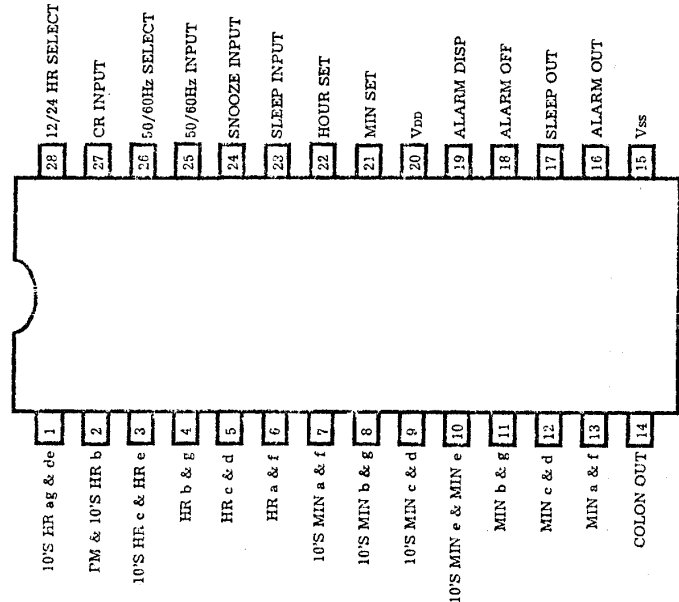# IL8560
CLOCK CIRCUIT

FEATURES

- LED direct drive by time-sharing (duplex)
- Wide operating voltage range
- Alarm on a 24-hour basis
- Time format: 12-hour AM/PM and 24-hour
- On-chip RC-oscillator for battery backup
- 50Hz or 60Hz is usable as the reference frequency
- Possible to automatically advance "hours", "minutes"
- Sleep timer (max. 59 minutes or 1 hour 59 minutes)
- Repeatedly usable snooze
- Power failure indicator
- 900Hz output for alarm tone
- Bare chip or SOP-28 are available
- Pin-to-Pin replacement with Sanyo LM8560

FUNCTIONS

- Real time display
- Alarm with snooze
- Sleep timer (max. 59 minutes or 1 hour 59 minutes)

PIN CONNECTION

Top pins (left to right):

Pin	Name
28	12/24 HR SELECT
27	CR INPUT
26	50/60Hz SELECT
25	50/60Hz INPUT
24	SNOOZE INPUT
23	SLEEP INPUT
22	HOUR SET
21	MIN SET
20	V_{DD}
19	ALARM DISP
18	ALARM OFF
17	SLEEP OUT
16	ALARM OUT
15	Vss

Bottom pins (left to right):

Pin	Name
1	10'S HR ag & de
2	PM & 10'S HR b
3	10'S HR c & HR e
4	HR b & g
5	HR c & d
6	HR a & f
7	10'S MIN a & f
8	10'S MIN b & g
9	10'S MIN c & d
10	10'S MIN e & MIN e
11	MIN b & g
12	MIN c & d
13	MIN a & f
14	COLON OUT

OPERATION DESCRIPTION

50Hz/60Hz Input: The on-chip Schmitt trigger circuit allows a simple RC filter at the input to remove possible line voltage transients. An internal pull-up resister is provided.

CR Input: Then AC power-down occurs, the time counter enters the "hold" mode and the on-chip clock oscillator starts operating immediately. If there is no input at "50/60 Hz input" during 3-clock period, this oscillator controls the time counter advance instead of "50/60Hz input". The values of CR determine the frequency of the on-chip clock oscillator. All segment outputs are off during backup oscillator operation.

NOTE: If the backup OSC is used at the power-down mode, "50/60Hz input" must be open or at Vss level.

50/60 select input: Connecting "50/60Hz select" to Vss enables 50Hz operation. For 60Hz operation, "50/60Hz select" is left unconnected: Pull-down to V_{DD} is provided by the internal pulldown resister.

Display mode select input (alarm display/sleep display); The internal pull-down resistor allows the use of 2 SPST (single-pole single-throw) switches to select 4 display modes listed in Table 1.

IL8560

Table 1. Display Mode

Select Input		Display Mode	Digit No.l	Digit No.2	Digit No.3	Digit No.4
Alarm	Sleep					
NC	NC	Time display	10's hour, AM/PM	Hour	10's minute	Minute
Vc,s	NC	Alarm display	10's hour, AM/PM	Hour	10's minute	Minute
NC	Vss	Sleep display	Blanked	Hour	10's minute	Minute
V..s	Vss	Seconds display	Blanked	Minute	10's second	Second

NOTE: If Vss is applied to both input of "alarm display" and "sleep display" simultaneously, the seconds display mode is entered.

Time setting input: Two setting inputs for "hours" and "minutes" are provided. The application of Vgg causes the time setting in Table 2 to occur. An internal pull-down resistor each is provided.

Table 2. Display Mode

Display Mode	Set Input	Functions
Time	HOUR	"Hours" are incremented +1 immediately and advance at a 2Hz rate 1/4 to 3/4 second later.
	MIN	"Minutes" are incremented +1 immediately and advance at a 2Hz rate 1/4 to 3/4 second later. "Seconds" are reset
	BOTH	Both operations shown above are performed.
Seconds (Alarm & Sleep)	HOUR (Note)	"Seconds" are cleared to [00].
	MIN	"Hold" mode.
	BOTH	"Hours" and "Minutes" are reset to (0:00) (24hour basis) or (12:00) (12hour basis).
Alarm	HOUR	"Hours" are incremented +1 immediately and advance at a 2Hz rate 1/4 to 3/4 second later.
	MIN	"Minutes" are incremented +1 immediately and advance at a 2Hz rate 1/4 to 3/4 second later.
	BOTH	"Hours" and "Minutes" are reset to [0:00] (24-hour basis) or [12:00] (12-hour basis).
Sleep	HOUR	The moment. V_{DD} is applied to "sleep display", the sleep counter is set to [0:59].
	MIN	The moment VDD is applied to "sleep display" and "hour set" simultaneously, the sleep counter is set to (1:59). The sleep counter counts down at a 2Hz rate.
	BOTH	The sleep counter counts down at a 2Hz rate.

Once the reset mode or hold mode is entered, another function input is locked until both "hour set" input and "minute set" input are released**.**

Note: When "seconds" display is at 50 to 59, "seconds" are reset to [00] and a carry occurs to "minutes" +1.

• 12/24-hour select input: Leaiving this pin unconnected (V_{DD}) causes the 12-hour basis to be selected; connecting this pin to V_{SS} causes the 24-hour basis to be selected. An internal pull-down resistor is provided.

• Power failure indication: It the power supply voltage drops and is applied again, all the on-segments flash and the power failure indication mode is entered. The power failure indication mode is released by applying V_{SS} to "hour set" or "minutes set"

• Alarm operation and alarm output: When the alarm set time is reached, the alarm signal is delivered. This signal continues to be delivered for 1 hour 59 minutes unless reset by "alarm off" or "snooze input". This signal is provided for the tone-signal of 900Hz with 50% duty of 2Hz gated. A simple LPF can be used to turn this alarm signal into DC signal as required.

• Snooze input: By momentarily connecting this pin to V_{SS} at the alarm on-state, the alarm output is inhibited for 8 to 9 minutes, after which used repeatedly for 1 hour 59 minutes. An

BELMICROSYSTEMS

internal pull-down resistor is provided. By connecting "snooze input" to V_{SS} at the alarm off-state, the sleep timer counter is reset to [0:00]. (The sleep timer is reset with one • touch.)

• Alarm off input: Connecting this input pin to V_{SS} inhibits the alarm output momentarily. An internal pulldown resistor is provided.

• Sleep timer and sleep output: The sleep output can be used to keep the radio turned on for any period of time up to 59 minutes or 1 hour 59 minutes. Table 2 shows how to select the period (59 minutes or 1 hour 59 minutes). This sleep timer uses a down counter. When the counter contents reach [00], the output stops being delivered, turning off the radio. By connecting "snooze input" to V_{SS} at the sleep output on-state, the sleep output is inhibited.

ABSOLUTE MAXIMUM RATINGS (T. = 25°C)

Characteristic	Symbol	Value	Unit
Maximum Supply Voltage	V_{DD}	-15 - + 0.3	V
Input Voltage	V_{IN}	-15 - + 0.3	V
Output Voltage	V_{OUT}	-15 -+ 0.3	V
Input Clamp Current (50/60Hz Input)	I_{IN}	-0.4 - + 0.4	mA
Allowable Power Dissipation (T_A = 70°C)	P_{dmax}	0.7	W
Operating Temperature	T_A	- 30 - + 70	°C
Storage Temperature	Tstg	- 55 - + 125	°C

ALLOWABLE OPERATING RANGES (T.=25°C, Vss=0V)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		-14.0		-7.5	V
Input High Voltage	V_{IH}	50/60Hz input	-1.0			V
		Other inputs	-1.5			
Input Low Voltage	V_{IL}	All inputs			V_{DD}+2	V
Input Voltage on 50/60Hz input	V_{AC-IN}	Referenced to Vgg	VLED			V

ELECTRICAL CHARACTERISTICS (T. = 25°C, V_{DD}= -12V; unless otherwise specified)

Characteristic	Pins	Symbol	Test Condition	Min	Max	Unit
High Level Output Voltage	1	V_{OH}	V_{IH}=-1,5V, V_{IL}=V_{DD}+2V, I_{OH}=36mA	-1±5%		V
	16,17		I_{OH}=5 mA	-1±5%		
	2-14		I_{OH}=18 mA, C_L=150pF	-1±5%		
Low Level Output Voltage	1	V_{OL}	I_{OL}=0,02mA		V_{DD}+2±0,2	V
	16,17		I_{OL}=0,01mA		V_{DD}+2±0,2	
	2-14		I_{OL}=0,02mA		V_{DD}+2±0,2	
Output Leakage Current	25	I_{IH}	U_{TEST}=12V		10±5%	μA
		I_{IL}		-10±5%		μA
Output Leakage Current	18,19,21-24,26,28	I_{IH}	U_{TEST}=12V		20±5%	μA
		I_{IL}		-5±5%		μA
Supply Current	20	I_{DD}	U_{TEST}=12V		7±5%	mA

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IL8560
BLOCK DIAGRAM

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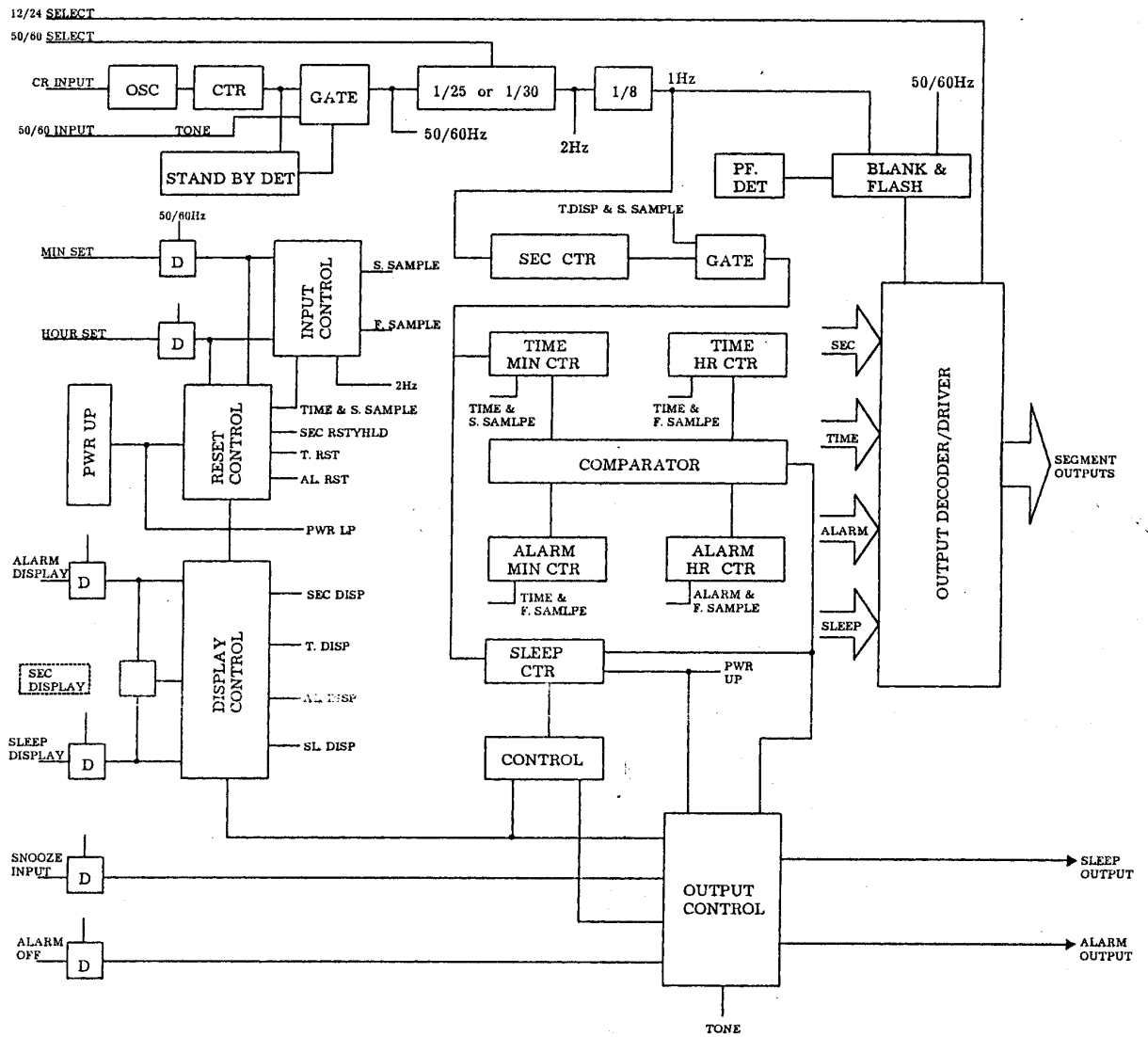
IL8560

SAMPLE APPLICATION CIRCUIT FOR CLOCK RADIO USE (+ power supply)

R1	110 kΩ
C1	0.015µF
f₀	900Hz

This circuit is used to remove noise to LW bank.
(Backup control at other than the battery backup mode)
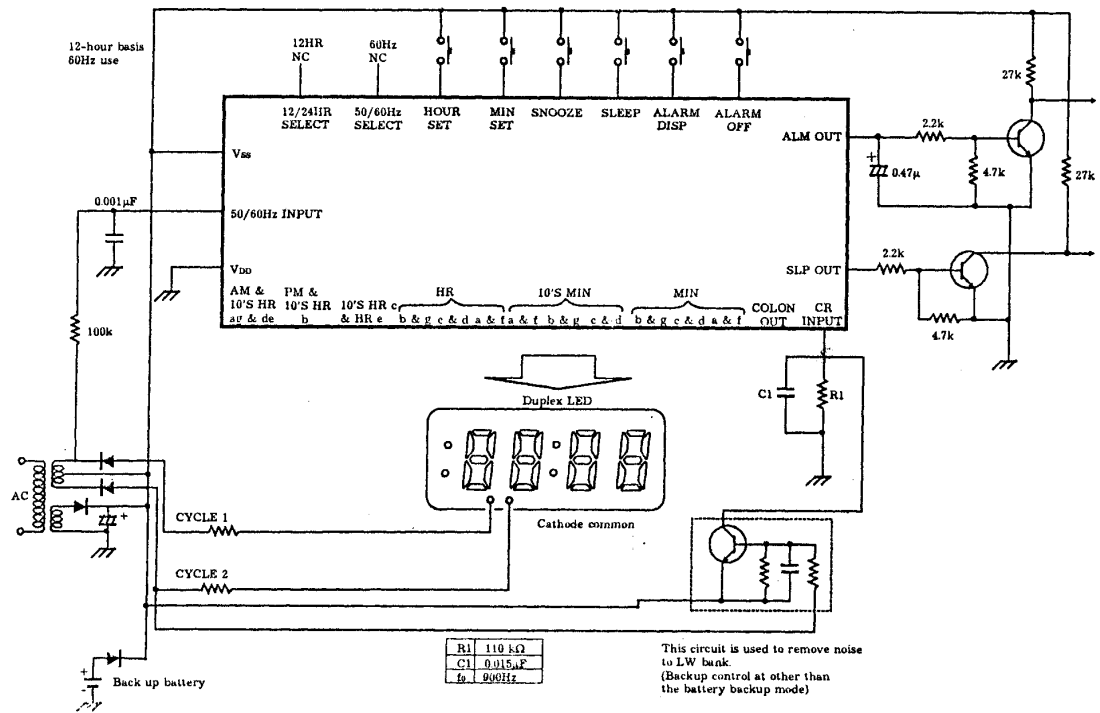
SAMPLE APPLICATION CIRCUIT FOR CLOCK USE (-power supply)

When no battery backup and tone output are used, " CR Input" must be connected to Vss.

R1	110 kΩ
C1	0.015µF
f₀	900Hz

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IL8560

PAD LAYOUT

PAD DIAGRAM
Chip size : 3050 x 3500
Pad size : 100 x 100
Unit : μm
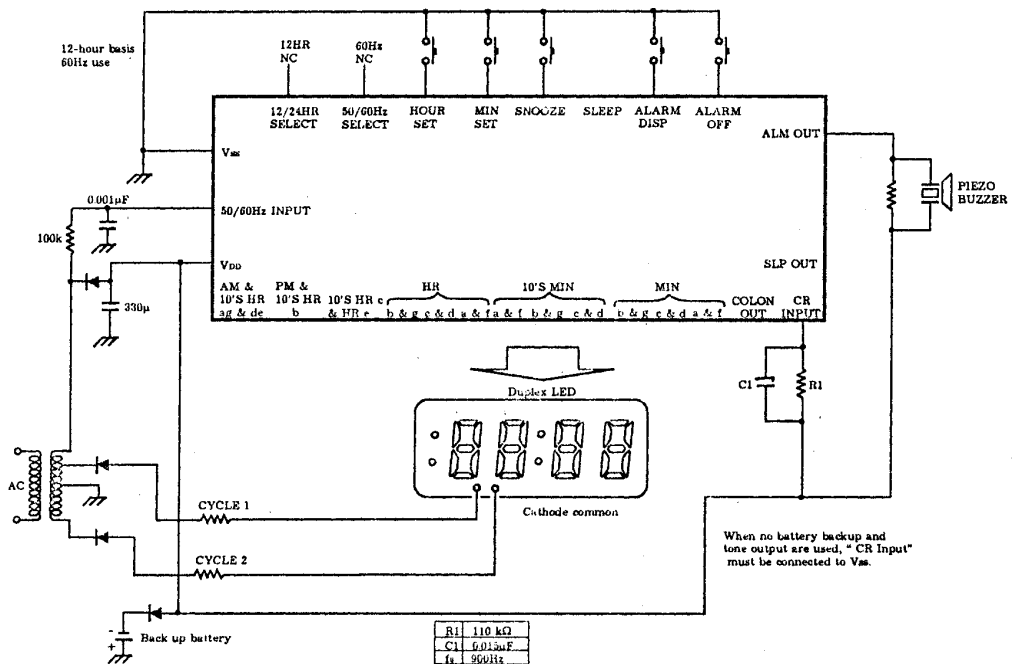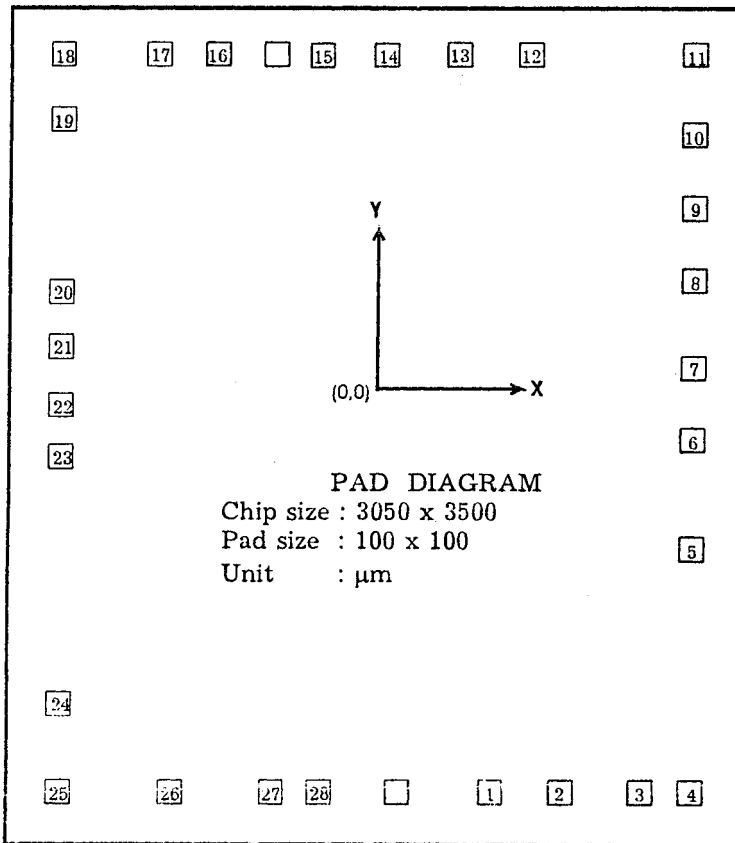
The substrate is connected to VDD.

PAD LOCATION

Pad No.	Pad Name	X	y	Pad No.	Pad Name	X	Y
1	AM & 10'S HR ag	486	-1533	15	Vss	-223	1533
2	PM & 10'S HR b	786	-1533	16	ALARM OUT	-660	1533
3	10'S HR c & HR e	1111	-1533	17	SLEEP OUT ⌐ •"••'•	-900	1533
4	HR b & g	1306	-1533	18	ALARM OFF	-1306	1533
5	HRc &d	1306	-515	19	ALARM DISP	-1306	1255
6	HR a & f	1306	-67	20	VDD	-1306	551
7	10'S MIN ,a & f	1306	233	21	MIN SET	-1306	320
8	10'S MIN b & g	1306	595	22	HOUR SET	-1306	79
9	10'S MIN c & d	1306	895	23	SLEEP INPUT	-1306	-142
10	10'S MIN e &	1306	1195	24	SNOOZE INPUT	-1306	-1160
11	MIN b & g --	1306	1533	25	50/601-tz INPUT	-1306	-1533
12	MIN c & d	638	1533	26	oO/eOHz SELECT	-832	-1533
13	MIN a & f	338	1533	27	CR INPUT	-416	-1533
14	COLON OUT	38	1533	28	12/2-1 HR	-218	-1533

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