



*Actions Semiconductor Co., Ltd.*

# TX6 ATS306T/RX6 ATS306R Data Sheet

Version 1.00



## Notice:

**The 7-function TX6 ATS306T/RX6 ATS306R heritages the sophisticated architecture and design methodology from TX6/RX6 of Realtek Semiconductor who is one of the leaders of remote controller technology design of toy product.**

This pair of TX6 ATS306T/RX6 ATS306R is the best Transmitter/ Receiver choice of remote control car and fully covers TX6RX6 features with superior performance. The TX6 ATS306T/RX6 ATS306R is with more functions and excellent quality, its stability and affectivity promoted to a higher level applications. Actions keeps on leading the designing technique of remote controller of toy product.

**Remark:** Realtek Semiconductor is the trademark of Taiwan Realtek Semiconductor

**REMOTE CONTROLLER WITH SEVEN FUNCTIONS**



## General Description

The **TX6 ATS306T/RX6 ATS306R** are a pair of CMOS LSIs designed for remote controlled car applications. TX6 ATS306T is the encoder and RX6 ATS306R is the decoder. They provide seven function keys to control forward, Backward, Rightward, Leftward, Turbo, F1 and F2 motions. Besides, a combination of these five common motions (Forward, Backward, Left, Right and Turbo) can be played. And RX6 ATS306R provides the ability of two shift gears for Forward and Backward functions.

TX6 ATS306T is built with auto Power-OFF function. When input key is pulled low, TX6 ATS306T will wake up, SO and SC will continuously send out the outputs used in wireless (Non-Carrier) and infrared (Carrier) applications respectively. When a complete code is sent out and all the keys are open, TX6 ATS306T will automatically go into power-off mode.

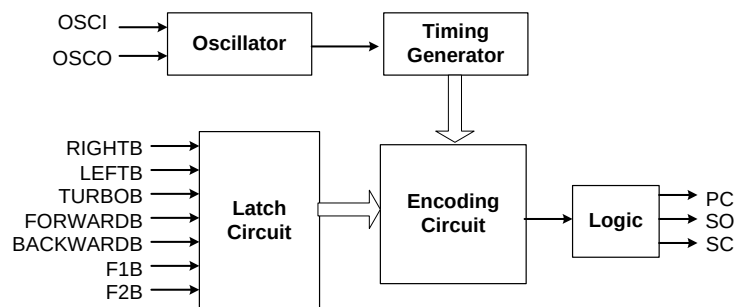
RX6 ATS306R provides two high effective amplifiers and enhance Signal Input (SI) recognition circuit for increasing remote control distance.

RX6 ATS306R has an internal, selectable DC-DC converter that makes the application stable, reliable under lower supply voltage.

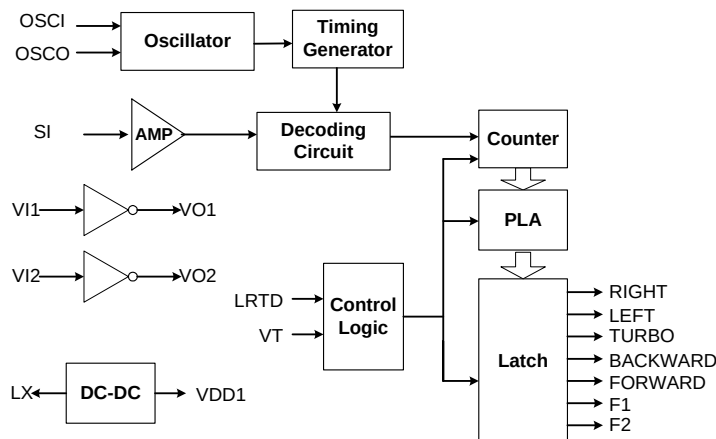
RX6 ATS306R has Motor Limit-Current Protection Circuit for safe and friendly application of RC toy.

## Block Diagrams

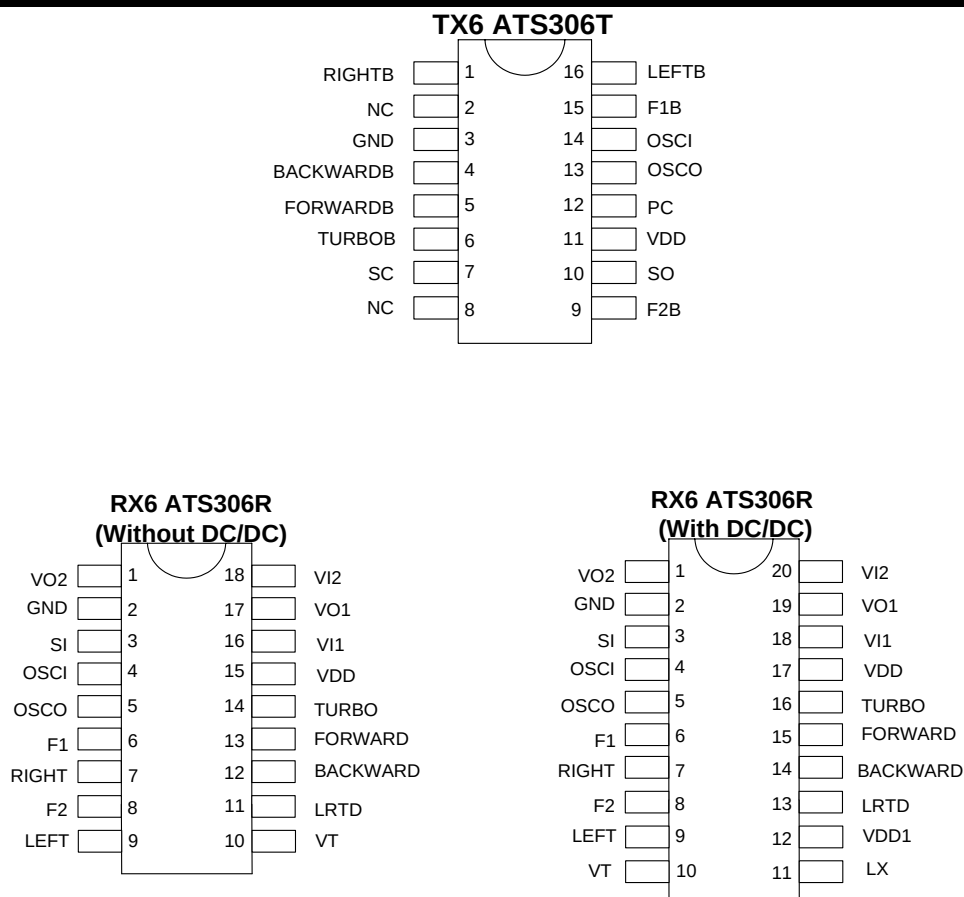
TX6 ATS306T(Encoder)



RX6 ATS306R(Decoder)



## Pin outs



## Features

- Wide and Low operating voltage range:
  - 2.0V to 5.0V(TX6 ATS306T and RX6 ATS306R without DC/DC)
  - A 3.8V zener is built in RX6 ATS306R, so a current limitation resistor is required
  - 1.0V ~ 3.0V (RX6 ATS306R with DC/DC)
- Seven-function remote controller controlling Forward/ Backward/ Turbo/ Right/ Left/F1/F2
- Provide two transmissive interface (RF and IR) for different application
- Two speed-shift is realized for Forward and Backward
- Few external components needed
- RX6 ATS306R's Oscillator only with an external resistor and an external capacitance.
- Low standby current and low operating current.
- Typical oscillator frequency:
  - RF: 128KHz
  - IR: 114KHz(Carrier Frequency: 57KHz)
  - IR: 76KHz(Carrier Frequency: 38KHz)
- Auto Power-OFF function for TX6 ATS306T
- Internal, Selectable Limit-Current protection function. If selected, few external components needed
- Provide the function of gearing down if swerving
- Provide two high effective amplifiers and enhance signal input (SI) recognition circuit for very weak signal for increasing remote control distance.



- Internal, Selectable DC-DC converter, which need few external components. The input voltage ranges from 1.0V to 3.0V, where  $V_{OUT}$  can be set to about 3.1V. Start-up is guaranteed from 1.0V inputs. Hold voltage is 0.8V.
- RX6 ATS306R has very strong driving ability about seven function-output

## Absolute Maximum Ratings

### Comments\*

DC Supply Voltage..... -0.3V to 6.0V  
 Input/Output Voltage..... GND -0.2V to VDD + 0.2V  
 Operating temperature..... -10°C to 60°C  
 Storage Temperature..... -25°C to 125°C

Never allow a stress to exceed the values listed under "Absolute Maximum Ratings", otherwise the device would suffer from a permanent damage. Nor is a stress at the listed value be allowed to persist over a period, since an extended exposure to the absolute maximum rating condition may also affect the reliability of the device, if not causing a damage thereof.

## Electrical Characteristics

### TX6 ATS306T

Typical operating Conditions : VDD = 3.8V, Fosc = 128KHz,  $T_A = 25^\circ\text{C}$ , (unless otherwise noted.)

| Parameter                      | Symbol          | Conditions                 | TX6 ATS306T |     |      | Units |
|--------------------------------|-----------------|----------------------------|-------------|-----|------|-------|
|                                |                 |                            | Min         | Typ | Max  |       |
| Input Low Voltage              | $V_{IL}$        | Function Input Pin         | -0.7        |     | 1.5  | V     |
| Stand by Current               | $I_{StandBy}$   | No function input          |             | 0.2 | 1.0  | uA    |
| Operating Current              | $I_{DD}$        | Unload                     |             | 0.1 | 0.6  | mA    |
| SO Driving Current             | $I_{DrSO}$      | Load=0.7V(1N4148)          | 10          |     |      | mA    |
| SC Driving Current             | $I_{DrSC}$      | Load=0.7V(1N4148)          | 10          |     |      | mA    |
| PC Driving Current             | $I_{DrPC}$      | Load=0.7V(1N4148)          | 10          |     |      | mA    |
| Oscillator Frequency Tolerance | $F_{tolerance}$ | RX6 ATS306R<br>Fosc=128KHz | -20%        |     | +20% | %     |
| Code Speed                     | $S_{Code}$      | Fosc=128KHz                | 500         |     | 1000 | Hz    |

**Note 1:** "Function input pin" means Forwardb, Backwardb, Rightwardb, Leftwardb, Turbob, F1B and F2B inputs

### RX6 ATS306R(Without DC/DC)

Typical operating Conditions: VCC (Power supply) = 4.5V, a Current Limitation resistor ( $68\Omega$ ) is between power supply and VDD pin. Fosc = 128KHz,  $T_A = 25^\circ\text{C}$ , (unless otherwise noted.)

| Parameter                      | Symbol          | Conditions                 | RX6 ATS306R |     |      | Units |
|--------------------------------|-----------------|----------------------------|-------------|-----|------|-------|
|                                |                 |                            | Min         | Typ | Max  |       |
| Function Output voltage        | $V_O$           | Unload                     | 3.7         | 3.8 | 3.9  | V     |
| Operating Current              | $I_{DD}$        | Unload                     |             | 8.0 |      | mA    |
| Output Driving Current         | $I_{Driving}$   | Load=0.7V(1N4148)          | 8.0         |     |      | mA    |
| Oscillator Frequency Tolerance | $F_{tolerance}$ | TX6 ATS306T<br>Fosc=128KHz | -20%        |     | +20% | %     |

**Note 1:** "Function Output pin" means forward, Backward, Rightward, Leftward, Turbo, F1 and F2 outputs



**Note 2.** Operating Current value is high because of supply voltage higher than zener voltage. The operating current will only be less than 0.8mA if power supply is less than 3.6V.

### RX6 ATS306R (With DC/DC)

Typical operating Conditions :  $V_{\text{INPUT}}=1.5\text{V}$ ,  $F_{\text{osc}}=128\text{KHz}$ ,  $T_A=25^\circ\text{C}$ . Using DC-DC converter, (unless otherwise noted.)

| Parameter                      | Symbol                 | Conditions                             | RX6 ATS306R |     |      | units |
|--------------------------------|------------------------|----------------------------------------|-------------|-----|------|-------|
|                                |                        |                                        | Min         | Typ | Max  |       |
| DC-DC Output voltage           | $V_{\text{DD}}$        |                                        | 3.0         | 3.1 | 3.3  | V     |
| Function Output voltage        | $V_{\text{OH}}$        | Unload                                 | 3.0         | 3.1 | 3.3  | V     |
| DC-DC Hold voltage             | $V_{\text{HOLD}}$      | Unload                                 | 0.8         |     |      | V     |
| Operating Current              | $I_{\text{DD}}$        | Unload (Use recommended DC-DC circuit) |             | 1.0 |      | mA    |
| Output Driving Current         | $I_{\text{Driving}}$   | Load=0.7V(1N4148)                      | 5.0         |     |      | mA    |
| Oscillator Frequency Tolerance | $F_{\text{tolerance}}$ | TX6 ATS306T 128KHz                     | -20%        |     | +20% | %     |

**Note 1:** "Function Output pin" means forward, Backward, Rightward, Leftward, Turbo, F1 and F2 outputs

**Note 2:** " $V_{\text{INPUT}}$ " means the input voltage to the DC-DC converter.

**Note 3:** The start-up voltage depends on the application circuit. 1.0V(Start-up) means that the Schottky Type Diode(1N5817) must be used.

## Pin Description

**TX6 ATS306T**

| NAME             | PIN | FUNCTION                                                                                                            |
|------------------|-----|---------------------------------------------------------------------------------------------------------------------|
| <b>RIGHTB</b>    | 1   | The rightward function will be selected when this pin is connected to GND. (High when open)                         |
| <b>GND</b>       | 3   | Negative power supply                                                                                               |
| <b>BACKWARDB</b> | 4   | The backward function will be selected when this pin is connected to GND. (High when open)                          |
| <b>FORWARDB</b>  | 5   | The forward function will be selected when this pin is connected to GND. (High when open)                           |
| <b>TURBOB</b>    | 6   | The turbo function will be selected when this pin is connected to GND. (High when open)                             |
| <b>SC</b>        | 7   | Output pin of the encoding signal with carrier frequency (IR)                                                       |
| <b>F2B</b>       | 9   | The F2 function will be selected when this pin is connected to GND. (High when open)                                |
| <b>SO</b>        | 10  | Output pin of the encoding signal without carrier frequency (Wireless)                                              |
| <b>VDD</b>       | 11  | Positive power supply                                                                                               |
| <b>PC</b>        | 12  | Power control output pin. When any function key is pulled low, PC will be high logic. If not, it will be Low logic. |
| <b>OSCO</b>      | 13  | Oscillator output pin                                                                                               |
| <b>OSCI</b>      | 14  | Oscillator input pin                                                                                                |
| <b>F1B</b>       | 15  | The F1 function will be selected when this pin is connected to GND. (High when open)                                |
| <b>LEFTB</b>     | 16  | The leftward function will be selected when this pin is connected to GND. (High when open)                          |

**RX6 ATS306R**



| NAME     | PIN<br>(Without<br>DC/DC) | PIN<br>(With<br>DC/DC) | FUNCTION                                                                                                                                      |
|----------|---------------------------|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| VO2      | 1                         | (1)                    | Output pin for the Second amplify                                                                                                             |
| GND      | 2                         | (2)                    | Negative power supply                                                                                                                         |
| SI       | 3                         | (3)                    | Input pin of the encoding signal. A inverter must be between SO and SI if connected directly                                                  |
| OSCI     | 4                         | (4)                    | Oscillator input pin                                                                                                                          |
| OSCO     | 5                         | (5)                    | Oscillator output pin                                                                                                                         |
| F1       | 6                         | (6)                    | F1 function output pin (High when active)                                                                                                     |
| RIGHT    | 7                         | (7)                    | Rightward output pin (High when active)                                                                                                       |
| F2       | 8                         | (8)                    | F2 function output pin (High when active)                                                                                                     |
| LEFT     | 9                         | (9)                    | Leftward output pin (High when active)                                                                                                        |
| VT       | 10                        | (10)                   | Input pin of Limit-Current protection function. If no used, it should be connected to GND                                                     |
| LX1      | -----                     | (11)                   | DC-DC converter Switch signal output pin. The LX pin should be connected with a switch-transistor through a resistor for Limiting the current |
| VDD1     | -----                     | (12)                   | DC-DC converter voltage output pin. Supply positive power for VDD                                                                             |
| LRTD     | 11                        | (13)                   | The Turbo (High speed) function will be cancelled in the swerve motion if it is connected to Gnd                                              |
| BACKWARD | 12                        | (14)                   | Backward output pin (High when active)                                                                                                        |
| FORWARD  | 13                        | (15)                   | Forward output pin (High when active)                                                                                                         |
| TURBO    | 14                        | (16)                   | Turbo output pin (High when active)                                                                                                           |
| VDD      | 15                        | (17)                   | Positive power supply                                                                                                                         |
| VI1      | 16                        | (18)                   | Input pin for the First amplify                                                                                                               |
| VO1      | 17                        | (19)                   | Output pin for the first amplify                                                                                                              |
| VI2      | 18                        | (20)                   | Input pin for the Second amplify                                                                                                              |





## Detailed Description

### (1) Common Functions

RC toy's Common Functions include Forward, Backward, Left, Right and Turbo motions.

#### Input/Output Tables

| Function input (TX6<br>ATS306T) ①              | Decode Result (RX6 ATS306R) ②                  |
|------------------------------------------------|------------------------------------------------|
| No any function Input                          | No output                                      |
| Forward (L)                                    | Forward pulse (Z)                              |
| Forward (L)&Turbo (L)                          | Forward (H)&Turbo(H)                           |
| Turbo(L)                                       | Turbo(H)                                       |
| Forward(L)&Left(L) <Or Right(L)>               | Forward pulse(Z) &Left(H) <Or Right(H)>        |
| Turbo(L) &Left(L) <Or Right(L)>                | Turbo(H)&Left(H) <Or Right(H)>                 |
| Turbo(L)&Forward(L)&Left(L)<br><Or Right (L)>  | Turbo(H)&Forward(H)&Left(H)<br><Or Right(H)>   |
| Backward (L)                                   | Backward pulse(Z)                              |
| Backward(L)&Turbo(L)                           | Backward(H)&Turbo(H)                           |
| Backward(L)&Left(L) <Or<br>Right(L)>           | Backward pulse(Z) &Left(H)<br><Or Right(H)>    |
| Turbo(L)&Backward(L)&Left(L)<br><Or Right (L)> | Turbo(H)&Backward(H)&Left(H)<br><Or Right (H)> |
| Left(L)                                        | Left(H)                                        |
| Right (L)                                      | Right(H)                                       |

**Note 1:** Tab ① longitudinal data indicates that corresponding Function input keys are pulled down to Gnd (L=LOW)

**Note 2:** Tab ② longitudinal data indicates that corresponding outputs are active. H=HIGH, Z= 84Hz 66.7% DUTY Pulse

**Note 3:** The frequency of pulse depends on the local oscillator frequency. If the local oscillator frequency is 128KHz, the frequency of pulse will be 84Hz.

**Note 4:** The duty of pulse will not vary in any case.

**Note 5:** The Forward and Backward outputs cannot be active at the same time in any case though AST305T has the corresponding inputs. So are left and right outputs.

### (2) F1 and F2 functions

RX6 ATS306R has two absolute independent Digital Channel: F1 and F2. They also haven't any relation with common functions and other F3, F4 functions.

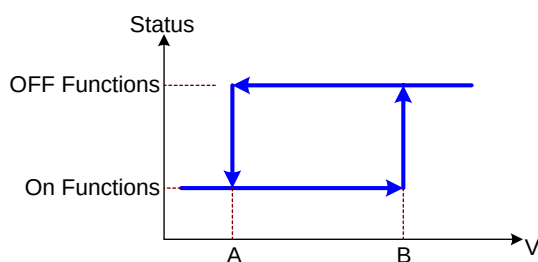
F1 and F2 functions can be used in audio control, Lamp indication and other motor driving.

### (3) VT: Limit-Current protection

At some time the toy's servomotor will be blocked for some reasons, so the function of protecting the motor is very important for us. And then, RX6 ATS306R provides the protection function for avoiding it take place.

The function is selectable. If not, VT pin should be pulled down to Gnd.

If select, the circuit that needs few external components should transform the servomotor current to the voltage for VT input



**Note 1:** The abscissa data is the voltage that is from VT input. And ordinate data is the On-Off status of All the IC outputs.

**Note 2:** There are different voltage overturn point of A and B depended on the power supply. For example, If power supply is 3.8V, A point 1.2V, B point 1.7V. And if power supply is 2.7V, A point is 1V, B point 1.35V.

#### (4) LRTD: Auto Gearing Down function

The toys should not be played in high speed when it is turning. Just do so, turnover will happen. RX6 ATS306R provides the function that prohibits the motion of high speed (Turbo output) while turning if LRTD is connected to Gnd.

LRTD function is selectable. If not, Let it be open.

| The steering output controlled by The toy player (TX6 ATS306T) | Input of LRTD   | The final output (RX6 ATS306R)                |
|----------------------------------------------------------------|-----------------|-----------------------------------------------|
| Turbo&Left <Or Right>                                          | Inactive( Open) | Turbo(H)&Left(H) <Or Right(H)>                |
| Turbo&Forward&Left <Or Right>                                  | Inactive (Open) | Turbo (H)&Forward (H)&Left(H) <Or Right (H)>  |
| Turbo&Backward&Left <Or Right>                                 | Inactive (Open) | Turbo (H)&backward (H)&Left(H) <Or Right (H)> |
| Turbo&Left <Or Right>                                          | Active (Low)    | Left(H) <Or Right(H)>                         |
| Turbo&Forward&Left <Or Right>                                  | Active (Low)    | Forward(Z)&Left(H) <Or Right(H)>              |
| Turbo&Backward&Left <Or Right>                                 | Active (Low)    | Backward(Z)&Left(H) <Or Right(H)>             |

**Note 1:** Z=pulse(84Hz 66.7%Duty) H= High logic.

#### (5) Two-speed Shift Function

How to realize the two-speed shift of servomotor?

Please use Forward and Backward output for driving the servomotor. If Turbo is inactive, the motor works in low speed because of pulse driving. And if Turbo is active, the motor works in high speed for High logic driving



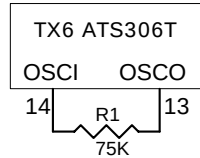
## Typical Application Circuit

Transmitter (TX6 ATS306T Fosc=128 KHz)

**Note 1:** Two-Speed shift is realized about forward output.

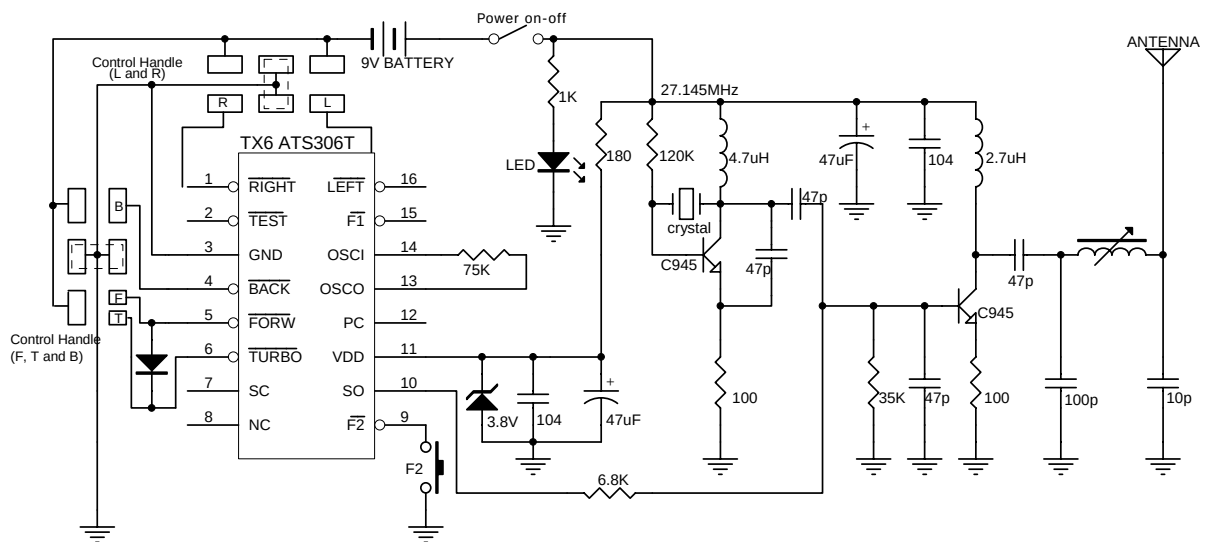
**Note 2:** The frequency in the table below is 128KHz. The value of resistor (R1) should be changed, if the other oscillator frequency needed.

Oscillator Circuit



Fosc=128KHz

| R1  | Fosc         |
|-----|--------------|
| 80K | About 120KHz |
| 75K | About 128KHz |
| 68K | About 143KHz |





## Receiver I (RX6 ATS306R Fosc =128 KHz)

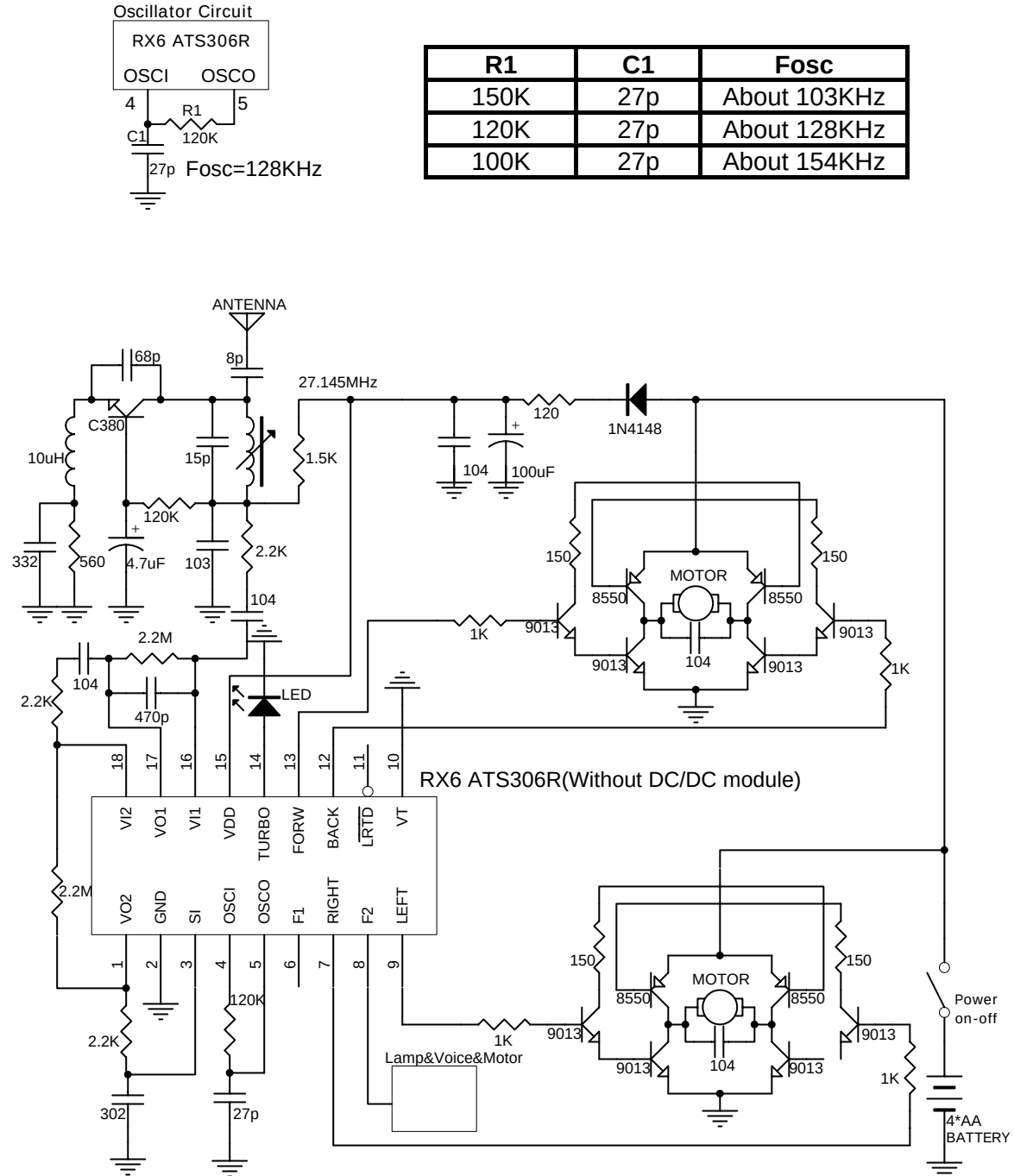
**Note 1:** The VT pin is pulled down to Gnd because of no using Limit-Current protection.

**Note 2:** Please use the appropriate Current-Limit resistor when using internal zener.

**Note 3:** F2 output is connected with the circuit that needs control.

**Note 4:** The frequency in the table below is 128KHz. The value of resistor (R1) should be changed, if the other oscillator frequency needed. And changing the value of oscillator capacitance (C1) is not necessary

**Note 5:** Without the DC/DC module





## Receiver II (RX6 ATS306R Fosc =128 KHz)

**Note 1:** Using the Limit-Current Protection function

**Note 2:** Please use the appropriate Current-Limit resistor when using internal zener.

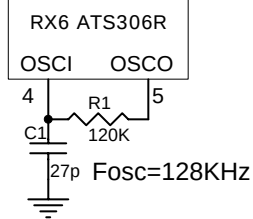
**Note 3:** F2 output is connected with the circuit that needs control.

**Note 4:** Using the LRTD function

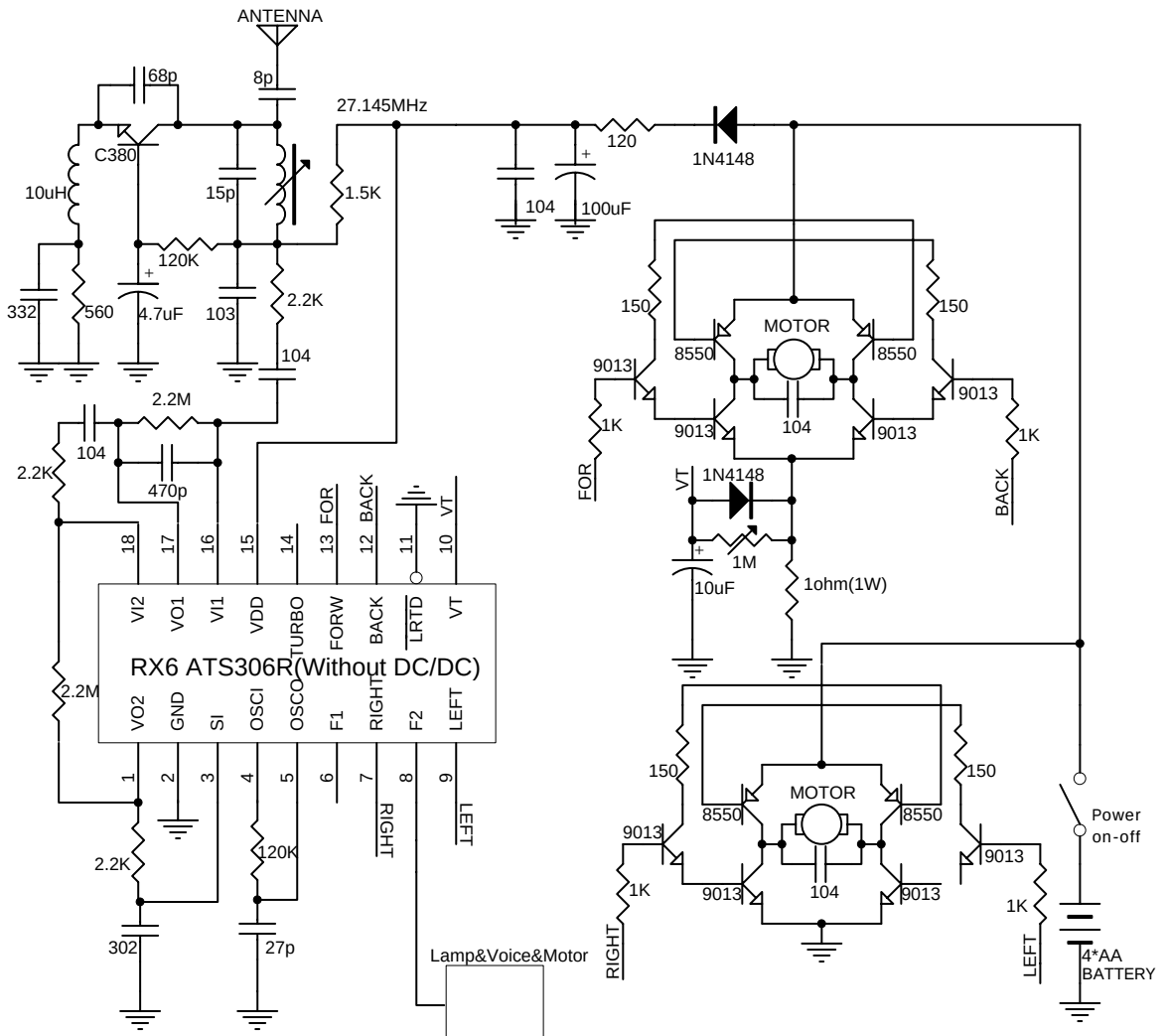
**Note 5:** The frequency in the table below is 128KHz. The value of resistor (R1) should be changed , if the other oscillator frequency needed. And changing the value of oscillator capacitance (C1) is not necessary

**Note 6:** Without the DC/DC module

Oscillator Circuit



| R1   | C1  | Fosc         |
|------|-----|--------------|
| 150K | 27p | About 103KHz |
| 120K | 27p | About 128KHz |
| 100K | 27p | About 154KHz |





**Note 1:** With the DC/DC module, because of lower supply voltage, and the Schottky Type Diode must be used

**Note 2:** Using the Limit-Current Protection function .The VT pin must be pulled down to Gnd If no using Limit-Current protection.

**Note 4:** F2 output is connected with the circuit that needs control.

**Note 5:** The frequency in the table below is 128KHz. The value of resistor (R1) should be changed, if the other oscillator frequency needed. And changing the value of oscillator capacitance (C1) is not necessary

RX6 ATS306R

OSC1 OSC0

4 5

C1

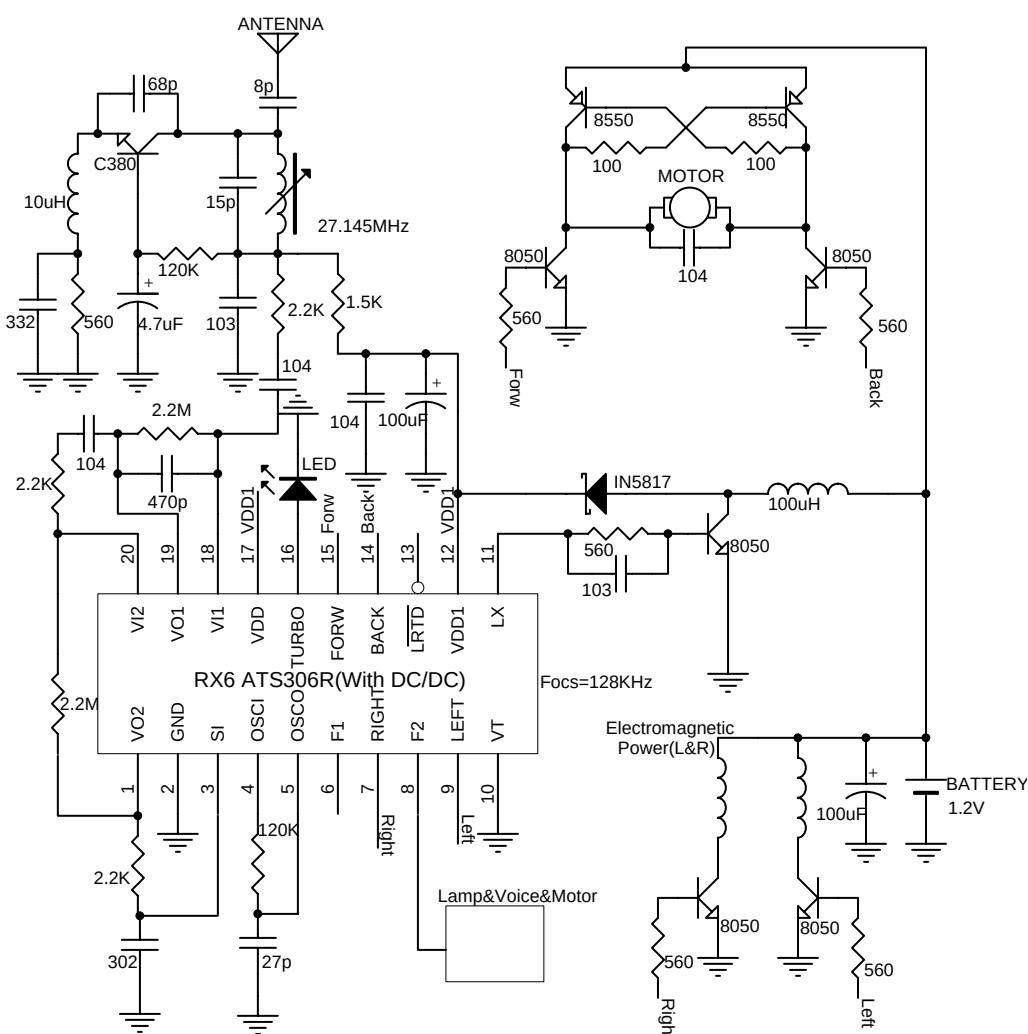
R1

120K

27p

Fosc=128KHz

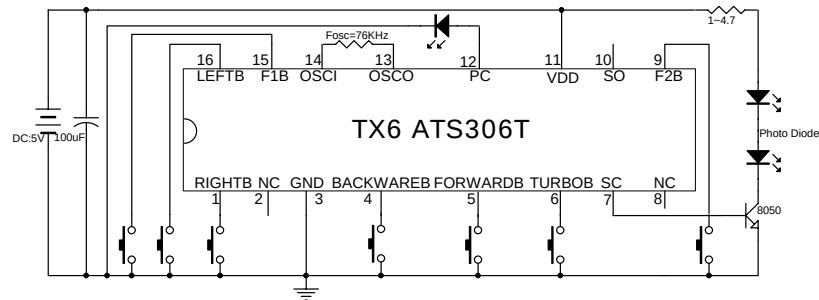
| R1   | C1  | Fosc         |
|------|-----|--------------|
| 150K | 27P | About 103KHz |
| 120K | 27P | About 128KHz |
| 100K | 27P | About 154KHz |



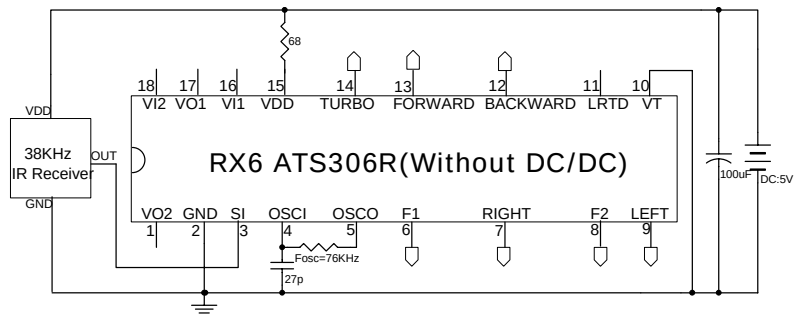


## Infrared Application Circuit

### Transmitter (TX6 ATS306T Fosc = 76 KHz)



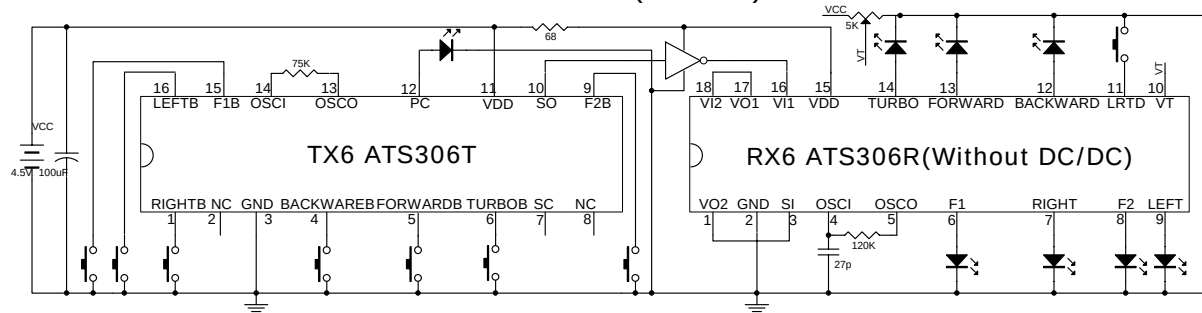
### Receiver (RX6 ATS306R Fosc=76KHz)



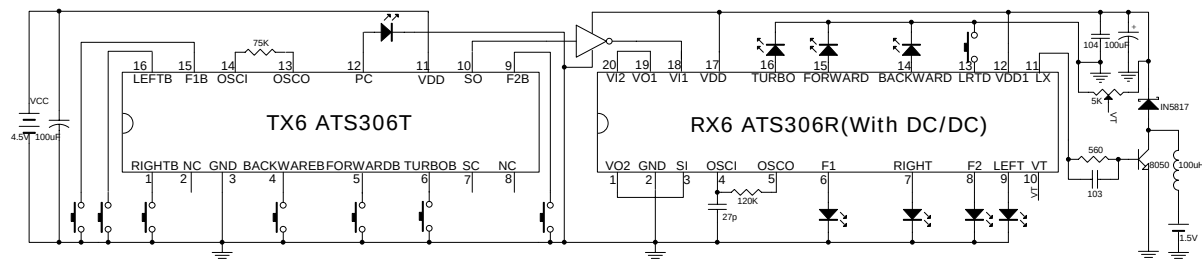


## Testing Circuit

TX6 ATS306T/RX6 ATS306R without DC/DC (128KHz)



TX6 ATS306T/RX6 ATS306R with DC/DC (128KHz)



**Note 1:** There must be an inverter between SO (TX6 ATS306T) output and SI (RX6 ATS306R) input when connected directly.

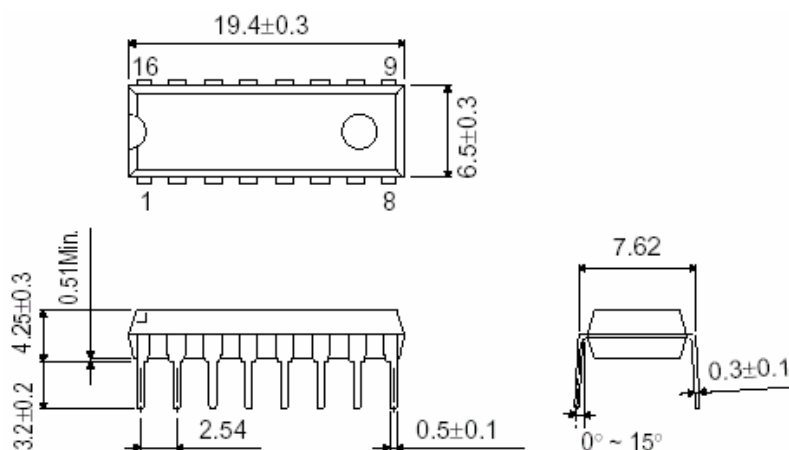




## Package Information

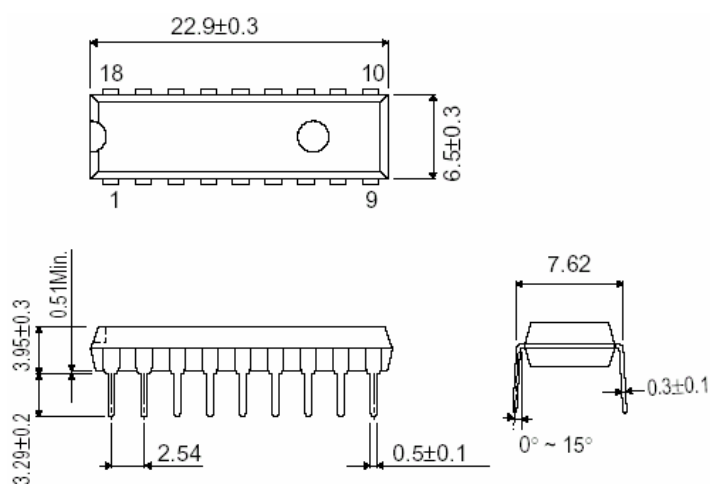
TX6 ATS306T DIP16 Pin Outline Drawing

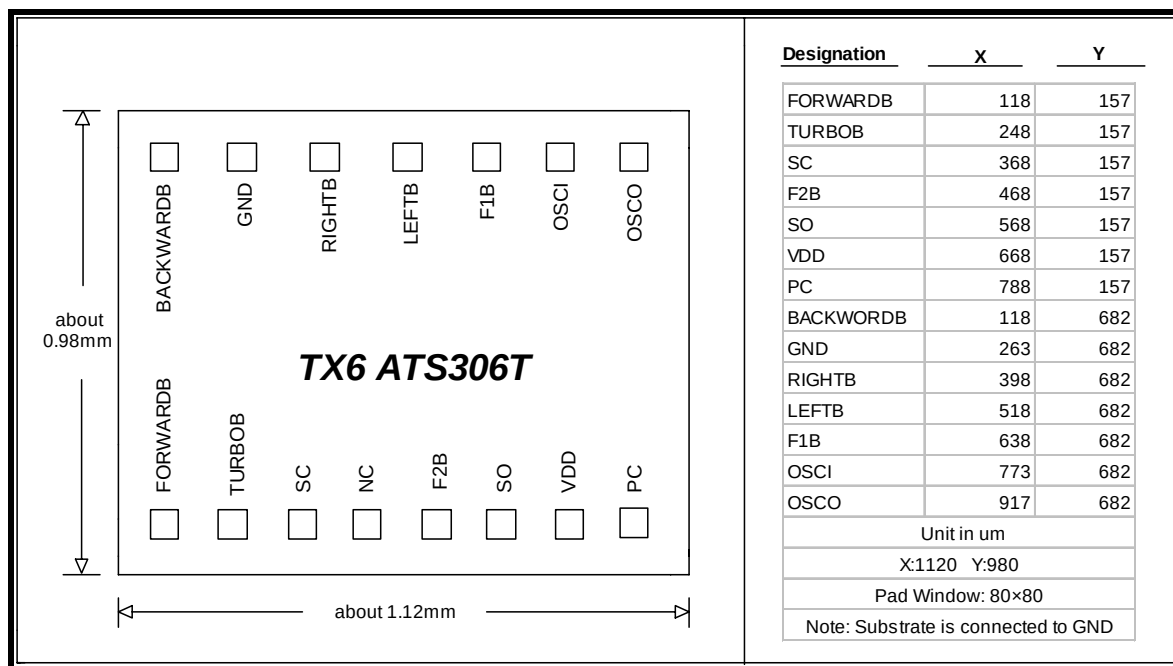
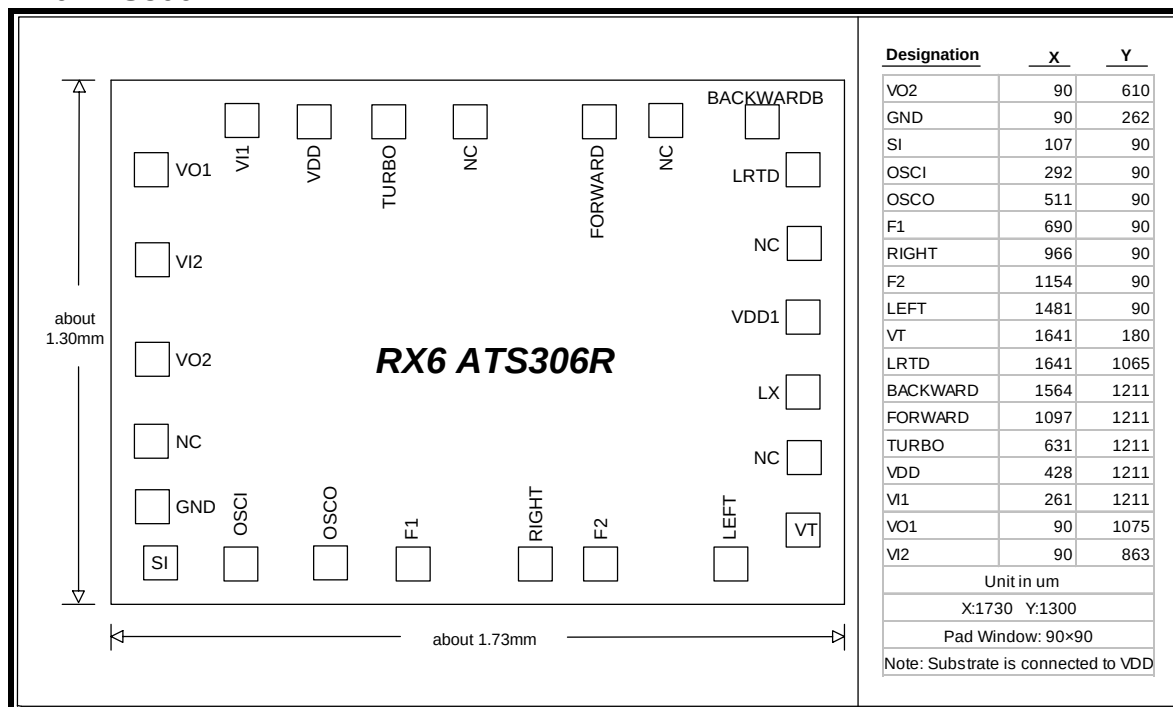
Unit in mm



RX6 ATS306R DIP18 Pin Outline Drawing

Unit in mm



**COB Bonding Figure****TX6 ATS306T****RX6 ATS306R**



### Version List

| Version | Release date | Comment       |
|---------|--------------|---------------|
| 1.00    | 2004/5/15    | First Version |

Notice: ACTIONS's products are sold by description only, ACTIONS reserves the rights to make changes in circuit design and/or specification at any time without notice. Accordingly, the reader is cautioned to make sure the latest versions of data sheets are available before placing orders.