

SANYO	No. 2644A	CMOS LSI
	LC7730,7730M	
		Timer

Overview:

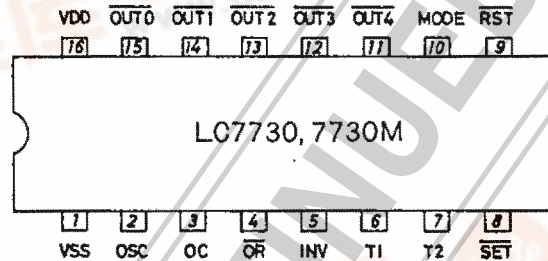
The LC7730s are the stable long-running timers that consists of a CR oscillator and multi-stage counters. If a 4.66kHz clock is used as a standard clock input, they can be used as an hour-long timer.

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

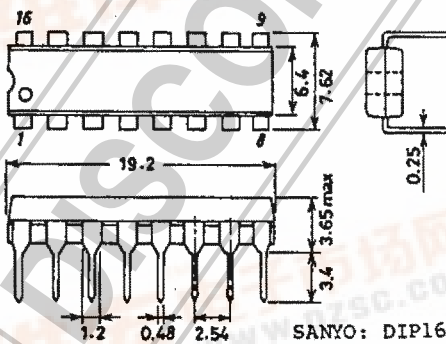


Package Dimensions

(unit: mm)

3006B-D16IC

[LC7730]

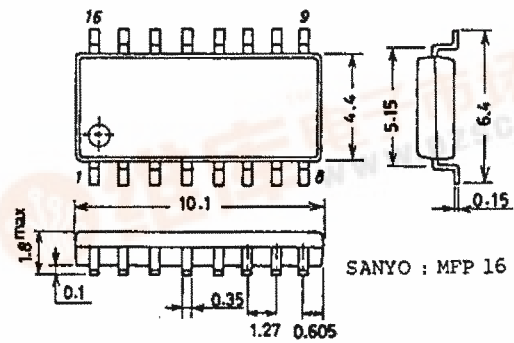


Package Dimensions

(unit: mm)

3035A-M16IC

[LC7730M]



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Absolute Maximum Ratings/ $T_a=25\pm 2^\circ\text{C}$, $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Limits	unit
Maximum Supply Voltage	$V_{DD\text{ max}}$		-0.3~7.0	V
Input Voltage	V_{IN}		-0.3~ $V_{DD}+0.3$	
Output Voltage	V_{OUT1}	Pin $\overline{\text{OUT0}}$	-0.3~15.0	
	V_{OUT2}	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$	-0.3~ $V_{DD}+0.3$	
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~+75	°C
Storage Temperature	T_{stg}		-55~+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/ $T_a=25\pm 2^\circ\text{C}$, $V_{SS}=0\text{V}$

Parameter	Symbol	Conditions	Limits				unit
			$V_{DD}(\text{V})$	min	typ	max	
Current Dissipation	I_{DD1}	$f_{osc}=4.66\text{kHz}$	5			1.0	mA
	I_{DD2}	OSC stop	5			1.0	
'L' Level Output Current	I_{OL1}	Pin $\overline{\text{OUT0}}$, $V_{OL}=1\text{V}$	2	1.0			mA
	I_{OL2}	Pin $\overline{\text{OUT0}}$, $V_{OL}=1\text{V}$	3	5.0			
Output Off-leakage Current	I_{OFF}	Pin $\overline{\text{OUT0}}$, $V_o=15\text{V}$	5			10	μA
'H' Level Output Current	I_{OH}	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$, $V_{OH}=2.5\text{V}$	3			-200	μA
'L' Level Output Current	I_{OL3}	Pins $\overline{\text{OUT1}}$ to $\overline{\text{OUT4}}$, $V_{OL}=0.5\text{V}$	3	200			
'H' Level Input Current	I_{IH1}	Pins $\overline{\text{RST}}$ and $\overline{\text{SET}}$ (50k Ω pull-up resistance)	5			1.0	μA
'L' Level Input Current	I_{IL1}		5		-100		
'H' Level Input Current	I_{IH2}	Pins T1 and T2 (50k Ω pull-down resistance)	5		100		μA
'L' Level Input Current	I_{IL2}		5	-1.0			
'H' Level Input Current	I_{IH3}	Pins $\overline{\text{INV}}$ and $\overline{\text{MODE}}$	5			1.0	μA
'L' Level Input Current	I_{IL3}		5	-1.0			
'H' Level Input Voltage	V_{IH}			0.7 V_{DD}		V_{DD}	V
'L' Level Input Voltage	V_{IL}			0		0.3 V_{DD}	

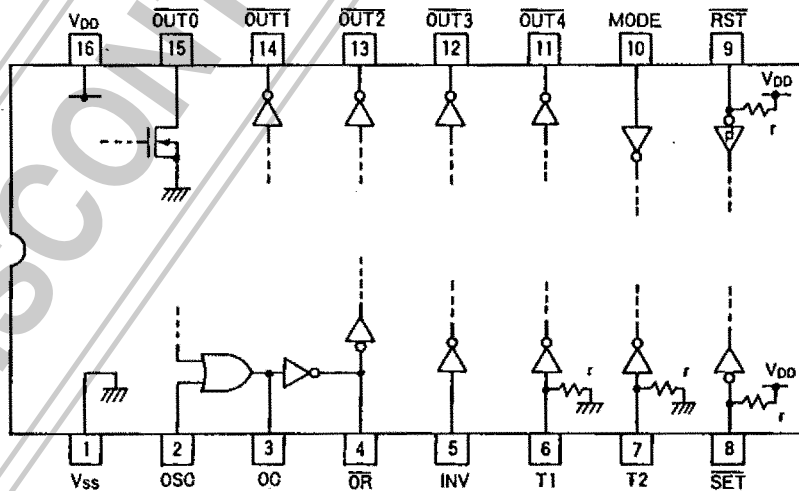
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● Pin Description

Pin No.	Pin Name	Functional Description	Input/Output
1	VSS	Power supply pin (0V)	—
2	OSC	Oscillation pins for external CR addition	Input
3	OC		Input/output
4	OR		Input/output
5	INV	Input pin for OUT0 output inversion (normally, this pin level is 'L'). H level: Output transistor OFF at the timer run time. L level: Output transistor ON at the timer run time.	Input
6	T1	Test pin (Normally, this pin is connected with the Vss pin or left open).	Input with a pull-down resistor
7	T2		Input with a pull-down resistor
8	SET	Set pin (for control input to the timer) If the MODE input = 'H', this pin is used to input a start/preset signal to the timer. If the MODE input = 'L', this pin is used to input a start/stop signal to the timer.	Input with a pull-up resistor
9	RST	Reset pin (for reset or stop input to the timer) If a capacitor is added externally to this pin, a power-on reset circuit can be formed.	Input with a pull-up resistor (Schmitt input)
10	MODE	Operation mode select pin (SET input function)	Input
11	OUT4	Output pins for elapsed time display If the chip is used as an hour-long timer, these pins become active ('L') every 15 minutes in the order of OUT1, OUT2, OUT3 and OUT4.	Output
12	OUT3		Output
13	OUT2		Output
14	OUT1		Output
15	OUT0	Switching output pin Output pin for switching the timer loads in radio circuits, etc. Normally, buffered by an external PNP transistor.	Open drain output
16	VDD	Power supply pin (1.8V to 6.0V)	—

Note: If a pin is low active, it is indicated by a 'top bar'.

-Input/Output Configuration



r ≈ 50kΩ

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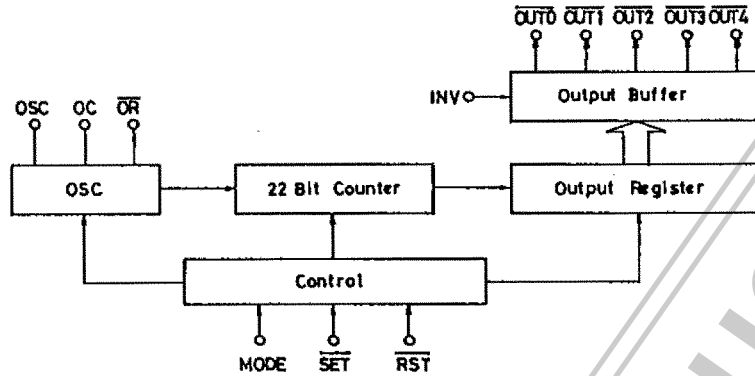


Figure-1. LC7730 Configuration

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.

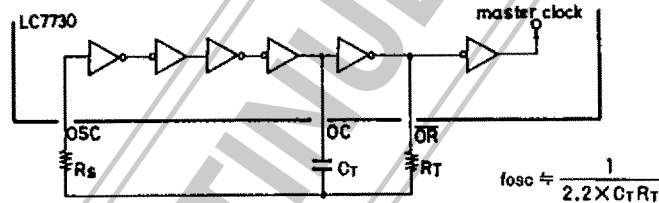


Figure-2. Oscillation Circuit

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

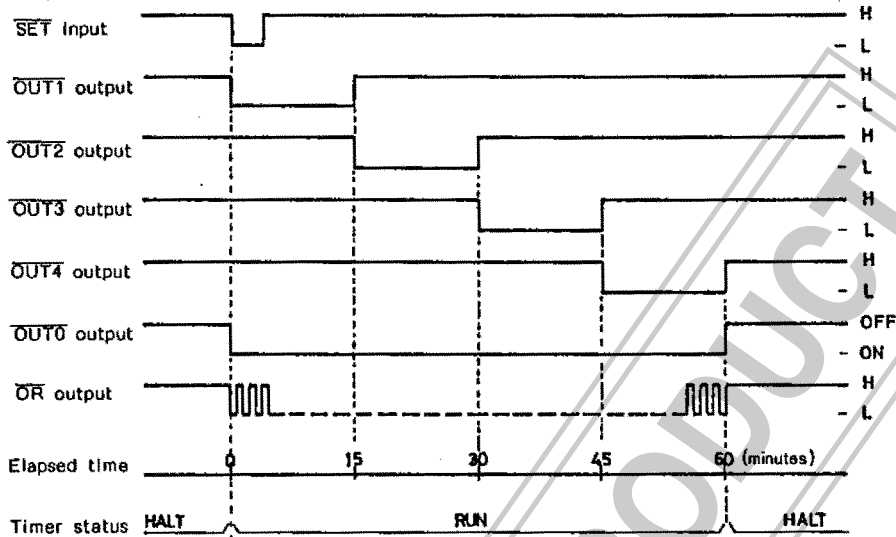


Figure-3. Basic operational timing chart
(fosc=4.66kHz/RST input pin = 'H' level, INV input pin = 'L' level)

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 $\overline{OUT0}$ output pin to drive a external load and then outputs an 'L' level signal from the $\overline{OUT1}$ pin. Output pins from $\overline{OUT1}$ to $\overline{OUT4}$ are provided to display timer elapsed times. They become active ('L' level) very 15 minutes in the order of $\overline{OUT1}$, $\overline{OUT2}$, $\overline{OUT3}$ and $\overline{OUT4}$.

If an hour elapses after the timer is started (with the fosc=4.66kHz), the timer turns off the $\overline{OUT1}$ pin, inactivates output pins $\overline{OUT1}$ to $\overline{OUT4}$, 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 $\overline{OUT0}$ output will be inverted.

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

Operational status		Output					
Status	Time elapsed (minute)	$\overline{OUT0}$		$\overline{OUT1}$	$\overline{OUT2}$	$\overline{OUT3}$	$\overline{OUT4}$
		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 0: L level
 RUN : In action 1: H level

Note: The $\overline{OUT0}$ 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{RST} (active low), \overline{SET} (active low) and MODE (active high).

If the \overline{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{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{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{SET} pin functions.

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Table-2. MODE input pin and SET pin functions

MODE input	SET pin function
0	Start/stop input
1	Start/preset input

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

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

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

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

Table-3. Preset time value (fosc=4.66kHz)

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

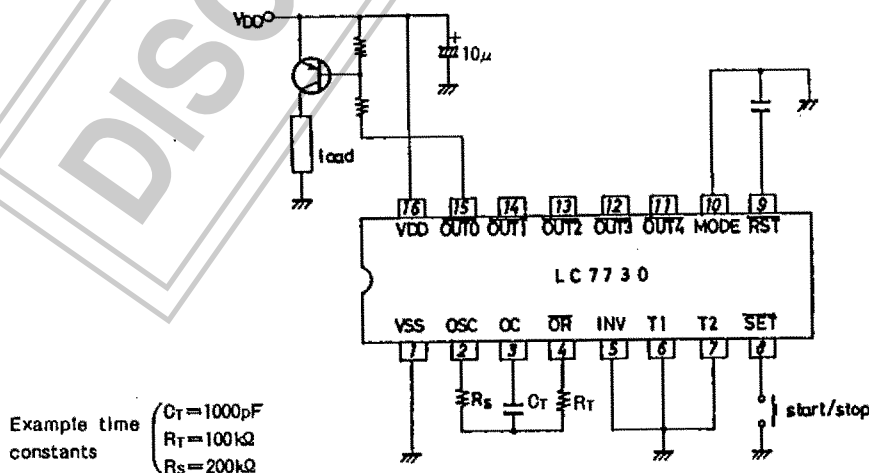
Table-4. Input-operational status relationship

Status	Input			Resulted status	Remarks
	RST	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

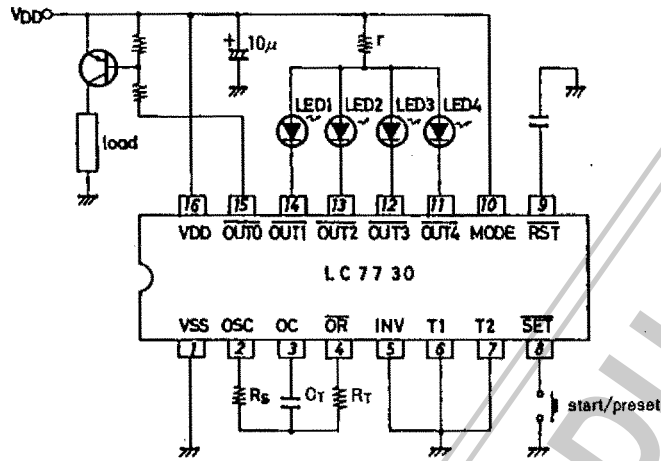
4. Sample Application Circuits

(1) Sleep timer 1 (minimum configuration)

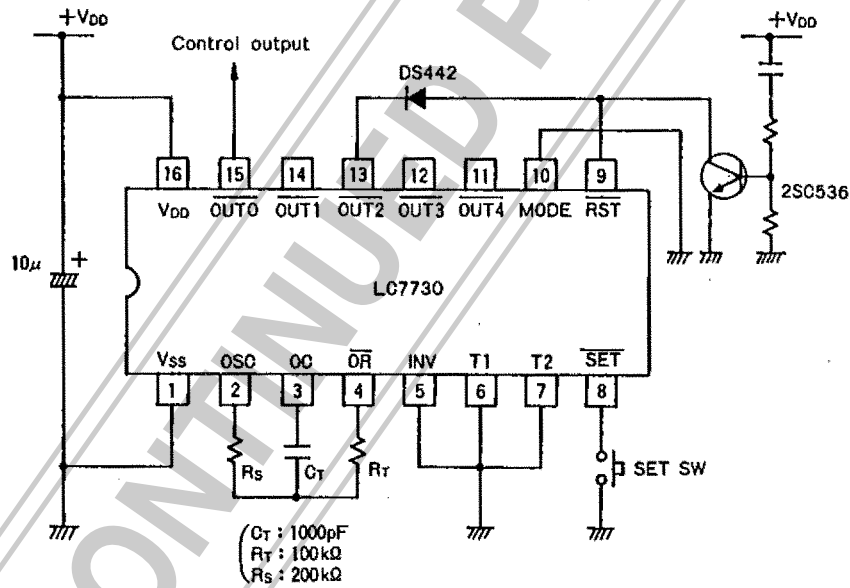


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(2) Sleep timer II (preset function/elapsed time display)



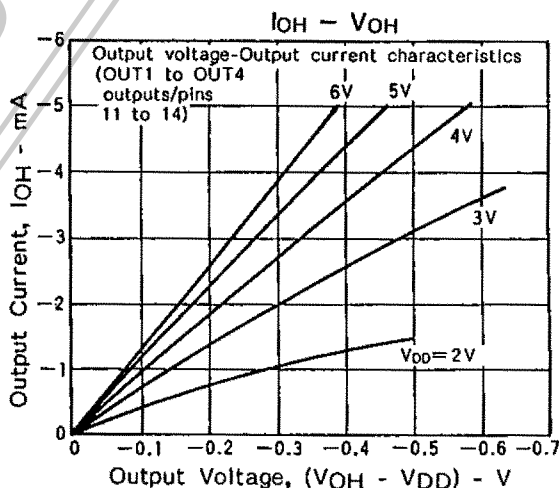
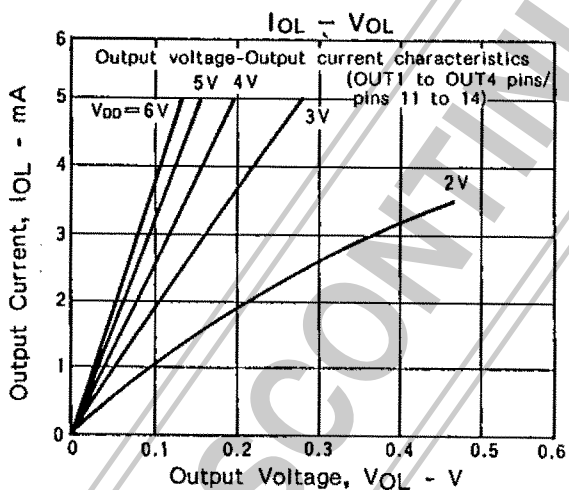
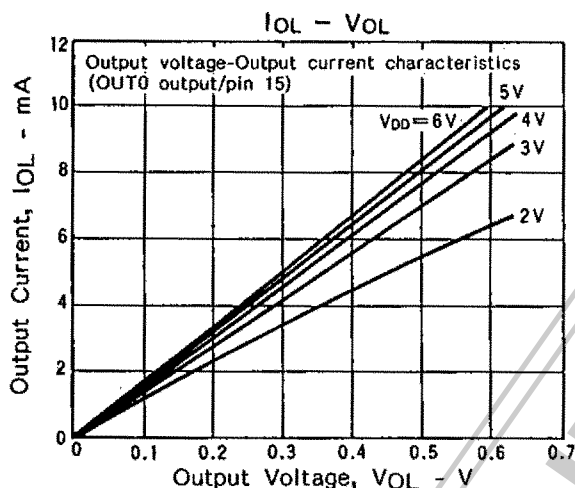
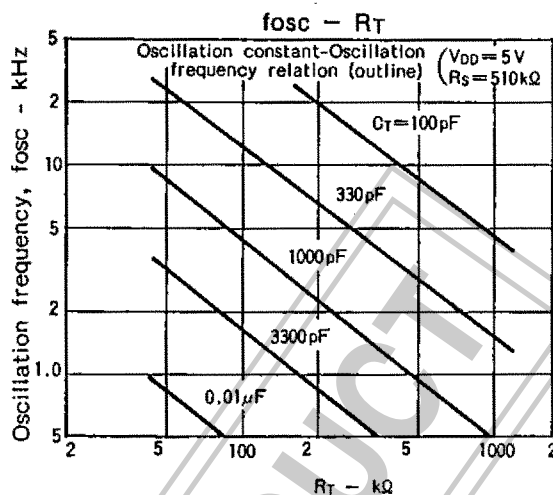
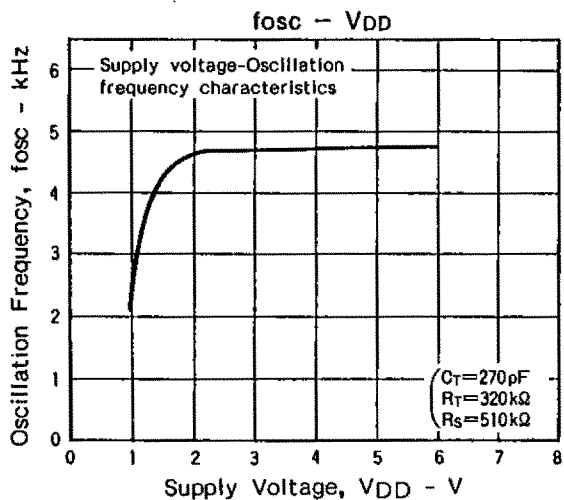
(3) Application example using smaller timer value



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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