

# LR3441 LCD Digital Clock Driver LSI

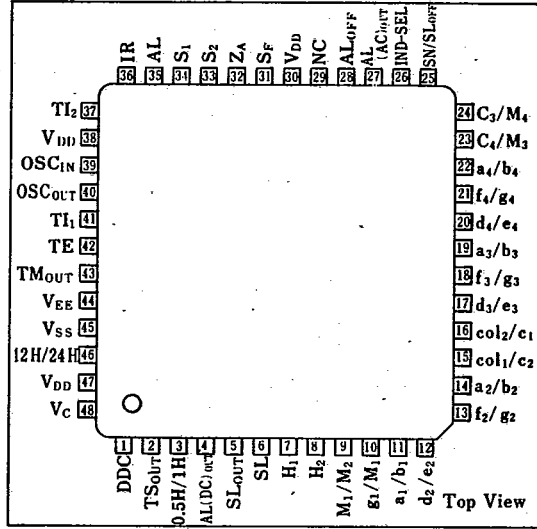
## Description

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

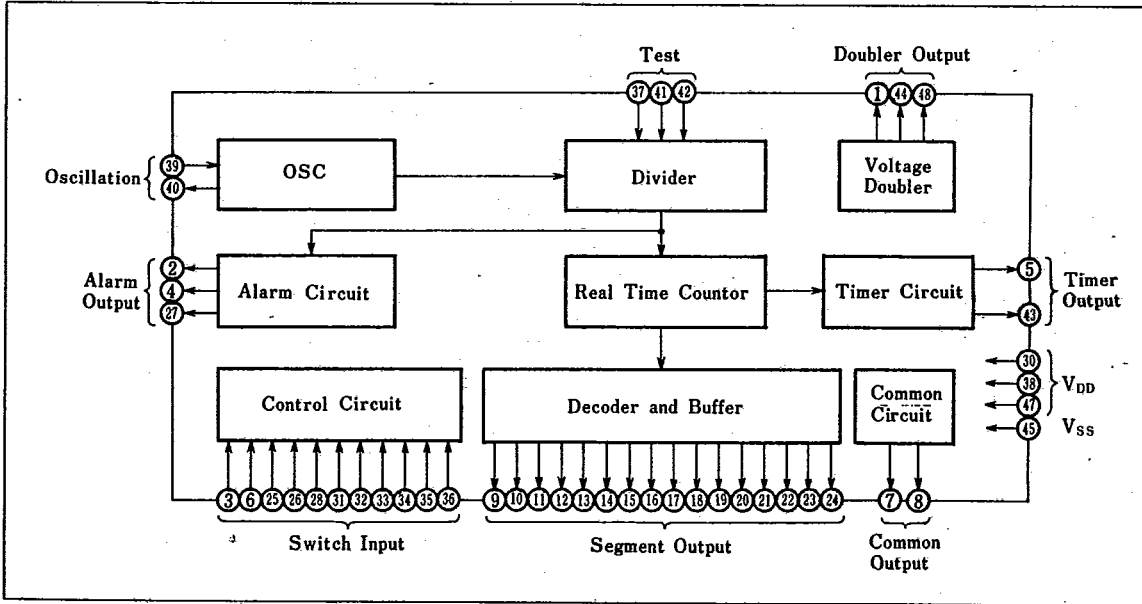
## Features

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 quad flat package

## Pin Connections



## Block Diagram



### Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit	Note
Pin voltage	V <sub>SS</sub>	-2.0 to +0.3	V	1
	V <sub>EE</sub>	-4.0 to +0.3	V	1
	V <sub>IN</sub>	V <sub>SS</sub> -0.3 to +0.3	V	1,2
	V <sub>OUT1</sub>	V <sub>SS</sub> -0.3 to +0.3	V	1,2
	V <sub>OUT2</sub>	V <sub>EE</sub> -0.3 to +0.3	V	1,3
Operating temperature	T <sub>opr</sub>	-10 to +60	°C	
Storage temperature	T <sub>str</sub>	-55 to +150	°C	

Note 1: Referenced to V<sub>DD</sub>

Note 2: Applied to V<sub>SS</sub> pin.

Note 3: Applied to V<sub>EE</sub> pin.

### Recommended Operating Conditions (Ta=25°C)

Parameter	Symbol	Ratings	Unit
Supply voltage	V <sub>SS</sub>	-1.8 to -1.2	V
	V <sub>EE</sub>	2V <sub>SS</sub> (TYP.)	V
Oscillator frequency	f <sub>osc</sub>	32.768 (TYP.)	kHz
Oscillation start voltage	V <sub>osc</sub>	-1.4	V

### Electrical Characteristics

(V<sub>DD</sub>=0V, V<sub>SS</sub>=-1.5V, V<sub>EE</sub>=-3.0V, Ta=25°C)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit	Note
Current consumption	I <sub>total</sub>	No load		1.5	3.0	μA	1
Oscillation start time	T <sub>osc</sub>	V <sub>SS</sub> =-1.4V			10	s	1
Segment output current	I <sub>OS</sub>	V <sub>DS</sub> =0.5V	20			μA	
Common output current	I <sub>OC</sub>	V <sub>DS</sub> =0.5V	60			μA	
DDC output current	I <sub>OD</sub>	V <sub>DS</sub> =0.5V	60			μA	
V <sub>C</sub> output current	I <sub>OV</sub>	V <sub>DS</sub> =0.5V	120			μA	
AL (AC) <sub>OUT</sub> , TS <sub>OUT</sub> Output current	I <sub>OH1</sub>	V <sub>OUT</sub> =-0.2V	200			μA	
AL (DC) <sub>OUT</sub> , SL <sub>OUT</sub> , TM <sub>OUT</sub> Output current	I <sub>OH2</sub>	V <sub>DS</sub> =0.2V	100			μA	
Pull down resistance	R <sub>S1</sub>	V <sub>IN</sub> =0V	200	700	3000	kΩ	2
	R <sub>S2</sub>	V <sub>IN</sub> =0V	150	500	2500	kΩ	3
	R <sub>T</sub>	V <sub>IN</sub> =0V	30	100	700	kΩ	4
Input voltage	V <sub>IH</sub>	V <sub>SS</sub> =-0.8 to -1.2V	-0.1		0	V	5
	V <sub>IL</sub>	V <sub>SS</sub> =-0.8 to -1.2V	V <sub>SS</sub>		V <sub>SS</sub> +0.1	V	5

Note 1: C<sub>D</sub>=C<sub>C</sub>=22pF, C<sub>1</sub>=C<sub>2</sub>=0.1μF

Note 2: Applied to pins 0.5H/1H and SF

Note 3: Applied to pins ZA, S<sub>1</sub>, S<sub>2</sub>, SN/SL<sub>OFF</sub>, SL and AL

Note 4: Applied to pins TE, TI<sub>1</sub>, TI<sub>2</sub> and IR

Note 5: Applied to pins 0.5H/1H, SF, ZA, S<sub>1</sub>, S<sub>2</sub>, SN/SL<sub>OFF</sub>, SL, AL, IND-SEL, AL<sub>OFF</sub> and 12H/24H



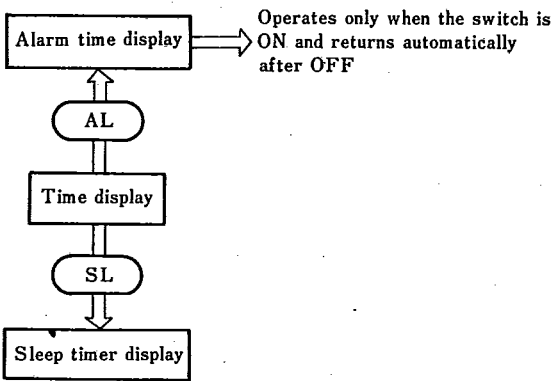
■ Specifications

(1) Input control

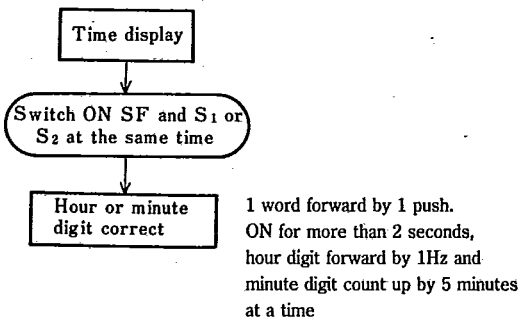
Symbol	Content	LR3441
S <sub>1</sub>	"Hour" set	Pull down to V <sub>DD</sub>
S <sub>2</sub>	"Minute" set	Pull down to V <sub>DD</sub>
SF	Safety	Pull down to V <sub>DD</sub>
ZA	0 adjust	Pull down to V <sub>DD</sub>
AL	Alarm mode switch	Pull down to V <sub>DD</sub>
SL	Sleep timer mode switch	Pull down to V <sub>DD</sub>
SN/SL <sub>OFF</sub>	Snooze "ON" sleep "OFF"	Pull down to V <sub>DD</sub>
AL <sub>OFF</sub>	Alarm output "OFF"	Open · drain
12H/24H	12 hours/24 hours switch	Open · drain
IND <sub>SEL</sub>	Indicator select	Open · drain
IR	Initial · reset	Pull down to V <sub>DD</sub>
0.5H/1H	Sleep time 32 minutes/64 minutes switch	Pull down to V <sub>DD</sub>

(2) Operation flow

(i) Function read operation

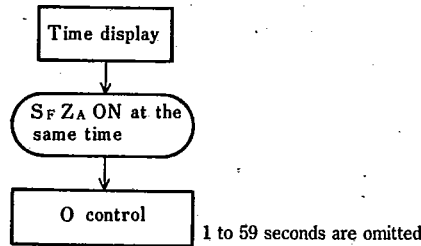


(ii) Time display adjust operation

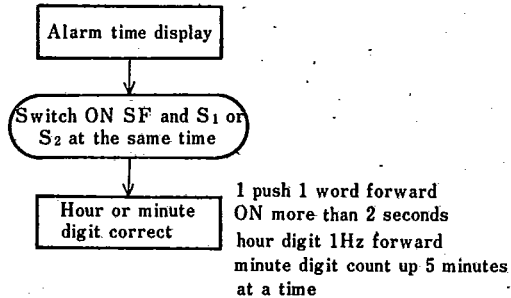


(Example) 2 → 3 → 5 → 10...

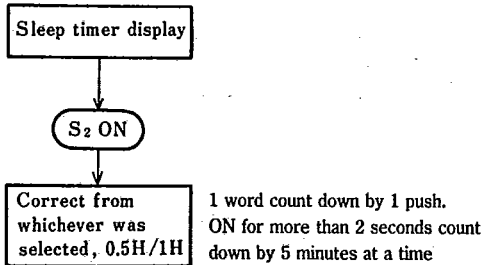
(iii) 0 adjust



(iv) Alarm time display adjust operation



(v) Sleep time display adjust operation



## (vi) Mode display format

Mode		Display
Time display		HH : MM
Time display	SF & S <sub>1</sub> ON	*1 : MM
adjust operation	SF & S <sub>2</sub> ON	HH : *2
Alarm time	AL ON	HH : MM
	AL & S <sub>1</sub> ON	*1 : MM
Sleep timer	AL & S <sub>2</sub> ON	HH : *2
	SL ON	MM
	SL & S <sub>2</sub> ON	*3

1 Hz flashing

\*1 S<sub>1</sub> 1 count-up with each ON\*2 S<sub>2</sub> 1 count-up with each ON. Fast forward by 5 minutes if S<sub>2</sub> held ON for more than 2 seconds.\*3 S<sub>2</sub> 1 count-down with each ON. Counts-down by 5 minutes if S<sub>2</sub> 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)<sub>OUT</sub> 4 minute tone output of 2kHz × 8Hz × 1Hz
- At AL(DC)<sub>OUT</sub> approximately 32 (64) minute control output
- At TM<sub>OUT</sub> approximately 32 (64) minute control output

(ii) When the SN/SL<sub>OFF</sub> 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<sub>SEL</sub> pin with the alarm timer being set can be displayed.

(iv) With AL<sub>OFF</sub> switch connected to V<sub>SS</sub>, 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<sub>OUT</sub> output, either 32 or 64 will be selected according to the state of the 0.5H/1H pin and TM<sub>OUT</sub> and SL<sub>OUT</sub> 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<sub>OFF</sub> 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<sub>OUT</sub> and AL(DC)<sub>OUT</sub> 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.

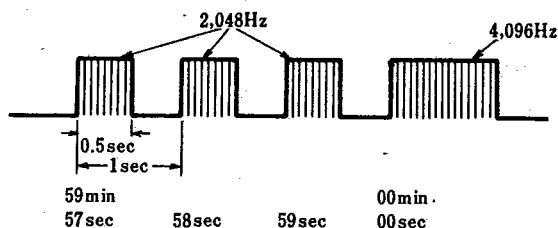
(v) When S<sub>2</sub> has been depressed to set the sleep timer to "0" in rapid feed, it will stay at "0" on further depression of S<sub>2</sub>.

## (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)<sub>OUT</sub>. If the AL<sub>OFF</sub> is ON with only AL(DC) as the output, the timer out will also be turned OFF.

## (4) Time signal

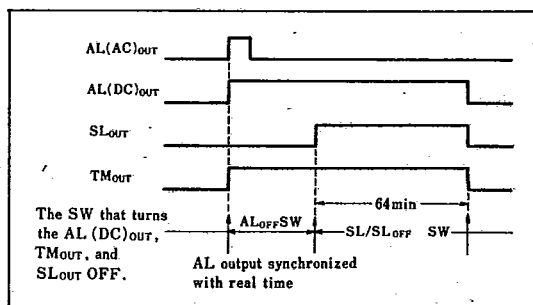
The TS<sub>OUT</sub> pin that outputs time signal is provided. The output starts at 59 minutes 57 seconds. (See the figure below.)



## (5) In the case of alarm and sleep overlap

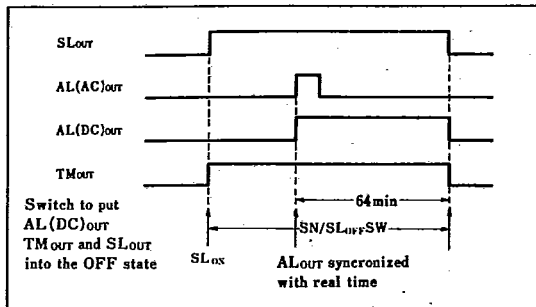
(i) The figure below shows the state of each output pin when the sleep timer goes into operation during the alarm output.

When the SL is turned ON, the AL(DC)<sub>OUT</sub> and TM<sub>OUT</sub> intervals will be set to another 64 min/32 min. When the SN/SL<sub>OFF</sub> is turned ON, the TM<sub>OUT</sub>, AL<sub>OUT</sub>, and SL<sub>OFF</sub> 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.

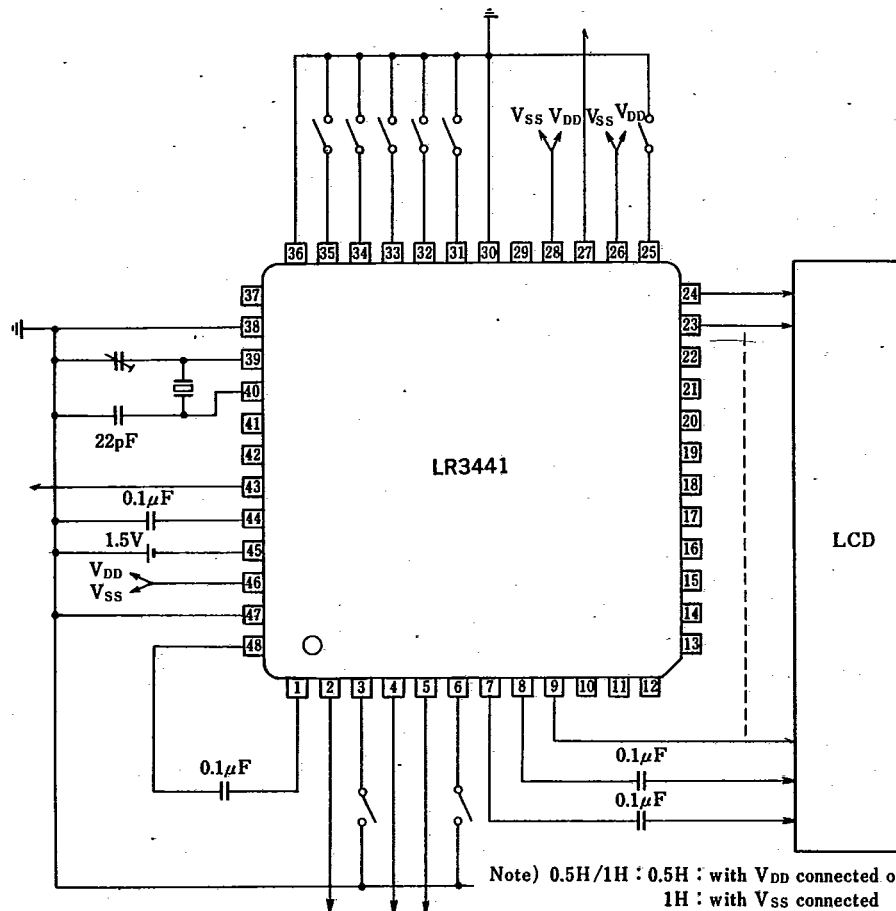
(7) Indicator select

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