HT12C/HT6337
Remote Fan Controllers

Features

- Operating voltage:
  - 2.4V~5.0V (HT12C)
  - 4.0V~5.5V (HT6337)
- Manual/remote control available
- Adjustable 3 levels of fan speed
- 8-hour time setting maximum
- Three kinds of wind control modes: normal, rhythm, and sleep
- Right/left swing control
- Up/down swing control
- Touch hold function

- Auto-temperature control
- Auxiliary control output
- 2-bit secret code setting
- LED indication
- 32768Hz crystal system clock
- Keytone output
- 16-pin DIP/SOP, 18-pin DIP or 20-pin SOP package for HT12C
- 18-pin/20-pin DIP package or 24-pin/28-pin DIP/SOP for HT6337
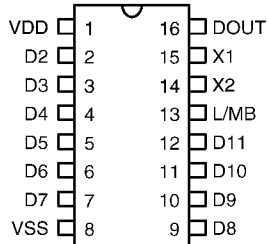
General Description

The HT6337 is a series of CMOS LSIs designed for remote/local fan control applications. It offers rhythm and sleep operation modes in addition to normal wind speed conventional control. All of the three operations (rhythm, sleep, and normal modes) provide different speed controls (level 1~level 3).
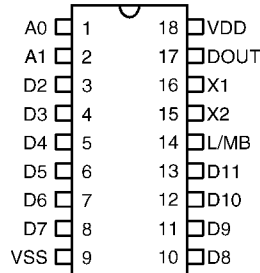
The HT6337 can be operated manually or by a remote control using the HT12C encoder. The HT12C encodes 12-bit information and transmits it serially upon receipt of independent keys along with two addressing input signals.

The HT6337 series also supports special functions (refer to the features) and all the operations are indicated by a LED display.
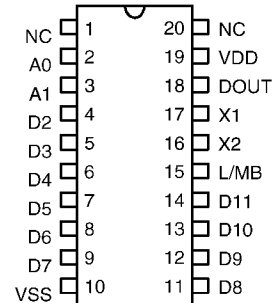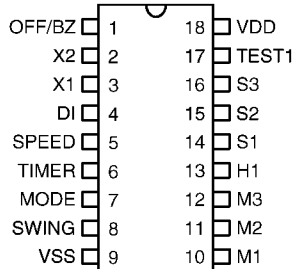
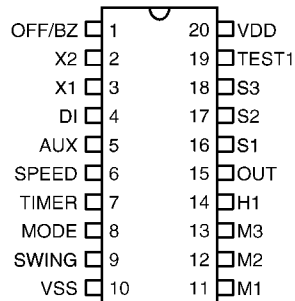1   18th Sep '97

Pin Assignment

HT12C – 16 DIP/SOP

Pin		Pin
VDD	1	16 DOUT
D2	2	15 X1
D3	3	14 X2
D4	4	13 L/MB
D5	5	12 D11
D6	6	11 D10
D7	7	10 D9
VSS	8	9 D8

HT12C – 18 DIP

Pin		Pin
A0	1	18 VDD
A1	2	17 DOUT
D2	3	16 X1
D3	4	15 X2
D4	5	14 L/MB
D5	6	13 D11
D6	7	12 D10
D7	8	11 D9
VSS	9	10 D8

HT12C – 20 SOP

Pin		Pin
NC	1	20 NC
A0	2	19 VDD
A1	3	18 DOUT
D2	4	17 X1
D3	5	16 X2
D4	6	15 L/MB
D5	7	14 D11
D6	8	13 D10
D7	9	12 D9
VSS	10	11 D8

HT6337D/FD/GD – 18 DIP

Pin		Pin
OFF/BZ	1	18 VDD
X2	2	17 TEST1
X1	3	16 S3
DI	4	15 S2
SPEED	5	14 S1
TIMER	6	13 H1
MODE	7	12 M3
SWING	8	11 M2
VSS	9	10 M1

HT6337E/FE/GE – 20 DIP

Pin		Pin
OFF/BZ	1	20 VDD
X2	2	19 TEST1
X1	3	18 S3
DI	4	17 S2
AUX	5	16 S1
SPEED	6	15 OUT
TIMER	7	14 H1
MODE	8	13 M3
SWING	9	12 M2
VSS	10	11 M1

HT6337C/FC/GC – 20 DIP

Pin		Pin
X2	1	20 OFF/BZ
X1	2	19 VDD
DI	3	18 TEST1
ATC	4	17 S3
SPEED	5	16 S2
TIMER	6	15 S1
MODE	7	14 H1
SWING	8	13 M3
TMS	9	12 M2
VSS	10	11 M1

HT6337B/FB/GB – 24 DIP/SOP

Pin		Pin
OFF/BZ	1	24 VDD
H2	2	23 TEST1
X2	3	22 S3
X1	4	21 S2
DI	5	20 S1
ATC	6	19 OUT
SPEED	7	18 H1
TIMER	8	17 TEST2
MODE	9	16 THD
SWING	10	15 M3
TMS	11	14 M2
VSS	12	13 M1

HT6337A/FA/GA – 28 DIP/SOP

Pin		Pin
OFF/BZ	1	28 VDD
A1	2	27 NC
H2	3	26 TEST1
X2	4	25 S3
X1	5	24 S2
DI	6	23 S1
ATC	7	22 OUT
AUX	8	21 H1
SPEED	9	20 TEST2
TIMER	10	19 THD
MODE	11	18 A0
SWING	12	17 M3
TMS	13	16 M2
VSS	14	15 M1

Selection Table

	Speed	Timer (hour)	Mode	Swing	Touch Hold	ATC	AUX	Secret Code
HT6337A	S1,S2,S3	1,2,4,8	Normal, Rhythm, Sleep	H1,H2	√	√	√	A0,A1
HT6337B				H1,H2	√	√	√	—
HT6337C				H1	—	√	—	—
HT6337D				H1	—	—	—	—
HT6337E				H1	—	—	√	—
HT6337FA	S1,S2,S3	0.5,1,2,4	Normal, Rhythm, Sleep	H1,H2	√	√	√	A0,A1
HT6337FB				H1,H2	√	√	√	—
HT6337FC				H1	—	√	—	—
HT6337FD				H1	—	—	—	—
HT6337FE				H1	—	—	√	—
HT6337GA	S1,S2,S3	1,2,4	Normal, Rhythm, Sleep	H1,H2	√	√	√	A0,A1
HT6337GB				H1,H2	√	√	√	—
HT6337GC				H1	—	√	—	—
HT6337GD				H1	—	—	—	—
HT6337GE				H1	—	—	√	—

*Note: AUX denotes the auxiliary control function. For the HT6337B, HT6337FB, and HT6337GB, AUX can be controlled only by the HT12C.
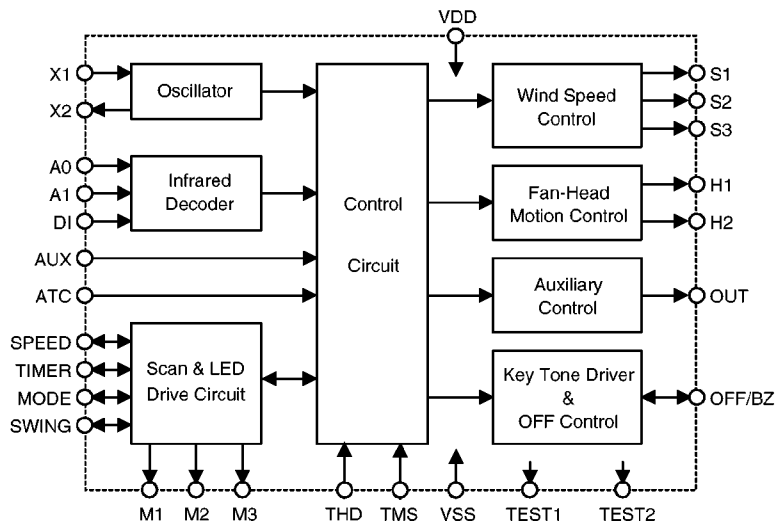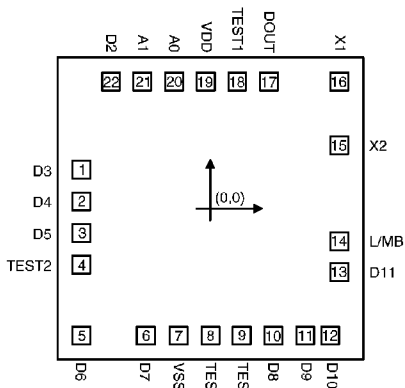The "√" denotes the function is active whereas "—" denotes the function is ineffective.

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Block Diagram

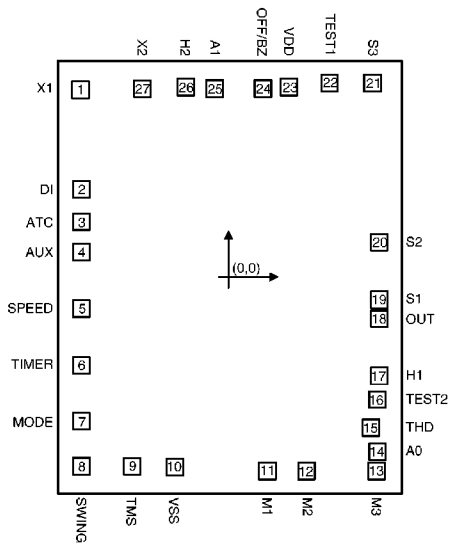**HT12C**
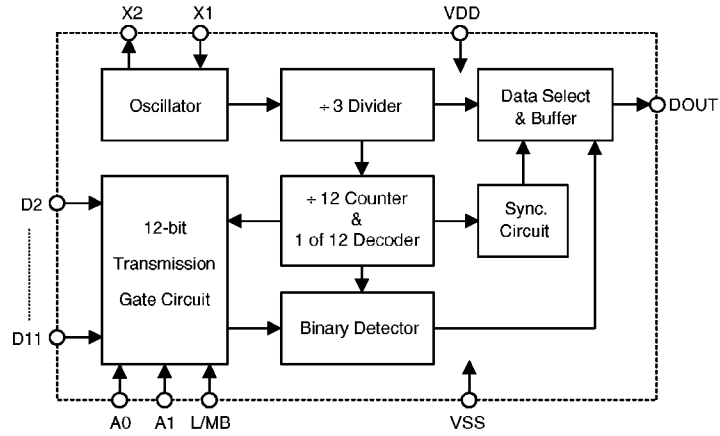
HT6337

Pad Coordinates

HT12C

Unit: mil

Chip size: 94 × 92 (mil)^2

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

Pad No.	X	Y	Pad No.	X	Y
1	–41.00	12.42	12	38.16	–40.37
2	–41.00	2.34	13	41.04	–20.12
3	–41.00	–7.74	14	41.04	–10.34
4	–41.00	–17.82	15	41.04	20.21
5	–41.00	–40.37	16	41.04	40.41
6	–20.57	–40.37	17	18.68	40.41
7	–10.13	–40.37	18	8.60	40.41
8	0.05	–40.37	19	–1.50	40.41
9	10.04	–40.37	20	–11.57	40.41
10	20.12	–40.37	21	–21.65	40.41
11	30.20	–40.37	22	–31.64	40.41

HT6337

Unit: mil

Chip size: 132 × 167 (mil)^2

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

Pad No.	X	Y	Pad No.	X	Y
1	–59.05	74.72	15	56.88	–60.01
2	–58.63	34.98	16	59.44	–48.83
3	–58.63	22.06	17	60.12	–39.40
4	–58.63	9.99	18	60.12	–16.66
5	–58.63	–12.54	19	60.12	–9.01
6	–58.63	–35.15	20	60.12	13.94
7	–58.63	–57.46	21	57.48	77.35
8	–58.63	–75.35	22	40.31	77.35
9	–38.48	–75.40	23	24.12	75.73
10	–21.44	–75.74	24	13.79	75.14
11	15.58	–77.35	25	–5.50	75.14
12	31.13	–77.35	26	–16.98	75.70
13	59.01	–77.35	27	–34.36	75.10
14	59.44	–69.66			

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Pin Description

HT12C

Pin No.	Pin Name	I/O	Internal Connection	Description
1,2	A0,A1	I	CMOS Pull-High	Security address setting input
3	D2	I	CMOS Pull-High	Wind speed adjustment input D2 executes the same function as the local Speed key of the HT6337
4,5	D3,D4	I	CMOS Pull-High	Not used
6	D5	I	CMOS Pull-High	Timer setting input D5 executes the same function as the local Timer key of the HT6337
7	D6	I	CMOS Pull-High	System turn off input pin D6 executes the same function as the local Off key of the HT6337
8	D7	I	CMOS Pull-High	Fan working mode selection input D7 executes the same function as the local Mode key of the HT6337
9	VSS	I	—	Power supply (ground)
10,11	D8,D9	I	CMOS Pull-High	Auxiliary output enable/disable selection toggle input Momentarily connect both D8 and D9 to VSS to toggle the logic state of the OUT pin of the HT6337. This function is the same as the function offered by the AUX pin of the HT6337
12	D10	I	CMOS Pull-High	Automatic temperature control function selection input Momentarily connects D10 to VSS to toggle ATC between enable and disable. D10 executes the same function as the local ATC key of the HT6337
13	D11	I	CMOS Pull-High	Fan head swing control input D11 executes the same function as the Swing key of the HT6337
14	L/MB	I	CMOS Pull-High	Data latch/momentary selection Connects L/MB to VSS to transmit a frame in the momentary form, or to VDD (or open) for transmission in the latch form. L/MB is open for remote fan controller applications
15	X2	O	CMOS	Oscillator output
16	X1	I	CMOS	Oscillator input
17	DOUT	O	CMOS	Encoded data transmit output
18	VDD	I	—	Power supply (positive)

HT6337A

Pin No.	Pin Name	I/O	Internal Connection	Description
1	OFF/BZ	I/O	CMOS Pull-High	OFF/BZ turns the system off and generates a keytone signal. When the system is operating, connecting this pin low forces the system to enter an off state. In the working state, the OFF/BZ pin generates a sound signal to affirm a key pressed
2	A1	I	CMOS Pull-High	Security address selection input
3	H2	O	NMOS Open Drain	Fan head swing driving signal H2 generates a low signal to trigger the TRIAC, making the fan head swing up and down
4	X2	O	CMOS	Oscillator output
5	X1	I	CMOS	Oscillator input
6	DI	I	CMOS	DI receives control data from the infrared receiver module. The received data is inverted for internal processing
7	ATC	I	CMOS Pull-High	Automatic temperature control enable/disable selection toggle input This function automatically changes the fan speed up or down so as to adjust the environmental temperature (refer to the functional description for detailed operation)
8	AUX	I	CMOS Pull-High	Auxiliary output enable/disable selection toggle input The AUX input can control the logic status of the OUT pin so as to control external electrical equipments such as desk lamps, etc.
9	SPEED	I/O	CMOS IN Pull-High PMOS OUT	Wind speed adjustment input and scanning signal output There are three speeds available: speed 1~speed 3. The scanning signal is for LED display
10	TIMER	I/O	CMOS IN Pull-High PMOS OUT	Timer setting input and scanning signal output There are four or three timer ranges to be used (refer to the selection table for various timers of different types of ICs). The scanning signal is for LED display
11	MODE	I/O	CMOS IN Pull-High PMOS OUT	Fan working mode selection input and scanning signal output There are three modes selectable: normal, rhythm, and sleep (refer to the functional description for detailed description). The scanning signal is for LED display

Pin No.	Pin Name	I/O	Internal Connection	Description
12	SWING	I/O	CMOS IN Pull-High PMOS OUT	Fan head swing control input and scanning signal output There are four modes selectable: up/down, left/right, both works, or both stops. The scanning signal is for LED display
13	TMS	I	CMOS	TMS senses the environmental temperature and adjusts the fan speed when ATC is enabled. It works with a thermistor and a capacitor (refer to the functional description for detailed operation)
14	VSS	I	—	Power supply (negative)
15~17	M1~M3	O	NMOS Open Drain	Scanning signal output These pins along with the SPEED, TIMER, MODE, and SWING pins make up a matrix structure which turns on the operation mode of the LED display
18	A0	I	CMOS Pull-High	Security address selection input
19	THD	I	CMOS Pull-Low	Touch hold input If the fan cover is touched (the THD pin receives an amplified signal from noises as a result of touching), the fan motor stops and the OFF/BZ pin generates a tone signal continuously (refer to the functional description for detailed operation)
20	TEST2	O	CMOS	For IC test only
21	H1	O	NMOS Open Drain	Fan head swing driving signal H1 generates a low signal to trigger the TRIAC, making the fan head swing left and right
22	OUT	O	NMOS Open Drain	Auxiliary control output OUT generates a low signal to trigger the TRIAC so that external electrical equipments such as desk lamps can be controlled
23~25	S1~S3	O	NMOS Open Drain	Wind speed driving signal These pins generate low voltage signals to trigger external TRIACs so that the wind speed can be controlled. S1 denotes the low speed, S2 the medium speed, and S3 the high speed
26	TEST1	O	NMOS Open Drain	For IC test only
27	NC	—	—	No connection
28	VDD	I	—	Power supply (positive)

Approximate internal circuits

CMOS IN, Pull-High PMOS OUT	CMOS OUT	OSCILLATOR	CMOS IN (For TMS pin of HT6337)	CMOS IN Pull-Low

CMOS IN/OUT Pull-High	CMOS IN Pull-High	NMOS Open Drain	CMOS IN
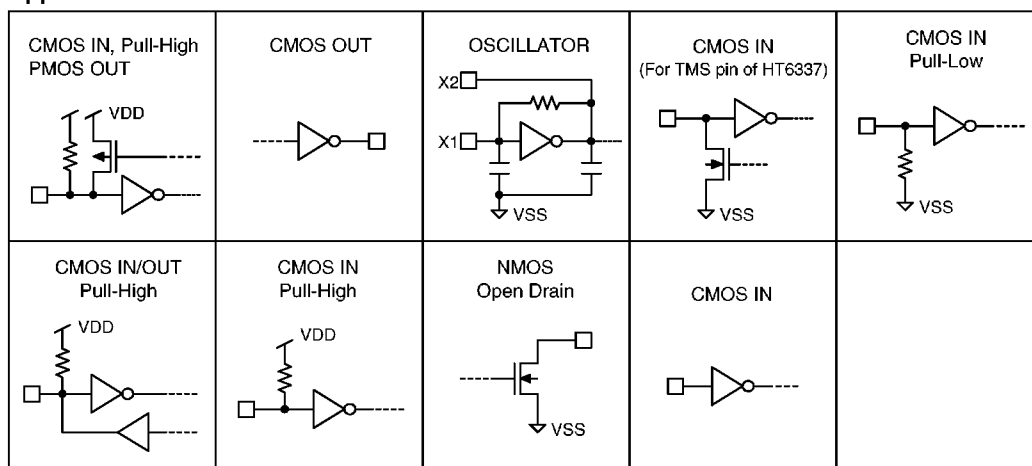
Absolute Maximum Ratings*

Supply Voltage ....–0.3V to 5.5V   Input Voltage.....................V_{SS}–0.3 to V_{DD}+0.3V

Storage Temperature.................–55°C to 125°C   Operating Temperature.................–0°C to 70°C

*Note: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied and exposure to absolute maximum rating conditions for extened periods may affect device reliability.

Electrical Characteristics

HT12C   (Ta=25°C)

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	2.4	3	5	V
I_{STB}	Standby Current	3V	Oscillator stops	—	0.1	1	µA
I_{DD}	Operating Current	3V	F_{OSC}=455kHz No load	—	200	400	µA
I_{OL}	DOUT Sink Current	3V	V_{OL}=0.3V	1.4	2.4	—	mA
I_{OH}	DOUT Source Current	3V	VOH=2.7V	–0.6	–1.0	—	mA

HT6337   (Ta=25°C)

| Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		V_{DD}	Conditions				
V_{DD}	Operating Voltage	—	—	4.0	—	5.5	V
I_{DD}	Operating Current	5V	F_{OSC}=32768Hz No load	—	50	200	μA
I_{OL1}	OFF/BZ Output Sink Current	5V	V_{OL}=0.5V	1.8	3.0	—	mA
I_{OL2}	Output Pin Sink Current (for H1, H2, S1~S3, OUT)	5V	V_{OL}=0.5V	6.0	11	—	mA
I_{OL3}	Scanning Pin Sink Current (for M1~M3)	5V	V_{OL}=0.5V	6.0	11	—	mA
I_{OH1}	Select Pin Source Current (for SPEED, TIMER, MODE, SWING)	5V	VOH=4.5V	–1.0	–1.8	—	mA
V_{IH}	"H" Input Voltage	5V	—	3.5	—	—	V
V_{IL}	"L" Input Voltage	5V	—	—	—	1	V
F_{OSC}	System Frequency	5V	—	—	32768	—	Hz

Functional Description

HT12C (Encoder) operation

The HT12C is a remote fan controller encoder. It encodes 12 bits of information. Of the 12 bits, 10 bits are used for control signals and 2 bits for secret addressing. In the stand-by state the oscillator stops so as to reduce power consumption. Once a control key is activated, the 12-bit information is transmitted serially.

Each function of the HT12C is represented by a data bit for transmission. The value of each data bit can be either a "0" or a "1" and is represented by a combination of a VSS signal and a number of 38kHz carrier clock cycles. A "0" caused by pressing a key or by having an address bit set to VSS is represented by a low signal of 1/3 period and a carrier clock of 2/3 periods. In contrast, a "1" is designated by a low signal of 2/3 period and a carrier clock of 1/3 period.

The transmitting frame consists of two parts, namely a pilot period and a code period. The pilot is used for synchronization which lasts for 12 bits and stays at VSS until the remaining 1/3 data bit period which is a 38kHz carrier is reached. The code period is used for code transmission, which also lasts for 12 data bits.
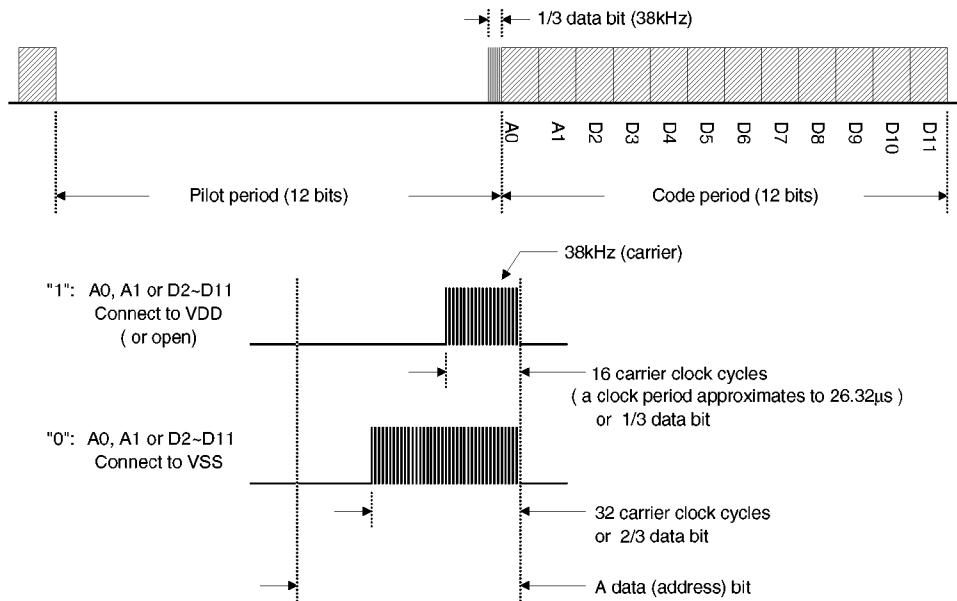
The flowchart of the HT12C operation is shown below (L/MB connects to VDD or is left open):
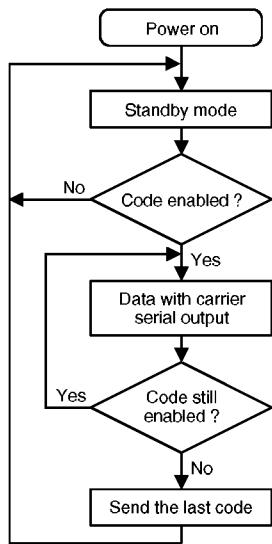
Speed

The fan controller provides three different speeds (speed 1~speed 3). When power is turned on and the Speed key is pressed, the system operates in the normal mode, and S2 outputs a 4-second low signal (speed 2 is active) to switch the motor on. After 4 seconds, the fan changes from speed 2 to speed 1, but the LED of speed 1 (see the application circuit for Spd1) remains on. At this time if the Speed key is pressed again, the speed is increased by one level. The level of speed is indicated by a LED. After the Speed key is pressed the OFF/BZ pin will sound a "beep" tone.

Refer to the operation flow for operation of the speed settings.

Timer

The time is set to zero (always on) after power is switched on. Pressing the Timer key once increases the setting step by step.

The set time of timer is indicated by a LED. After the Timer key is pressed the OFF/BZ pin will sound a "beep" tone.

Refer to the selection table for various timers of different types of ICs. As for the operation of timer settings, see the operation flow.

Mode

The Mode key selects the operation mode (normal mode, rhythm mode, or sleep mode). Pressing the Speed key after the power is turned on causes the system to go to the normal mode.
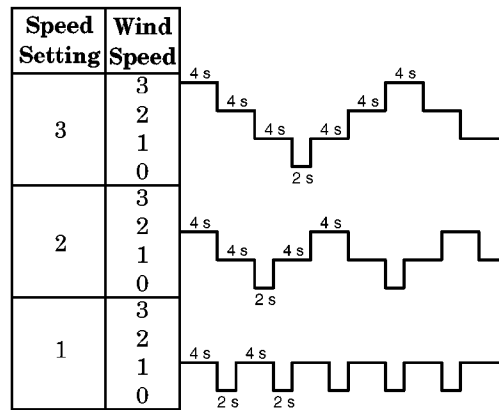
Refer to the operation flow for operation of the mode settings.

The relation between the wind speed and time is as shown:

• Normal mode

Speed Setting	Wind Speed	
3	3 2 1 0	
2	3 2 1 0	
1	3 2 1 0	

• Rhythm mode (that wind speed=0 indicates that the fan motor is in the stop state)


• Sleep mode

Speed Setting	State (see the rhythm mode)
3	Speed 3 rhythm wind 1 hour Speed 2 rhythm wind 1 hour Speed 1 rhythm wind to time-out
2	Speed 2 rhythm wind 1 hour Speed 1 rhythm wind to time-out
1	Speed 1 rhythm wind to time-out

In the sleep mode, the timer should be set before operation. If it has not been set, the sleep time turns out to be the maximum time by default.

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System off and keytone

The OFF/BZ pin has two functions. Pressing this key turns the system off and clears all the states when the IC is operating. The preceding states will not be saved. The OFF/BZ pin also generates a tone signal if any key is pressed. The keytone signal is as shown.
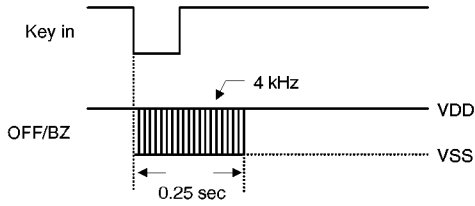

Touch hold function

Touching the fan cover causes noises from the body to be amplified and this signal is then transmitted to the THD pin (refer to the application circuits).

When the fan cover is touched the outputs S1~S3, H1, and H2 becomes disabled, and the TRIACs are all turned off. The "beep" tone signals from the OFF/BZ pin are generated continuously till the fan is turned off or the touch is removed. The auxiliary output, however, still remains unaffected.

If the time for touching the fan cover lasts less than 12 seconds, the fan will restart at its previous condition once the touch is removed. On the other hand, if the touching lasts more than 12 seconds the system will go to an OFF state.

Following is a state diagram of the touch hold function:
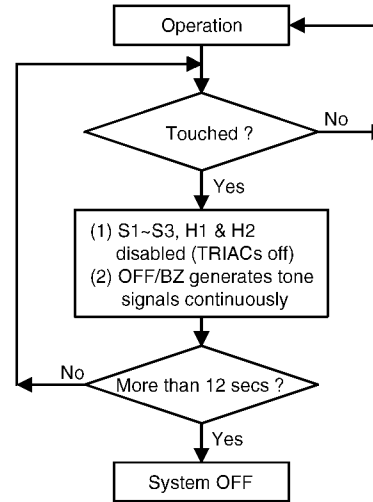

Fan head swing mode

There are two control outputs for the fan head. One controls the up/down swing and the other the left/right swing of the head. H2 can be assigned to control the up/down swing and H1 the left/right swing. Refer to the operation flow for operation of the head swing.

Automatic temperature control (ATC)

The HT6337 uses the environmental temperature as a control variable to change the fan speed. A thermistor and a capacitor should be connected as shown in the application circuits. For example, if the fan speed is at level 2 (speed 2) at the room temperature and the ATC function is enabled, the fan speed will change to speed 3 if the temperature is high. But if the temperature is low, the fan speed will reduce one level (speed 2 → speed 1).

The speed remains at the current state (at the room temperature) if the environmental temperature doesn't change. But if the speed automatically changes to speed 3 and the environmental temperature is high, the speed will be held at speed 3. Once the fan speed turns out to be speed 1 and the temperature is decreasing continuously, the system will enter the OFF state. The diagram of the operation state is illustrated below:
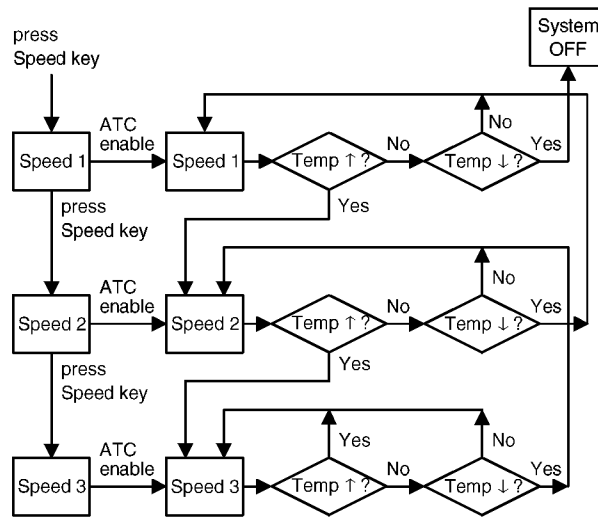
* Note: "Temp ↑" denotes the high temperature.
"Temp ↓" denotes the low temperature.

Variations in temperature lead to different frequencies at the TMS pin. When the ATC function is enabled the system records the current frequency on the TMS pin. The capacitor charge time will change the frequency if the resistance of the thermistor varies due to temperature changes.

Given this, if the frequency increases or decreases 7 times continuously from the recorded 36Hz, the system will change the speed accordingly by one level. The approximate circuits of the TMS pin and its waveform are as shown.

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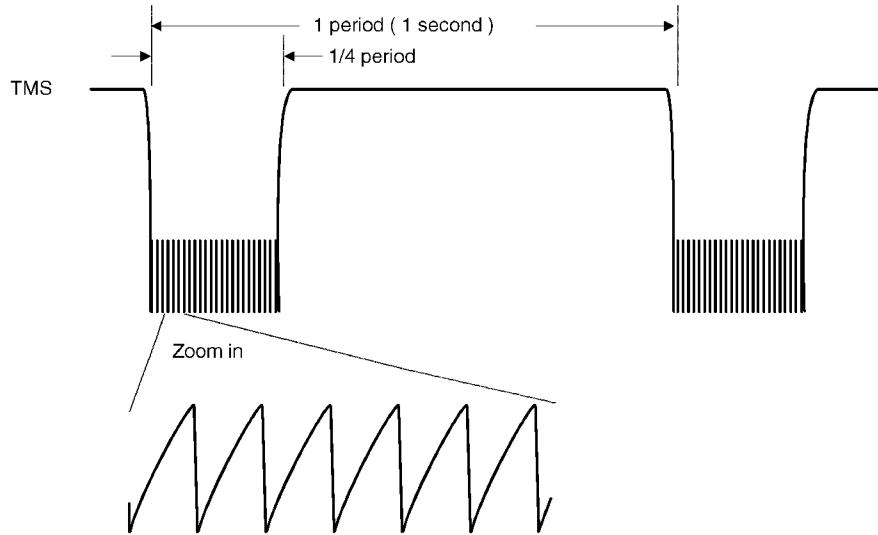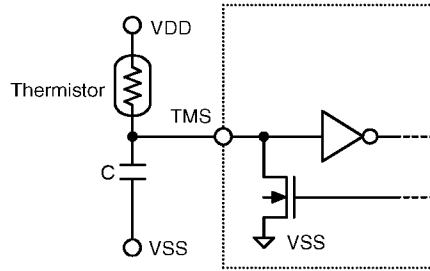
Operation flow (for the HT6337A)

The flowchart of system operation is as shown (refer to the application circuits):

```
                                        ┌─────────────────────┐
                                        │     System OFF      │◄──────────┐
                                        │  all states cleared │           │
                                        └─────────────────────┘           │
                                                                          │
                    press Off key                    press Speed key      │
                                                                          │
        ┌─────────────────┐              ┌──────────────────────────┐     │
        │   Operation     │              │ Normal mode              │     │
        │   State         │              │ Fan turns on (speed 1)   │     │
        └─────────────────┘              │ always ON                │     │
                                         │ Fan head does not swing  │     │
                                         │                          │     │
                                         │ "ATC" function disabled  │     │
                                         │ Auxiliary output disabled│     │
                                         └──────────────────────────┘
```

```
press          press          press          press          press          press
Swing          Timer          Mode           Speed          ATC            Aux
key            key            key            key            key            key

Swing left/right   Timer=1 hour   Rhythm        Speed 2       "ATC"         Auxiliary
(H1 ON only)                      mode                        enable        output
                                                                            enable
press              press          press         press         press         press
Swing              Timer          Mode          Speed         ATC           Aux
key                key            key           key           key           key

Swing up/down      Timer=2 hours  Sleep         Speed 3       "ATC"         Auxiliary
(H2 ON only)                      mode                        disable       output
                                                                            disable
press              press          press         press         press         press
Swing              Timer          Mode          Speed         ATC           Aux
key                key            key           key           key           key

Swing left/right   Timer=4 hours  Normal        Speed 1
& up/down                         mode
(both H1, H2 ON)
press              press          press         press
Swing              Timer          Mode          Speed
key                key            key           key

Fan head does      Timer=8 hours
not swing
(both H1, H2 OFF)
press              press
Swing              Timer
key                key

                   Always ON

                   press
                   Timer
                   key
```

Note: Speed 1 (S1 outputs low) denotes the low wind speed, speed 2 (S2 outputs low) the middle wind speed, and speed 3 (S3 outputs low) the high wind speed.

When the system is in the OFF state, the Timer or Mode key can also be pressed to set the operating time or operation mode, but the fan motor will not revolve.

The auxiliary output can be controlled whether or not the system is in the OFF state.

The ATC (Automatic Temperature Control) function is enabled after the Speed key and the ATC key are both pressed.

The fan head swing setting can be set after the Speed key is pressed.

The Touch Hold function is not listed in the flowchart.

The timers of the HT6337FA/B/C/D/E are 0.5, 1, 2, and 4 hours.
The timers of the HT6337GA/B/C/D/E are 1, 2, and 4 hours.

Application Circuits

HT12C encoder application circuit (for 18-pin package)
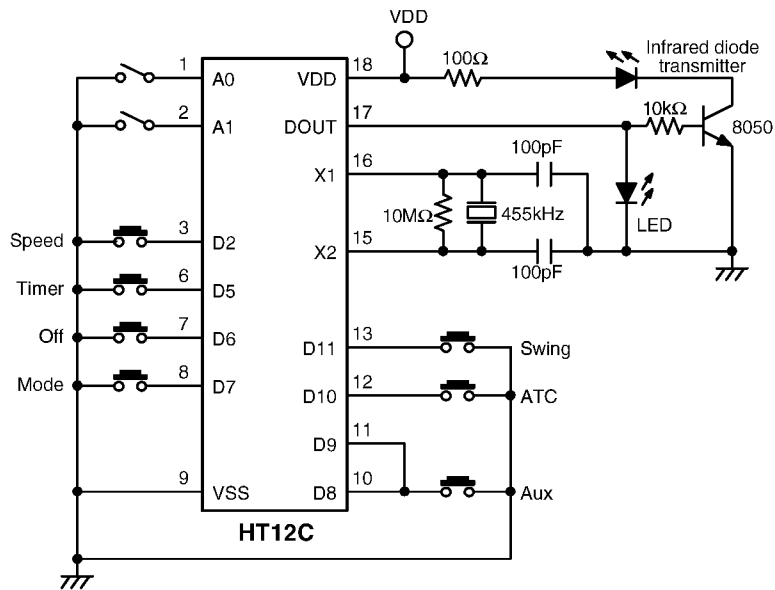
* Note: Typical infrared diode—EL-1L2 (KODENSHI CORP.)
The oscillator is a ceramic resonator of 455kHz.

HT6337 application circuit

• With capacitor power supply (for the HT6337A)
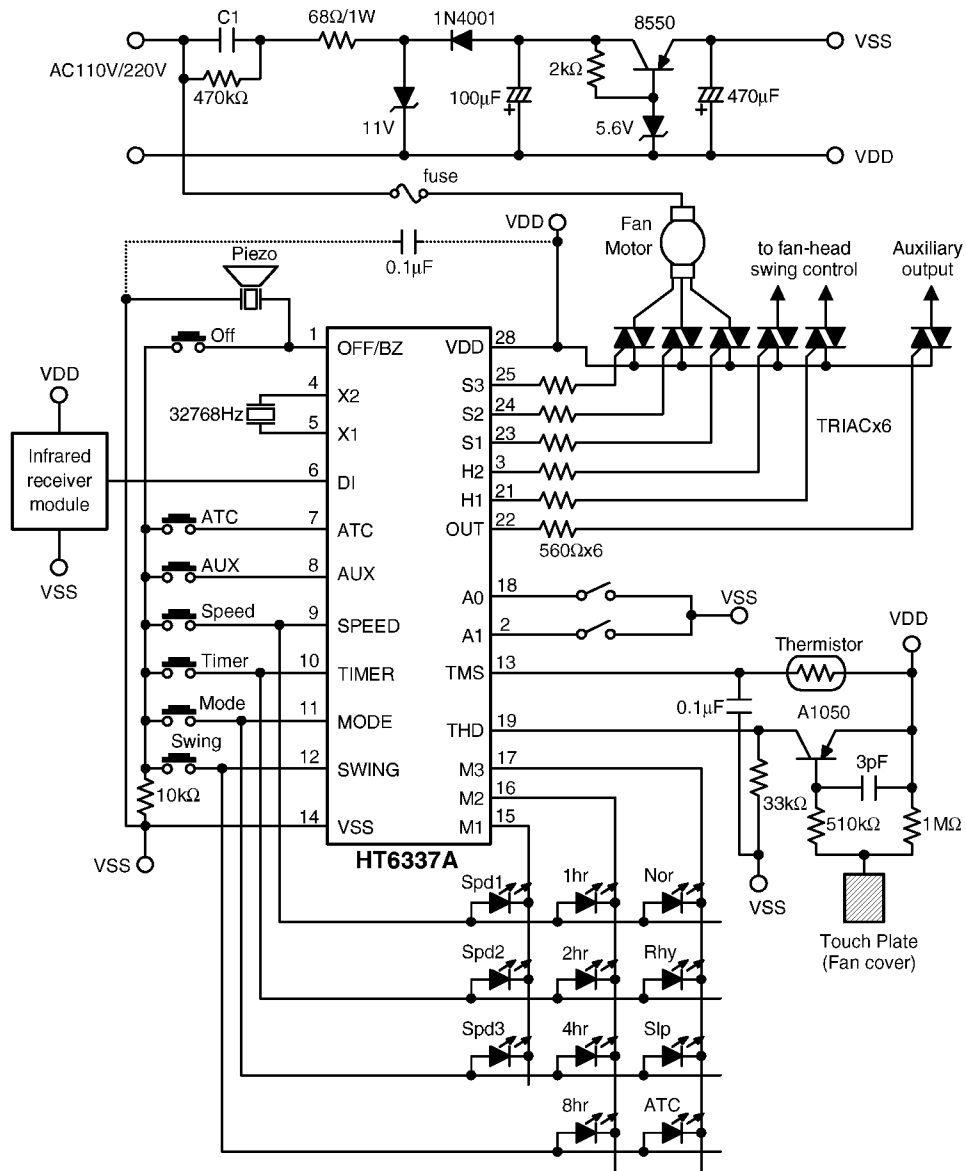
Note: C1=2μF/300V when the AC power supply is 110V.
C1=1μF/600V when the AC power supply is 220V.
Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
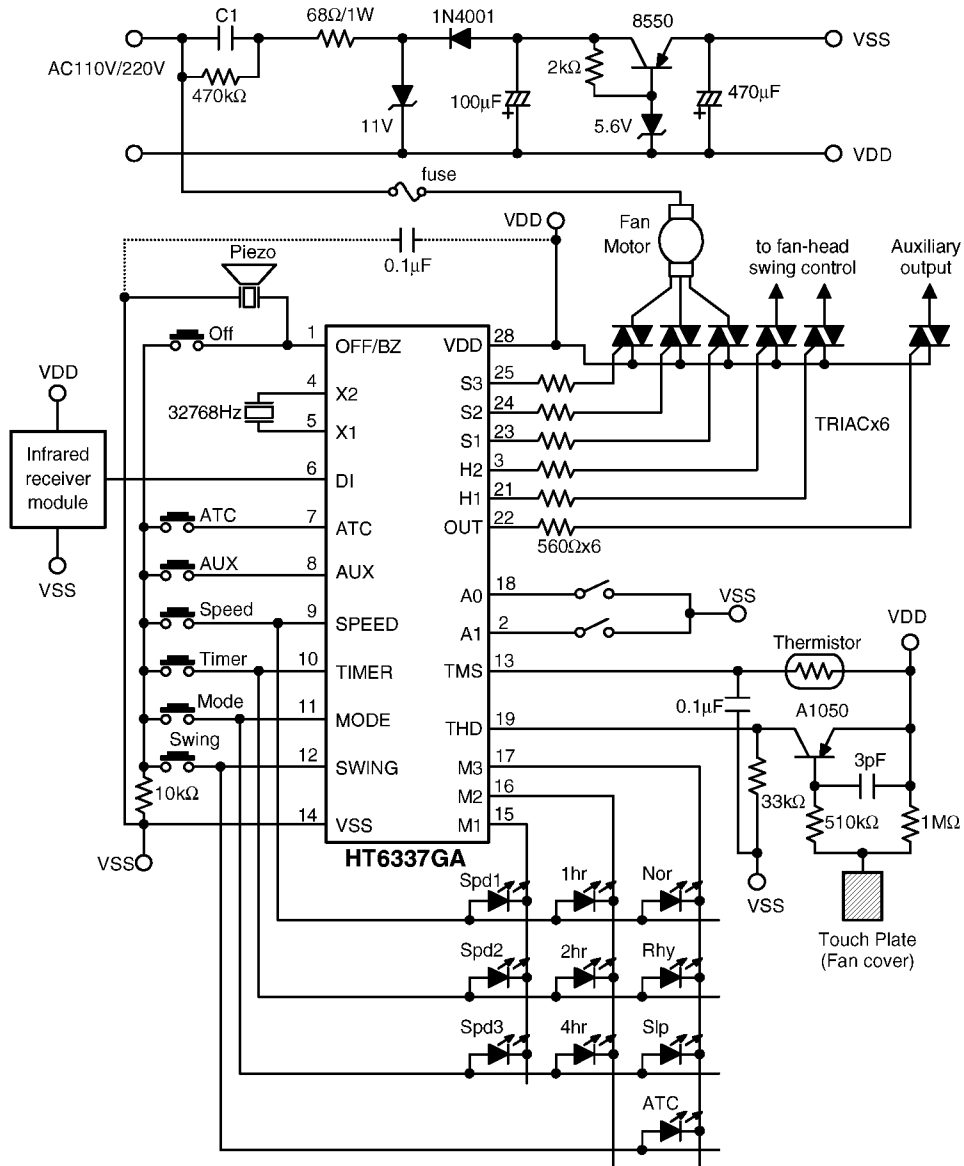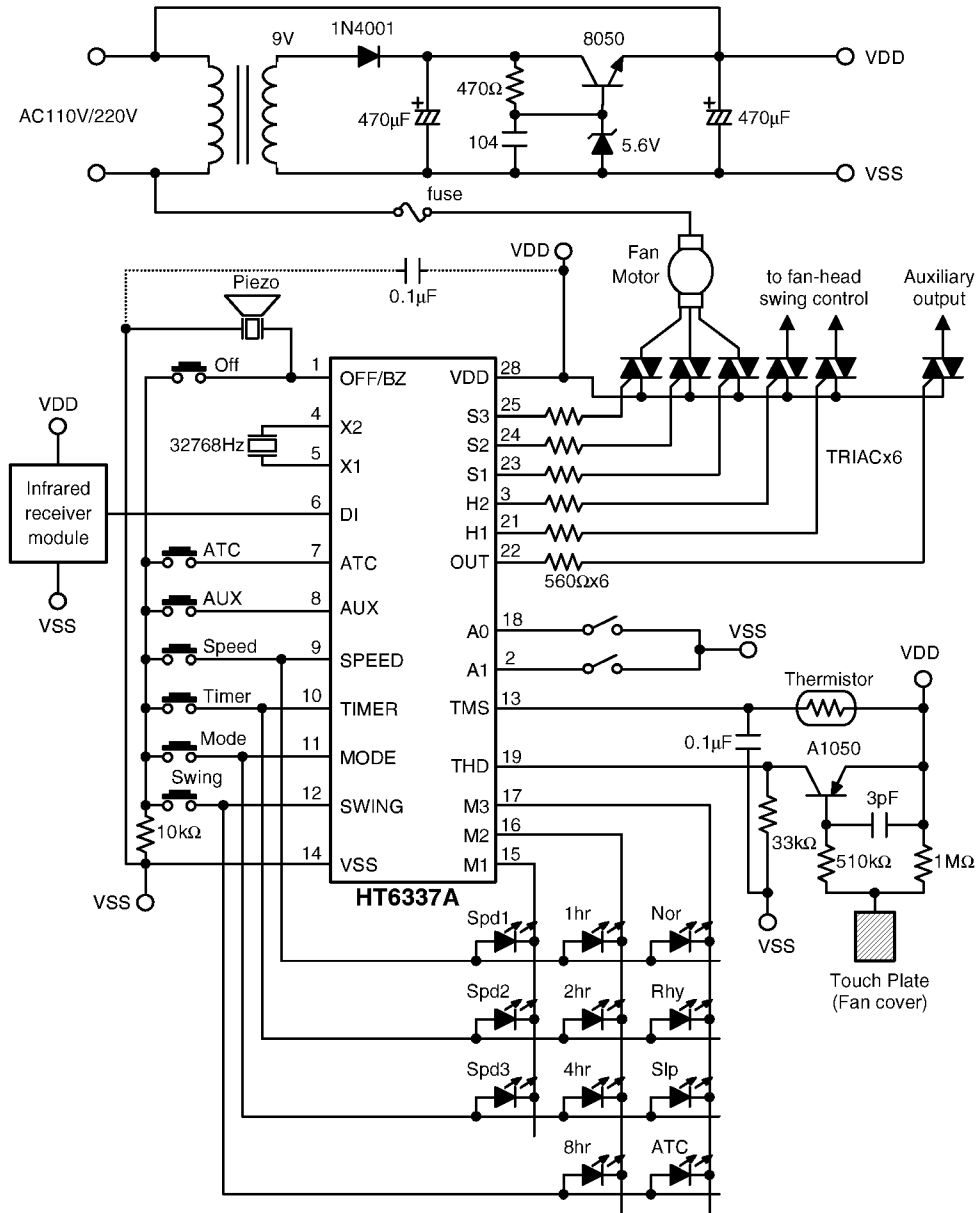or LTM9052 (LITEON CORP.)
The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

• With capacitor power supply (for the HT6337FA)
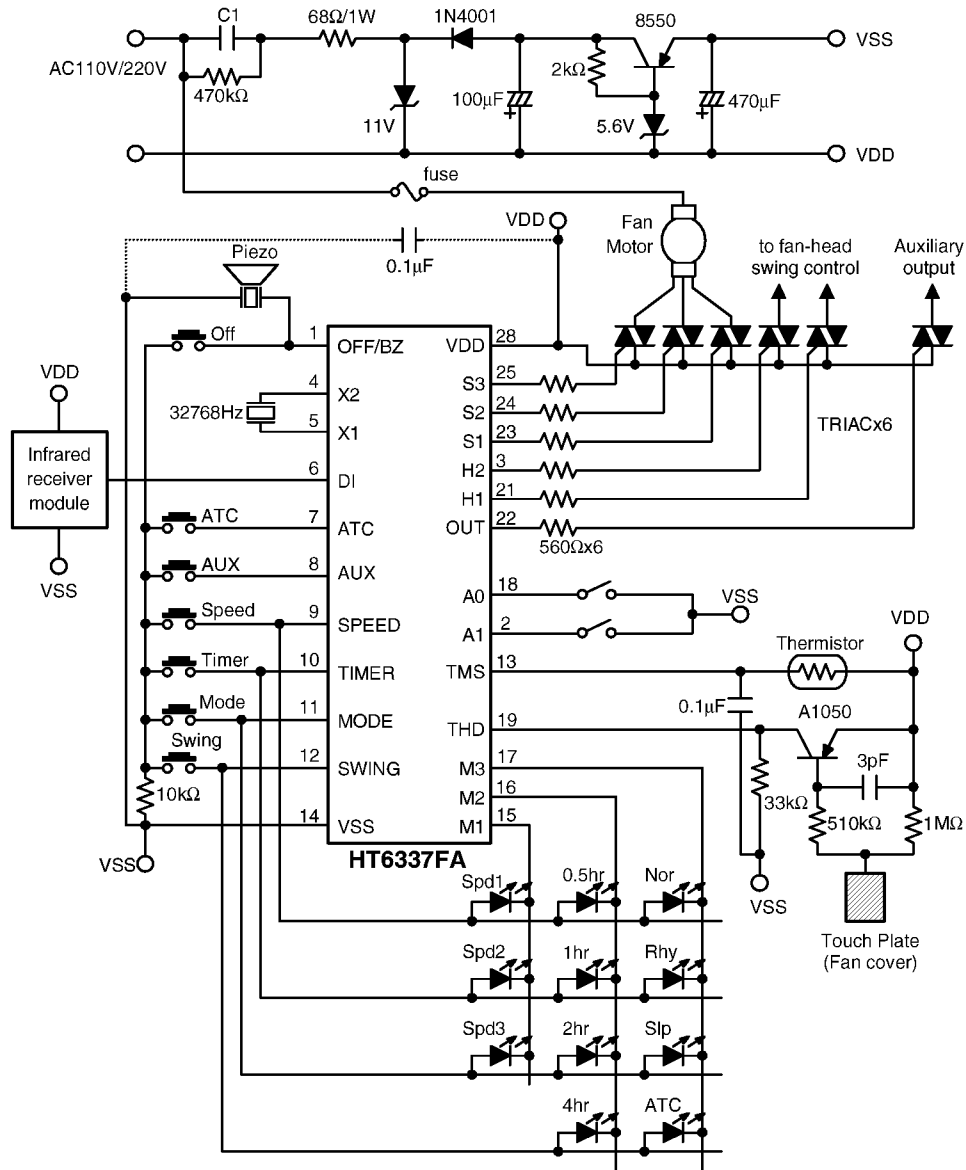
Note: C1=2µF/300V when the AC power supply is 110V.
C1=1µF/600V when the AC power supply is 220V.
Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
    or LTM9052 (LITEON CORP.)
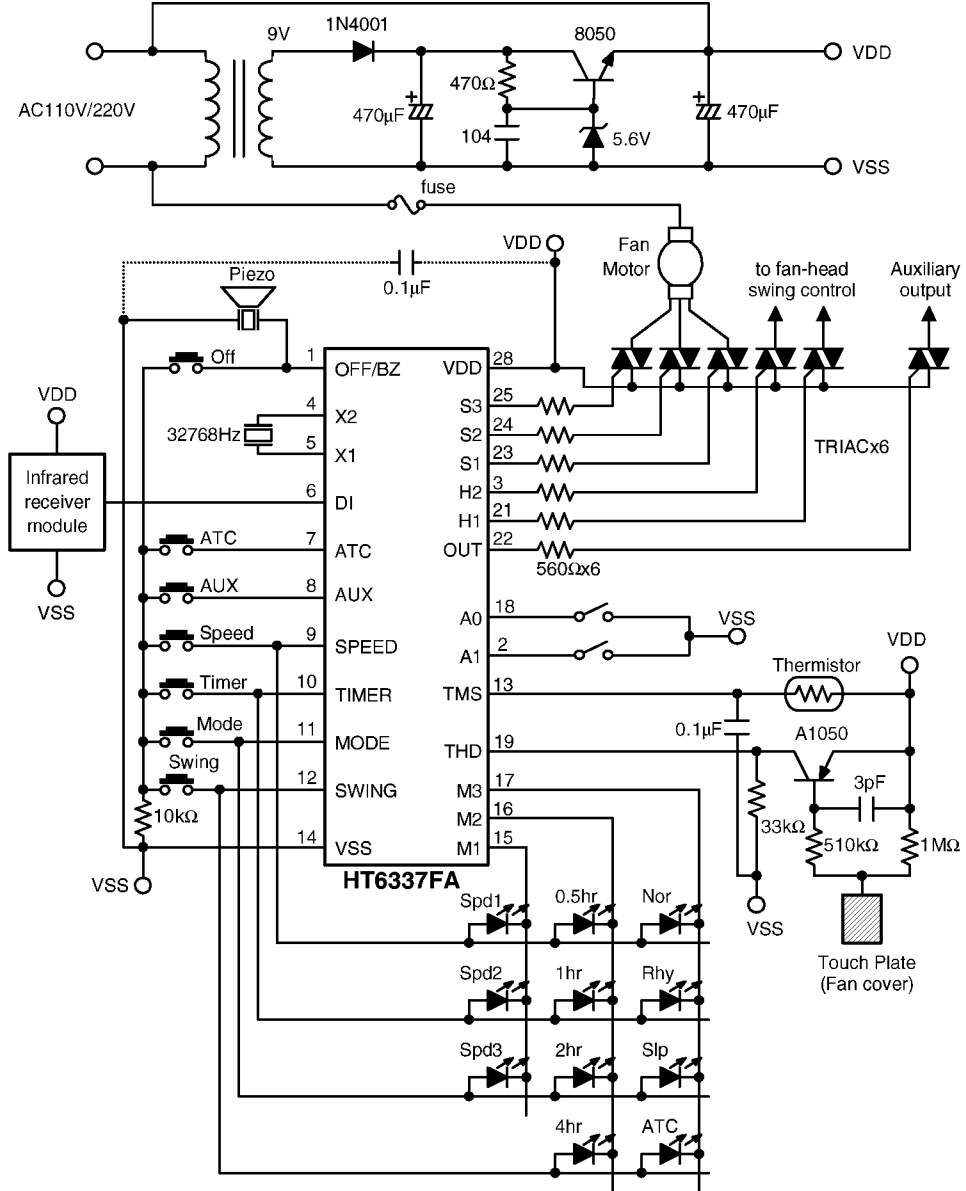The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

• With capacitor power supply (for the HT6337GA)

Note: C1=2µF/300V when the AC power supply is 110V.
　　　C1=1µF/600V when the AC power supply is 220V.
　　　Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
　　　　　　　　　　　　　　　　　　　　　or LTM9052 (LITEON CORP.)
　　　The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

• With transformer power supply (for the HT6337A)

Note: Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
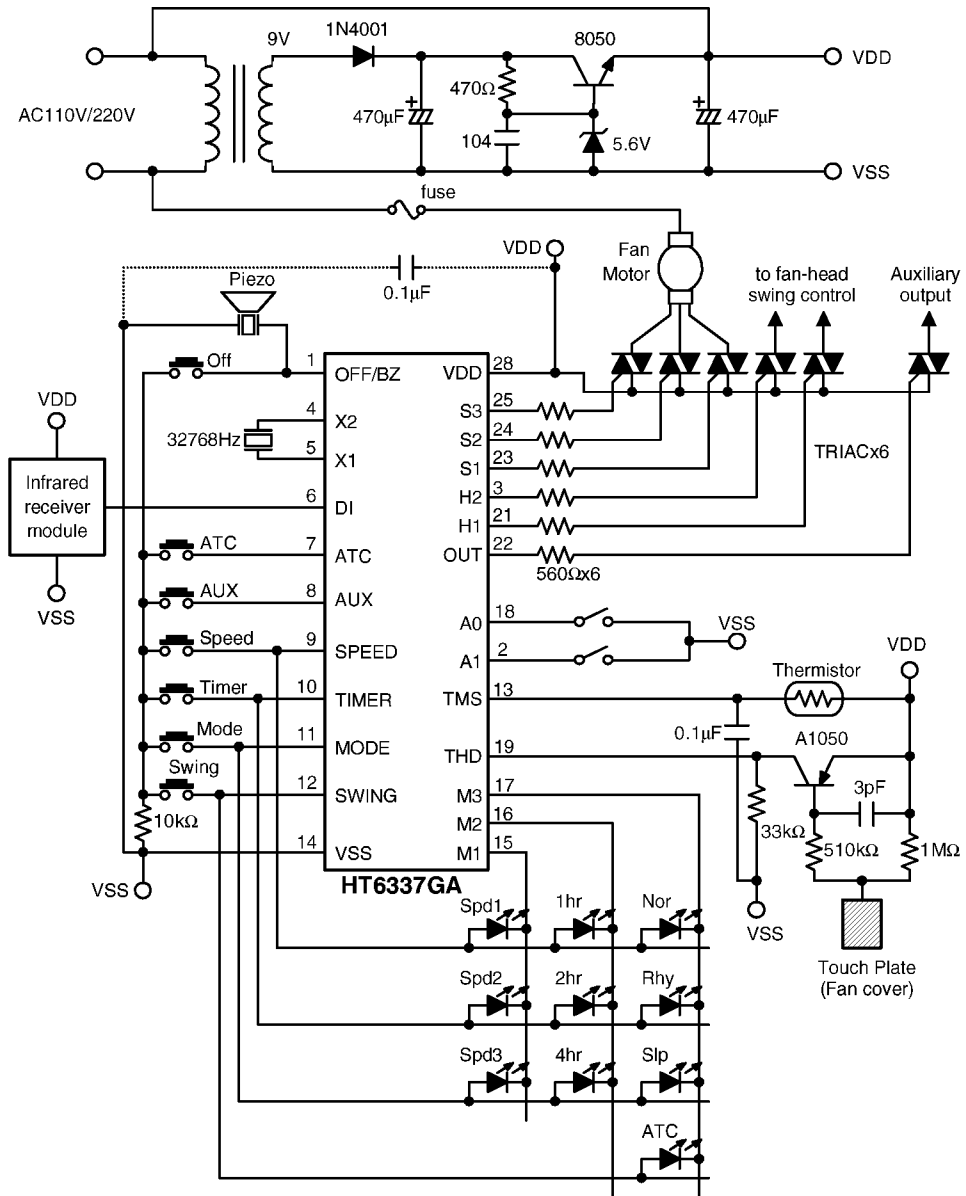or LTM9052 (LITEON CORP.)
The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

• With transformer power supply (for the HT6337FA)

Note: Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
or LTM9052 (LITEON CORP.)
The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

• With transformer power supply (for the HT6337GA)

Note: Typical infrared receiver modules: PIC-12043T/PIC-12043S (KODENSHI CORP.)
or LTM9052 (LITEON CORP.)

The thermistor is 50kΩ at 25°C and has a negative temperature coefficient.

18th Sep '97