

## Features

- The PT8A9701 works as the encoder and the PT8A973/973L works as the decoder
- Seven output pins, 5 for forward, backward, left, right and turbo functions, and 2 functional keys
- Operation power supply for PT8A9701: 3V to 12V (with series resistor)
- Auto power-off if no key pressed (PT8A9701)
- Motor current limit to meet toy safety standard HD271 (PT8A973/973L)
- Low operating current
- On-chip oscillator with an external resistor
- On-chip reversing amplifiers

- Built-in 3.7V Zener (Vz) (PT8A973) and 3.1V Zener (Vz) (PT8A973L)
- Few external components needed
- Pin to pin compatible with TX6/RX6

## General Description

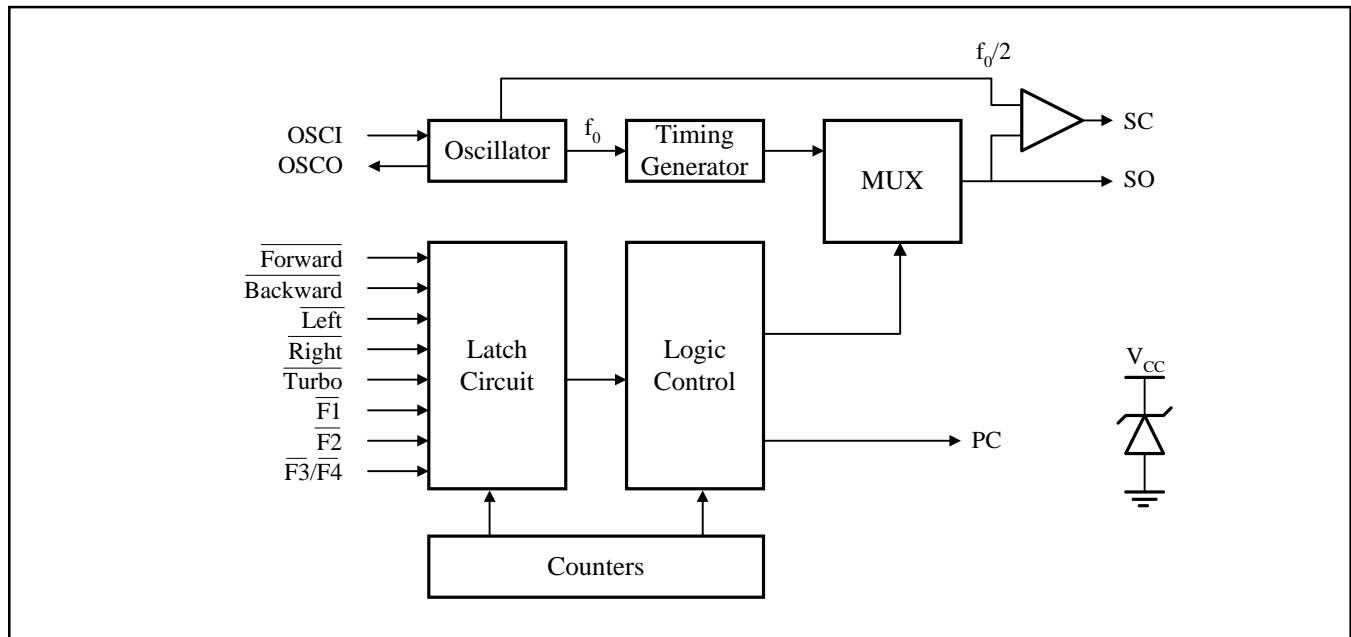
The PT8A9701 and PT8A973/973L is a pair of CMOS LSIs designed for remote controlled toy car application. They have seven control keys for controlling the corresponding motion (forward, backward, left, right, turbo and 2 functional keys) of the remote controlled car. They also have 'Forward (Backward)' and 'Turbo' combination application.

## Ordering Information

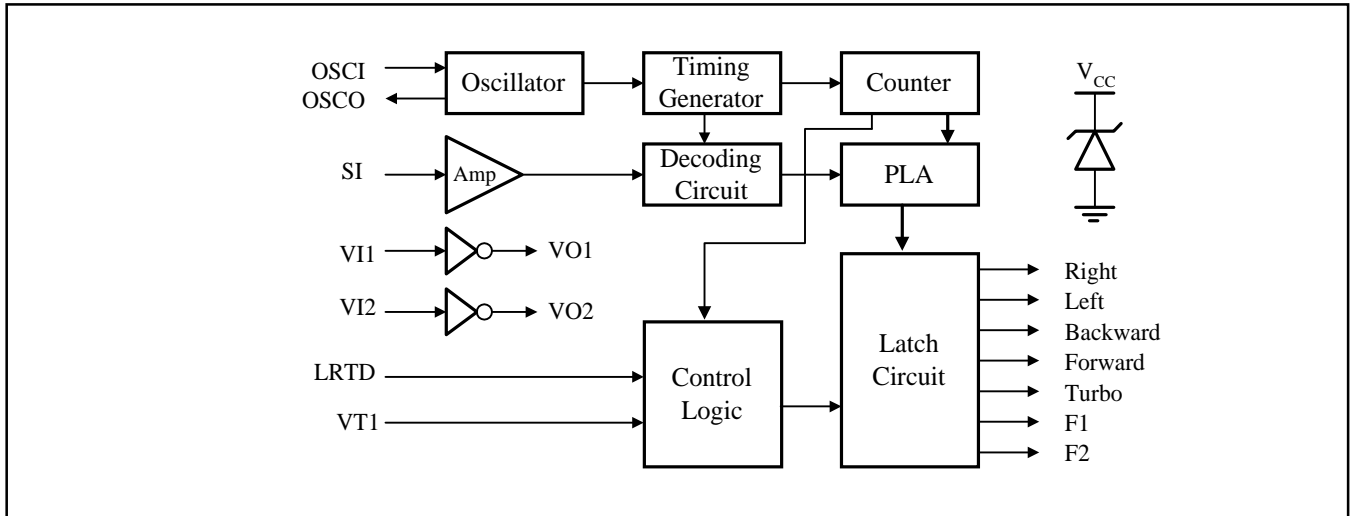
Device Name	Encoder	Decoder			
Part No.	PT8A9701P	PT8A973P	PT8A973LP	PT8A973DE	PT8A973LDE
Package	16-pin PDIP	18-pin PDIP		Die Form	

## Block Diagram

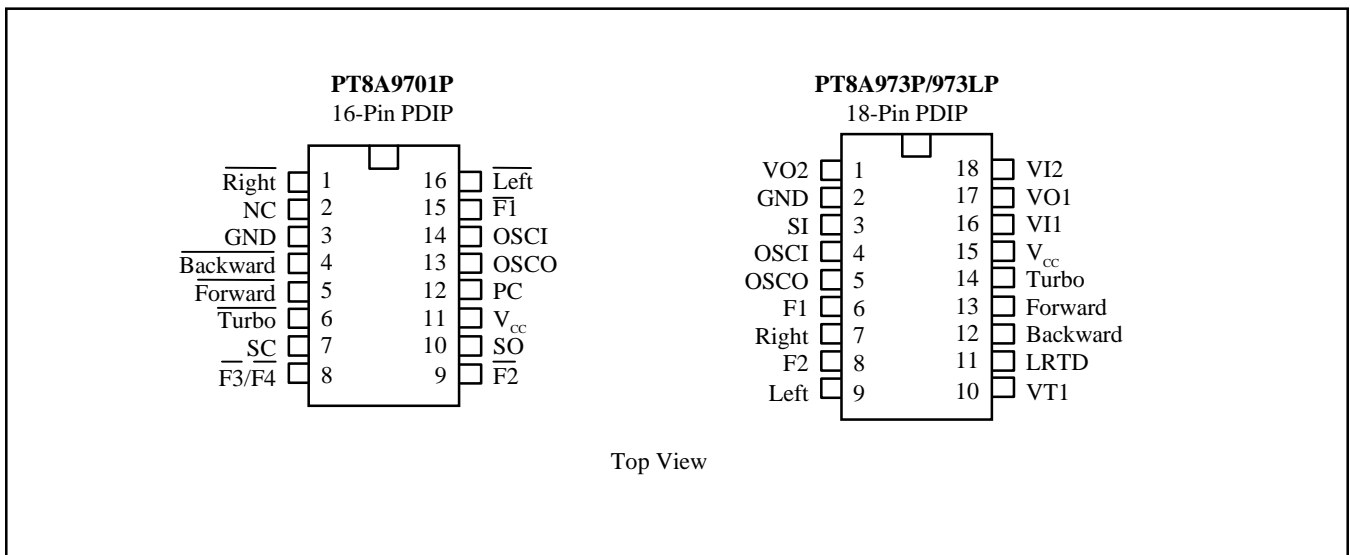
Figure 1. Block Diagram of PT8A9701



**Figure 2. Block Diagram of PT8A973/973L**

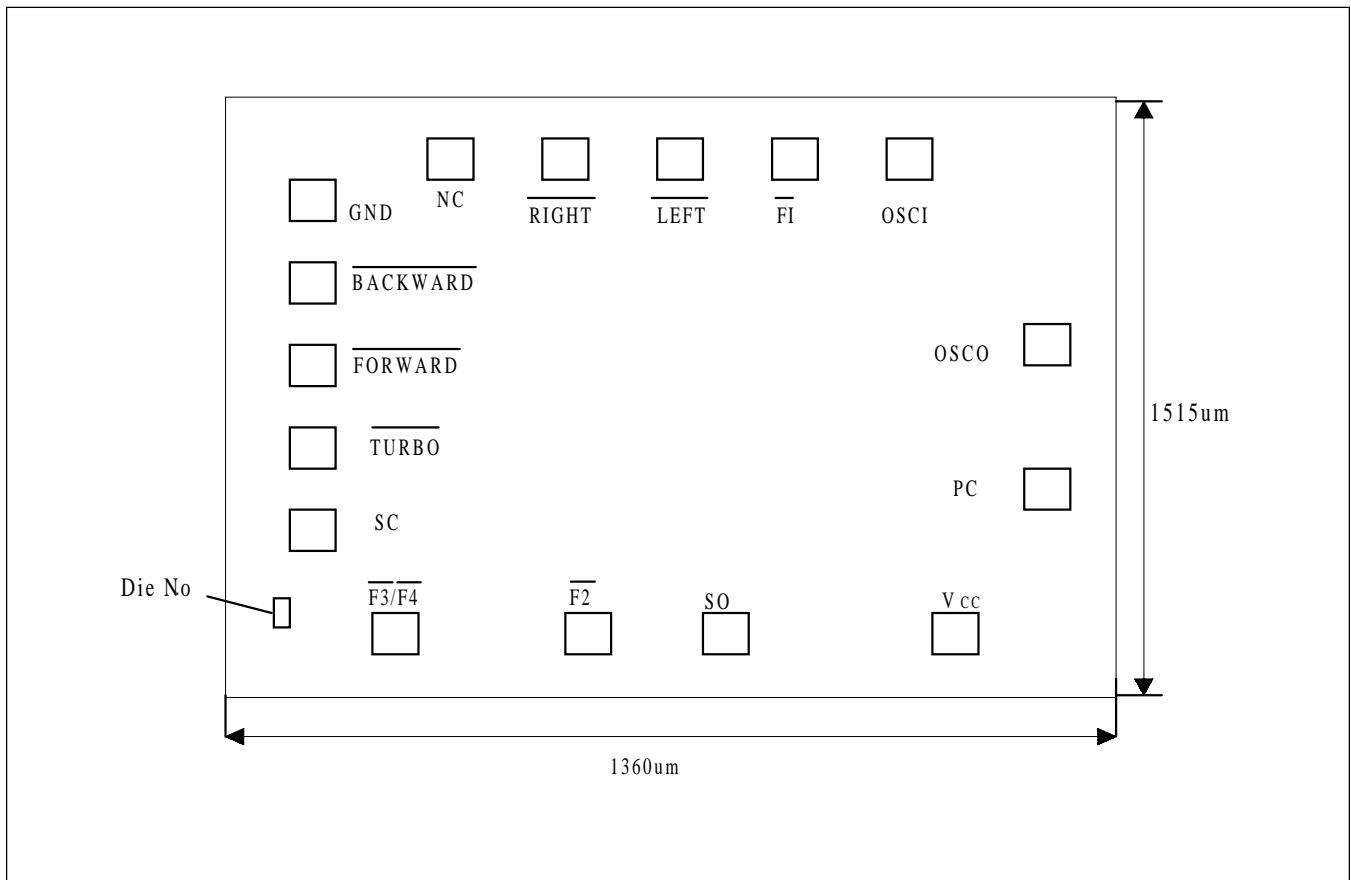


**Pin Configuration**



**Pad Location**

**PT8A9701DE**



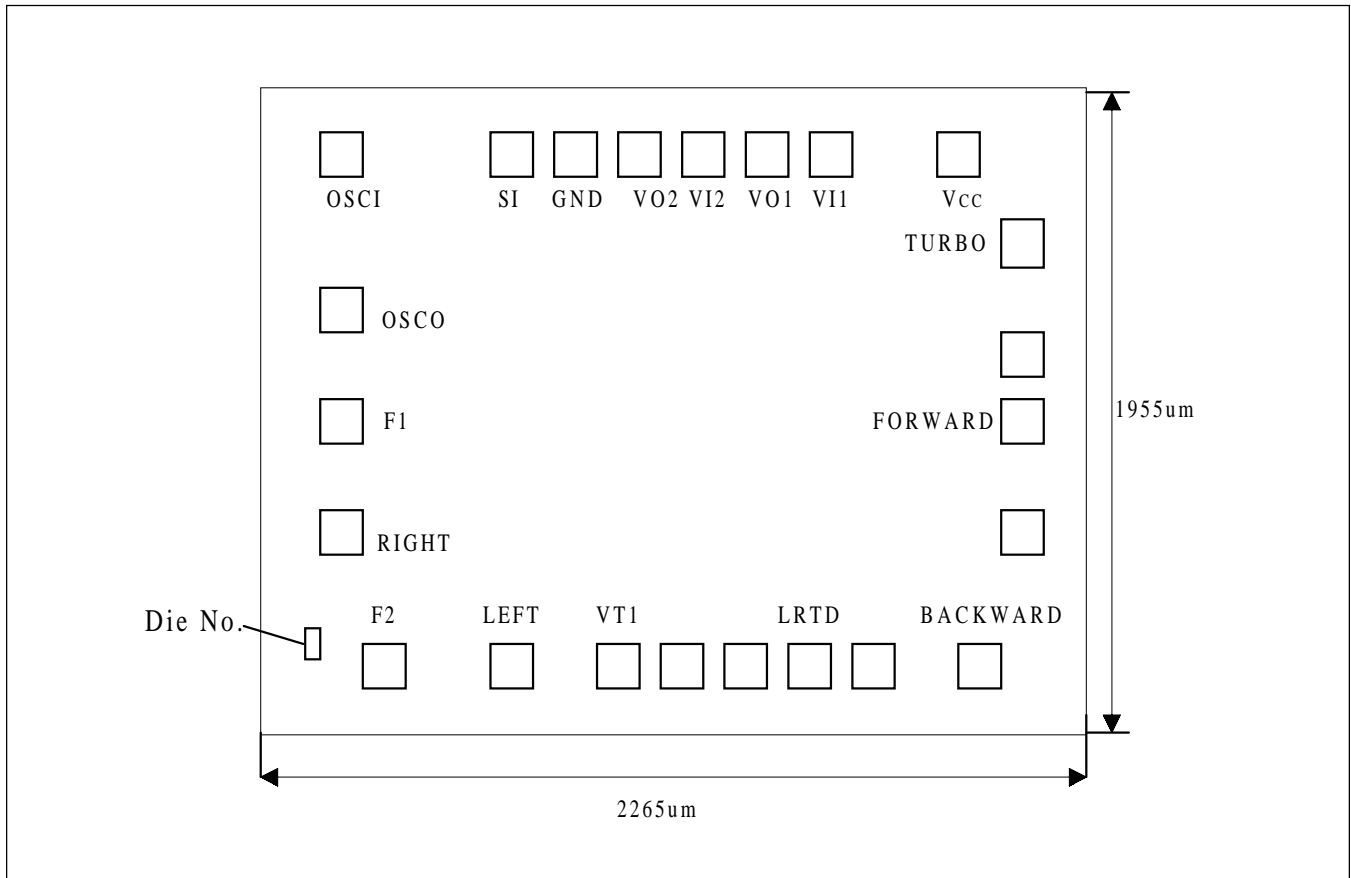
**Pad Coordinates**

Pad Name	X Coordinate	Y Coordinate	Pad Name	X Coordinate	Y Coordinate
RIGHT	457.5	1300.5	F2	363.5	97.5
NC	317.5	1300.5	SO	627	108
GND	115.5	1202	Vcc	972	98
BACKWARD	98	1053	PC	1152	339.5
FORWARD	98	903	OSCO	1146	728.5
TURBO	98	763	OSCI	961.5	1300.5
SC	108.5	460	FI	812.5	1300.5
F3/F4	171.5	145.5	LEFT	658	1300.5

Note: Substrate is connected to Vcc

**Pad Location**

**PT8A973DE**



**Pad Coordinates**

Pad Name	X Coordinate	Y Coordinate	Pad Name	X Coordinate	Y Coordinate
VO2	1024.1	1654.4	VT1	1003.1	147.5
GND	854.6	1654.4	LRTD	1433.1	147.5
SI	687.6	1671.9	BACKWARD	1898.1	136
OSCI	138.5	1653.3	FORWARD	1922.7	990.1
OSCO	138.5	1089.3	TURBO	1922.7	1487.2
F1	136.5	836.8	V <sub>CC</sub>	1831.3	1654.8
RIGHT	136.5	447.8	VI1	1475.6	1654.4
F2	360.6	136	VO1	1341.6	1654.4
LEFT	749.6	136	VI2	1158.1	1654.4

Note: Substrate is connected to Vcc

## Pin/Pad Description

**Table 1. Pin/Pad Description of PT8A9701**

Pin No	Pin/Pad Name	Type	Description
1	$\overline{\text{Right}}$	I	Rightward function selected if this pin connected to GND
2	NC	-	No connection
3	GND	GND	Ground
4	$\overline{\text{Backward}}$	I	Backward function selected if this pin connected to GND
5	$\overline{\text{Forward}}$	I	Forward function selected if this pin connected to GND
6	$\overline{\text{Turbo}}$	I	Turbo function selected if this pin connected to GND
7	SC	O	Output pin of the encoding signal with carrier frequency
8	$\overline{\text{F3/F4}}$	I	Able to toggle between Function 3 and Function 4 if connected to GND
9	$\overline{\text{F2}}$	I	Function 2 selected if connected to GND
10	SO	O	Output pin of the encoding signal without carrier frequency
11	V <sub>cc</sub>	P	Power supply
12	PC	O	Power control output pin
13	OSCO	O	Oscillator output pin
14	OSCI	I	Oscillator input pin
15	$\overline{\text{F1}}$	I	Function 1 selected if connected to GND
16	$\overline{\text{Left}}$	I	Leftward function selected if this pin connected to GND

**Table 2. Pin/Pad Description of PT8A973/973L**

Pin No	Pin/Pad Name	Type	Description
1, 17	VO2, VO1	O	Output pins of amplifiers 1 and 2
2	GND	GND	Ground
3	SI	I	Input pin for encoded signal
4	OSCI	I	Oscillator input pin
5	OSCO	O	Oscillator output pin
6	F1	O	F1 function output pin
7	Right	O	Rightward output pin
8	F2	O	F2 function output pin
9	Left	O	Leftward output pin
10	VT1	I	Auto shut-off input pin: If voltage on VT1 pin is over $0.095V_{CC}$ for 3 sec, all outputs will be shut off automatically.
11	LRTD	I	Left/Right turbo disable pin
12	Backward	O	Backward output pin
13	Forward	O	Forward output pin
14	Turbo	O	Turbo output pin
15	$V_{CC}$	P	Power supply
16, 18	VI1,VI2	I	Input pins of amplifiers 1 and 2

**LRTD Function**

LRTD Status	Key Selected	Output Function
High (Open)	Forward + Left (Right) + Turbo	Forward + Left (Right) + Turbo
Low	Forward + Left (Right) + Turbo	Forward + Left (Right)

## Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested)

### Maximum Ratings PT8A9701

Storage Temperature .....	-25°C to +85°C
Ambient Temperature with Power Applied .....	0°C to +70°C
Supply Voltage to Ground Potential (Inputs & V <sub>CC</sub> Only) .....	-0.5 to +5.5V
Supply Voltage to Ground Potential (Outputs & D/O Only) .....	-0.5 to +5.5V
DC Input Voltage .....	-0.5 to +5.5V
DC Output Current .....	20mA
Power Dissipation .....	500mW

### Maximum Ratings PT8A973

Storage Temperature .....	-25°C to +85°C
Ambient Temperature with Power Applied .....	0°C to +70°C
Supply Voltage to Ground Potential (Inputs & V <sub>CC</sub> Only) .....	-0.5 to +5.5V
Supply Voltage to Ground Potential (Outputs & D/O Only) .....	-0.5 to +5.5V
DC Input Voltage .....	-0.5 to +5.5V
DC Output Current .....	30mA
Power Dissipation .....	500mW

### Maximum Ratings PT8A973L

Storage Temperature .....	-25°C to +85°C
Ambient Temperature with Power Applied .....	0°C to +70°C
Supply Voltage to Ground Potential (Inputs & V <sub>CC</sub> Only) .....	-0.5 to +5.0V
Supply Voltage to Ground Potential (Outputs & D/O Only) .....	-0.5 to +5.0V
DC Input Voltage .....	-0.5 to +5.0V
DC Output Current .....	30mA
Power Dissipation .....	500mW

**Note:**

Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Recommended Operating Conditions

**Table 4. Recommended Operating Conditions**

Sym	Description	Min	Typ	Max	Units
I <sub>CC</sub>	Supply Current for PT8A973P			30	mA
	Supply Current for PT8A973LP			30	mA
V <sub>IH</sub>	Input HIGH Voltage	0.7V <sub>CC</sub>			V
V <sub>IL</sub>	Input LOW Voltage		0	0.3V <sub>CC</sub>	V
F <sub>OSC</sub>	Oscillator Frequency	109	128	146	kHz
T <sub>A</sub>	Operation Temperature	0		70	°C

## DC Electrical Characteristics

**Table 5. DC Electrical Characteristics of PT8A9701**

Sym	Description	Test Conditions	Min	Typ	Max	Units
V <sub>Z</sub>	Voltage of Zenner	I <sub>Z</sub> = 2~30mA	3.4	3.7	4.0	V
I <sub>OH</sub>	Output HIGH Current - PC Pin	V <sub>OH</sub> = V <sub>CC</sub> -0.5V	-3	-5		mA
	Output HIGH Currentl - SC and SO Pins		-3	-5		mA
	Output HIGH Current - OSCO Pin		-200		-1000	uA
I <sub>OL</sub>	Output LOW Current - PC Pin	V <sub>OL</sub> = 0.5V	2	3		mA
	Output LOW Currentl - SC and SO Pins		2	3		mA
	Output LOW Current - OSCO Pin		200		1000	uA
I <sub>IH</sub>	Input HIGH Current - Forward, Backward, Left, Right, Turbo, F1, F2, F3/F4 and OSCI Pins	V <sub>IH</sub> = V <sub>CC</sub>			1	uA
I <sub>IL</sub>	Input LOW Current - Forward, Backward, Left, Right, Turbo, F1, F2 and F3/F4 Pins	V <sub>IL</sub> = 0V	-20	-40	-100	uA
	Input LOW Current - OSCI Pin				-10	uA

**Note:** These specifications apply for V<sub>CC</sub> = 3.5V and T<sub>A</sub> = 25°C, unless otherwise specified.



**Table 6. DC Electrical Characteristics of PT8A973/973L**

Sym	Description	Test Conditions	Min	Typ	Max	Units
I <sub>OH</sub>	Output HIGH Current - VO1, VO2 and OSCO Pins	V <sub>OH</sub> = V <sub>CC</sub> -0.5V	300		800	uA
	Output HIGH Current - Forward, Backward, Left and Right Pins		-3			mA
	Output HIGH Current - Turbo, F1 and F2 Pins		-3			
I <sub>OL</sub>	Output LOW Current - VO1, VO2 and OSCO Pins	V <sub>OL</sub> = 0.5V	200		1000	uA
	Output LOW Current - Forward, Backward, Left, Right and Turbo Pins		2	3		mA
	Output LOW Current - F1 and F2 Pins		2	3		
I <sub>IH</sub>	Input HIGH Current - OSC1, VI1, VI2 ,LRTD and SI Pins	V <sub>IN</sub> = V <sub>CC</sub>			10	uA
	Input HIGH Current -VT1				50	uA
I <sub>IL</sub>	Input LOW Current - OSC1, VT1, VI1, VI2 and SI Pins	V <sub>IN</sub> = 0V			-10	uA
	Input LOW Current - LRTD Pins				-50	uA
VT	Over-Current Limit - VT1 Pins for PT8A973P		0.30		0.40	V
	Over-Current Limit - VT1 Pins for PT8A973LP		0.25		0.35	V
V <sub>Z</sub>	Voltage of Zenner - PT8A973P	I <sub>Z</sub> = 2~30mA	3.4	3.7	4	V
	Voltage of Zenner - PT8A973LP		2.8	3.1	3.4	V

**Note:** These specifications apply for T<sub>A</sub> = 25°C, V<sub>CC</sub> = 3.5V (973), V<sub>CC</sub> = 3.0V (973L), unless otherwise specified.

## AC Electrical Characteristics

**Table 7. AC Electrical Characteristics of PT8A9701**

Sym	Description	Test Conditions	Min	Typ	Max	Units
$f_{OSC}$ (Note2)	Oscillator Frequency	$R_f = 200k\Omega$	109	128	146	kHz
$t_{FUN}$	Period of Function Code	$f_{OSC} = 128kHz$	1.7	2	2.3	ms
$t_{STA}$	Start-Code Period	$f_{OSC} = 128kHz$	1.7	2	2.3	ms
$f_{CSC}$	Carrier Frequency	$f_{OSC} = 128kHz$		64		kHz
$t_{OFF}$	Auto-off Time	$f_{OSC} = 128kHz$		2		s
$V_{CC}$	Power Supply Range	-	3	9	12	V
$I_{CC}$	Supply Current	Output Unloaded			30	mA

**Note:**

1. These specifications apply for  $V_{CC} = 3.5V$  and  $T_A = 25^\circ C$ , unless otherwise specified.
2. The frequency of standard samples is tested on standard testing-board.

**Table 8. AC Electrical Characteristics of PT8A973/973L**

Sym	Description	Test Conditions	Min	Typ	Max	Units
$f_{OSC}$ (Note2)	Oscillator Frequency	$R_f = 200k\Omega$	109	128	146	kHz
$t_{FUN}$	Period of Function Code	$f_{OSC} = 128kHz$	1.7	2	2.3	ms
$t_{STA}$	Start-Code Period	$f_{OSC} = 128kHz$	1.7	2	2.3	ms
$I_{CC}$	Supply Current	Output Unloaded			30	mA

**Notes:**

1. These specifications apply for  $T_A = 25^\circ C$ ,  $V_{CC} = 3.5V$  (973),  $V_{CC} = 3.0V$  (973L), unless otherwise specified.
2. The frequency of standard samples is tested on standard testing-board.

Figure 5. Typical Application Circuit of PT8A9701

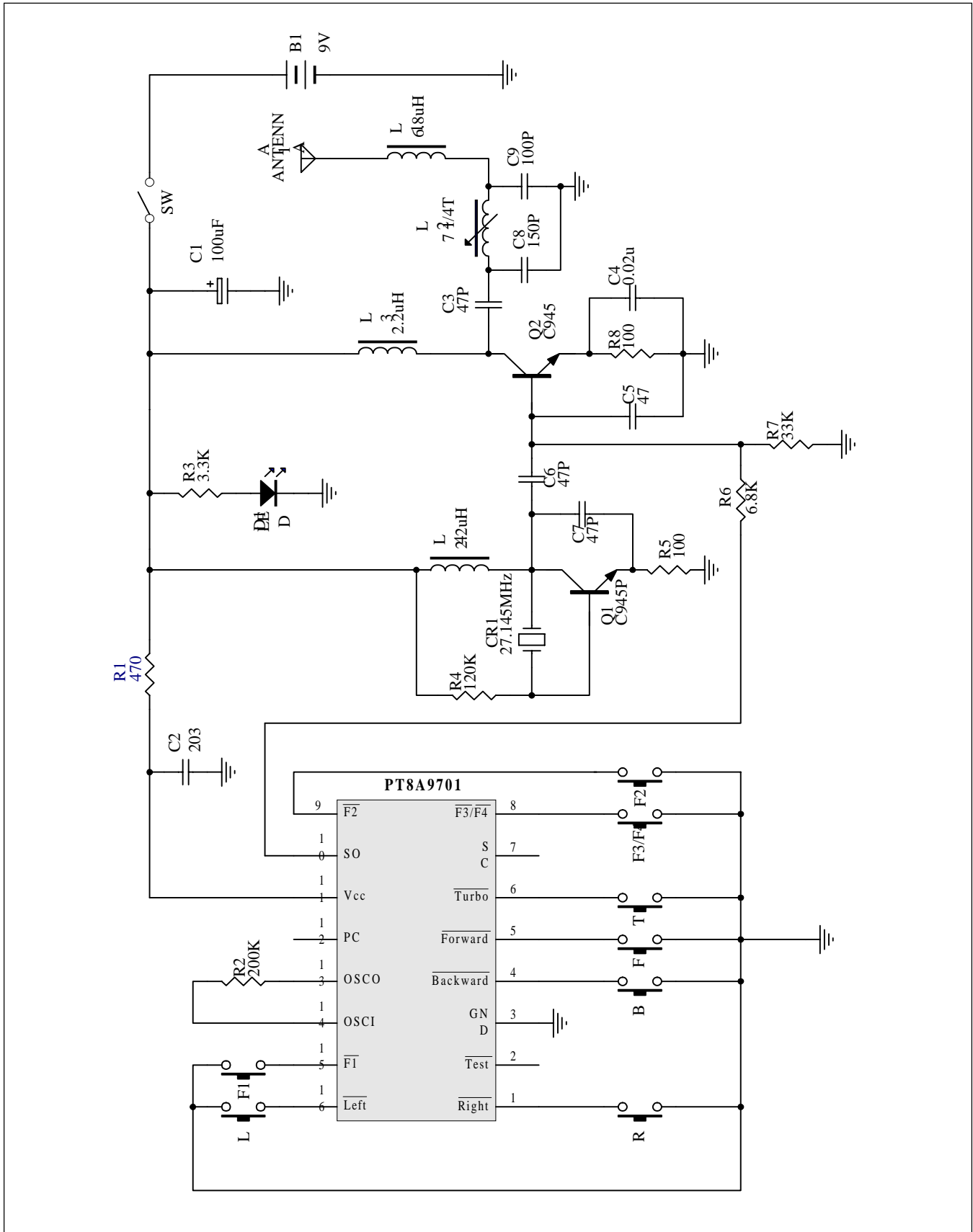
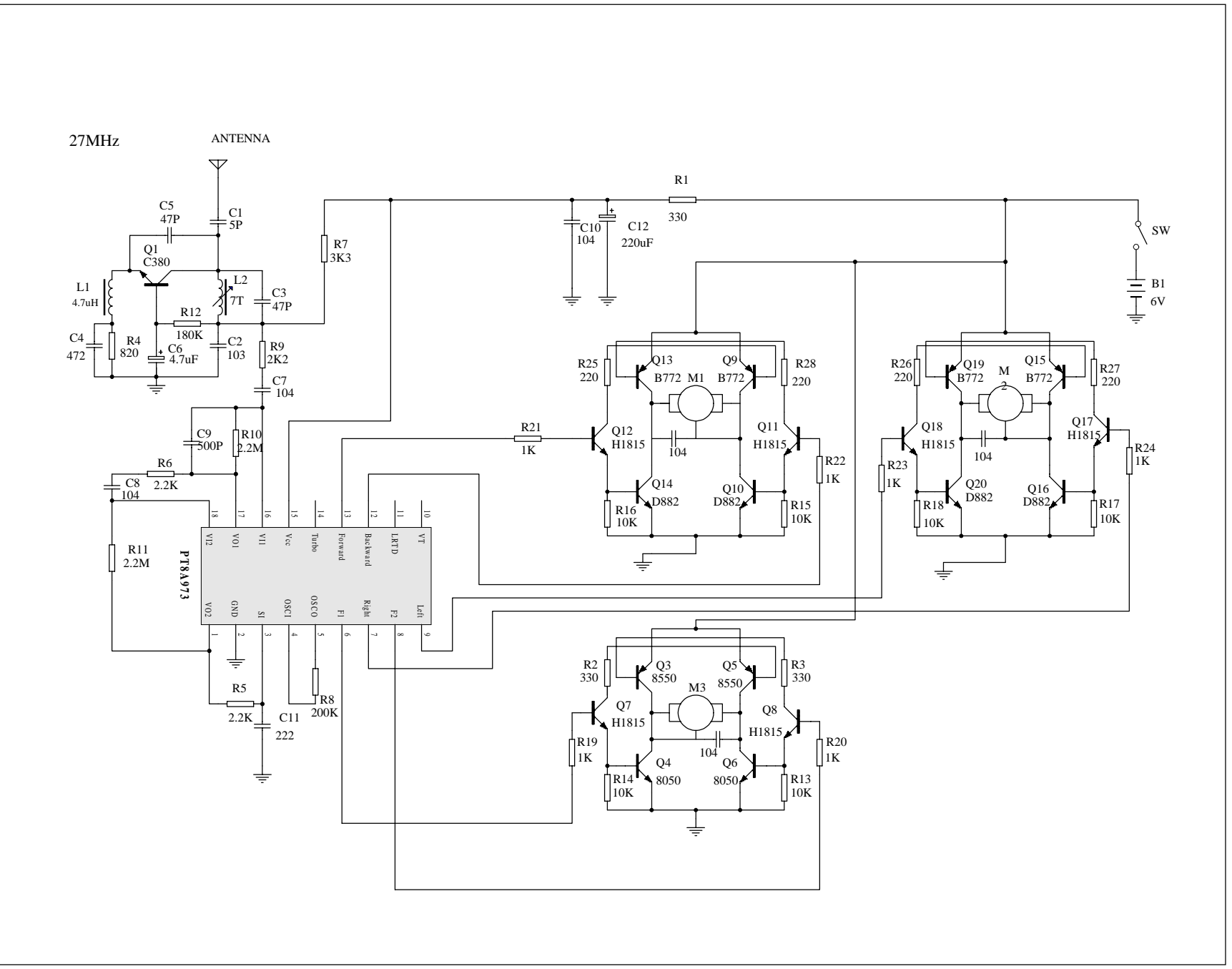


Figure 6. Typical Application Circuit of PT8A973



**Notes**

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