

CMOS LSI

SANYO

No. 2644A

LC7730,7730M

Timer

Overview:

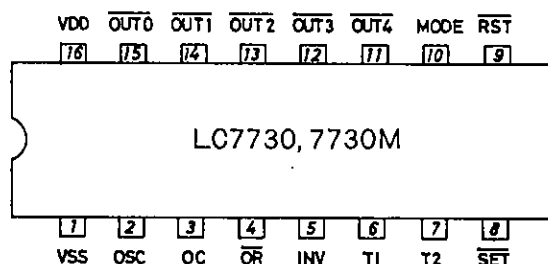
The LC7730s are the stable long-running timers that consists of a CR oscillator and multi-stage counters. If a 4.66kHz clock is used as a standard clock input, they can be used as an hour-long timer.

Features:

- Elapsed time display function
- Two operation modes
- 15V withstand voltage open drain output for switching output (NPN and PNP type transistors directly drivable by the INV input selection)
- Various timer values can be set by changing the oscillator CR value properly (from 10 minutes to several hours).

Applications:

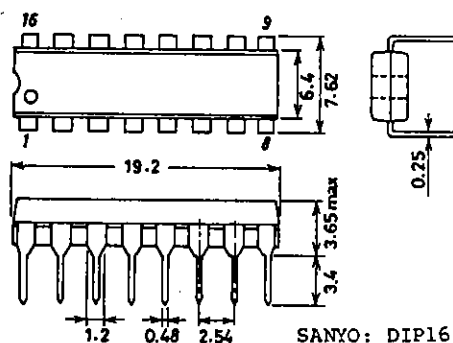
- Sleep timer for radios and radio cassette players
- Battery charger timer
- Ultra-low frequency signal generator

**Package Dimensions**

(unit: mm)

3006B-D16IC

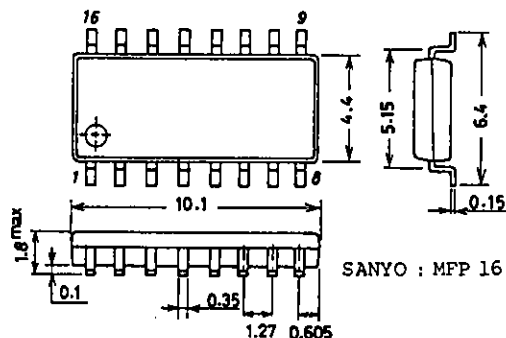
[LC7730]

**Package Dimensions**

(unit: mm)

3035A-M16IC

[LC7730M]



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Absolute Maximum Ratings/ $T_a=25\pm2^\circ\text{C}$, $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Limits	unit
Maximum Supply Voltage	$V_{DD\text{ max}}$		$-0.3\sim7.0$	V
Input Voltage	V_{IN}		$-0.3\sim V_{DD}+0.3$	
Output Voltage	V_{OUT1}	Pin $\overline{\text{OUT0}}$	$-0.3\sim15.0$	
	V_{OUT2}	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$	$-0.3\sim V_{DD}+0.3$	
Output Current	I_{OUT1}	Pin $\overline{\text{OUT0}}$	15	mA
	I_{OUT2}	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$	± 5	
Power Dissipation	$P_d\text{ max}$	DIP, $T_a\leq 75^\circ\text{C}$	300	mW
		MFP, $T_a\leq 75^\circ\text{C}$	150	
Operating Temperature	T_{opr}		$-10\sim+75$	$^\circ\text{C}$
Storage Temperature	T_{stg}		$-55\sim+125$	

Allowable Operating Range/ $T_a=-10$ to $+75^\circ\text{C}$, $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Limits			unit
			min	typ	max	
Supply Voltage	V_{DD}	T_{opg}	1.8		6.0	V
Input Voltage	V_{IN}	T_{opg}	0		V_{DD}	
Output Voltage	V_{OUT1}	T_{opg} , pin $\overline{\text{OUT0}}$	0		15.0	
	V_{OUT2}	T_{opg} , Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$	0		V_{DD}	

Electrical Characteristics/ $T_a=25\pm2^\circ\text{C}$, $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Limits			unit	
			VDD(V)	min	typ		max
Current Dissipation	IDD1	fosc=4.66kHz	5			1.0	mA
	IDD2	OSC stop	5			1.0	μA
'L' Level Output Current	IOL1	Pin $\overline{\text{OUT0}}$, VOL= 1 V	2	1.0			mA
	IOL2	Pin $\overline{\text{OUT0}}$, VOL= 1 V	3	5.0			
Output Off-leakage Current	IOFF	Pin $\overline{\text{OUT0}}$, Vo=15V	5			10	μA
'H' Level Output Current	IOH	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$,VOH=2.5V	3			-200	μA
'L' Level Output Current	IOL3	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$,VOL=0.5V	3	200			
'H' Level Input Current	IIH1	Pins $\overline{\text{RST}}$ and $\overline{\text{SET}}$ (50kΩ pull-up resistance)	5			1.0	μA
'L' Level Input Current	IL1		5		-100		
'H' Level Input Current	IIH2	Pins T1 and T2 (50kΩ pull-down resistance)	5		100		μA
'L' Level Input Current	IIL2		5	-1.0			
'H' Level Input Current	IIH3	Pins INV and MODE	5			1.0	μA
'L' Level Input Current	IIL3		5	-1.0			
'H' Level Input Voltage	VIH			0.7VDD		VDD	V
'L' Level Input Voltage	VIL			0		0.3VDD	

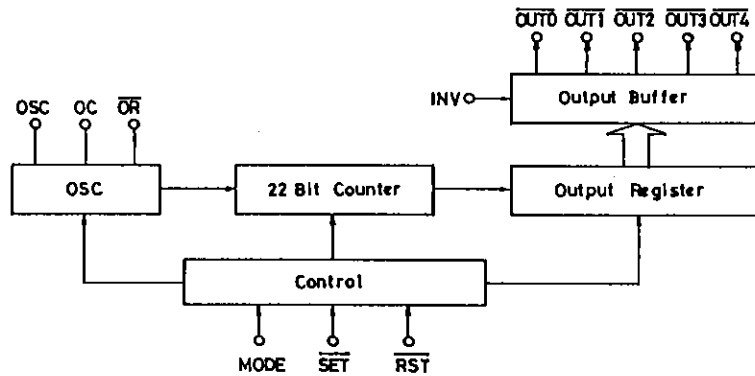


Figure-1. LC7730 Configuration

1. Oscillation Circuit

The LC7730 uses a CR oscillation circuit to generate various timing signals.

The C and R shown in Figure-2 determine a time constant to generate required timing signals. The RS is a resistance to limit the current that flows into the input protection circuit, thereby reducing the total power dissipation of the oscillation circuit.

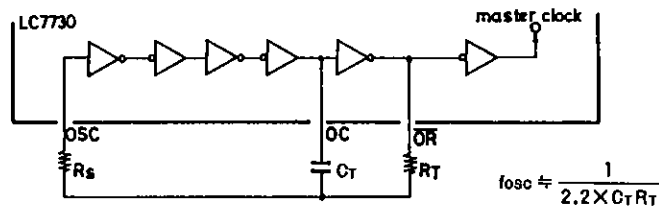


Figure-2. Oscillation Circuit

If the LC7730 uses an oscillation frequency of 4.66kHz, it can work as an hour-long timer. As the oscillation frequency can be changed, the LC7730 can be used as various types of timers. The relation between oscillation frequencies and timer values is as follows:

$$f_{osc}(\text{Hz}) = \frac{2^{24}}{\text{Timer value} \times 60 (\text{min.})} \quad \left(f_{osc} \approx \frac{1}{2.2 \times C_T R_T} \right)$$

•Timer values and Oscillation frequencies

Timer value	Oscillation frequency	Timer value	Oscillation frequency
10 minutes	28.0kHz	1 hour	4660Hz
20 minutes	14.0kHz	2 hours	2330Hz
30 minutes	9320Hz	3 hours	1554Hz
40 minutes	6991Hz	4 hours	1165Hz
50 minutes	5592Hz	5 hours	932Hz

2. Basic LC7730 Operations

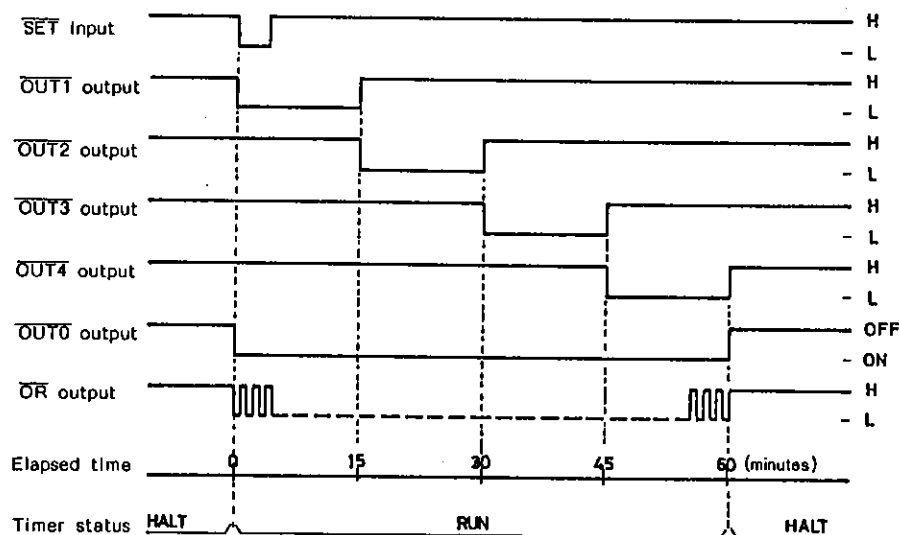


Figure-3. Basic operational timing chart

(fosc=4.66kHz/RST input pin = 'H' level, INV input pin = 'L' level)

If the SET pin of the timer currently in the stop mode becomes active (active low), the timer will enter the 'run' status. When the timer is started, it turns on the $\overline{\text{OUT0}}$ output pin to drive a external load and then outputs an 'L' level signal from the $\overline{\text{OUT1}}$ pin. Output pins from $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$ are provided to display timer elapsed times. They become active ('L' level) very 15 minutes in the order of $\overline{\text{OUT1}}$, $\overline{\text{OUT2}}$, $\overline{\text{OUT3}}$ and $\overline{\text{OUT4}}$.

If an hour elapses after the timer is started (with the fosc=4.66kHz), the timer turns off the $\overline{\text{OUT1}}$ pin, inactivates output pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$, and then enters the stop mode.

When the timer enters the stop mode, it stops the oscillation to reduce the power dissipation.

Note that if the INV input pin changes to the 'H' level, the $\overline{\text{OUT0}}$ output will be inverted.

Table-1. Operational Status-Output level (fosc=4.66kHz)

Operational status		Output					
Status	Time elapsed (minute)	$\overline{\text{OUT0}}$		$\overline{\text{OUT1}}$	$\overline{\text{OUT2}}$	$\overline{\text{OUT3}}$	$\overline{\text{OUT4}}$
		INV input L level	INV input H level				
HALT	—	1	0	1	1	1	1
RUN	0~15	0	1	0	1	1	1
RUN	15~30	0	1	1	0	1	1
RUN	30~45	0	1	1	1	0	1
RUN	45~60	0	1	1	1	1	0

HALT: Stop
RUN : In action

0: L level
1: H level

Note: The $\overline{\text{OUT0}}$ H level means that the open drain output transistor is in the OFF state.

3. LC7730 Control

The LC7730 can be controlled by using three pins $\overline{\text{RST}}$ (active low), $\overline{\text{SET}}$ (active low) and MODE (active high).

If the $\overline{\text{RST}}$ (reset) pin changes its level to 'L' from 'H', the timer will stop and its internal circuitry will be reset. This pin has the schmitt input specification with an internal pull-up resistance. If a capacitor is added to this pin externally, the power-on reset circuit will be formed.

The $\overline{\text{SET}}$ (active low) pin is used to input a start/stop and start/preset signal to the timer. The pin functions depend on the MODE pin level. The $\overline{\text{SET}}$ pin has a chattering elimination circuit with an internal pull-up resistance. The timer will start its operation at the moment when this pin becomes active.

The MODE pin has the functions as shown in Table-2. It is used to select one of the $\overline{\text{SET}}$ pin functions.

Table-2. MODE input pin and $\overline{\text{SET}}$ pin functions

MODE input	$\overline{\text{SET}}$ pin function
0	Start/stop input
1	Start/preset input

(1) Start/stop function (MODE pin = 'L' level)

If MODE pin = 'L', the $\overline{\text{SET}}$ pin can be used for start/stop input. When the timer is in the stop state and the $\overline{\text{SET}}$ pin becomes active (active low), the timer is started. If the timer is in action and the $\overline{\text{SET}}$ pin becomes inactive, the timer stops.

(2) Start/preset function (MODE pin = 'H' level)

If MODE pin = 'H', the $\overline{\text{SET}}$ pin can be used for start/preset input. When the timer is in the stop state and the $\overline{\text{SET}}$ pin becomes active (active low), the timer is started. If the $\overline{\text{SET}}$ pin becomes active immediately after the timer is started, the timer value advances 15 minutes.

Table-3. Preset time value ($f_{\text{osc}}=4.66\text{kHz}$)

Elapse time (minute)	Preset time (minute)
0 to 15	15
15 to 30	30
30 to 45	45
45 to 60	60

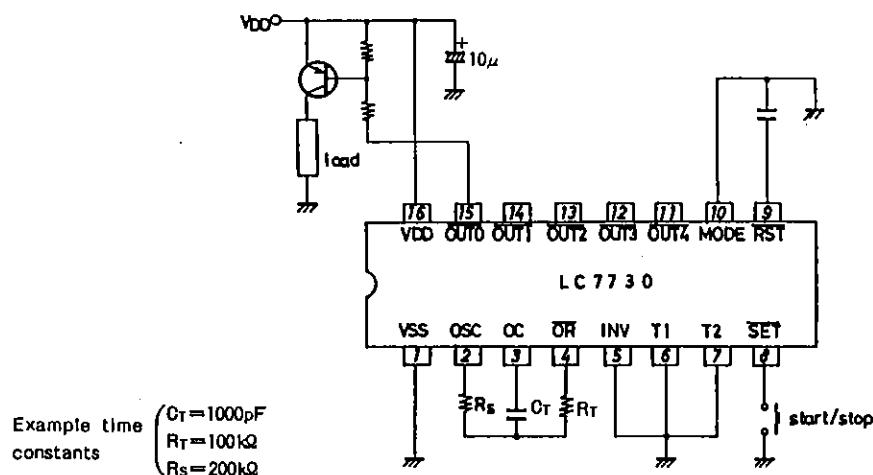
Table-4. Input-operational status relationship

Status	Input			Resulted status	Remarks
	$\overline{\text{RST}}$	$\overline{\text{SET}}$	MODE		
HALT	0	X	X	HALT	Reset
RUN	0	X	X	HALT	
HALT	1	\downarrow	0	RUN	Start/stop mode
RUN	1	\downarrow	0	HALT	
HALT	1	\downarrow	1	RUN	Start/preset mode
RUN	1	\downarrow	1	RUN (preset)	

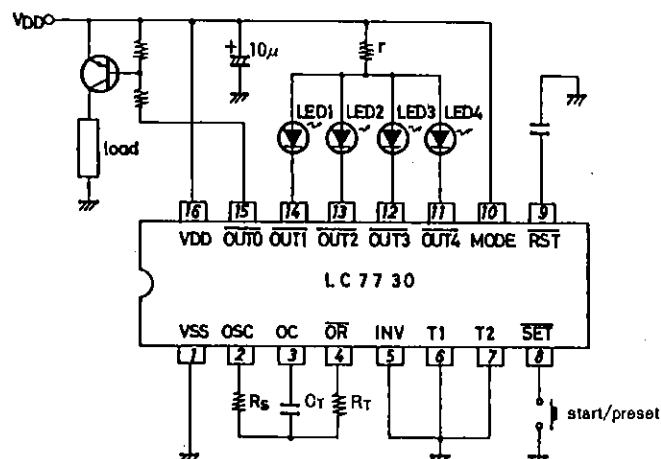
HALT : Stop 0 : 'L' level X : Don't care
 RUN : In action 1 : 'H' level \downarrow : Falling signal edge

4. Sample Application Circuits

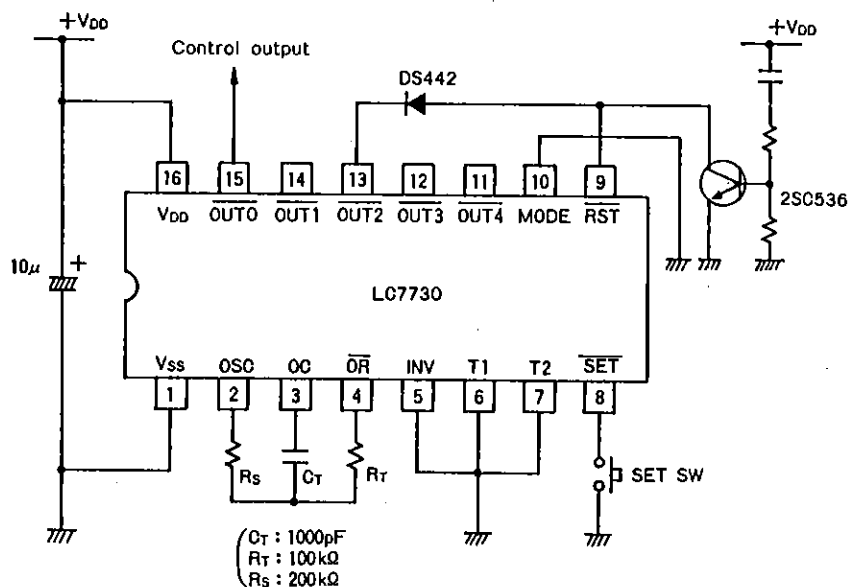
(1) Sleep timer I (minimum configuration)



(2) Sleep timer II (preset function/elapsed time display)



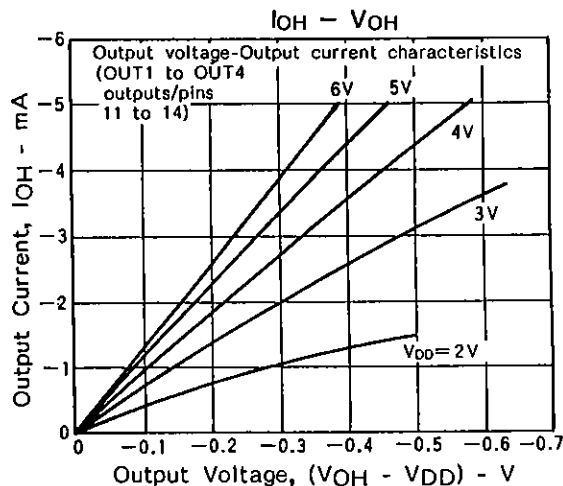
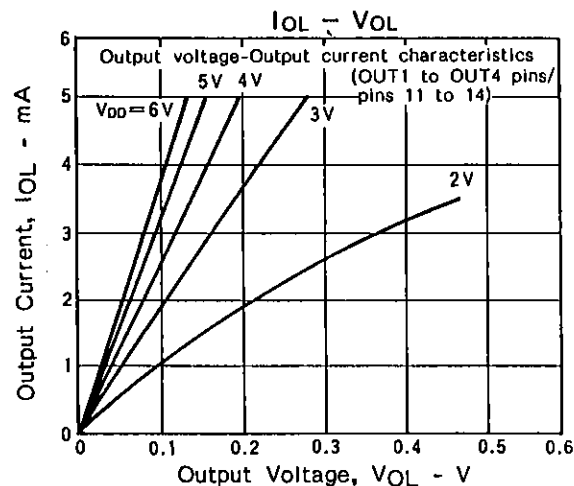
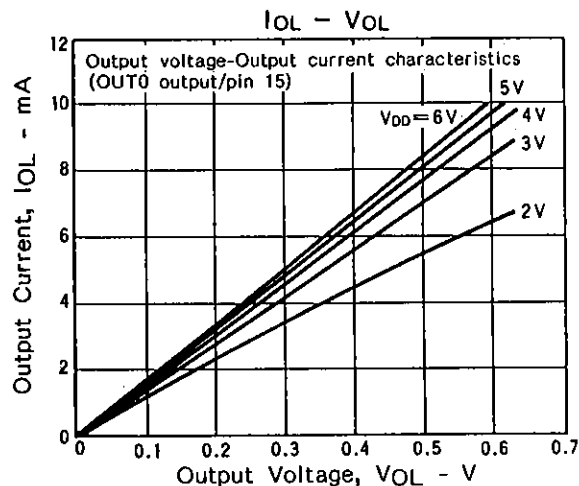
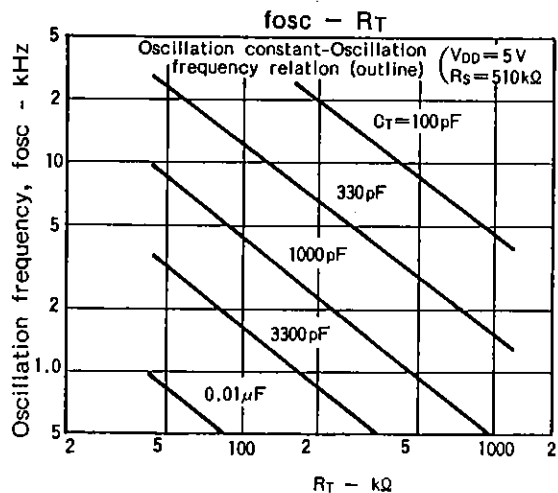
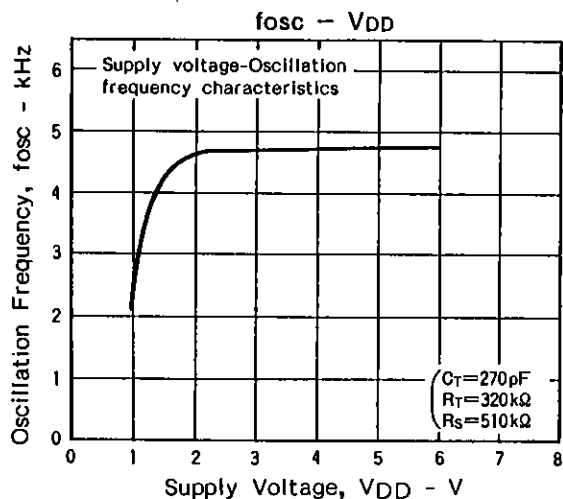
(3) Application example using smaller timer value



In this application circuit, the $\overline{\text{OUT2}}$ pin output signal causes the timer to be forcibly reset. This can be called a self-reset function. As a result, this timer value can be reduced to the 1/4 of a normal time value. The CR time constant is given for an hour-long timer. However, this timer can work as a 15-minute timer.

The time value for this circuit is calculated in the following manner:

$$f_{osc}(\text{Hz}) = \frac{2^{22}}{\text{Timer value} \times 60 (\text{min.})}$$



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