LR3441 LCD Digital Clock Driver LSI

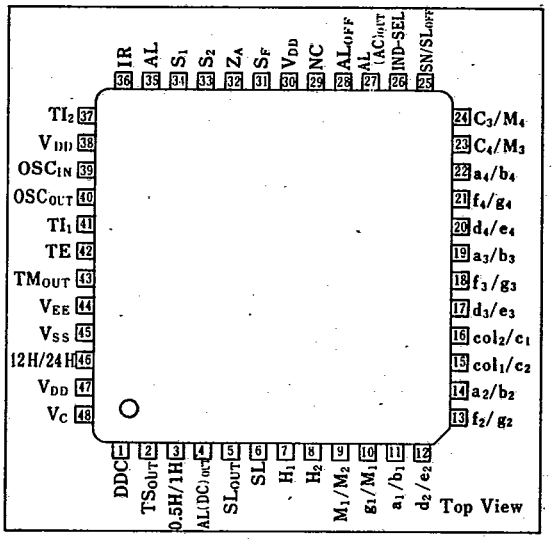
Description

The LR3441 is a CMOS LSI for LCD clocks with a basic three function, daily alarm, hourly alarm and timer.

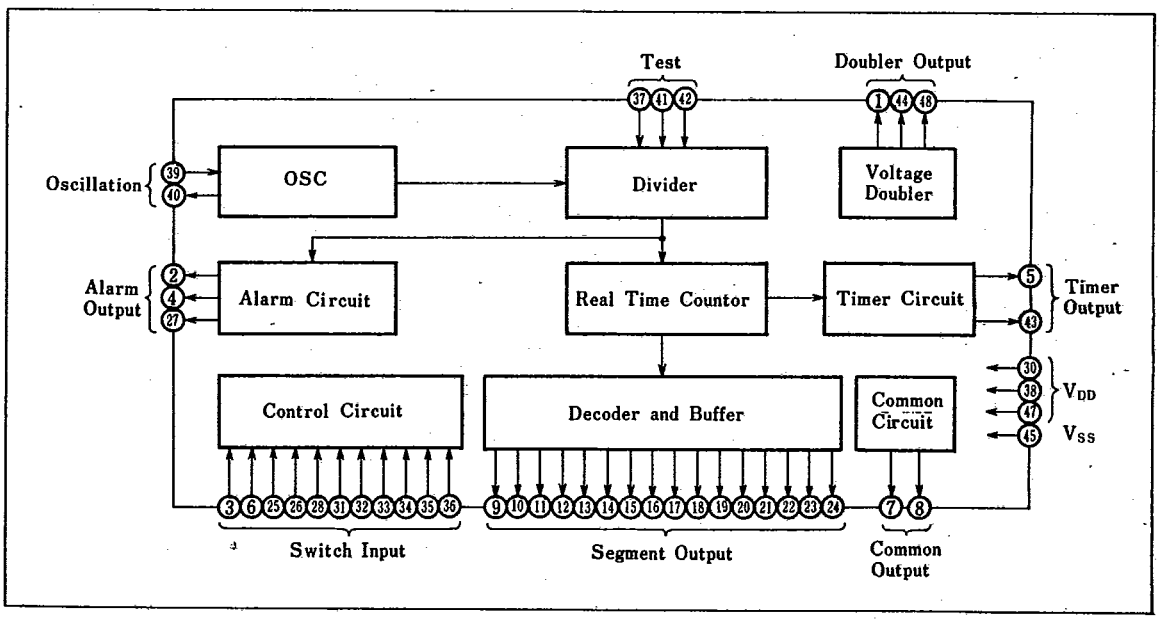
Features

1. Three functions ("Hour", "Minute", "Second") "Second" display by colon
2. Alarm function with Snooze function
3. Hourly alarm
4. Timer function
5. Instant second set function (1 to 59 sec..... No carry to the minute digit)
6. 3V dynamic LCD drive
7. 32.768kHz crystal oscillator
8. Single power supply : − 1.5V (with voltage doubler)
9. 48-pin guad flat package

Pin Connections



Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Note
Pin voltage	V_{SS}	−2.0 to +0.3	V	1
	V_{EE}	−4.0 to +0.3	V	1
	V_{IN}	V_{SS}−0.3 to +0.3	V	1,2
	V_{OUT1}	V_{SS}−0.3 to +0.3	V	1,2
	V_{OUT2}	V_{EE}−0.3 to +0.3	V	1,3
Operating temperature	T_{opr}	−10 to +60	℃	
Storage temperature	T_{stg}	−55 to +150	℃	

Note 1: Referenced to V_{DD}
Note 2: Applied to V_{SS} pin.
Note 3: Applied to V_{EE} pin.

■ Recommended Operating Conditions (Ta=25℃)

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{SS}	−1.8 to −1.2	V
	V_{EE}	$2V_{SS}$ (TYP.)	V
Oscillator frequency	f_{osc}	32.768 (TYP.)	kHz
Oscillation start voltage	V_{osc}	−1.4	V

■ Electrical Characteristics (V_{DD}=0V, V_{SS}=−1.5V, V_{EE}=−3.0V, Ta=25℃)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Current consumption	I_{total}	No load		1.5	3.0	μA	1
Oscillation start time	T_{osc}	V_{SS}=−1.4V			10	s	1
Segment output current	I_{OS}	V_{DS}=0.5V	20			μA	
Common output current	I_{OC}	V_{DS}=0.5V	60			μA	
DDC output current	I_{OD}	V_{DS}=0.5V	60			μA	
V_C output current	I_{OV}	V_{DS}=0.5V	120			μA	
AL $(AC)_{OUT}$, TS_{OUT} Output current	I_{OH1}	V_{OUT}=−0.2V	200			μA	
AL $(DC)_{OUT}$, SL_{OUT}, TM_{OUT} Output current	I_{OH2}	V_{DS}=0.2V	100			μA	
Pull down resistance	R_{S1}	V_{IN}=0V	200	700	3000	kΩ	2
	R_{S2}	V_{IN}=0V	150	500	2500	kΩ	3
	R_T	V_{IN}=0V	30	100	700	kΩ	4
Input voltage	V_{IH}	V_{SS}=−0.8 to −1.2V	−0.1		0	V	5
	V_{IL}	V_{SS}=−0.8 to −1.2V	V_{SS}		V_{SS}+0.1	V	5

Note 1: C_D=C_C=22pF, C_1=C_2=0.1μF
Note 2: Applied to pins 0.5H/1H and SF
Note 3: Applied to pins ZA, S_1, S_2, SN/SL_{OFF}, SL and AL
Note 4: Applied to pins TE, TI_1, TI_2 and IR
Note 5: Applied to pins 0.5H/1H, SF, ZA, S_1, S_2, SN/SL_{OFF}, SL, AL, IND-SEL, AL_{OFF} and 12H/24H

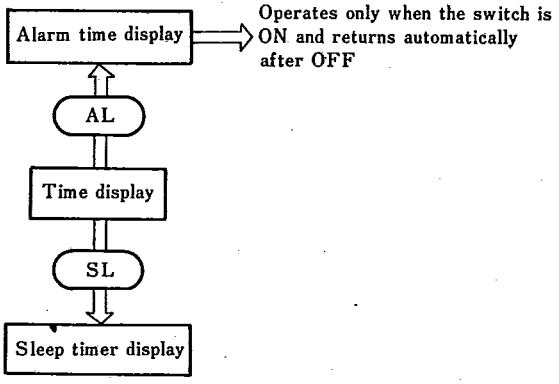
■ Specifications

(1) Input control

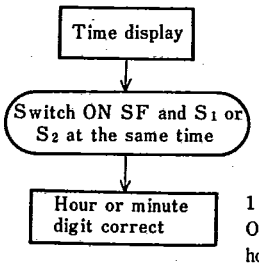
Symbol	Content	LR3441
S_1	"Hour" set	Pull down to V_{DD}
S_2	"Minute" set	Pull down to V_{DD}
SF	Safety	Pull down to V_{DD}
ZA	0 adjust	Pull down to V_{DD}
AL	Alarm mode switch	Pull down to V_{DD}
SL	Sleep timer mode switch	Pull down to V_{DD}
SN/SL_{OFF}	Snooze "ON" sleep "OFF"	Pull down to V_{DD}
AL_{OFF}	Alarm output "OFF"	Open · drain
12H/24H	12 hours/24 hours switch	Open · drain
IND_{SEL}	Indicator select	Open · drain
IR	Initial · reset	Pull down to V_{DD}
0.5H/1H	Sleep time 32 minutes/64 minutes switch	Pull down to V_{DD}

(2) Operation flow

(i) Function read operation



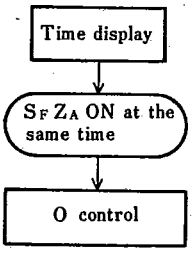
(ii) Time display adjust operation



1 word forward by 1 push.
ON for more than 2 seconds, hour digit forward by 1Hz and minute digit count up by 5 minutes at a time

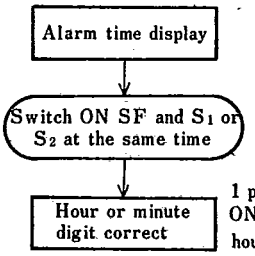
(Example) 2→3→5→10···

(iii) 0 adjust



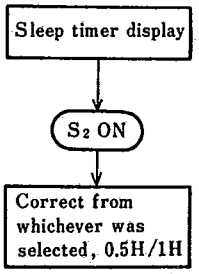
1 to 59 seconds are omitted

(iv) Alarm time display adjust operation



1 push 1 word forward
ON more than 2 seconds hour digit 1Hz forward
minute digit count up 5 minutes at a time

(v) Sleep time display adjust operation



1 word count down by 1 push.
ON for more than 2 seconds count down by 5 minutes at a time

(vi) Mode display format

Mode		Display
Time display		HH : MM
Time display adjust operation	SF & S_1 ON	*1 : MM
	SF & S_2 ON	HH : *2
Alarm time	AL ON	HH : MM
	AL & S_1 ON	*1 : MM
	AL & S_2 ON	HH : *2
Sleep timer	SL ON	MM
	SL & S_2 ON	*3

1 Hz flashing
*1 S_1 1 count-up with each ON
*2 S_2 1 count-up with each ON. Fast forward by 5 minutes if S_2 held ON for more than 2 seconds.
*3 S_2 1 count-down with each ON. Counts-down by 5 minutes if S_2 held ON for more than 2 seconds.

■ Functions

(1) Alarm function

(i) If the set alarm time coincides with the real time, the following outputs will be generated at each of the following outputs.

- At $AL(AC)_{OUT}$ 4 minute tone output of 2kHz × 8Hz × 1Hz
- At $AL(DC)_{OUT}$ approximately 32 (64) minute control output
- At TM_{OUT} approximately 32 (64) minute control output

(ii) When the SN/SL_{OFF} is turned ON while the alarm output is being generated, the output will be interrupted for approximately 7 minutes until the output generation is resumed. Called snooze function, it can be repeated for either approximately 32 minutes or 64 minutes.

(iii) The alarm indicator selected by the IND_{SEL} pin with the alarm timer being set can be displayed.

(iv) With AL_{OFF} switch connected to V_{SS}, the alarm indicator will not be displayed and alarm will not be output even if the alarm time and the real time coincide.

(v) The alarm control output time can be selected by the 0.5H/1H pin to either 32 or 64 minutes except when alarm output is being generated.

(2) Sleep timer function

(i) If the SL is depressed with no TM_{OUT} output, either 32 or 64 will be selected according to the state of the 0.5H/1H pin and TM_{OUT} and SL_{OUT} will be output.

(ii) The remainder of the time can be displayed if the SL is turned ON while the sleep timer is in operation.

(iii) Whenever the SN/SL_{OFF} pin is turned ON while the sleep timer is in operation, the sleep out will go OFF.

(iv) If the SL is turned ON during the alarm output, the TM_{OUT} and $AL(DC)_{OUT}$ will be output for another 32 or 64 minutes. The timer interval can be selected by the 0.5H/1H pin to either 32 or 64 minutes except in the sleep operation.

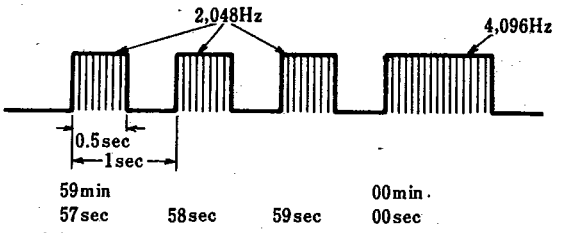
(v) When S_2 has been depressed to set the sleep timer to "0" in rapid feed, it will stay at "0" on further depression of S_2.

(3) Timer out

The TM output (DC) will be generated when either the sleep output or the alarm output (DC) is generated. The timer out is an OR-circuit of the sleep out and $AL(DC)_{OUT}$. If the AL_{OFF} is ON with only AL(DC) as the output, the timer out will also be turned OFF.

(4) Time signal

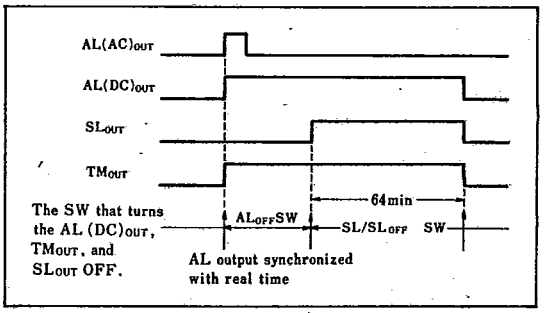
The TS_{OUT} pin that outputs time signal is provided. The output starts at 59 minutes 57 seoncds. (See the figure below.)



(5) In the case of alarm and sleep overlap

(i) The figure below shows the state of each output pin when the sleep timer goes into operation during the alarm output.

When the SL is turned ON, the $AL(DC)_{OUT}$ and TM_{OUT} intervals will be set to another 64 min/32 min. When the SN/SL_{OFF} is turned ON, the TM_{OUT}, AL_{OUT}, and SL_{OFF} will be turned OFF.



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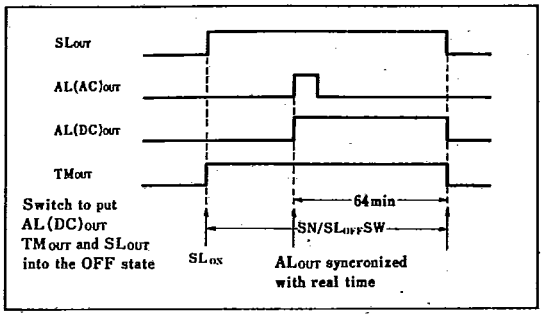
(ii) When the alarm time and the real time coincide while the sleep timer is in operation to generate the alarm output, the SL_{OUT} and TM_{OUT} intervals will be set for another 64 min/32 min.



In this case if the SN/SL_{OFF} is turned ON, the $AL(DC)_{OUT}$ and $AQ(AC)_{OUT}$ will go OFF never to be output even 7 minutes later. When the AL_{OFF} is turned ON, only the $AL(AC)_{OUT}$ will go OFF.

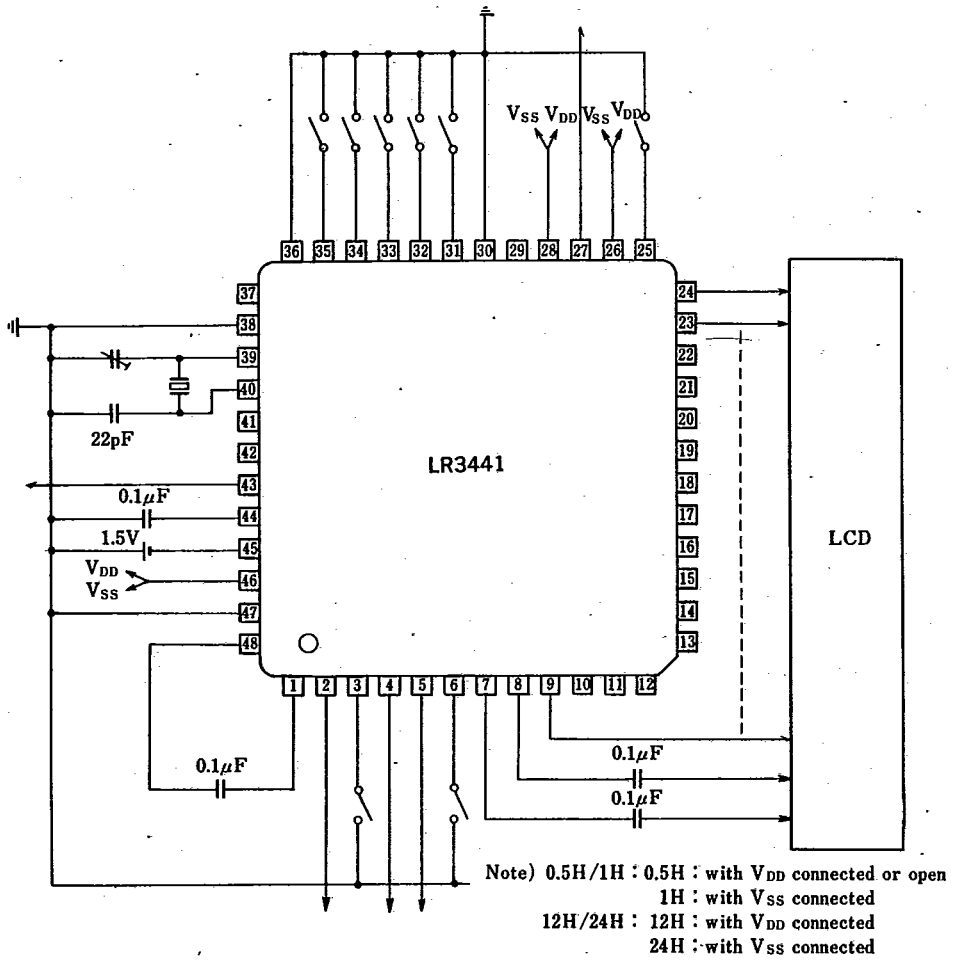
(6) Initial reset

If the IR pin is connected to V_{SS}, initial reset will be applied to immediately reset all the counters and AM 12 : 00 or 0 : 00 will be displayed depending on the 12H system in the case of the former, 24H system in the case of the latter.

(7) Indicator select

The IND_{SEL} pin can select either the bell mark or the note mark.
Note mark : with V_{DD} connected or open
Bell mark : with V_{SS} connected

■ System Configuration Example



Note) 0.5H/1H : 0.5H : with V_{DD} connected or open
1H : with V_{SS} connected
12H/24H : 12H : with V_{DD} connected
24H : with V_{SS} connected