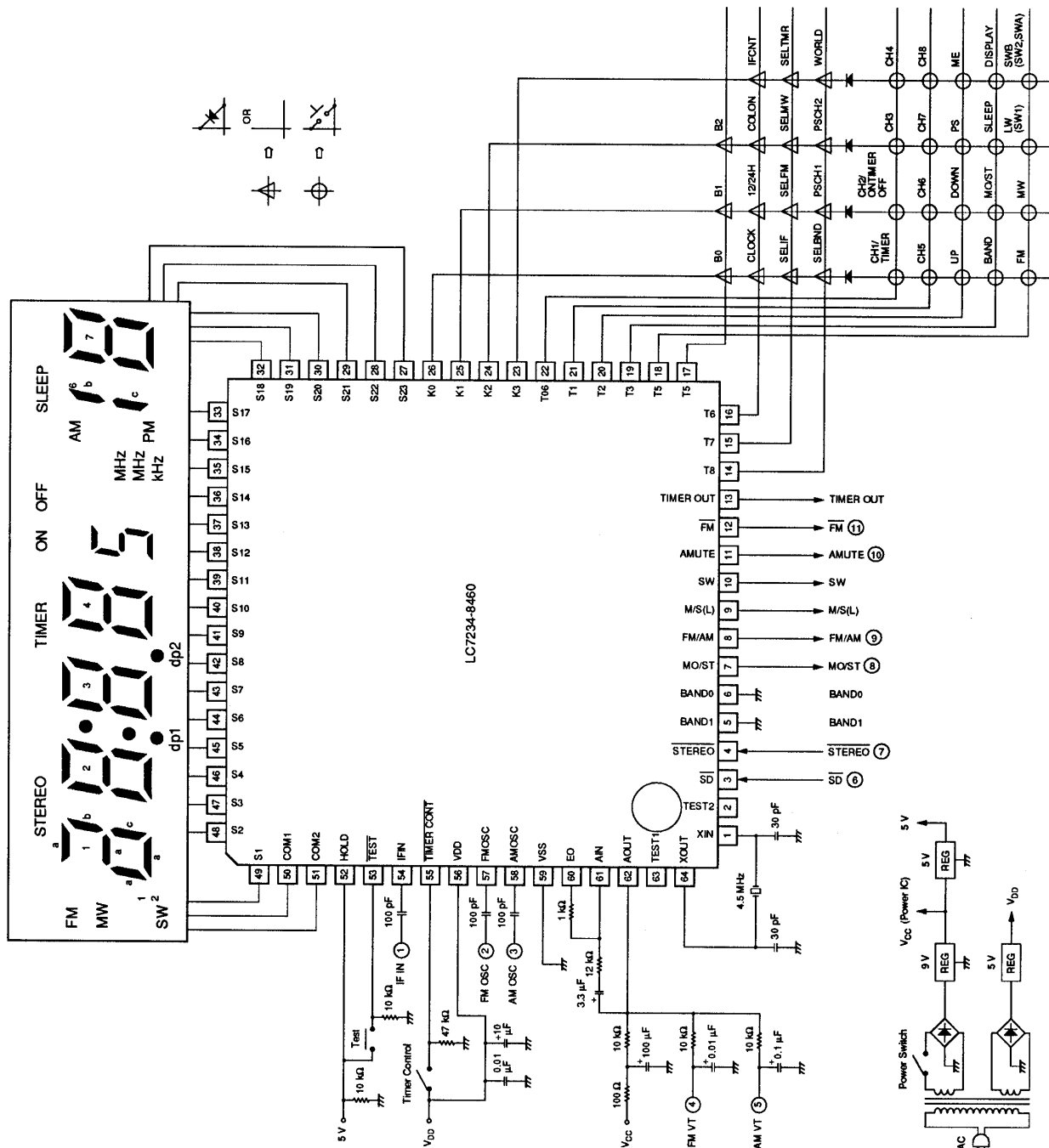
With Clock (Clock = 1), Logic-level Input Band Select
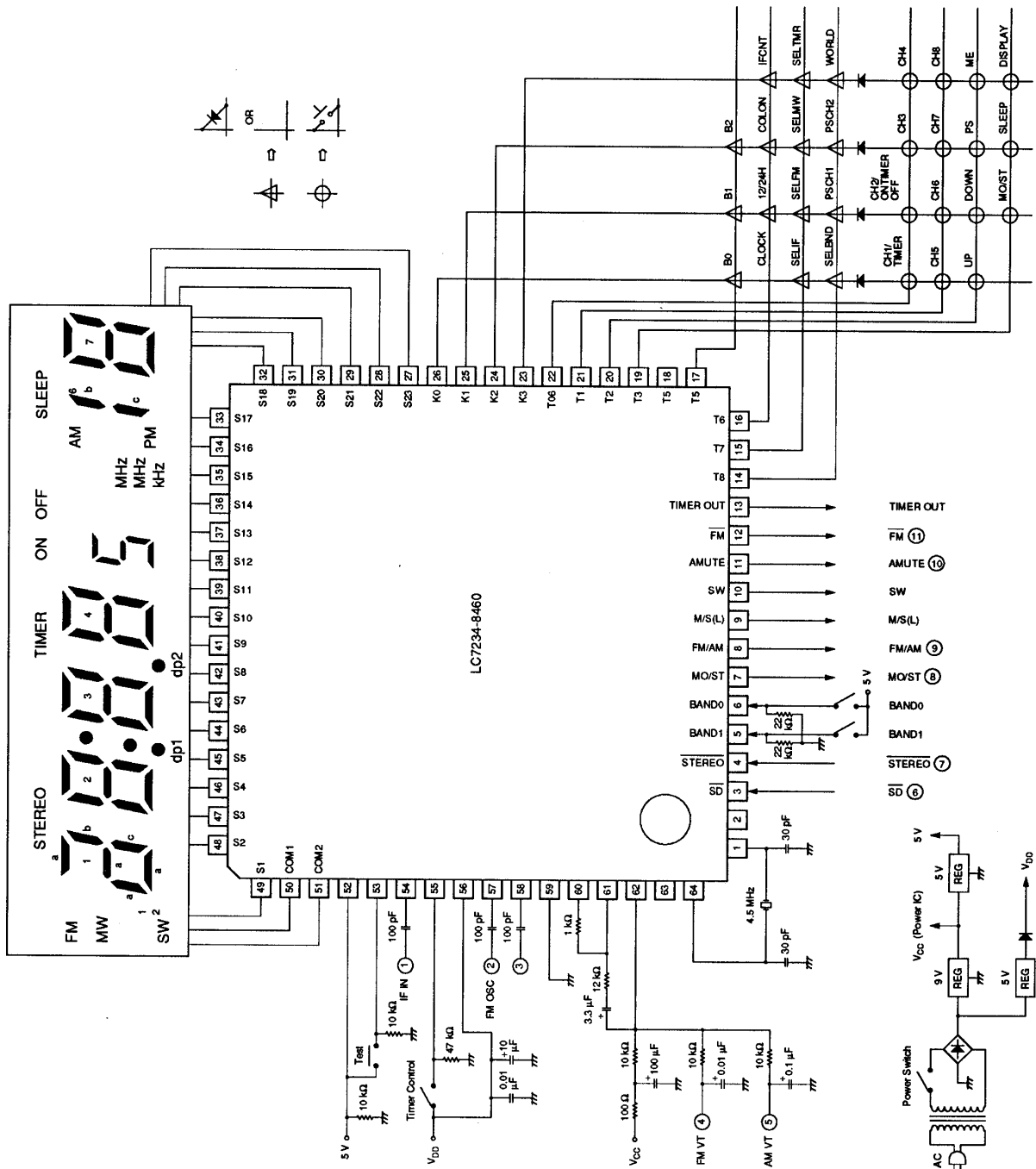
Without Clock (Clock = 0), Momentary Switch Band Select
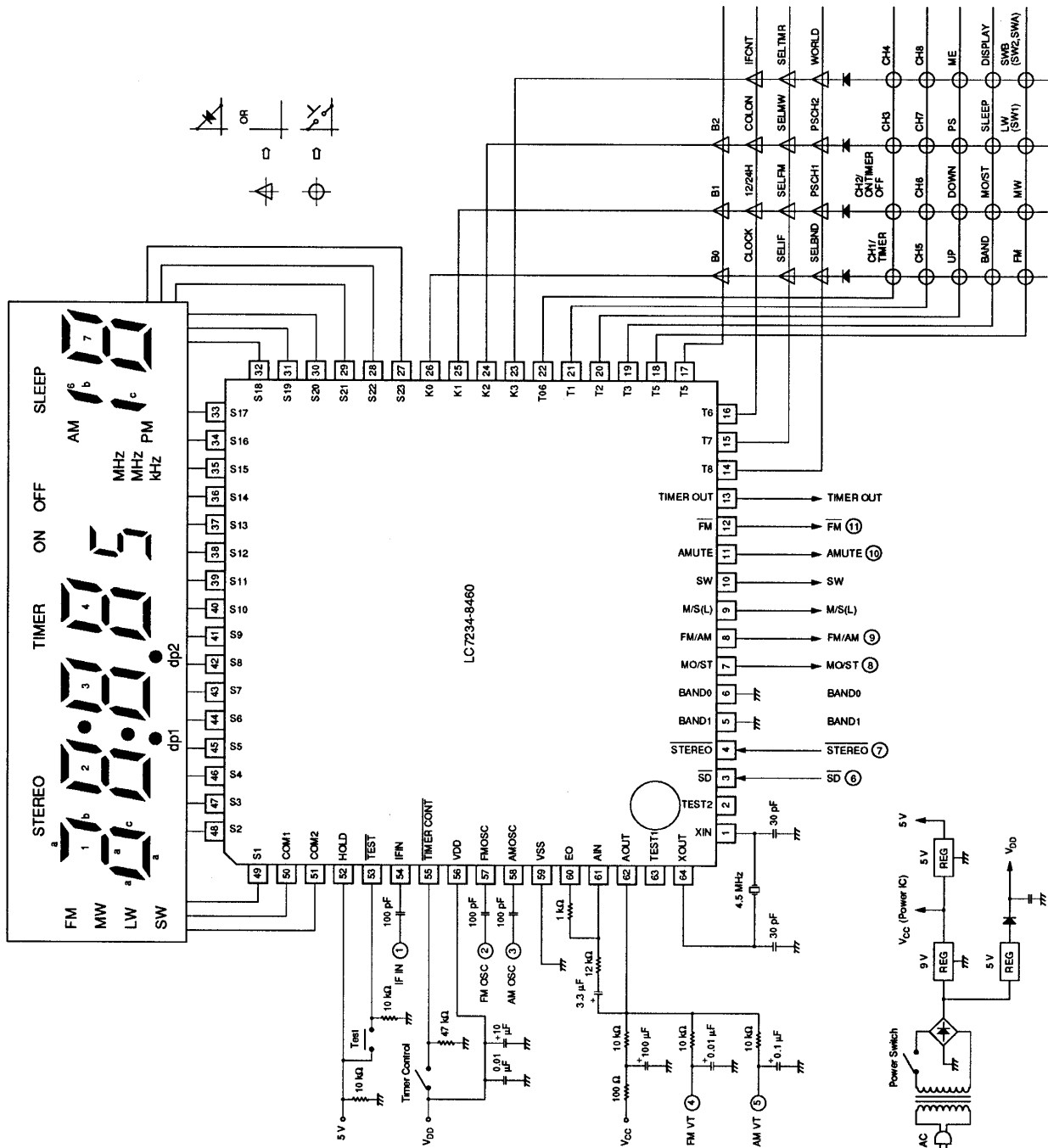
With Clock (Clock = 1), Momentary Switch Band Select
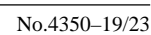
With Clock (Clock = 1), Logic-level Input Band Select
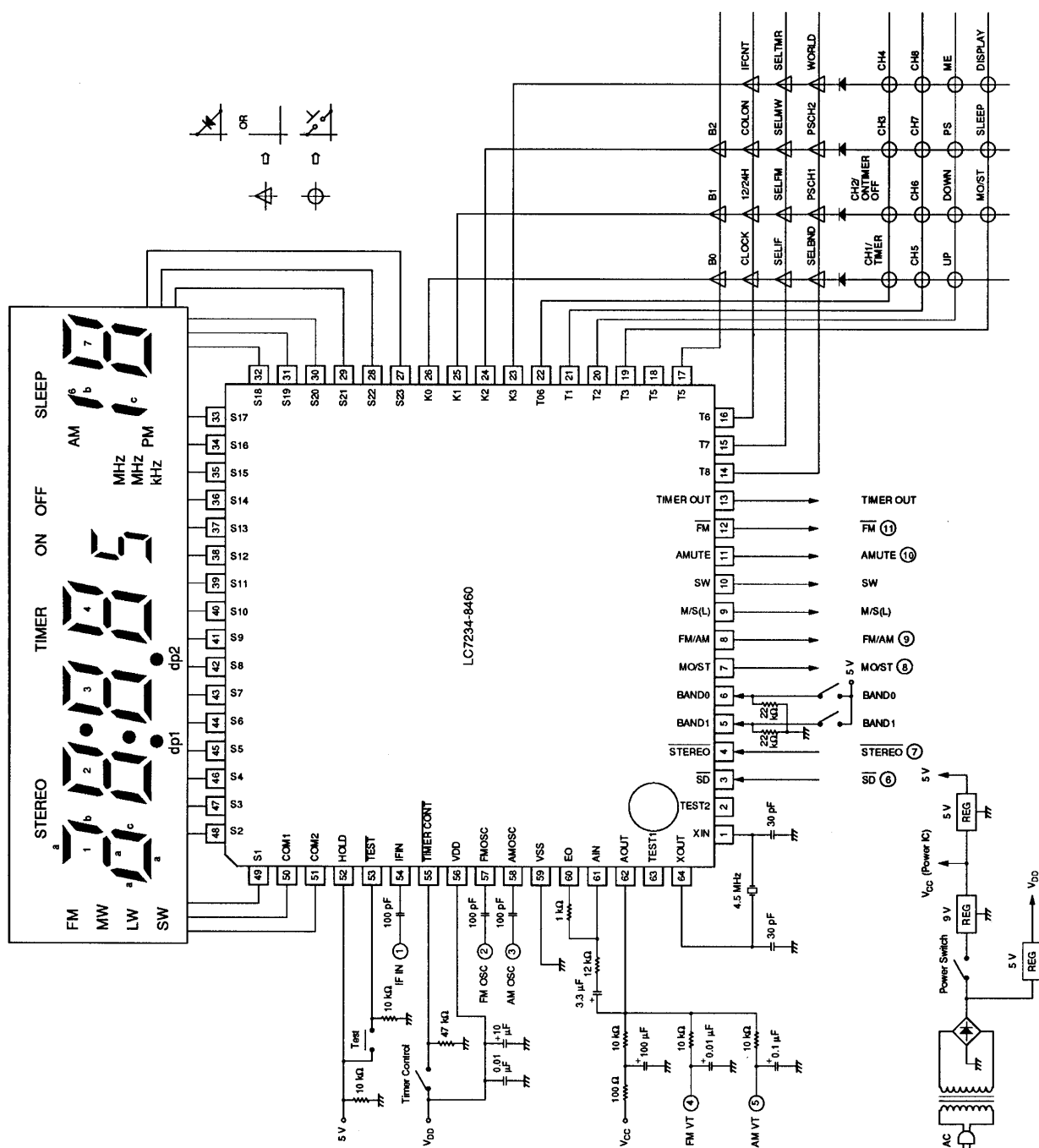
2-band AM/FM Electronic Tuning Radio
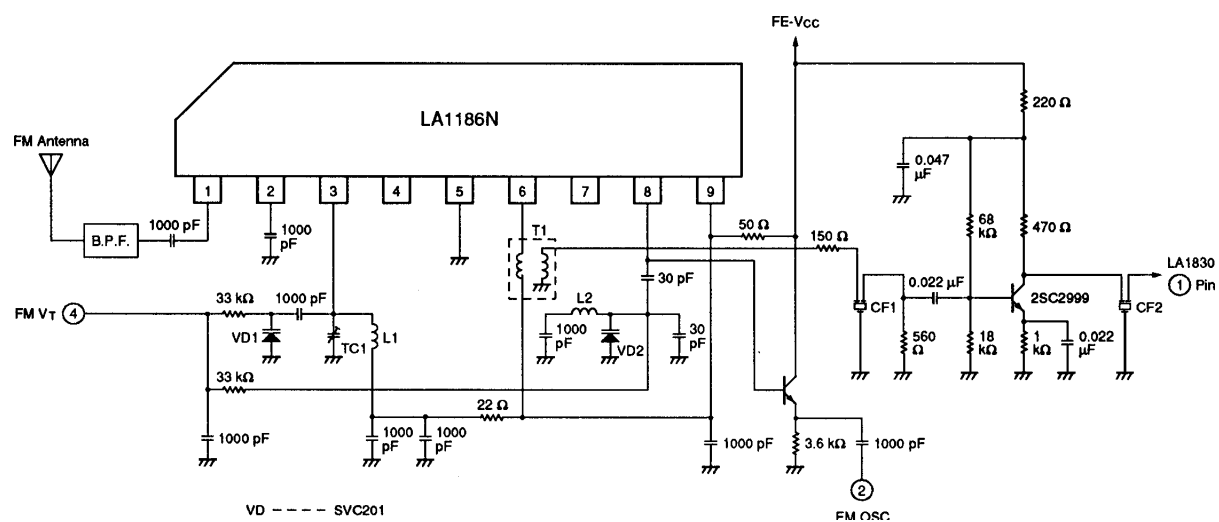
Peripheral Components Interface

This catalog provides information as of October, 2001. Specifications and information herein are subject to change without notice.