Features

- The PT8A990P works as the encoder and the PT8A991P works as the decoder
- Nine output pins, 5 for forward, backward, left, right and turbo functions, and 4 functional keys
- Operation power supply: 3.0V to 5.5V
- Auto power-off if no key pressed within 2s (PT8A990P)
- Auto shut-down if keep pressing a key for more than 4 minutes (PT8A990P)
- Auto shut down if no signal input for more than 5 minutes (PT8A991P)
- Low operating current
- On-chip oscillator with an external resistor
- On-chip receiving amplifiers
- Few external components needed

General Description

The PT8A990P/991P is a pair of CMOS LSIs designed for remote controlled toy car application. They have nine control keys for controlling the corresponding motion (i.e. forward, backward, left, right, turbo and 4 functional keys) of the remote controlled car. They also have 'Forward (Backward)' and 'Turbo' combination application.

Block Diagram

Figure 1. Block Diagram of PT8A990P

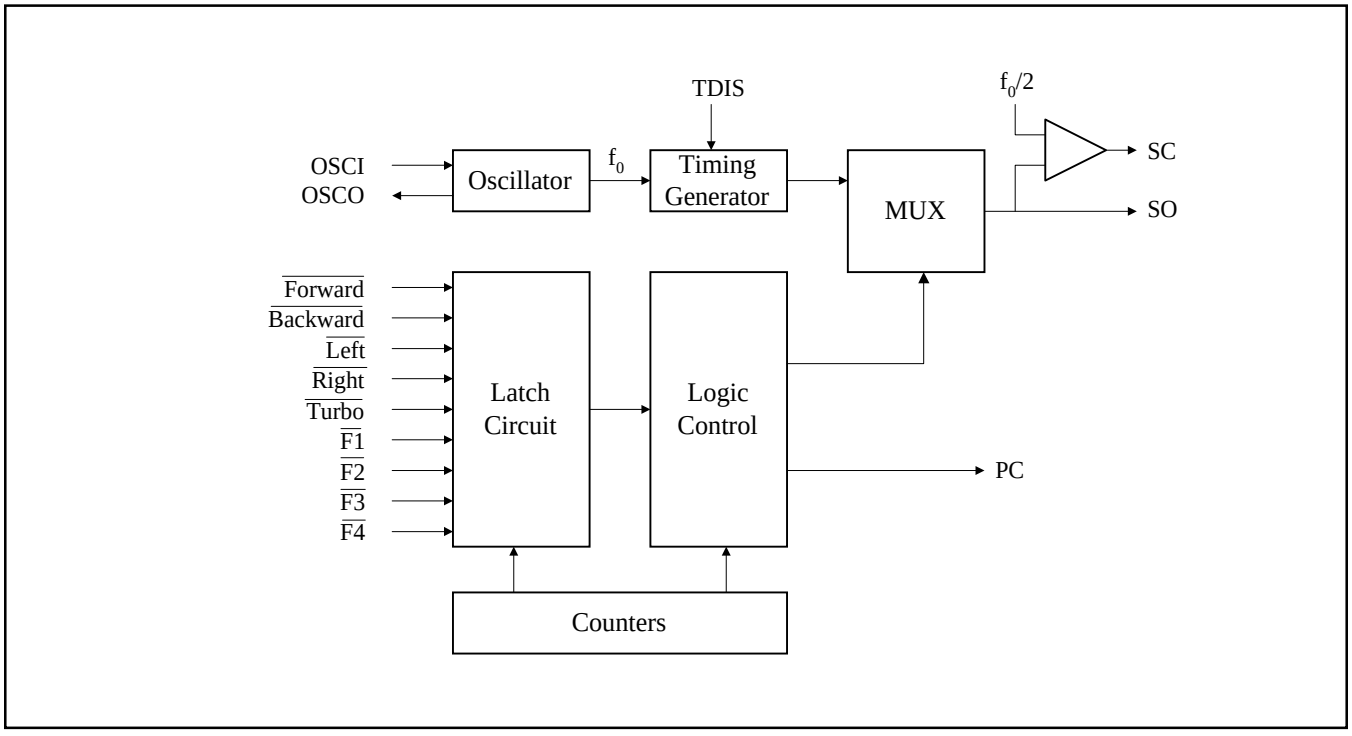
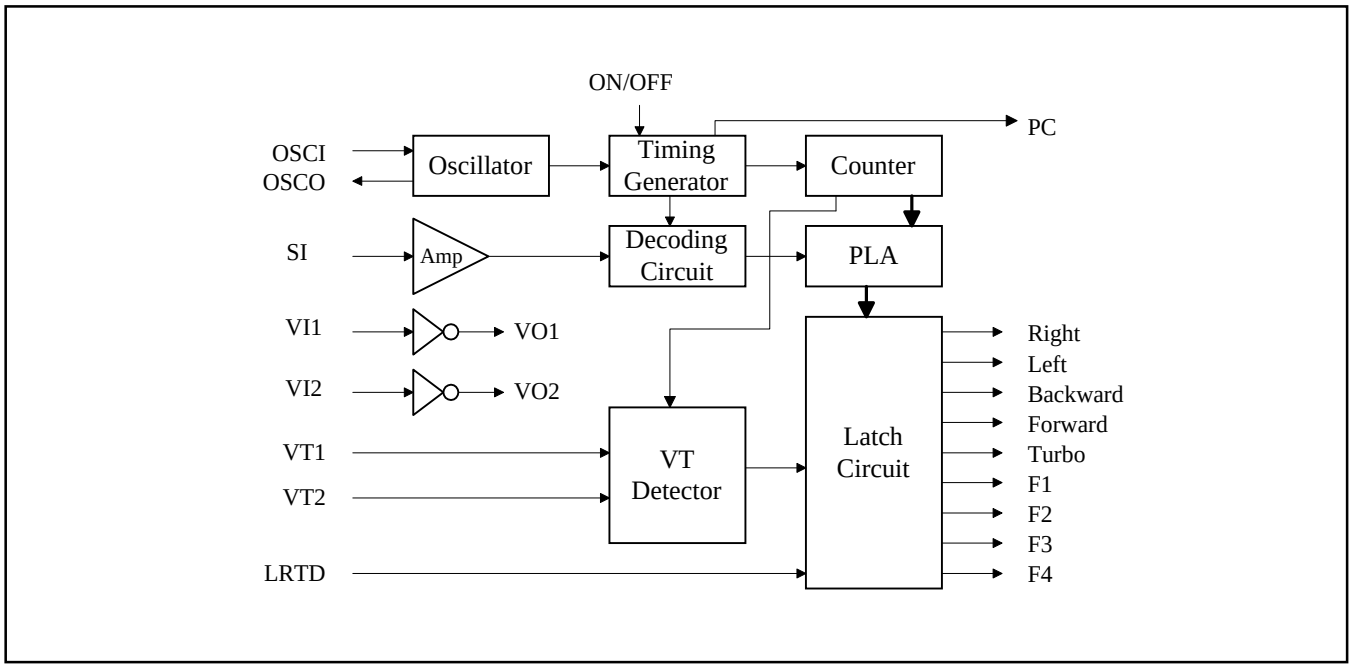
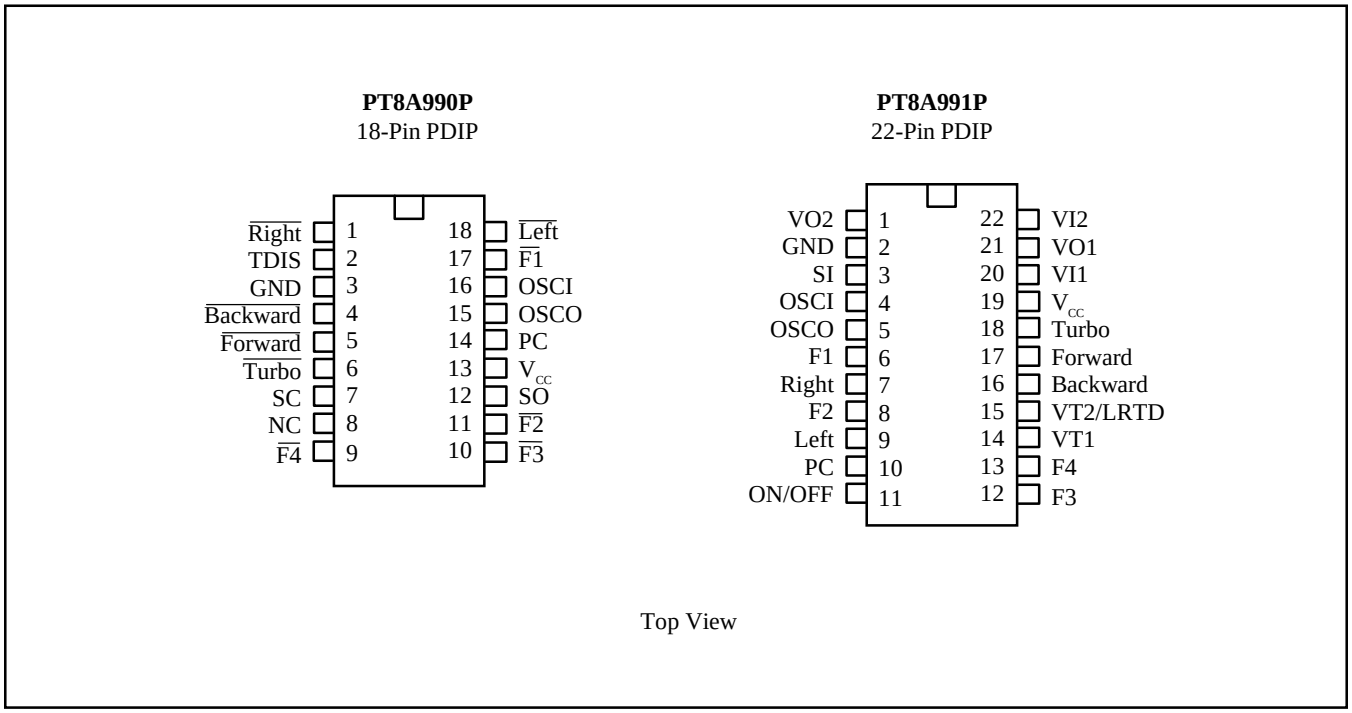


Figure 2. Block Diagram of PT8A991P



Package and Pin Assignment



Pin Description

Table 1. Pin Description of PT8A990P

Pin	Name	Type	Description
1	$\overline{\text{Right}}$	I	Rightward function selected if this pin connected to GND
2	TDIS	I	For timer enable: opened or connected to V_{CC}, For timer disenable: connected to GND, For test mode: connected to 1/2 V_{CC}
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 freqency
8	NC		No Connection
9	$\overline{\text{F4}}$	I	Function 4 selected if connected to GND
10	$\overline{\text{F3}}$	I	Function 3 selected if connected to GND
11	$\overline{\text{F2}}$	I	Function 2 selected if connected to GND
12	SO	O	Output pin of the encoding signal without carrier freqency
13	V_{CC}	P	Power supply
14	PC	O	Power control output pin
15	OSCO	O	Oscillator output pin
16	OSCI	I	Oscillator input pin
17	$\overline{\text{F1}}$	I	Function 1 selected if connected to GND
18	$\overline{\text{Left}}$	I	Leftward function selected if this pin connected to GND

Table 2. Pin Description of PT8A991P

Pin	Name	Type	Description
1, 21	VO2, VO1	O	Output pins of inverter 1 and 2 for Signal amplifier
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	PC	O	Power control pin
11	ON/OFF	I	ON/OFF pin
12	F3	O	F3 function output pin
13	F4	O	F4 function output pin
14	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.
15	LRTD/VT2	I	Left/Right turbo disable pin. Optional for the 2nd Auto Shut-Off input pin.
16	Backward	O	Backward output pin
17	Forward	O	Forward output pin
18	Turbo	O	Turbo output pin
19	V_{CC}	P	Power supply
20,22	VI1,VI2	I	Input pins of invertor 1 and 2 for signal amplifier

Functional Description

In normal operation without 'Turbo', forward (backward) output pin of the decoder PT8A991P sends out a 60Hz signal. In operation with 'Forward (Backward)' and 'Turbo' combined, the output signal will be completely high. This function is depicted as follows.

Once a key is pressed, the PT8A990P is powered on, and the PC output pin keeps on a high level. If no key pressed, The PT8A990P will shut off automatically in 2s and nothing is output on the PC pin. It can save battery power by shutting down the device after pressing on any key for 4 minutes. The PC pin is used to control on/off of the external power supply.

The PT8A991P has Auto Power Down feature when no signal received within 5 minutes. The VT pins are used for Current Limit Protection to meet HD271 Toys safety standard. There are two over- current-protection pins in PT8A991P. If the input voltage is over $0.095V_{CC}$ for 3 seconds, the output level will be off. The LRTD/VT2 is optional.

Data Format

See Figure 4.

Coding Method

Each trigger pin is triggered by corresponding bit of data in format of "1". The data string is 18-bit and divided to four segments, i.e., Start Code, Data Code, Parity Code and End code, where

Start Code = 11110.

Data Code =

F3	F4	F	B	T	R	L	F1	N1	N2	F2

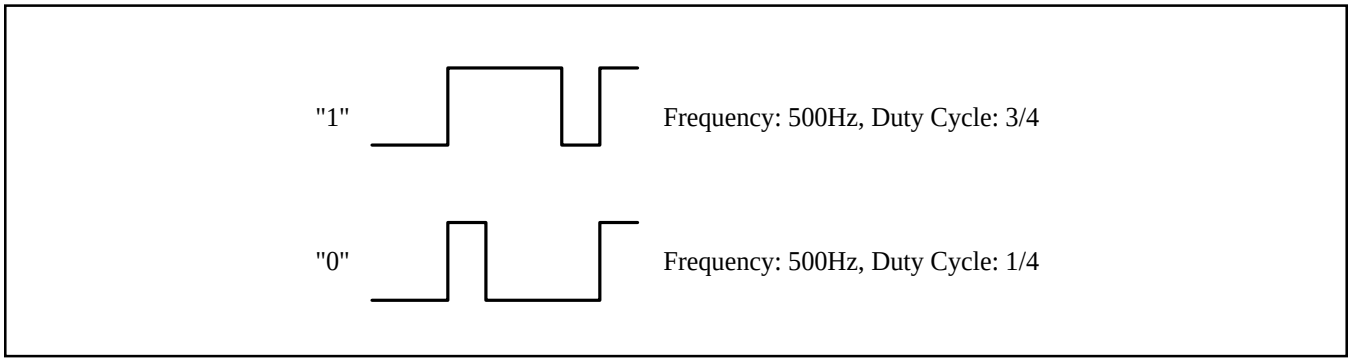
F = Forward, B = Backward, T = Turbo
R = Right, L = Left, F1= Function 1
F2 = Function 2, F3 = Function 3, F4 = Function 4
N1, N2 = Reserved

Parity Code = Even parity check result

End Code is for data latch.

Data code can be any combination of F, B, T, R, L, F1, F2, F3 and F4 except F&B, R&L, N1 and N2.

Figure 4. Data Format



Maximum Ratings

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

Storage Temperature	-25°C to +85°C
Ambient Temperature with Power Applied	0°C to +70°C
Supply Voltage to Ground Potential (Inputs & V_{CC} 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

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 3. Recommended Operating Conditions

Sym	Description	Test Conditions	Min	Typ	Max	Units
V_{CC}	Supply Voltage		3	4	5	V
V_{IH}	Input HIGH Voltage		$0.7V_{CC}$	4	-	V
V_{IL}	Input LOW Voltage		-	0	$0.3V_{CC}$	V
F_{OSC}	Oscillator Frequency		109	128	146	kHz
T_A	Operation Temperature		0	-	70	^OC

DC Electrical Characteristics

Table 4. DC Electrical Characteristics of PT8A990P

Sym	Description	Test Conditions	Min	Typ	Max	Units
I_{STB}	Stand-by Current	$T_A = 70^OC$, Off State		1	3	uA
I_{OH}	Output HIGH Current - PC and SO Pins	$V_{OH} = 3.5V$, $T_A = 25^OC$	2	3		mA
	Output HIGH Currentl - SC Pin		4	5		mA
	Output HIGH Current - OSCO Pin		220		600	uA
I_{OL}	Output LOW Current - PC and SO Pins	$V_{OL} = 0.5V$, $T_A = 25^OC$	2	4		mA
	Output LOW Currentl - SC Pin		4	5		mA
	Output LOW Current - OSCO Pin		220		600	uA
I_{IH}	Input HIGH Current - $\overline{Forward}$, $\overline{Backward}$, $\overline{Left}$, $\overline{Right}$, $\overline{Turbo}$, $\overline{F1}$, $\overline{F2}$, $\overline{F3}$, $\overline{F4}$, NC, OSCI and TDIS Pins	$V_{CC} = 5.5V$, $V_{IH} = V_{CC}$, $T_A = 25^OC$		1	10	uA
I_{IL}	Input LOW Current - $\overline{Forward}$, $\overline{Backward}$, $\overline{Left}$, $\overline{Right}$, $\overline{Turbo}$, $\overline{F1}$, $\overline{F2}$, $\overline{F3}$, $\overline{F4}$, NC and TDIS Pins	$V_{CC} = 5.5V$, $V_{IL} = 0V$, $T_A = 25^OC$	10	25	100	uA
	Input LOW Current - OSCI Pin			1	10	

Note: These specifications apply for $V_{CC} = 4.0V$ and $0^OC \le T_A \le 70^OC$, unless otherwise specified.

Table 5. DC Electrical Characteristics of PT8A991P

Sym	Description	Test Conditions	Min	Typ	Max	Units
I_{STB}	Stand-by Current	Off State		3	5	uA
I_{OH}	Output HIGH Current - VO1, VO2 and OSCO Pins	V_{OH} = 3.5V, T_A = 25°C	300		850	uA
	Output HIGH Current - Forward, Backward, Left and Right Pins		6	10		mA
	Output HIGH Current - Turbo, F1, F2, F3 and F4 Pins		3	6		
	Output HIGH Current - PC Pin		2	5		
I_{OL}	Output LOW Current - VO1, VO2 and OSCO Pins	V_{OL} = 0.5V, T_A = 25°C	300		850	uA
	Output LOW Current - Forward, Backward, Left and Right Pins		3	5		mA
	Output LOW Current - Turbo, F1, F2, F3 and F4 Pins		6	11		
	Output LOW Current - PC Pin		2	9		
I_{IH}	Input HIGH Current - VT1 Pin	V_I = V_{CC}, T_A = 25°C, On state	20	30	100	uA
	Input HIGH Current - SI, VI1, VI2, VT2, ON/OFF and OSCI Pins			1	10	
I_{IL}	Input LOW Current - SI, VI1, VI2, VT1 and OSCI Pins	V_I = 0V, T_A = 25°C, On state		1	10	uA
	Input LOW Current - ON/OFF and VT2 Pins		15	30	100	
I_{DR}	Pull-Down Resistor Current - VI1 and VI2 Pins	V_I = 4.0V, Off State	100		290	uA
I_{UR}	Pull-Up Resistor Current - SI Pin	V_I = 0V, Off State	20		100	uA
V_{OH}	Output HIGH Voltage - VO1 and VO2 Pins	VI1, VI2 = 1.5V	3.5			V
V_{OL}	Output LOW Voltage - VO1 and VO2 Pins	VI1, VI2 = 2.5V			0.5	V
VT	Over-Current Limit - VT1 and VT2 Pins	Forward is high.	0.35		0.45	V

Note: These specifications apply for V_{CC} = 4.0V and 0°C £ T_A £ 70°C, unless otherwise specified.

AC Electrical Characteristics

Table 6. AC Electrical Characteristics of PT8A990P

Sym	Description	Test Conditions	Min	Typ	Max	Units
f_{OSC} (Note2)	Oscillator Frequency	T_A=25 C, R_f = 200kΩ	109	128	146	kHz
t_{FUN}	Period of Function Code	f_{OSC} = 128kHz, T_A = 25°C	1.7	2	2.3	ms
t_{STA}	Start-Code Period	f_{OSC} = 128kHz, T_A = 25°C	1.7	2	2.3	ms
f_{CSC}	Carrier Frequency	f_{OSC} = 128kHz, T_A = 25°C		64		kHz
t_{OFF}	Auto-off Time	f_{OSC} = 128kHz, T_A = 25°C		2		s
V_{CC}	Power Supply Range	-	3	4	5.5	V
I_{CC}	Supply Current	Output Unloaded			300	uA

Note:
1. These specifications apply for V_{CC} = 4.0V and 0°C ≤ T_A ≤ 70°C, unless otherwise specified.
2. The frequency of standard samples is tested on standard testing-board.

Table 7. AC Electrical Characteristics of PT8A991P

Sym	Description	Test Conditions	Min	Typ	Max	Units
f_{OSC} (Note2)	Oscillator Frequency	T_A=25 C, R_f = 200kΩ	109	128	146	kHz
t_{FUN}	Period of Function Code	f_{OSC} = 128kHz, T_A = 25°C	1.7	2	2.3	ms
t_{STA}	Start-Code Period	f_{OSC} = 128kHz, T_A = 25°C	1.7	2	2.3	ms
t_{OFF}	Auto-off Time	f_{OSC} = 128kHz, T_A = 25°C		5		minute
V_{CC}	Power Supply Range	-	3	4	5.5	V

Note:
1. These specifications apply for V_{CC} = 4.0V and 0°C ≤ T_A ≤ 70°C, unless otherwise specified.
2. The frequency of standard samples is tested on standard testing-board.

Figure 5. Typical Application Circuit of PT8A990P

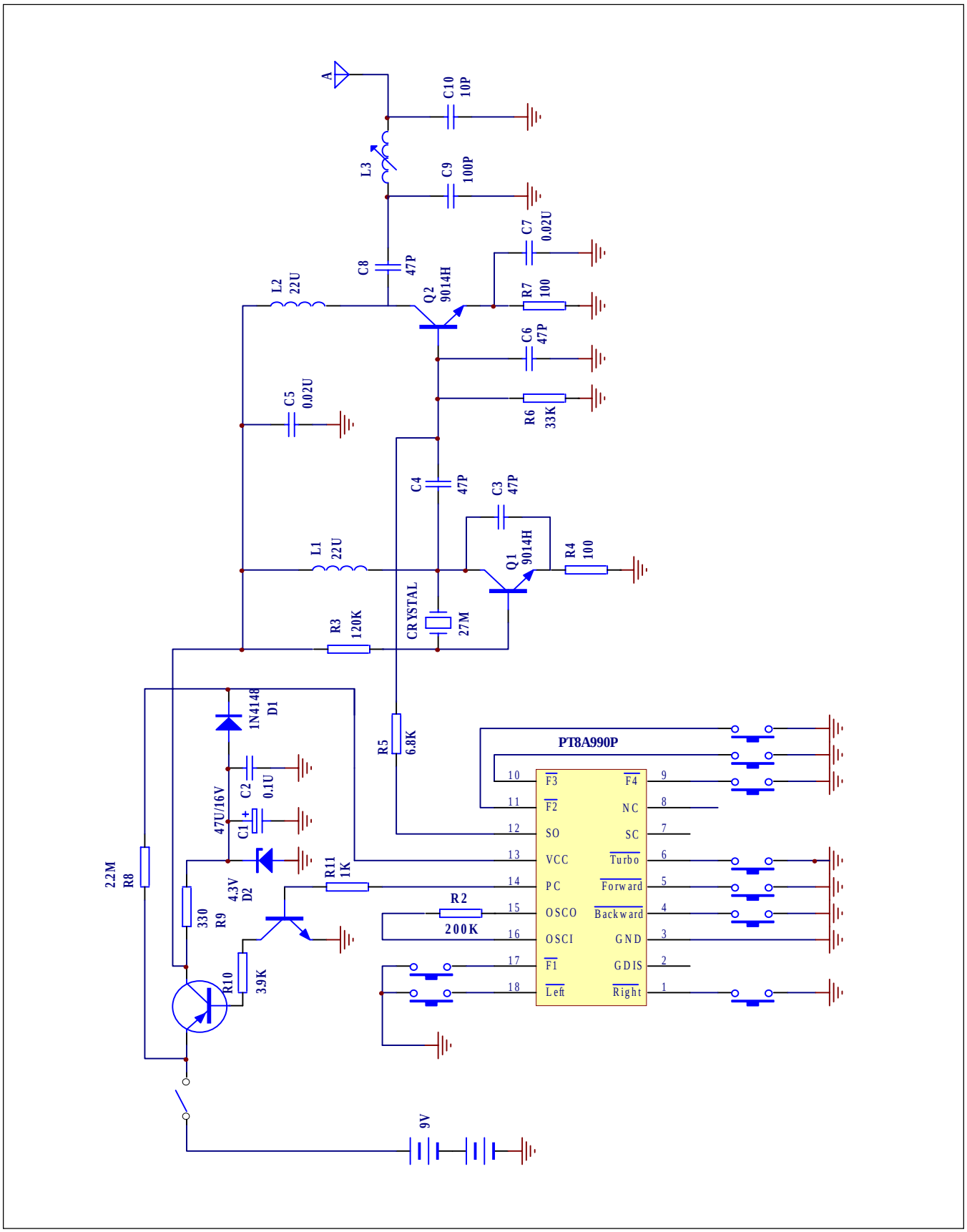
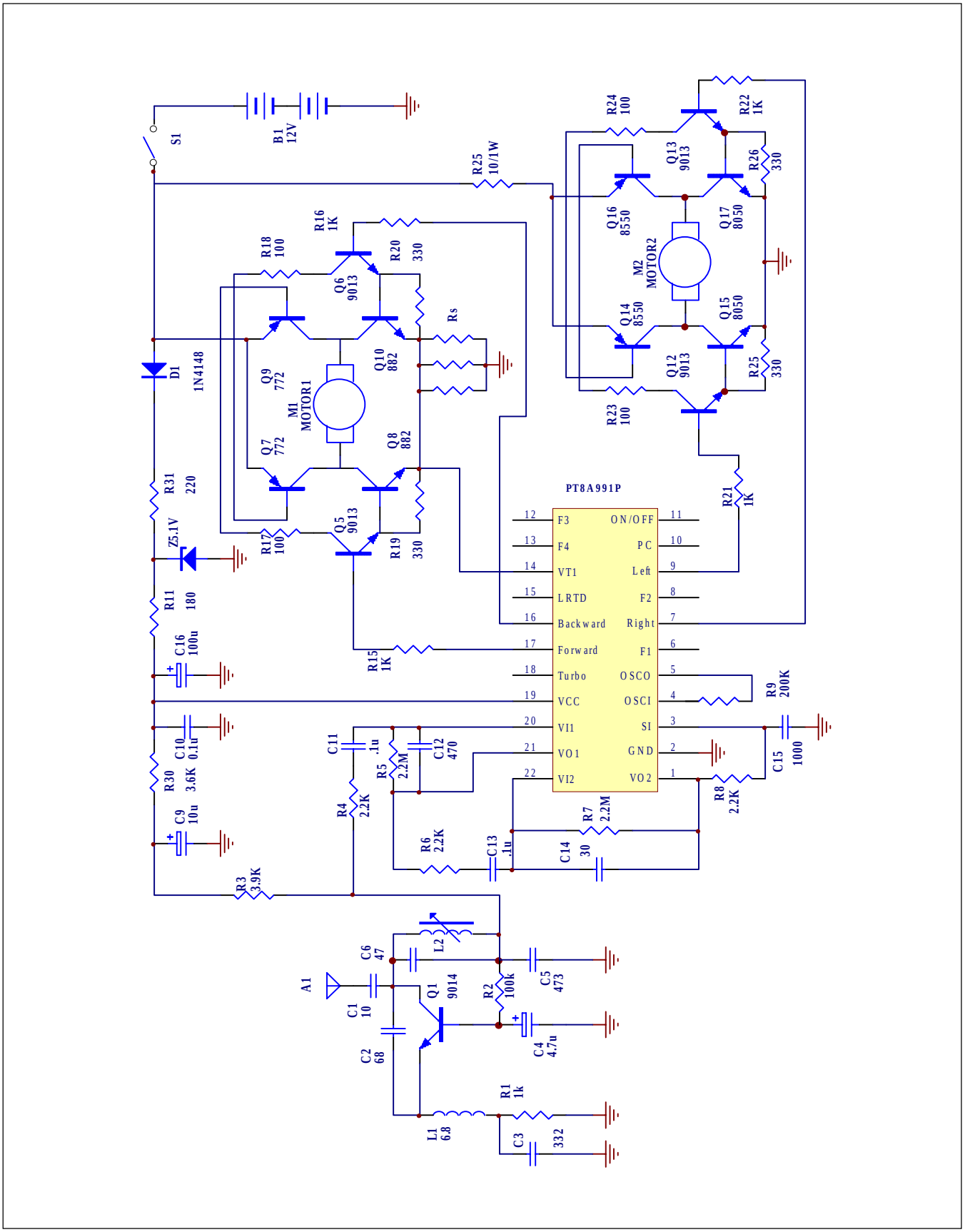


Figure 6. Typical Application Circuit of PT8A991P



Notes

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