HT2040A
Xmas Lights Controller

Features

- Operating voltage: 4.5V~5.5V
- 4 SCRs direct drive outputs
- 10 groups for showing
- Up to 8 patterns for each group
- Demo function
- One key show function
- Up to 23 patterns can be programmed inside
- Buill-in PLL circuit
- 50Hz or 60Hz AC power supply applications

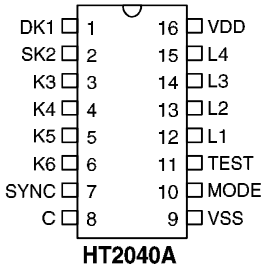
General Description

The HT2040A is a low cost, low power CMOS LSI for Christmas lights control applications.

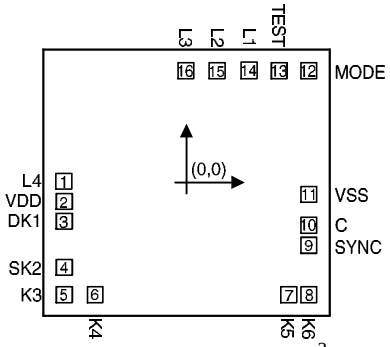
There are 4 SCR outputs to control the lamps. The lamps can be displayed in 10 different ways, selectable by input keys. In addition all 10 ways or groups can be displayed automatically or sequentially by a single key function.

An internal PLL circuit permits synchronised control of the SCRs at either 50Hz or 60Hz AC supply voltage.

Pin Assignment



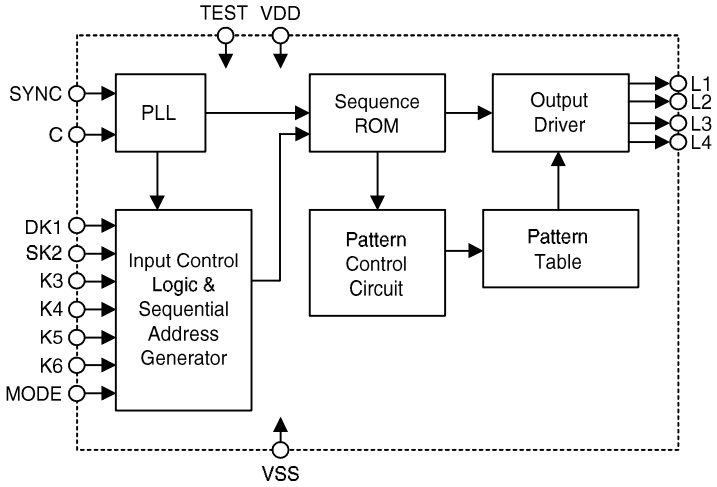
Pad Assignment



Chip Size: 107×99 (mil)^2

*The IC substrate should be connected to VDD in the PCB layout artwork.

Block Diagram



Pad Coordinates

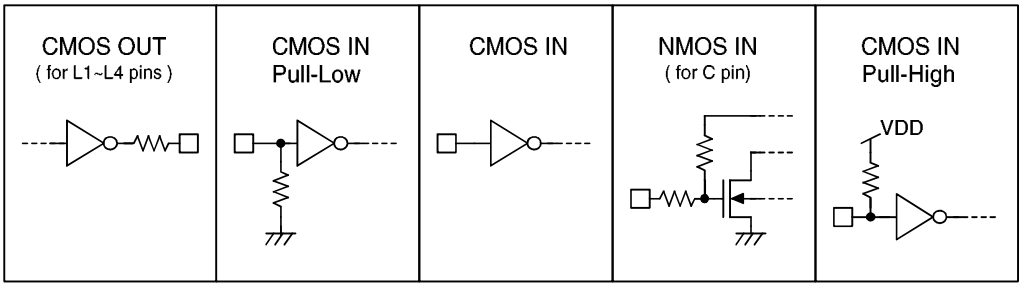
Unit: mil

Pad No.	X	Y	Pad No.	X	Y
1	–46.47	–0.17	9	46.47	–23.89
2	–46.47	–7.01	10	46.47	–16.24
3	–46.47	–14.66	11	46.47	–4.51
4	–46.47	–32.22	12	46.47	42.59
5	–46.47	–42.59	13	35.17	42.59
6	–34.74	–42.59	14	23.86	42.59
7	38.82	–42.59	15	11.62	42.59
8	46.47	–42.59	16	–0.32	42.59

Pad Description

Pad No.	Pad Name	I/O	Internal Connection	Description
1	L4	O	CMOS	Lamp driving signal. Generates a high SCR trigger signal to control the lamp intensity.
2	VDD	I	—	Power supply (positive).
3	DK1	I	CMOS Pull-Low	Demo function or Group-5 selection input. With MODE connected to VSS or open, DK1 when momentarily connected to VDD will enable demo mode, i.e show all groups automatically from 1 to 10. With MODE connected to VDD, will show Group-5 when the DK1 connected to VDD.
4	SK2	I	CMOS Pull-Low	One key show or Group-6 selection. With MODE connected to VSS or floating, SK2 when pressed momentarily shows the next group. If the MODE pad is connected to VDD, connects SK2 to VDD to show Group-6.
5~8	K3~K6	I	CMOS Pull-Low	Group-1~Group-4 selection with MODE connected to VSS or floating. Group-7~Group-10 with MODE connected to VDD.
9	SYNC	I	CMOS	PLL synchronous signal input. The PLL circuit will be synchronised to the AC power supply. The system can operate with a 60Hz or 50Hz AC power supply system.
10	C	I	NMOS	For the low pass PLL filters.
11	VSS	I	—	Power supply (ground).
12	MODE	I	CMOS Pull-Low	MODE defines the two operating function for DK1, SK2 and K3~K6. Refers to the functional description for detail.
13	TEST	I	CMOS Pull-High	For IC test only.
14~16	L1~L3	O	CMOS	Lamp driving signal. Generates a high SCR trigger signal to control the lamp intensity.

Approximate internal connection circuit



Absolute Maximum Ratings

Supply Voltage ..... –0.3V to 5.5V
Input Voltage ..... V_{SS}–0.3V to V_{DD}+0.3V
Storage Temperature ..... –50°C to 125°C
Operating Temperature ..... –20°C to 75°C

Electrical Characteristics

(Ta=25°C)

Symbol	Parametar	Test Condition		Min.	Typ.	Max.	Unit
		V_{DD}	Condition				
V_{DD}	Supply Voltage	—	—	4.5	5.0	5.5	V
I_{DD}	Operation Current	5V	No Load	—	300	600	μA
I_{OL}	L1~L4 Output Sink Current	5V	V_{OL}=0.5V	2.0	4.0	—	mA
I_{OH}	L1~L4 Output Source Current	5V	V_{OH}=4.5V	–15	–22	—	μA
V_{IH}	"H" Input Voltage	—	—	0.8V_{DD}	—	—	V
V_{IL}	"L" Input Voltage	—	—	—	—	0.2V_{DD}	V
F_{OSC}	Internal System Frequency	—	AC 60Hz	—	122.9	—	KHz
			AC 50Hz	—	102.4	—	

Functional Description

The HT2040A provides 10 different ways of displaying the lamps, each of which is called a group. Within each group each of the 4 lamps has an individual display pattern. There are a total of 12 patterns available. The HT2040A therefore provides a very versatile and easy way of controlling the lamps.

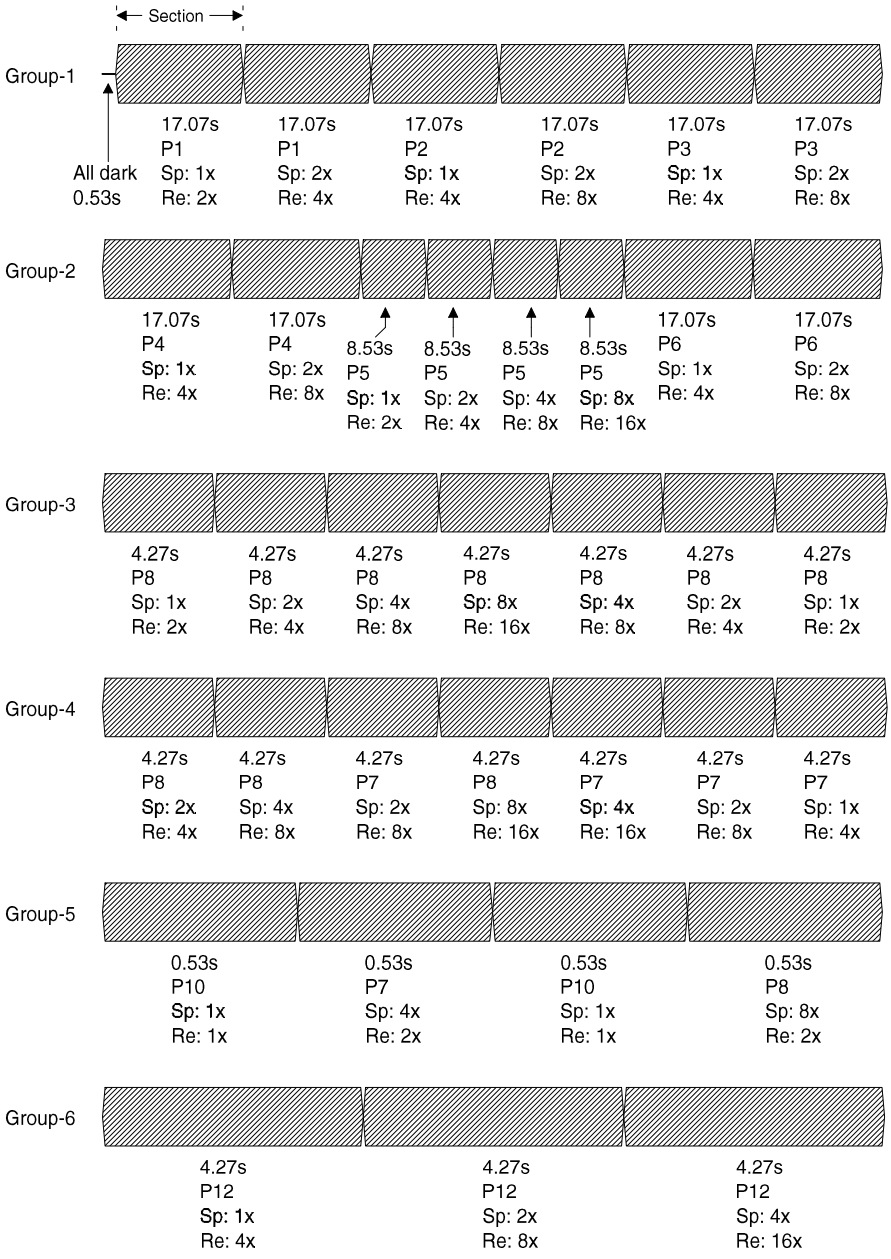
Each group can be selected indivedually using the DK1, SK2 and K3~K6 pins, with each pin having 2 functions, selectable by the condition of the MODE pin. In addition all group can be displayed automatically by connecting DK1 momentarilly to VDD with MODE connected to VSS. The groups can also be selected sequentially by connecting pin SK2 momentarilly to VDD with MODE connected to VSS.

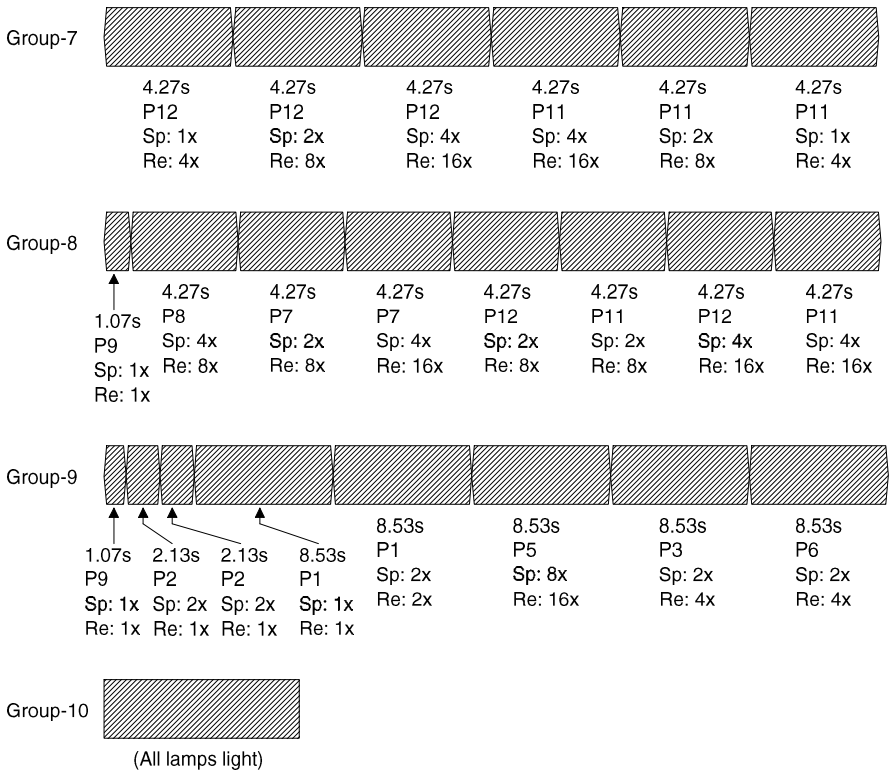
When power is turned on, the system will operate in demo mode if MODE did not connect to VDD, otherwise, the system will show the assigned group that the corresponding pin is connected to VDD.

Select Pin		MODE	
		Open or VSS	VDD
DK1	active high	—	Show Group-5
	momentarily	Demo function	—
SK2	active high	—	Show Group-6
	momentarily	One key show	—
K3 (active high)		Show Group-1	Show Group-7
K4 (active high)		Show Group-2	Show Group-8
K5 (active high)		Show Group-3	Show Group-9
K6 (active high)		Show Group-4	Show Group-10

Group List

The 10 ways or groups in which the lamps can be displayed is as follows. Each group is composed of several sections with each section have 1 pattern. The approximate time of each section is found when the frequency of AC power is 60Hz.



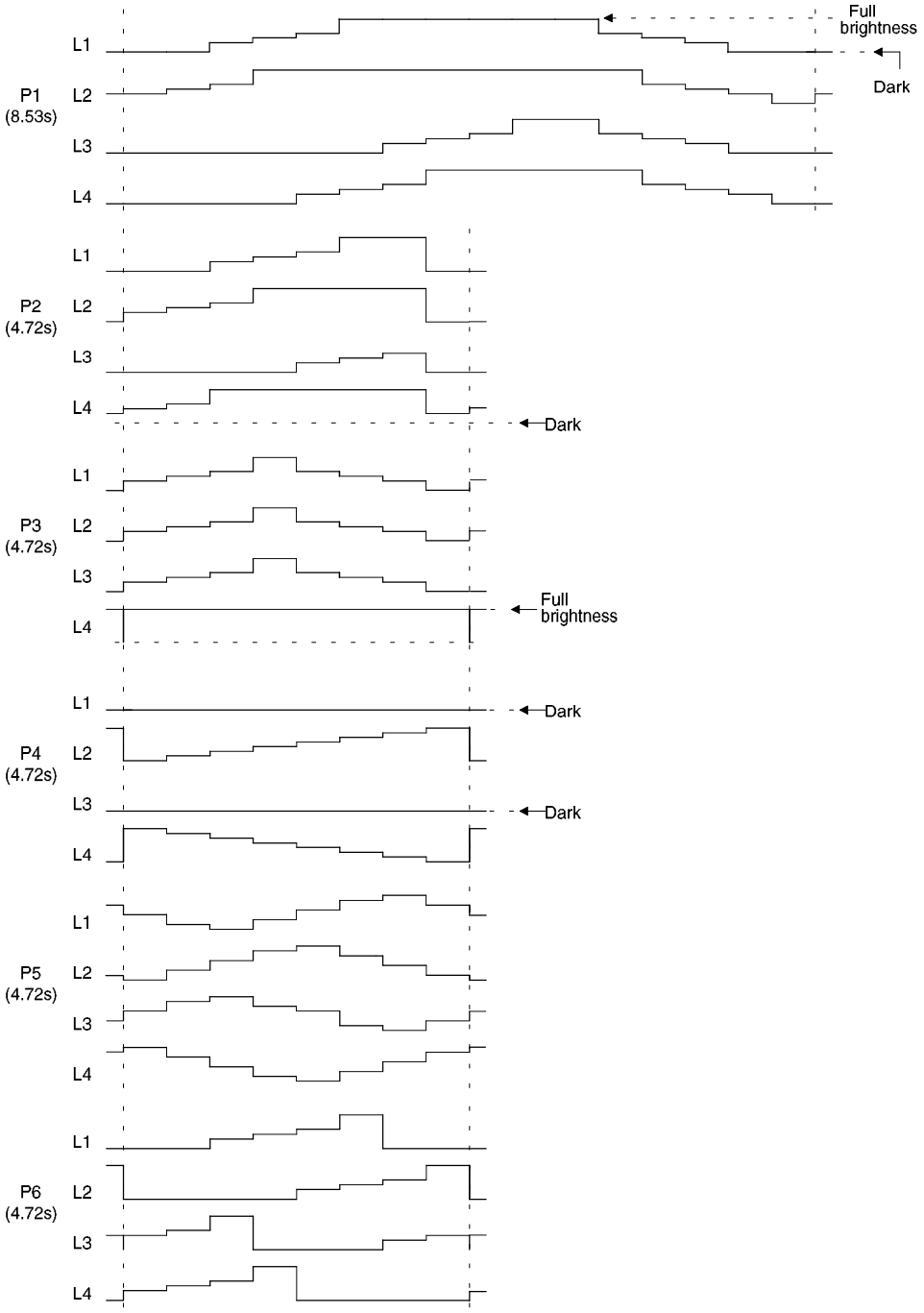


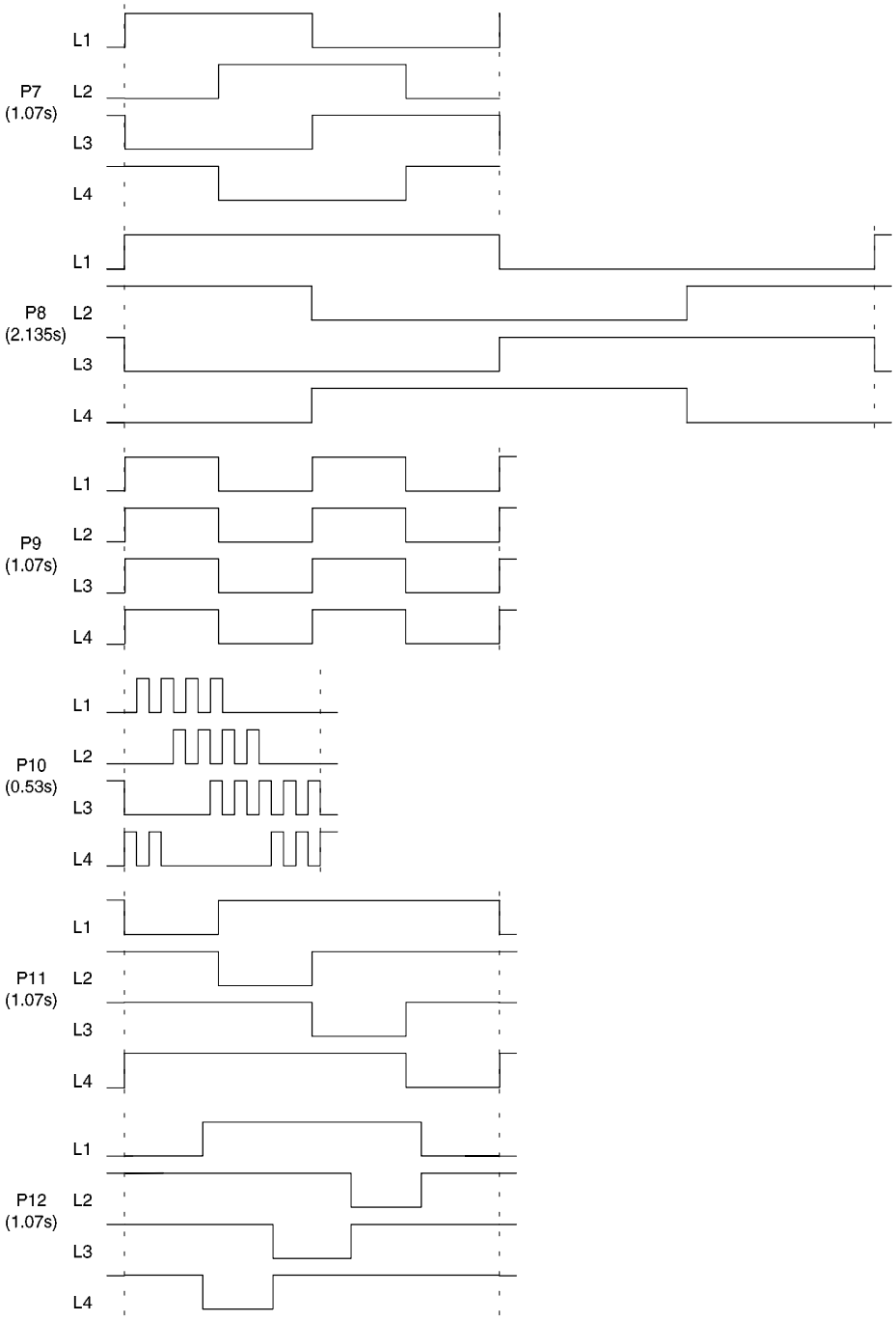
∗Note: The Sp denotes the display speed of a pattern, and the Re denotes the times of repeat.
For example, the Sp: 1x means normal speed
the Sp: 2x means double speed
the Re: 1x only show once
the Re: 2x show twice of a pattern

Lamp Pattern

The patterns determine the individual control of each lamp. These are a total of 12 different patterns.

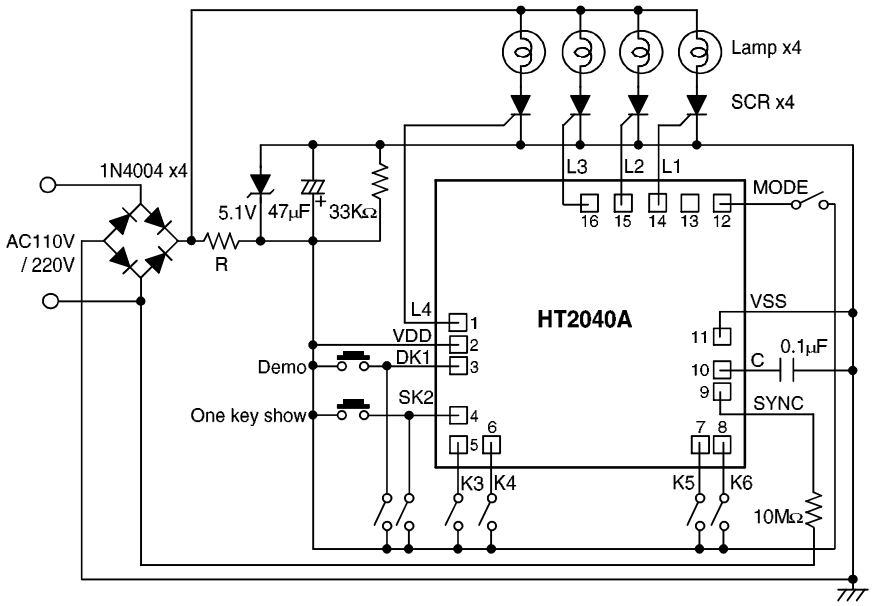
Patterns P1 to P6 have the ability to offer varying degrees of lamp brightness from fully on to fully off, but patterns P7~P12 can only turn the lamps fully on or off.




P7
(1.07s)
L1
L2
L3
L4
P8
(2.135s)
L1
L2
L3
L4
P9
(1.07s)
L1
L2
L3
L4
P10
(0.53s)
L1
L2
L3
L4
P11
(1.07s)
L1
L2
L3
L4
P12
(1.07s)
L1
L2
L3
L4

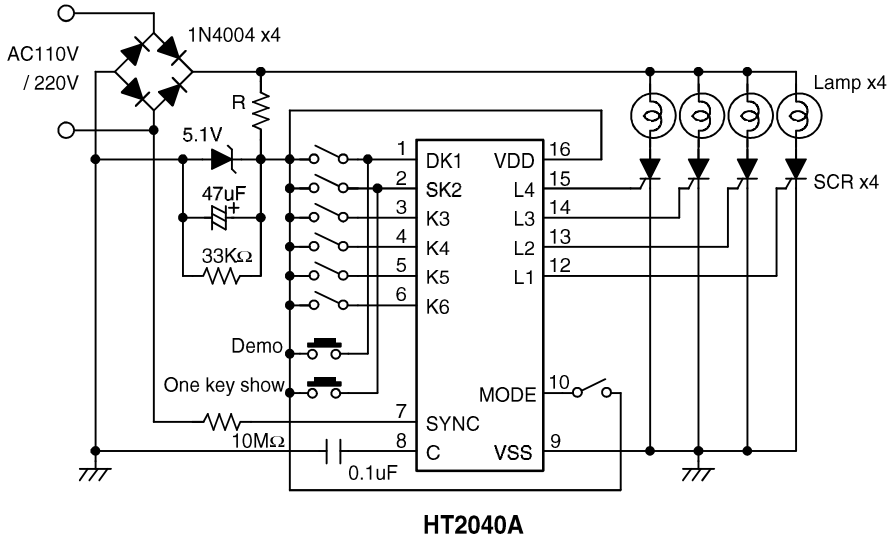
Application Circuit

Chip form



*Note: 1. The IC substrate should be connected to VDD in the PCB layout artwork.
2. R = 47KΩ/0.5W when the AC power supply is 110V
R = 91KΩ/1W when the AC power supply is 220V.

Package form



*Note: R = 47KΩ/0.5W when the AC power supply is 110V
R = 91KΩ/1W when the AC power supply is 220V.