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4 Digit Clock Radio Circuit

FEATURES

- 4 Digits plus colons
- LED direct duplex drive
- No display-IC interface components
- No radio frequency interference problems
- No external contact noise elimination circuits required
- No external line frequency noise rejection circuits required
- 12 or 24 hour display
- Leading zero suppression in 24 hour mode
- PM indication in 12 hour mode
- Alarm-snooze indicator
- 50Hz or 60Hz operation
- On-chip oscillator for standby operation with battery during line Failure
- Line power interrupt indication
- Sleep operation indicator
- Low power dissipation (under 30 mW)

CLOCK RADIO FEATURES

- Simple support electronics
- Analog sleep setting (user controlled 5 to 120 mins with 1 minute resolution). No necessity for daily adjustment
- Totally independent sleep and wake timing
- Independent volume of music during sleep and wake
- Radio sound muting during normal radio listening
- Wake to music or alarm tone
- Self-cancelling alarm after 80 minutes of wake
- 5 minute repeating snooze with radio and/or alarm
- Sleep override or sleep repeat
- Wake to alarm tone with quiet radio override (every 5 minutes) during snooze time (repeatable)
- Simple setting of time, alarm, and sleep
- Hold and synchronize capability for time setting
- Independent hours, minutes setting (carry propagation suppressed)
- 5 minute pre-alarm appliance switching
- Automatic tape recorder control (record your favorite program automatically 0-120 minutes—starting from the exact second)

PIN CONFIGURATION

28 LEAD DUAL IN LINE

Top View

V_N	1	28	V_P
Colons	2	27	50/60 Count Input
PM/Indicator/Sleep Indicator	3	26	OSC 1 (Standby Timing)
f Digits 3 & 4	4	25	OSC 2 (Sleep Timing)
g Digits 3 & 4	5	24	Inc Hours (SIN)
e Digits 3 & 4	6	23	Inc Mins (S C /S R)
d Digits 3 & 4	7	22	S T Set Time
c Digits 3 & 4	8	21	S A Set Alarm
b Digits 3 & 4	9	20	Wake 1 Out (12/24 Hr Sel)
a Digits 3 & 4	10	19	Wake 2 Out (50/60 Sel)
a Digits 1 & 2	11	18	Sleep Out
f Digits 1 & 2	12	17	b Digits 1 & 2
e Digits 1 & 2	13	16	g Digits 1 & 2
d Digits 1 & 2	14	15	c Digits 1 & 2

DESCRIPTION

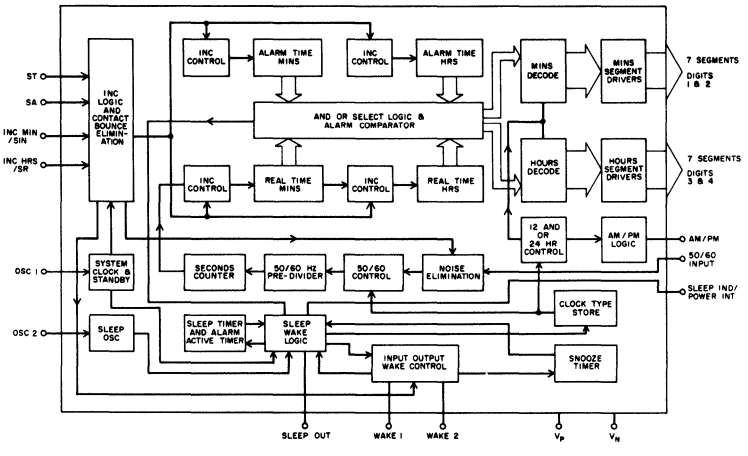
The CK3300 N-Channel MOS I.C. contains all the necessary logic, contact noise elimination circuits, control switching, segment drivers and timing circuits to implement simple-to-use, low cost, multi-featured clock radios.

Due to the extreme difficulties in eliminating R.F.I. in radios when used in conjunction with digital electronics a great deal of care has gone into the design of the L.S.I. to ensure that little or no R.F.I. problems are met by the clock radio designer. The largest R.F.I. problem in Display Driving has been solved using a novel technique—that of half-line cycle anode duplexing using the half-sine waves produced by two diodes, and ensuring that all segment data changes occur at the zero crossings of the line cycle. This technique allows brightness control to be achieved simply by resistively dividing down the line voltage with a potentiometer, or a simple two level scheme using a transformer tap.

Segment driving of the two groups is directly from the I.C. through 50 ohm switches which allow the high current peaks required of LEDs, up to one inch in size, while keeping the I.C. Power dissipation, for reliability, down to the 200 to 250 mW level.

The I.C. also contains many unique features which enable the equipment designer to put into the clock radio his company's own product image.

BLOCK DIAGRAM



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PIN FUNCTIONS

V_N - (Pin 1)

Most negative power supply to the chip (0 volts).

Segment Drivers (Pins 2-17)

These outputs are 50Ω switches which drive the segments of common anode LED's directly. Their use and operation is as follows:

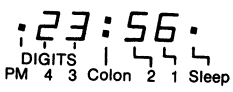
To use the CK3300 with LEDs, the LEDs must be of the COMMON ANODE TYPE, and connected in the following manner.

segment a digit 1 connected to segment a digit 2
segment b digit 1 connected to segment b digit 2
segment c digit 1 connected to segment c digit 2
segment d digit 1 connected to segment d digit 2
segment e digit 1 connected to segment e digit 2
segment f digit 1 connected to segment f digit 2
segment g digit 1 connected to segment g digit 2

segment a digit 3 connected to segment a digit 4
segment b digit 3 connected to segment b digit 4
segment c digit 3 connected to segment c digit 4
segment d digit 3 connected to segment d digit 4
segment e digit 3 connected to segment e digit 4
segment f digit 3 connected to segment f digit 4
segment g digit 3 connected to segment g digit 4

Colon 1 segment connected to colon 2 segment
PM indicator segment connected to sleep/power down indicator segment
Anode digit 1 to anode digit 3
Anode PM indicator to anode digit 4
Anode sleep indicator to anode digit 1
Anode colon upper to anode digit 3
Anode digit 2 to anode digit 4
Anode colon lower to anode digit 2

The anodes can then be selected by the application of alternate half-cycle sine waves derived from a transformer from the line. The phase of the incoming 50/60Hz count to IC will then automatically deliver the correct segment data to the display.



Anode phasing: 50/60 high = digit (1 & 3) selected
low = digit (2 & 4) selected

Sleep Output (Pin 18)

This output turns on while the sleep counter is running and is indicated as active by an indicator in the display (Pin 3). This output turns on immediately following a sleep initiate and is cancelled either by sleep time being complete, a sleep cancel, an alarm comparison taking place, or an end of snooze period. This pin is also used as an input during circuit test to speed up testing.

Wake 2 Output/50-60Hz Mode Select (Pin 19)

This output turns on at alarm compare time and stays on unless either an alarm cancel or a snooze repeat is activated.

If snooze repeat is activated this pin will go off until the next 5 minute period elapses when it will again turn on.

The snooze can be repeated indefinitely.

If the alarm is not cancelled this output will turn off 80 mins after the last snooze repeat re-triggering alarm for the next 24 hour period.

This pin is also the 50/60Hz Select input during the time at which Set Time and Set Alarm are at a logic '1' (last data on this input when either Set Time or Set Alarm changes state is stored in an internal latch).

Wake 1 Output/12 or 24 Hour Select (Pin 20)

This output turns on at alarm compare time and stays on uninterrupted until either:

a. An alarm cancel
b. 80 continuous minutes from alarm time
c. 80 continuous minutes from last snooze repeat

During the time that Set Time and Set Alarm are at logic '1' together, this pin is the 12/24 hour select input.

The last data on this pin before a data change on Set Time or Set Alarm is stored internally in a latch, and defines 12 or 24 hour operation.

Set Alarm (Pin 21)

This pin, held at zero while Set Time is at a logic '1', enables the Increment Minutes and Increment Hours inputs to the alarm counter, such that each change of state (1→0) of the increment inputs will advance the appropriate counter by one unit.

Set Time (Pin 22)

Is identical in operation to the Set Alarm pin, but in this instance allows the counts to be entered into the time counter.

Taking both Set Time and Set Alarm to a logic '0' allows the Wake outputs to become active when the time reaches the alarm time. Returning either Set Time or Set Alarm to a logic '1' will cancel the alarm.

Increment Mins/Sleep Cancel/Snooze Repeat (Pin 23)

If Set Time or Set Alarm is at zero, this input provides one unit of increment for each logic transition from one to zero. (This input is de-bounced against switch noise). If both Set Time and Set Alarm are at a logic '1' or logic '0' and the sleep timer is running, a logic zero on this input will cancel sleep.

If both Set Time and Set Alarm are at a zero and the Wake outputs are active (i.e., post alarm time), then Wake 2 will be cancelled for a period of up to 5 mins when Pin 23 is taken to logic '0'. If this input is at zero when the alarm comparison takes place, then Wake 2 will stay off until 5 minutes have passed.

Increment Hours/Sleep Initiate (Pin 24)

If either Set Time or Set Alarm is at logic '0', this input provides one unit of increment to the required counter for each logic transition from 1 to 0. (This input is de-bounced against switch noise). If both Set Alarm and Set Time are at logic '1' or logic '0', this input will cause Sleep output to become active for the time resulting from current sleep oscillator frequency.

OSC 2 (Pin 25)

This pin produces a triangular wave oscillation depending on the value of resistance and capacitance. This oscillator is used to produce the sleep period by being gated internally with 160th of Osc 1 frequency (i.e. 50/60Hz).

Additionally connected to this pin is a low level detect circuit used with oscillator 1 for re-setting all internal logic to 12:00 in 12 hour mode and 0:00 in 24 hour mode. This low level detect is also used to detect that standby operation is required.

OSC 1 (Pin 26)

This pin produces a triangular wave oscillation depending on the external value of resistance and capacitance. The signal is used during normal operation to provide internally to the I C —
a. the internal timing for a series of one-shot gates
b. After division, the frequency to de-bounce other external pins via D-type latches. This frequency is further divided down to 50/60Hz and is used as the source frequency during standby operation.
Connected internally to this pin is a low level voltage detector which is used in conjunction with a low level voltage detector on Osc. 2 (pin 25) to reset all the internal logic to 12:00 in 12 hour mode and 0:00 in 24 hour mode. This low level detect is also used for test purposes.

50/60Hz In (Pin 27)

This input is the normal source of timing. This input drives both the internal count and the alternate half line selection of the segment outputs.
For equal brightness in the display this input must have a 1:1 mark space ratio (±20%).
There is no necessity for eliminating line noise externally when providing this input signal as an internal arrangement eliminates undesired counts.

V_P (Pin 28)

Is the most positive power supply to the chip (typically 10 volts)

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FUNCTIONAL OPERATION

Pins 19, 20, 23 and 24 are dual function pins which operate as inputs or outputs dependent on the state of the Set Time and Set Alarm inputs:

S.T.	S.A.	INC MIN	INC HR	SC/ SR	SIN	Wake 1	Wake 2	50/ 60	12/ 24
1	1	-	-	*	*	-	-	*	*
1	0	*	*	-	-	-	-	-	-
0	1	*	*	-	-	-	-	-	-
0	0	-	-	*	*	*	*	-	-

*Operable - Not Operable

Set time (S.T.)	Pin 22
Set alarm (S.A.)	Pin 21
Increment minutes (inc min)	Pin 23
Increment hours (inc hrs)	Pin 24
Sleep cancel (S.C.)	Pin 23
Snooze repeat (S.R.)	Pin 23
Sleep initiate (SIN)	Pin 24
Wake 1	Pin 20
Wake 2	Pin 19
50/60Hz Select	Pin 19
12/24Hr. Select	Pin 20

Using Wake 1 Or 2—Input/Output Functions

When the Set Time (S.T.) and Set Alarm (S.A.) inputs are at logic one, the IC outputs Wake 1 and Wake 2 become inputs to two bistable gates which store the logic conditions on those pins: 50/60Hz Select on the Wake 2 pin and 12/24Hr. Select on the Wake 1 pin.

50/60Hz Select

Set Time or Set Alarm must be at zero before data on Wake 2 changes, or clock can change its 50/60 pre-divide mode. To avoid this, the following circuit is recommended:

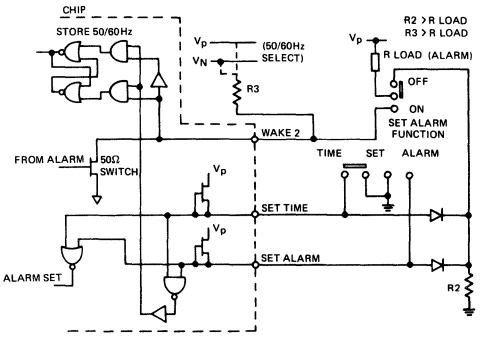


Fig. 1 SUGGESTED USE OF WAKE OUTPUTS TO ENSURE PROPER OPERATION OF INPUT/OUTPUT FUNCTION

With the Set switch in the center position the set inputs are pulled up to a logic '1' by the IC, provided the Alarm switch is in the off position. The load (R load) will pull the junction of the two diodes and R2 to a logic '1'.

The output pin Wake 2 will either be pulled up or down depending on the connection of R3.

Changing of Set switch will pull down the appropriate input and not affect other external circuit conditions.

Change of position of alarm ON-OFF switch will allow R2 to pull down both Set inputs to zero before Wake 2 output is connected to load. This ensures that the internal IC latch is disconnected from wake line before data on wake line can influence stored data in latch.

12/24 Hr. Select

For the "Wake 1 output 12-24 hour select", changing the logic polarity will immediately change the displayed time from 12 hour mode to 24 hour mode or vice versa.

e.g. 21 : 56 becomes •9 : 56
or •9 : 56 becomes 21 : 56

No leading zero is shown in 24 hour mode:

12 : 32 in 12 hour time becomes 0 : 32 in 24 hour time

(Note: 12 to 24 hour displayed time change can only be achieved when the alarm is not requested and not in set mode)

For economy of LEDs a single dot is employed which is illuminated during the PM period in 12 hour time.

Time Setting

Four input pins (S.T., S.A., Inc Hr., Inc Mins.) are provided to enable the following four functions to be provided:

a. Setting the time
b. Setting the alarm
c. Stopping the clock
d. Starting the clock
For synchronizing purposes

S.T. = 0

Allows each depression of Inc Hrs to advance hrs by one count. Clock will stop on the first inc mins and will remain stopped until ST = 1, thus allowing synchronization. The device assumes that the hours may need to be changed without affecting mins, but assumes clock is incorrect if minutes are changed, thus stopping clock and re-setting internal seconds counter to zero.

S.A. = 0

Selects alarm time and, for each depression of Inc Hours, hours are advanced one and, for each depression of Inc Mins, minutes are advanced one.

NOTE:
No carries from minutes to hours occur during setting of time or alarm

Radio Control Inputs

The inputs S.T., S.A., Inc Min, Inc Hr, serve as radio control inputs under the following conditions.

S.T. And S.A.

At zero together—alarm is requested S T and S A at logic one together—alarm not requested, but if taken to logic one during post alarm, alarm is cancelled.

S.T. and S.A. different will also cancel alarm if alarm is active

S.T.	S A.	Pre-Alarm	Post-alarm
1	1	Not required	Cancel
1	0	Not required	Cancel
0	1	Not required	Cancel
0	0	Requested	Alarm maintained for 80 mins

S.T., S.A. = 1

If S.T. and S.A. are at a logic 1 together during pre-alarm time, the following functions can be obtained using Inc Min—Inc Hrs inputs Inc Hrs input going to logic zero for at least 20 msecs will result in sleep output going to zero for the period of time set by sleep potentiometer.

At any time Inc Mins input (SC/SR) going to zero for at least 20 msecs will cancel sleep timer if sleep output is active

To reduce the number of knobs, switches, wiring etc., in the clock radio the following alternative feature is provided. If (S.C /S.R.) is wired to (SIN) a dual action is achieved, 1st depression of switch activates sleep, 2nd cancel sleep, 3rd re-activates etc. This allows features (a) if user decides he wishes radio off after he has been in bed for a few minutes, he pushes button, or (b) radio goes off automatically because sleep period has finished, but user is not asleep and would like radio to continue, so he presses button again.

S.T., S.A. = 0

In pre-alarm period the function performed when S.T., S.A. = 1 is identical. (When the alarm sounds at the requested alarm time the input (S.C./S.R.) (Inc Mins) becomes the 5 min snooze repeat input.)

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At alarm[illegible]e effect of (S.C./S.R.) becoming zero for at least 20 m[illegible]s to turn Wake 2 output off until next 5 min interval, if [illegible]epressed, Wake 2 will turn off for a further 5 mins—this sequence will go indefinitely until S.T., or S.A. or both are returned to logic '1', cancelling alarm. If inputs to the device are left unchanged for 80 mins then alarm will re-set for 24 hours.

Again to improve the radio features and simplify radio operation the tied function of (S.C./S.R.) and (SIN) on one button performs the following three functions:

Initiate sleep (SIN)
Cancel sleep (S.C.)
Snooze repeat (S.R.)

Delaying Alarm by 5 Minutes

If, when Wake 1 ouput is capacitively coupled to (S.C./S.R.) input then at alarm time Wake 1 will turn on and stay on but Wake 2 will immediately become cancelled, hence no alarm will be heard from radio until 5 minutes later; this allows an electrical appliance to be turned on 5 minutes prior to alarm sounding.

Use of Sleep Timer for Tape Recorder Control

If sleep input (SIN) in directly coupled to Wake 1 output, then a tape recorder or any electrical equipment can be turned on at alarm time using sleep output for a period of time set on sleep potentiometer.

Radio Control Outputs

There are three radio control outputs:

a. Wake 1
b. Wake 2
c. Sleep output

Function

1. Wake 1—goes at zero; i.e. is on at alarm time for a period of 80 mins or until an alarm cancel.

2. Wake 2 goes to zero at alarm time, and stays at zero until a snooze repeat is activated then it will stay off until next 5 minute point then return to zero, for a period of 80 mins unless snooze repeat is re-activated. Snooze repeat can be used indefinitely, until either a continuous 80 mins occurs or alarm is cancelled.

Note: The 5 minute period is any 5 min interval from alarm time and not 5 min from each snooze repeat.

3. Sleep output goes low after a sleep initiate for the period of time set by sleep potentiometer. (Will be overridden by Wake if sooner.)

Colon Utilization

	COLON CONDITIONS	
FUNCTION	BOTTOM	TOP
Set time	on	off
Set alarm	off	on
Stopped (Sync)	off	off
Run (alarm not requested)	1Hz	off
Run (alarm requested)	1Hz	1Hz
Snooze period	1Hz	1Hz

Sleep dot is on for sleep timer running, flashing for[illegible]e interrupt (removed from flashing by movement of S.T. c[illegible] to '0')

Stand-By Operation

If a circuit is employed to change the IC power source to battery during line failure, e.g. two diodes, then if the external timing components of oscillator 1 are set to give 8kHz (nominally R = 120KΩ = 2200pF), then the IC will maintain operation to an accuracy of one part in 120, i.e., 30 secs/hr, during the failure. On return to main power the sleep indicator will flash at 1Hz to notify user that indicated time could be in error.

The standby condition is detected by the failure of oscillator 2 to oscillate, therefore oscillator 2 is connected to the line-derived power source, not the battery.

It is assumed OSC 2 input has gone to zero volts.
To remove flash condition take S.T. or S.A. momentarily to zero.

Analog Sleep Control

A second oscillator is provided on IC whose frequency can be controlled by an RC network. The oscillator is identical to oscillator one (Standby oscillator) and occupies the same silicon real estate location ensuring that process variations, temperature variations and voltage variations have as nearly as possible identical effects on frequency stability. Oscillator 1, which is set to 8KHz is divided down to 50Hz (20.0 msecs) and is used as a gating time for oscillator 2 (Sleep Timer Source). The number of gated counts is loaded in the sleep timer (capacity 160 counts) and subsequently counted up at one per minute until 160 is reached.

The range of sleep time is controlled by varying OSC 2 resistance. At 4:1 change in resistance will give variation of 160 to 40 gated pulses, this giving a sleep time of 0 to 120 minutes.

NOTE:
Minimum sleep time to ensure correct snooze operation should be a minimum of 5 minutes.

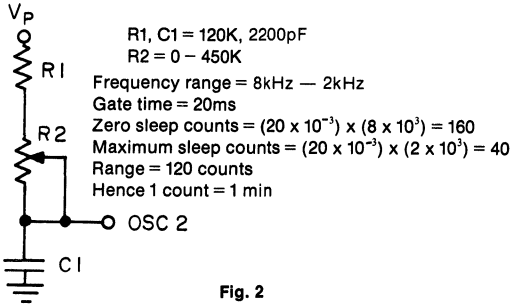


Fig. 2

To initiate the sleep timer both S.T. and S.A. must logically be the same, and INC HR/SIN must be momentarily at zero. (See later section).

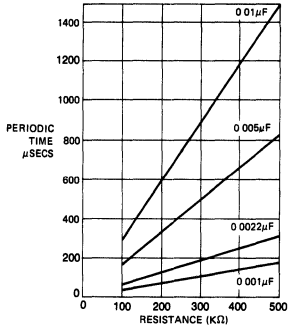


Fig. 3 OSCILLATOR CHARACTERISTICS FOR V_P = 10V

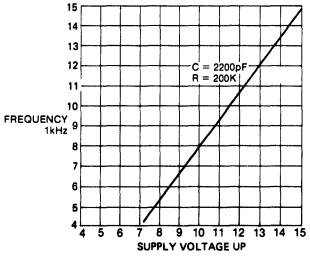


Fig. 4 OSCILLATOR CHARACTERISTICS WITH VOLTAGE

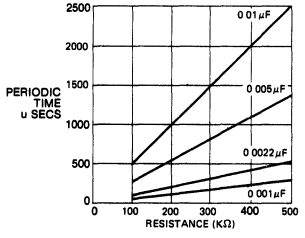


Fig. 5 OSCILLATOR CHARACTERISTICS FOR V_P = 7.5V

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Operation Clock Radio Example

(sho some features and their use) - ref Figs.21 and 22.

Set up

Radio is connected to line for 1st time, then battery is inserted.

Assume following switch position RADIO OFF, SET TIME SWITCH = RUN

Actions

Display will illuminate and read 12:00 sleep indicator will flash at 1Hz. Set clock as indicated previously (flashing will cease).

In 24hr mode 0:00 will illuminate with flashing sleep indicator.

Snooze Bar Action

IN RADIO OFF POSITION

1st button depression	Low volume radio (set required volume)
2nd button depression	Radio off
3rd button depression	Radio on low volume
4th button depression	Radio off

etc. . . .

IN RADIO ON POSITION

Radio comes on high volume (set wake volume required)

1st button depression	Low volume radio (mute facility)
2nd button depression	High volume
3rd button depression	as 1
4th button depression	as 2

Radio Auto

In auto, alarm is requested at "set alarm" time. If sleep is desired press button. Subsequent button pushes will have same effect as in radio "off" position.

Select Wake to Alarm Tone or Radio

Assume radio selected

At alarm time radio will come on at wake volume setting.

1st button depression	Radio will switch to low volume
2nd button depression	Radio will switch off
3rd button depression	Radio back a low volume

If after first depression radio is left untouched, radio will return to wake volume after five minutes.

If after 2nd depression radio is left untouched, radio will stay off for five minutes then return to wake volume.

This wake volume, if left, will be maintained for 80 mins unless radio is returned to radio ON or radio OFF switch position, changing switch momentarily from auto to ON or OFF and back to auto will reset alarm and re-request for same time next day. The above, repeating snooze, can be maintained indefinitely if button is pushed before 80 mins elapses.

Note: 80 mins is timed either from alarm time, if untouched, or 80 mins from last button depression

Select Wake to Alarm Tone

The alarm tone or buzzer is obtained by placing positive feedback around the audio amplifier or radio in such a n ne at the desired sound can be achieved and the feedba n be stopped by open circuit one point in the network.

At alarm time buzzer will sound:

On 1st button depression	Buzzer will cease and radio will switch to low volume
2nd button depression	Radio and buzzer will be off

If after first depression radio is left untouched, radio will return to buzzer after 5 mins.

If after 2nd depression radio is left untouched, radio and buzzer will be off and at 5 mins BUZZER WILL AGAIN SOUND.

As for radio position—radio will reset after 80 mins for 24 hrs. At any time in buzzer sequencing, buzzer radio select can be changed over to radio, then the radio will alternate high-low volume with button. Cancelling in buzzer mode is identical to radio mode.

Typical Application

To combine the S.A. and S.T. functions to provide simple and rapid clock setting. It is suggested that the following is incorporated in the clock radio.

Two toothed wheels are placed over two separate sprung contacts and coupled to two concentric rotating knobs, (say 12 teeth each) along side is a three position switch labeled 'set time, run, set alarm'.

To set clock, select time or alarm and rotate Hrs knob, or mins knob, each click will result in one unit change of time, rapid rotation will result in 12 increments per revolution of knob.

The above procedure results in an easy to use system with the advantage over mechanical clocks of independent hrs and mins setting.

NOTE:
No carries from mins to hrs can occur during setting of time or alarm.

Use of Auto Tape

Fig.21 shows - the facility for automatically switching on an appliance (e.g. tape recorder) at a specific time and keeping appliance active for a period of time up to 120 mins. In this mode the wake output is made to start the sleep - timer at the wake time.

Use of 5 Min Delayed Alarm with Appliance Switching

In this mode of operation the wake 1 output is made to cancel the first alarm through the SC (inc hr) input such that radio or alarm time will only occur at the end of the first snooze period.

This result in appliance being activated at set alarm time and after 5 mins the alarm or radio will sound.

Fig.6 — shows a typical clock-radio block diagram

Fig.7 — shows the chip/display circuit.

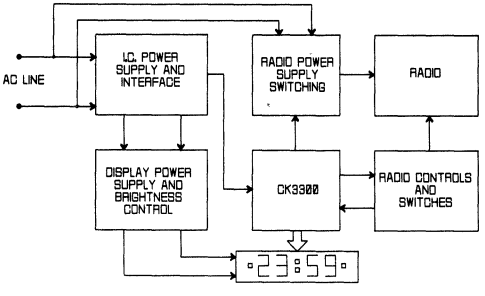


Fig. 6

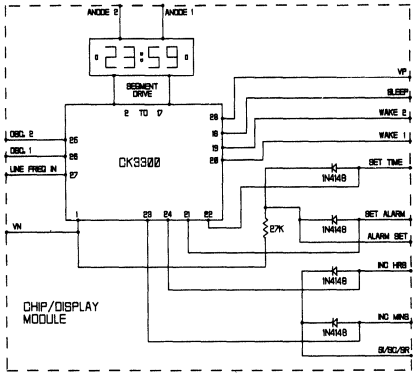


Fig. 7

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Interfacing with a Radio

There are many possible configurations of clock radios in use and a wide range of different radio chassis are employed in these units. It is necessary therefore that the clock radio I.C. be sufficiently flexible to allow simple interfacing to be accomplished.

The following section gives different options, features and interfacing to demonstrate some of the approaches possible with the CK3300.

Power Supply Interface

To enable any existing line operated radio chassis to be used with the minimum of changes it is suggested that the following power supply is used with the adoption of a 2nd line transformer. This will (a) reduce the need for a change at the existing transformer. (It is unlikely that the existing transformer will be capable of providing the additional power required of the display).

a. Allow the electronic clock movement to be self contained therefore, keeping the interface wiring to a minimum.

b. Allow the same electronic movement to be used with several radio chassis.

Options

1. Without battery standby facility Fig.8
2. With battery standby facility Fig.9

Display Interface and Power Source

Four options are shown

1. No brightness control Fig.10
2. Day/night brightness (two level) Fig.11
3. Manual brightness control Fig.12
4. Automatic brightness control Fig.13

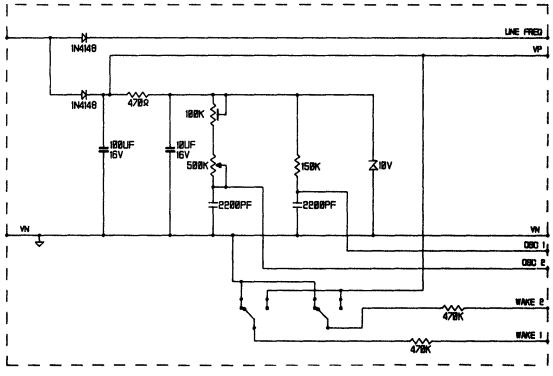


Fig. 8 POWER SUPPLY INTERFACE WITHOUT STANDBY

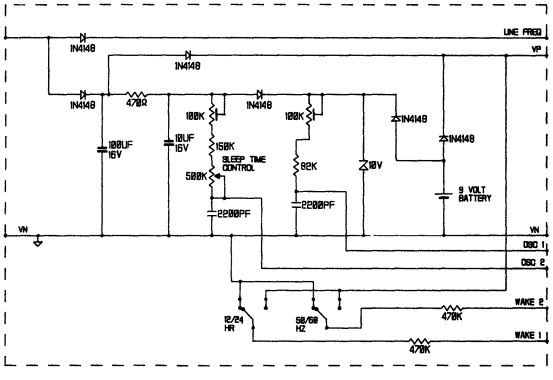


Fig.9 POWER SUPPLY INTERFACE WITH STANDBY OPTION

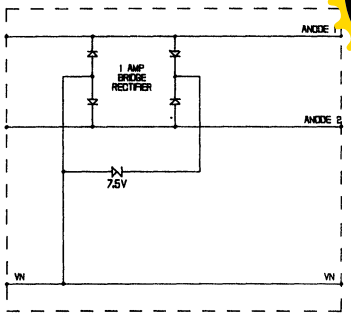


Fig.10 NO BRIGHTNESS CONTROL

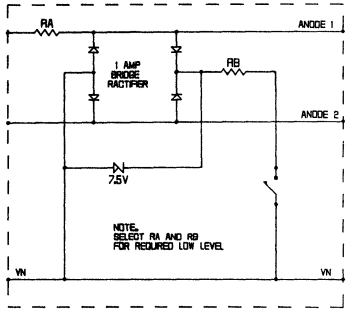


Fig.11 TWO LEVEL BRIGHTNESS CONTROL

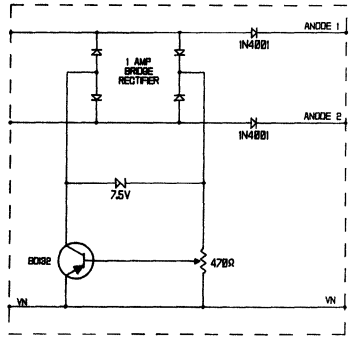


Fig.12 MANUAL BRIGHTNESS CONTROL

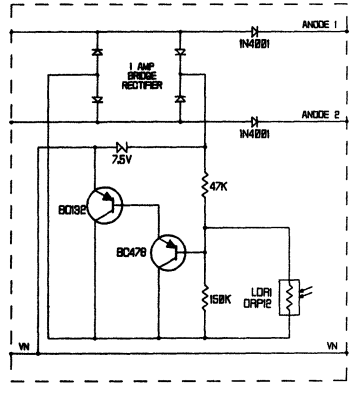


Fig.13 AUTOMATIC BRIGHTNESS CONTROL

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CK3300

Radio Switching

Option 1 Push button operation (Fig.14)

Option 2 Rotary switch operation (Fig.15)

Radio Powering

Option 1(Fig.16A, 16B) Direct audio amplifier control (no active components)

Option 2 (Fig.17) Power supply switching using Transistor

Option 3 (Fig.18) Power supply switching using a relay

Tone Generation

Option 1 (Fig 19) Saw tooth generation independent of radio

Option 2 (Fig 20) Sine wave generation independent of radio

Option 3 (Fig.15,16B) Sine wave using the existing radio audio amplifier

Additional Facilities

1. Automatic tape recording (Fig.21)
2. Appliance switching with delayed alarm (Fig.21)
3. Wake to normal radio with 5 minute alarm over-ride (Fig.22)
4. Wake to quiet radio with 5 minute alarm over-ride (Figs. 21 and/or 22)
5. Ratio muting during normal radio listening (Figs.21 and /or 22)

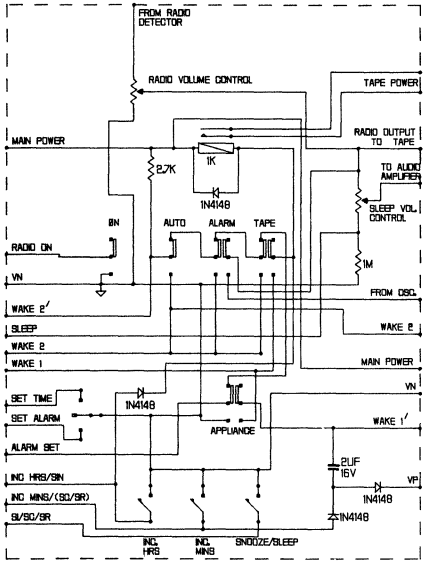


Fig.14 RADIO SWITCHING

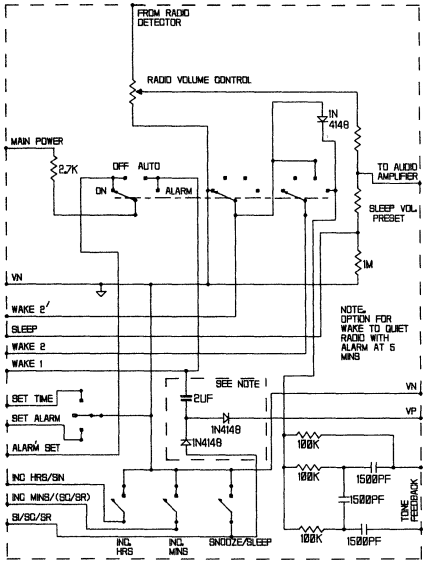


Fig. 15 RADIO SWITCHING

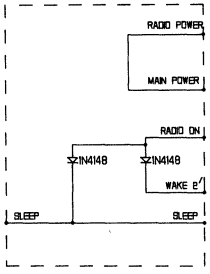


Fig. 16a RADIO SWITCHING BY BIAS CHANGE

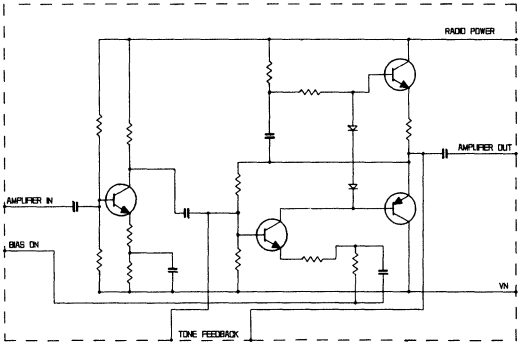


Fig. 16b TYPICAL TRANSFORMERLESS AUDIO AMPLIFIER

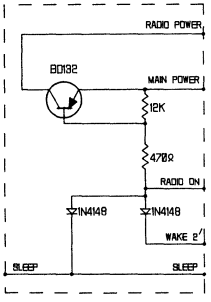


Fig.17 RADIO POWER SWITCHED BY TRANSISTOR

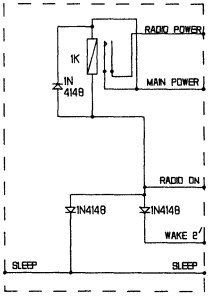


Fig.18 RADIO POWER SWITCHED BY RELAY

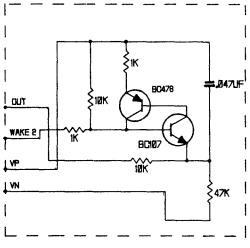


Fig.19 SAW TOOTH OSC

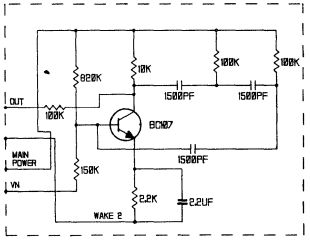


Fig. 20 SINE-WAVE OSC

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ELEC ICAL CHARACTERISTICS

um Ratings*

Voltage any Pin with Respect to V_n ..... +20V
Storage Temperature ..... −65°C to +150°C
Operating Temperature ..... −20°C to +70°C
Lead Temperature (Soldering 10 sec) ..... +300°C

*Exceeding these ratings could cause perma t age to the device. This is a stress rating only a nc- tional operation of this device at these condition implied—operating ranges are specified in Standa Conditions. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

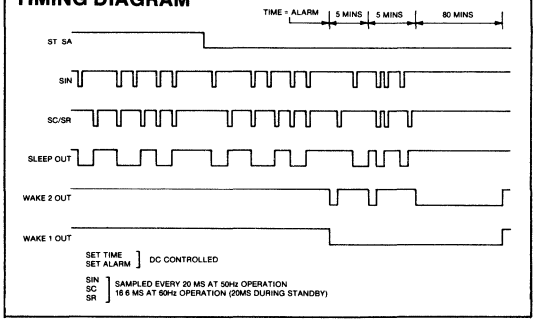
Data labeled "typical" is presented for design guidance only and is not guaranteed.

Characteristic	Min	Typ**	Max	Units	Conditions
Power Supply Voltage	7	10	—	Volts	V_n = 0V
Supply Current	—	2	—	mA	
50/60Hz Input					
Frequency (must be identical to anodes)	0	50/60	50,000	Hz	V_p = 10V
Logic '1' level	0.6Vp	—	Vp	Volts	
Logic '0' level	0.0	—	0.7	Volts	
Inputs (Excl Oscillators)					
Logic '1' level	0.6Vp	—	Vp	Volts	
Logic '0' level	0.0	—	0.7	Volts	
Segments Out (on)	—	30	—	mA	V_{OUT} = 1.5V
(off)	—	10	—	μA	
Wake 1, 2, Sleep Out (on)	—	30	—	mA	V_{OUT} = 1.5V
(off)	—	10	—	μA	
Wake 1, 2 (As Inputs)					
Logic '1' level	0.6Vp	—	Vp	Volts	
Logic '0' level	0.0	—	0.7	Volts	
Oscillators 1 and 2					
Hi level	—	5.5	—	Volts	Free run
Lo level	—	3.5	—	Volts	
Reset Level	—	—	0.7	Volts	

Unless specified otherwise, characteristics are defined with V_p = 10V at T_A = +25°C.
**Typical values are at +25°C and nominal voltages.

NOTES:
1. Under no circumstances during IC operation must any pin either input or output be taken to a voltage more negative than V_n or IC malfunction will occur.
2. No input or output must be taken to a positive voltage greater than 20 volts or permanent damage can result.
3. No output must be allowed to dissipate a continuous power in excess of 100mW.
4. Total chip continuous power dissipation must not exceed 500mW.
5. The total current being returned to V_n through all device pins must not exceed 1 amp

TIMING DIAGRAM



Input and Output Characteristics

INPUTS
S.A.
S.T.
INC HR (SIN)
INC MIN (SC/SR)
} Active pull up's to V_p } 250KΩ
Operate level logic '0'

50/60Hz count input, active pull down
For correct operation duty cycle of 50/60Hz must be 1:1 ± 20%

OUTPUTS
Normally open circuit
Operate "on" (low impedance typically 50Ω)

INPUTS
Wake 1—as input '1' = 12hr '0' = 24hr
Wake 2—as input '1' = 60Hz '0' = 50Hz

CLOCK INPUT NOISE ELIMINATION TIMING
50/60Hz—strobed every 4ms internally for less than 1μs

Testing I.C. Facilities

1. Master reset: This can be activated by pulling OSC1 (Pin 26) and OSC 2 (Pin 25) to zero volts together.
2 Internal debounce and predivider logic may be bypassed if OSC 1 is taken to zero volts while OSC 2 is left running.
a. Under this condition Inc Hrs and Inc Mins pins are not debounced to allow fast incrementing for test purposes.
b Also in this mode the 50/60Hz input pin is directed straight to the main counters under control of the sleep pin. If Sleep pin at '0'—50/60Hz input clocks 120 minute sleep counter, and with Sleep at '1' it clocks the main minutes count by passing the debounce and divide by 50/60 counter Under this condition it also clocks the 5 minute snooze counter.

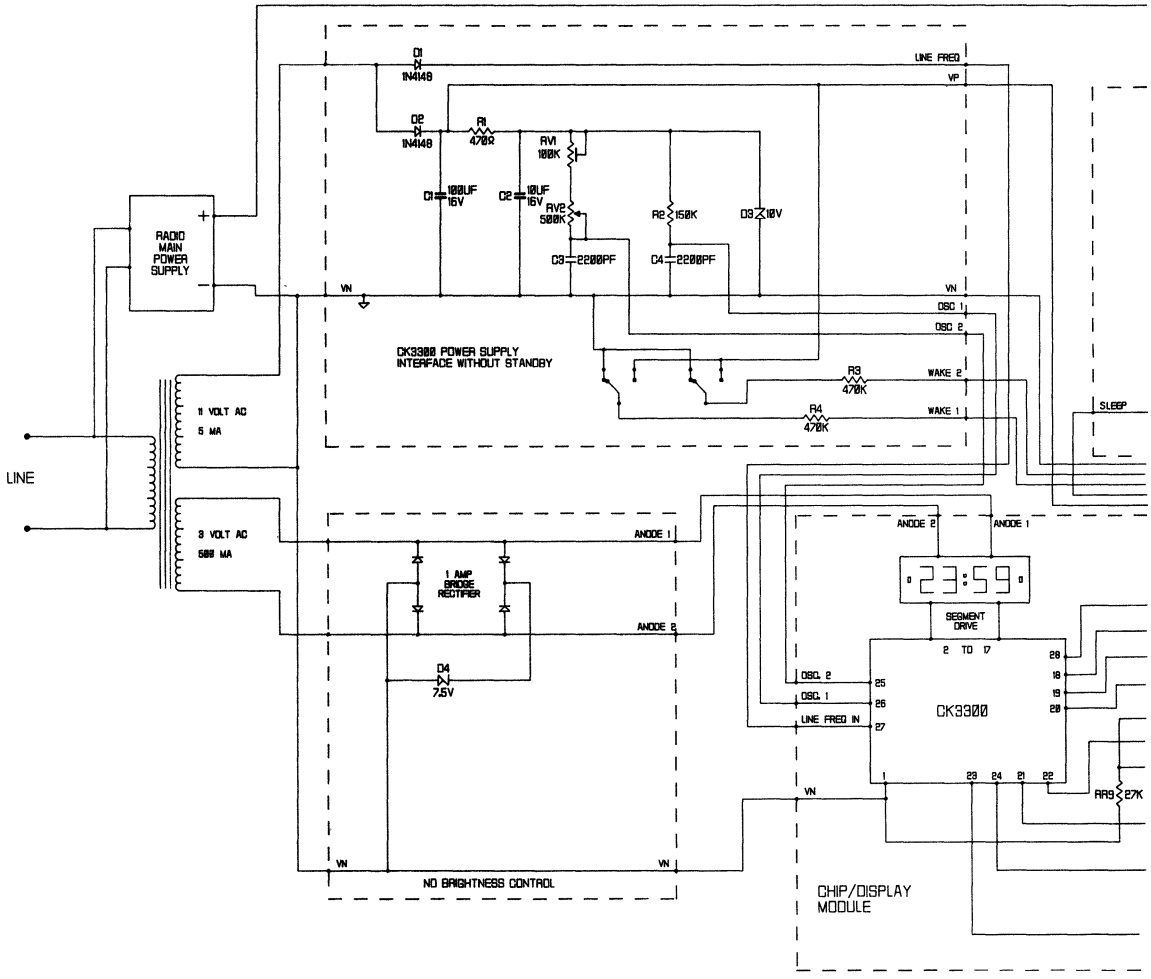


Fig. 21 (a) TYPICAL "BASIC" CLOCK RADIO CIRCUITRY

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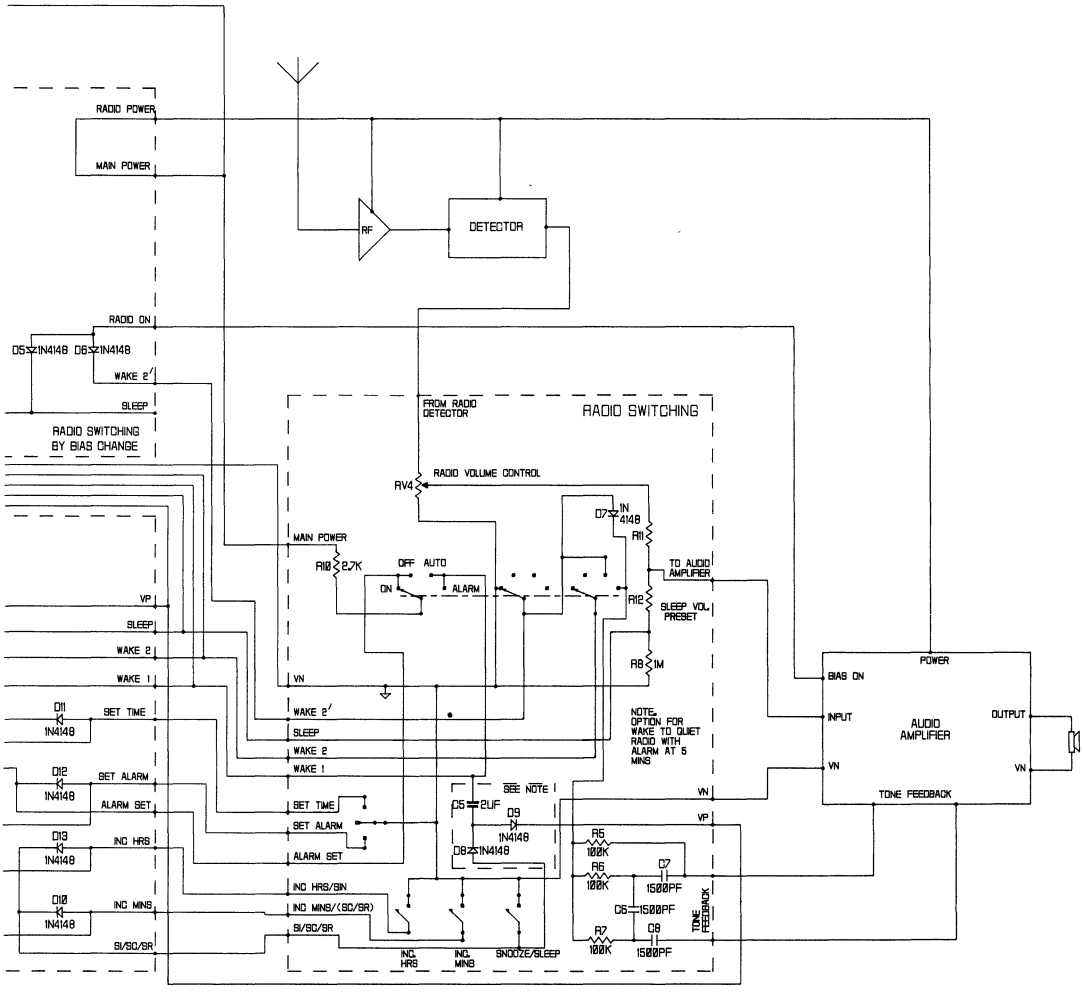


Fig. 21 (b) TYPICAL "BASIC" CLOCK RADIO CIRCUITRY

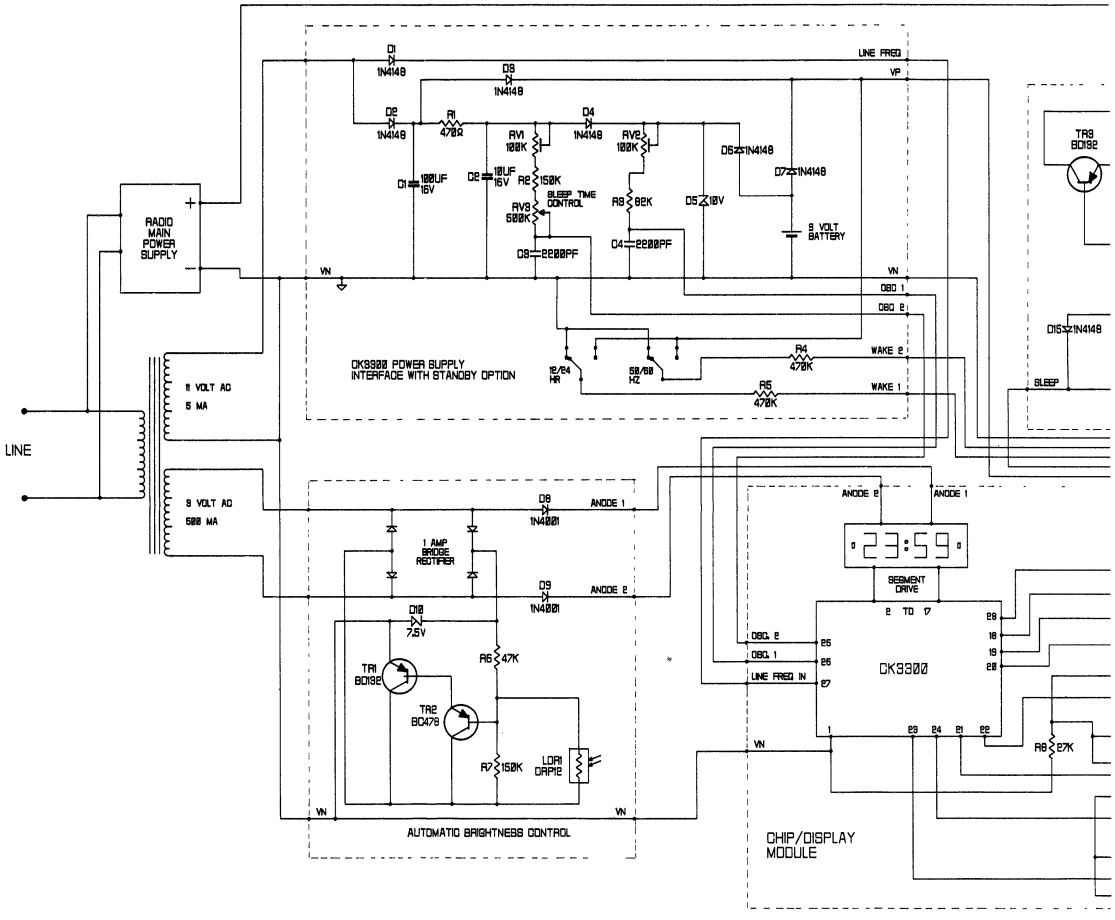


Fig. 22(a) TYPICAL "FULL-FEATURE" CLOCK RADIO CIRCUITRY

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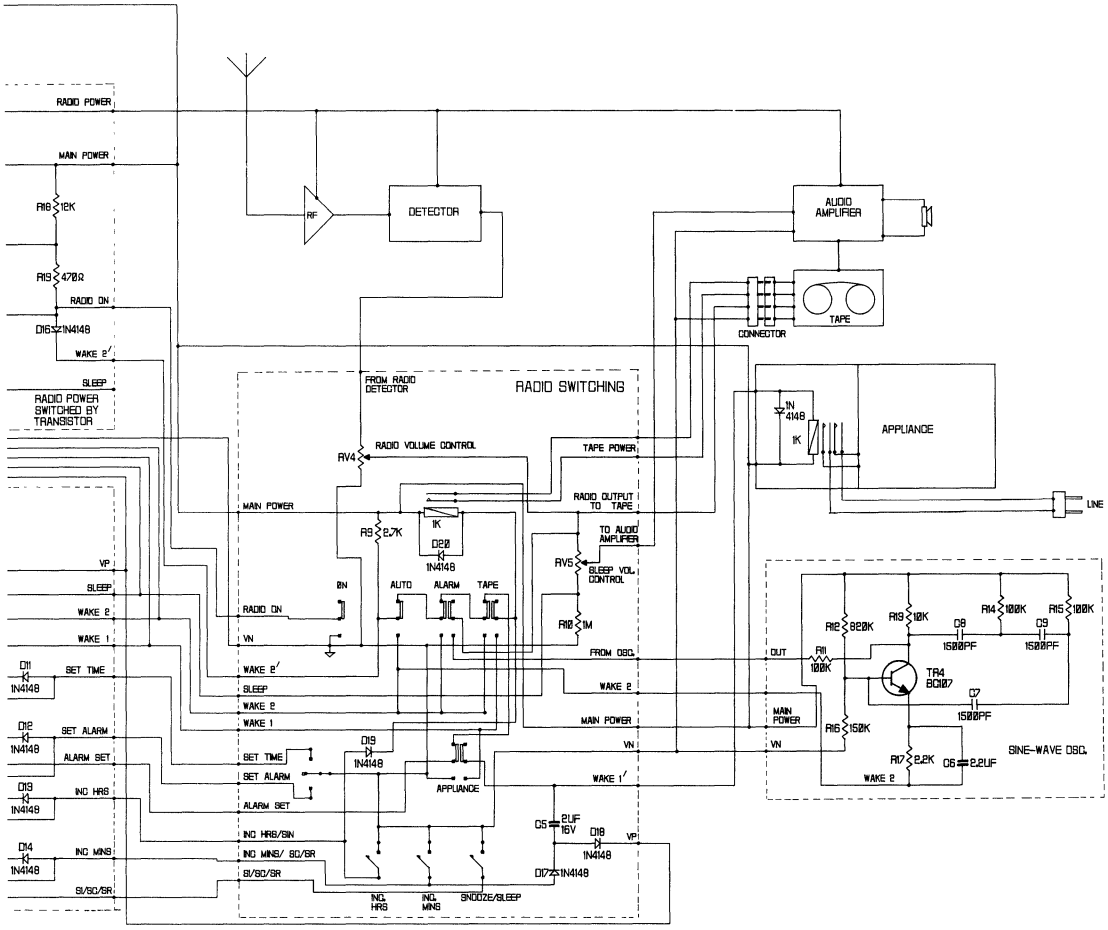


Fig.22(b) TYPICAL "FULL-FEATURE" CLOCK RADIO CIRCUITRY