

IL8560

CLOCK CIRCUIT

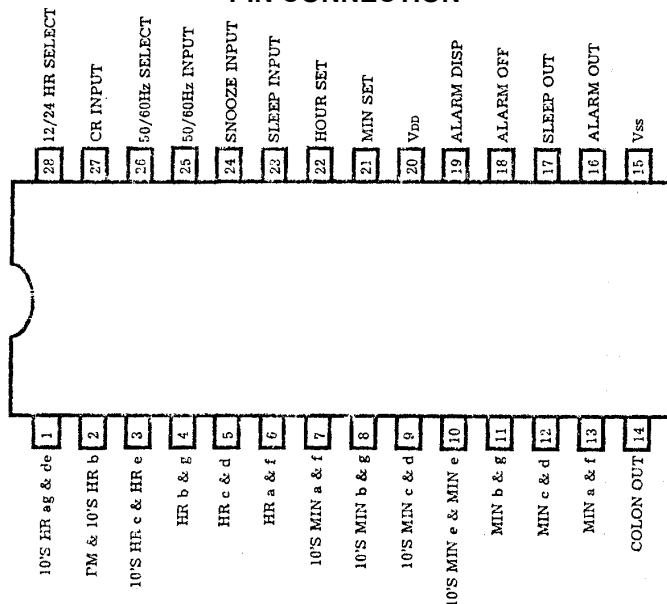
FEATURES

- 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



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 resistor 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 VDD is provided by the internal pulldown resistor.

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.

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Table 1. Display Mode

Select Input		Display Mode	Digit No.1	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	HOURL	"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	"Seconds" are reset Both operations shown above are performed.
Seconds (Alarm & Sleep)	HOURL	"Seconds" are cleared to [00].
	(Note) MIN	"Hold" mode.
	BOTH	"Hours" and "Minutes" are reset to (0:00) (24hour basis) or (12:00) (12hour basis).
Alarm	HOURL	"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	HOURL	The moment. V _{DD} is applied to "sleep display", the sleep counter is set to [0:59].
	MIN	The moment V _{DD} 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: Leaving 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: If 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

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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 ($T_A = 25^\circ\text{C}$)

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 ($T_A = 70^\circ\text{C}$)	P_{dmax}	0.7	W
Operating Temperature	T_A	- 30 - + 70	$^\circ\text{C}$
Storage Temperature	T_{stg}	- 55 - + 125	$^\circ\text{C}$

ALLOWABLE OPERATING RANGES ($T_A = 25^\circ\text{C}$, $V_{SS} = 0\text{V}$)

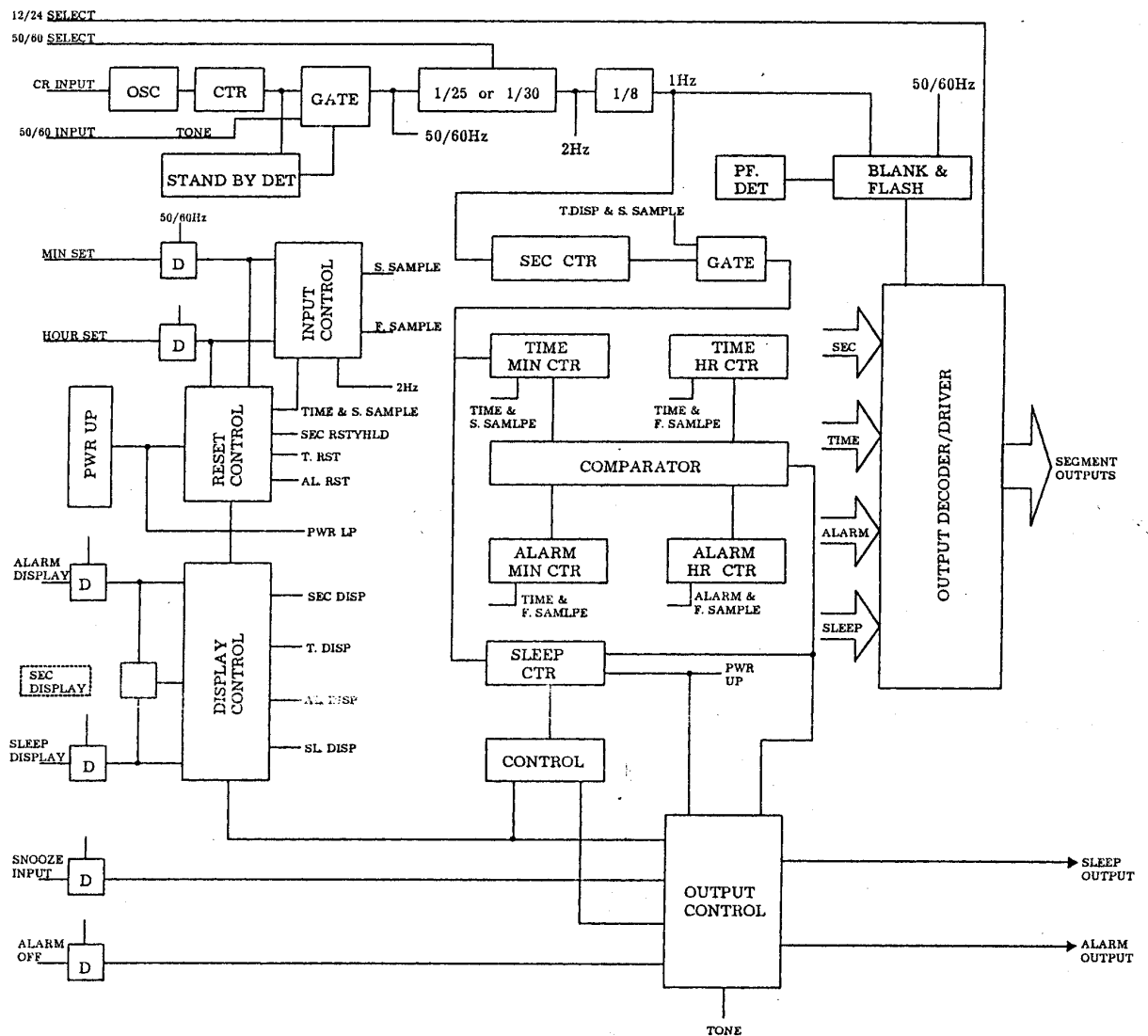
Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage	V_{DD}		-14.0		-7.5	V
Input High Voltage	V_{IH}	50/60Hz input	-1.0			V
		Other inputs	-1.5			
Input Low Voltage	V_{IL}	All inputs			$V_{DD} + 2$	V
Input Voltage on 50/60Hz input	V_{AC-IN}	Referenced to Vgg	V_{LED}			V

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $V_{DD} = -12\text{V}$; unless otherwise specified)

Characteristic	Pins	Symbol	Test Condition	Min	Max	Unit
High Level Output Voltage	1	V_{OH}	$V_{IH} = -1.5\text{V}$, $V_{IL} = V_{DD} + 2\text{V}$, $I_{OH} = 36\text{mA}$	-1±5%		V
	16,17		$I_{OH} = 5\text{mA}$	-1±5%		
	2-14		$I_{OH} = 18\text{mA}$, $C_L = 150\text{pF}$	-1±5%		
Low Level Output Voltage	1	V_{OL}	$I_{OL} = 0.02\text{mA}$		$V_{DD} + 2 \pm 0.2$	V
	16,17		$I_{OL} = 0.01\text{mA}$		$V_{DD} + 2 \pm 0.2$	
	2-14		$I_{OL} = 0.02\text{mA}$		$V_{DD} + 2 \pm 0.2$	
Output Leakage Current	25	I_{IH}	$U_{TEST} = 12\text{V}$		10±5%	μA
		I_{IL}		-10±5%		μA
Output Leakage Current	18,19,21-24,26,28	I_{IH}	$U_{TEST} = 12\text{V}$		20±5%	μA
		I_{IL}		-5±5%		μA
Supply Current	20	I_{DD}	$U_{TEST} = 12\text{V}$		7±5%	mA

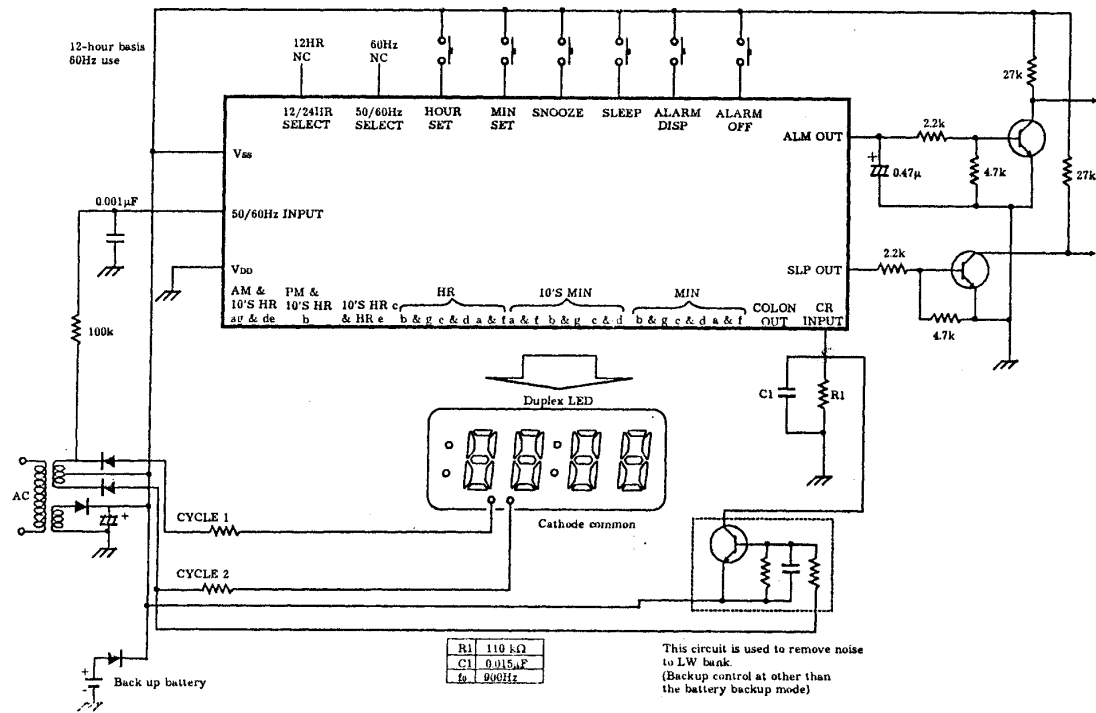
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BLOCK DIAGRAM

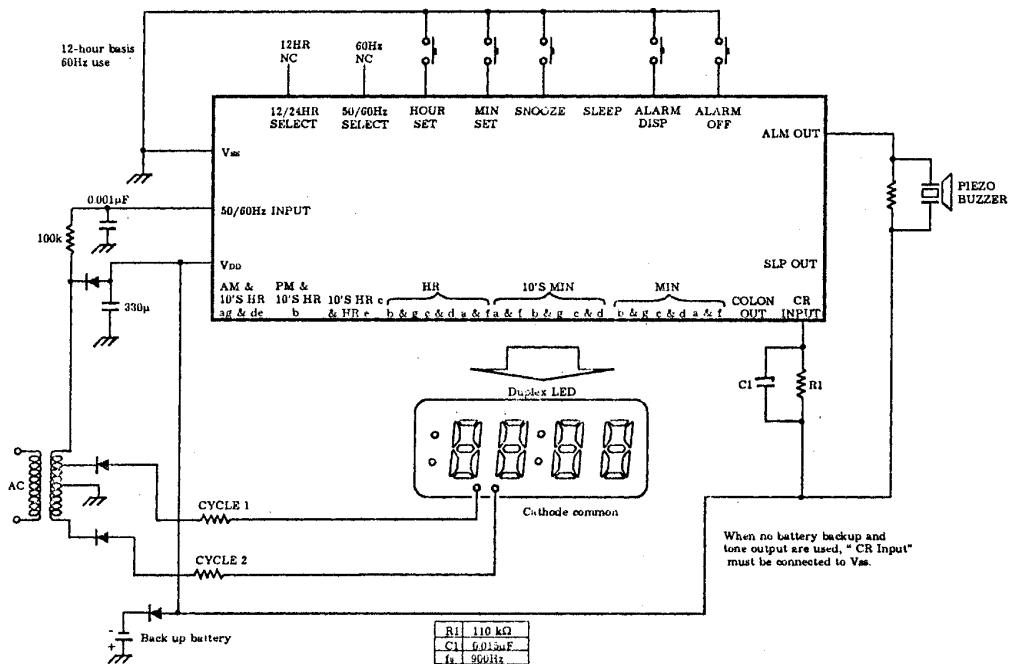


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SAMPLE APPLICATION CIRCUIT FOR CLOCK RADIO USE (+ power supply)

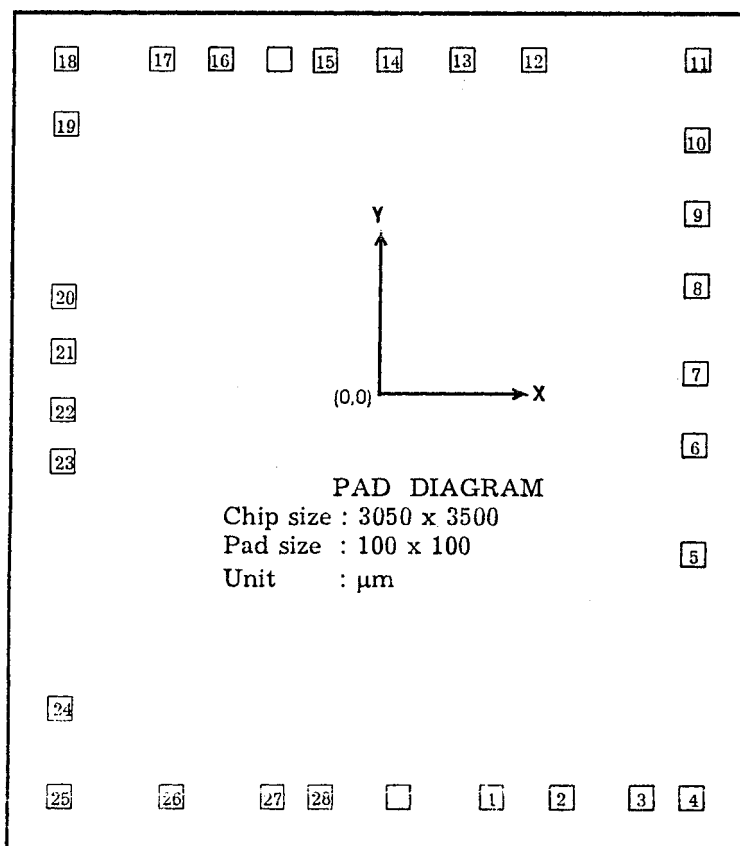


SAMPLE APPLICATION CIRCUIT FOR CLOCK USE (-power supply)



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PAD LAYOUT



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