2.1 Create drive coil

Draw > Rectangle

Starting point: (X,Y,Z)>(43,0,0)

Coordinate offset: (dX, dY, dZ)> (30, 0, 50)

Rename the rectangle to coil

Select coil>Assign Material> copper (set the material to copper)

2.2 Create an armature

Draw > Rectangle

Starting point: (X,Y,Z)>(11 ,0,25)

Coordinate offset: (dX,dY,dZ)>(30 ,0, 60)

rename the rectangle to dianshu

Check dianshu>Assign Material> aluminum (set the material to aluminum)

2.3 Create armature motion path

Draw > Rectangle

Starting point: (X,Y,Z)>(10 ,0,-10)

Coordinate offset: (dX,dY,dZ)>(32 ,0, 460)

Rename the rectangle to band

Select band>Assign Material> vacuum (set the material to air)

The armature is included in the armature movement path, where the width of the armature is 2 mm

smaller than the armature movement path and is 1 mm apart from the drive coil
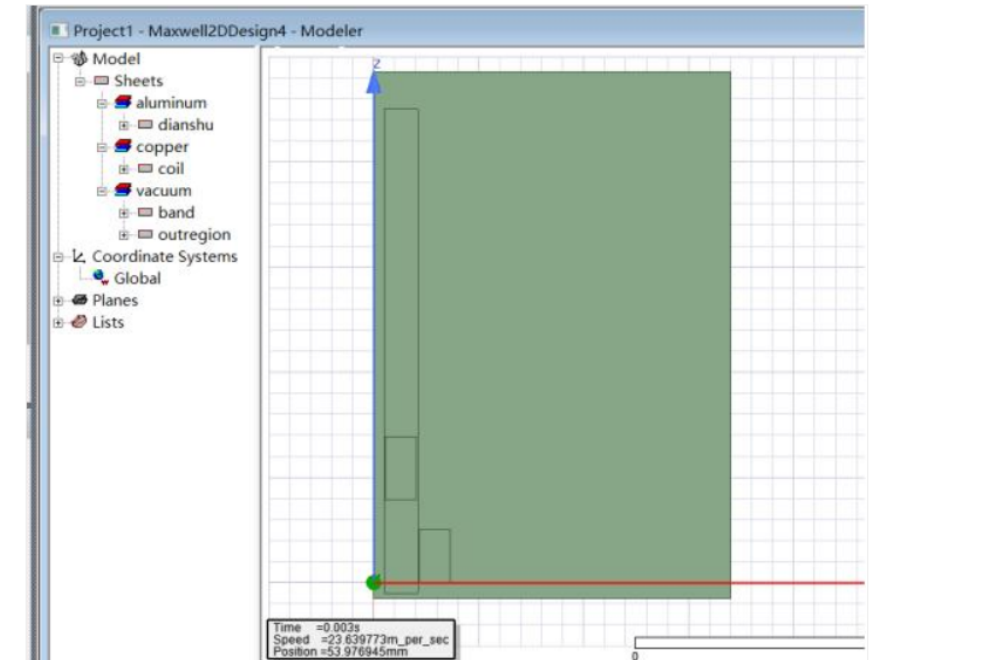
2.4 Create a solution field

Draw > Rectangle

Starting point: (X,Y,Z)>(0 ,0,-15)
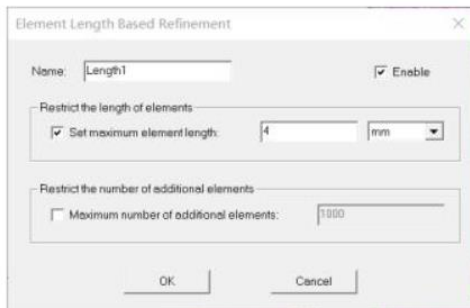
Coordinate offset: (dX,dY,dZ)>(400 ,0, 515)

rename the rectangle to outregion

Check outregion>Assign Material> vacuum (set the material to air)

3.1 Meshing

Select Armature>Right click>Assign mesh operation>On selection>Length Based>Restrict the length of elements>4mm

The maximum element size settings of the armature, armature motion area, drive coil, and solution field are: 4, 8, 12, and 4, respectively.

The following are the parameters after the meshing of the armature movement area is set.
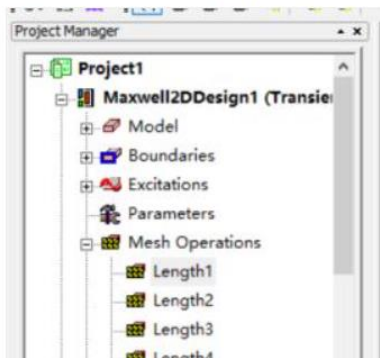
3.2 Set the boundary conditions of the solution domain

After the meshing is completed, you need to set the boundary conditions of the solution domain, select the outer boundary of the solution field, then right-click, select Assign Boundary (set boundary conditions) in the pop-up menu, and click to select from the pop-up submenu Corresponding boundary conditions. Induction coil gun simulation is generally set to "Ballon (balloon)" boundary conditions. Right-click the blank area>select edges>Select the outer boundary of the solution field (four edges)>Right-click>Assign Boundary>Set to "Ballon" boundary condition

4. Set Excitation (Assign Excitation)

Apply a source of excitation

After setting the boundary conditions, the excitation source of the model must be set. It can be seen from the working principle of the induction coil gun that a pulse current needs to be applied to the drive coil during its work to generate a pulsed magnetic field. In the transient solver, there are several forms of excitation sources such as current, current density, external circuit, coil excitation and so on. In order to better simulate the launch process of the induction coil gun, an external circuit is generally selected as the excitation source when analyzing its dynamic characteristics.

For the drive coil model, Ansoft requires that the drive coil model be set to coil excitation before applying the excitation source.
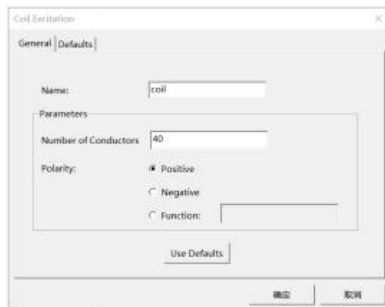
4.1 Coil setting

Select coil>Right click>Assign Excitation>coil

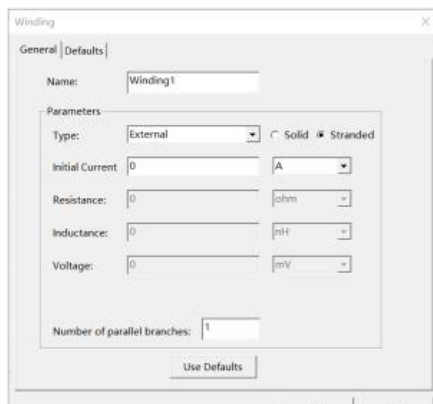Name>coil

Number of Conductors>40

Polarity>positive

4.2 Add coil excitation to winding

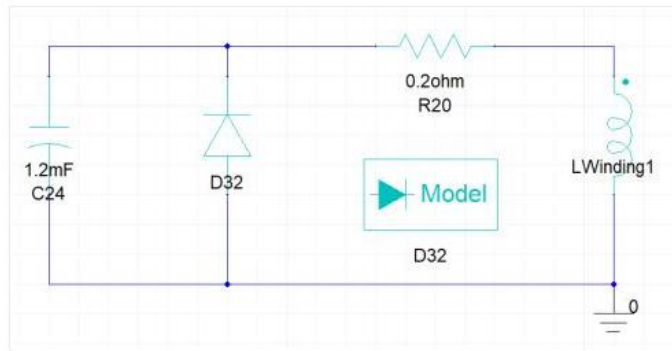Excitations>Add Winding

Name>Winding1

Type>External Stranded

Five external circuit drawing

The circuit diagram is shown below, the diode function is freewheeling, and the resistance function is to protect the circuit

The name of the coil winding is the same as the winding name added in the above figure, and the ID of the diode and diode mode are also the same

Excitation>External Circuit>Edit External Circuit>Creat Circuit

(1) Capacitor

C23:Cap Properties: Project1 - Project1_ckt   ✕

Parameter Values | Symbol | Property Displays

⦿ Value   ○ Statistics

Name	Value	Unit	Evaluated...	Description	Callback	Override
Name	24			Element instan...	...	☑
C	1.2	mF	1.2mF		...	☑
IC	5000	V	5000V	Initial voltage, ...	...	☑
Status	Active				...	☐
Info	Cap				...	☐

☐ Show Hidden

确定   取消   应用(A)

(2) Resistance

R20:Res Properties: Project1 - Project1_ckt   ✕

Parameter Values | Symbol | Property Displays

⦿ Value   ○ Statistics

Name	Value	Unit	Evaluated...	Description	Callback	Override
Name				Element instan...	...	☐
R	0.2	ohm	0.2ohm		...	☑
Status	Active				...	☐
Info	Res				...	☐

☐ Show Hidden

确定   取消   应用(A)

(3) Diode

D22:DIODE Properties: Project1 - Project1_ckt   ✕

Parameter Values | Symbol | Property Displays

⦿ Value   ◯ Statistics

Name	Value	Unit	Evaluated...	Description	Callback	Override
Name	32			Element instan...	...	✔
MOD	D32			Name of mod...	...	✔
Status	Active				...	☐
Info	DIODE				...	☐

☐ Show Hidden

确定   取消   应用(A)

(4)The model number of the diode should be the same as the diode

D32

DData21:DIODE_Model Properties: Project1 - Project1_ckt   ✕

Parameter Values | Symbol | Property Displays

⦿ Value   ◯ Statistics

| Name	Value	Unit	Evaluated...	Description	Callback	Override
DeviceN...	D32			Name of devic...	...	✔
IS	1e-14	A	1e-14A	Saturation curr...	...	☐
RS	0	ohm	0ohm	Contact resista...	...	☐
N	1		1	Emission coeffi...	...	☐
EG	1.11	V	1.11V	Barrier height ...	...	☐
XTI	3		3	Diode saturati...	...	☐
BV	1e+30	V	1e+30V	Magnitude of ...	...	☐
IBV	0.001	A	0.001A	Magnitude of ...	...	☐
TNOM	27		27	Reference tem...	...	☐
Status	Active				...	☐
Info	DIODE_Model				...	☐

☐ Show Hidden

(5) Inductance
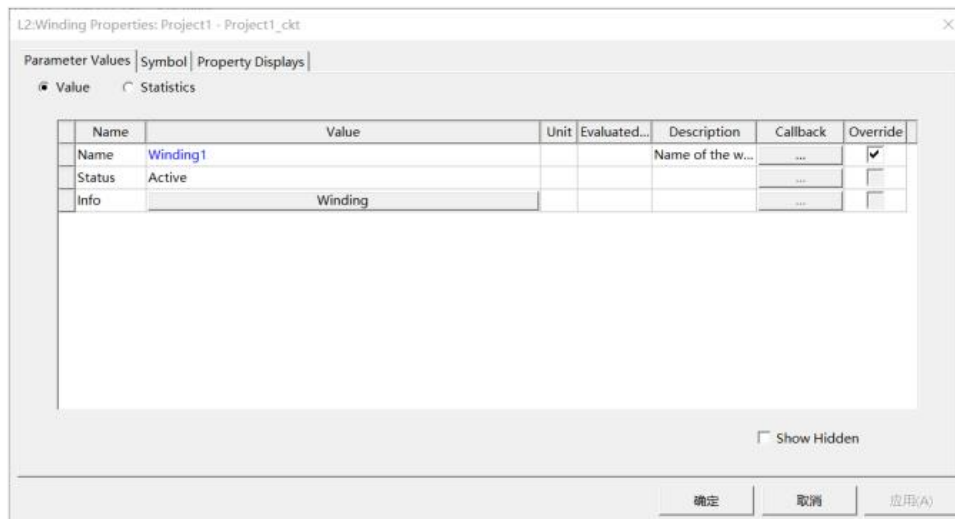
The Maxwell Circuit>Export Netlist on the main menu will be used to export the circuit file of the circuit diagram.

Then return to the Ansoft work interface, select Excitation>Right click>ExternalCircuit>Edit External Circuit on the left side of the interface, and the dialog box as shown in the figure will pop up .
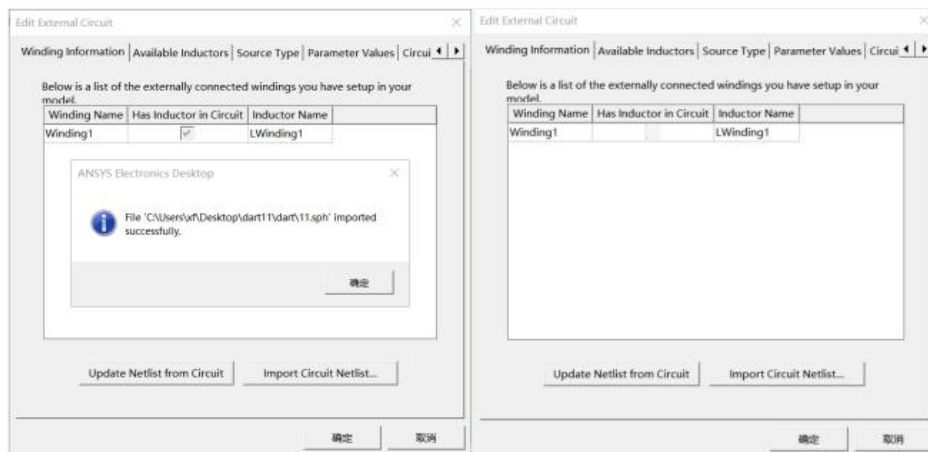

Click Import Circuit Netlist, browse the folder and select the network file for establishing an external circuit, and click OK to complete the setting of the excitation source.

Six sports area settings
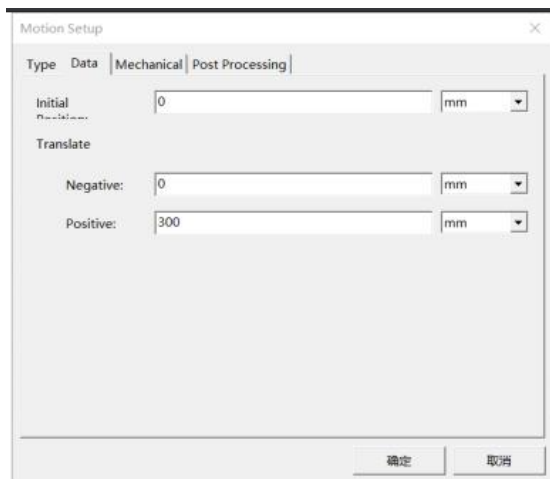
Finally, for the movement of the armature during the launch of the induction coil gun, it is also necessary to specify the movement characteristics of the armature, and perform the following operations in the modeling area of the working interface.

Select the armature movement area> right click>Assign Band, a dialog box pops up as shown in the figure.
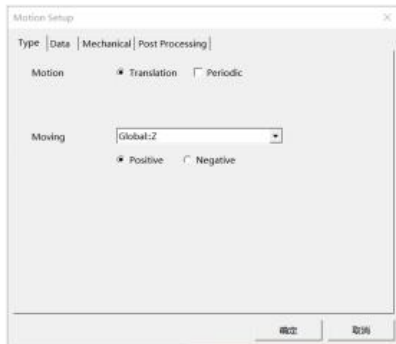
First, you need to set the type of motion, which mainly includes rotary motion and linear drive. When you select Translation linear motion, you also need to select the direction of its motion. The induction coil gun simulation is generally selected to be along the positive direction of the Z axis.
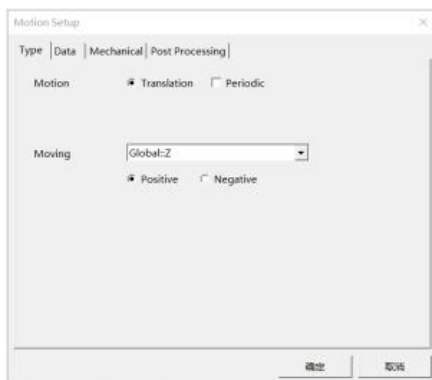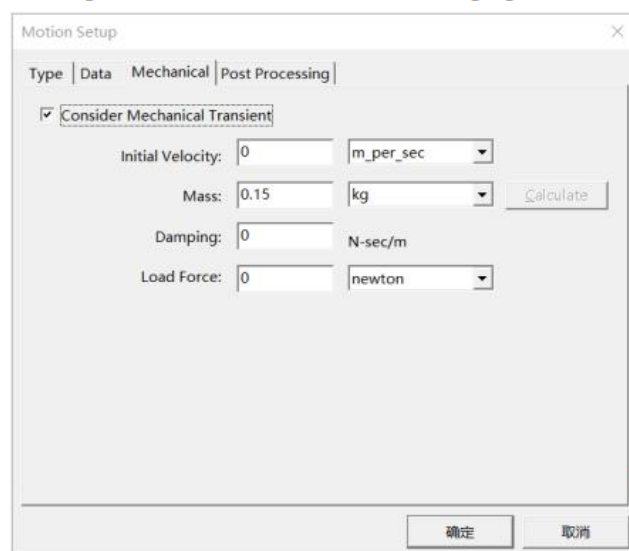
Then select the Mechanical mechanical parameter setting. There are two cases in this setting. If you do not select Consider Mechanical Translation, only the initial speed of the moving object is considered during the system operation, and the moving object moves at a constant speed If you check Consider Mechanical Translation, you need to set the initial speed, mass, load force and other parameters of the moving object, as shown in the following figure.

At this point, the simulation model has been established, and the simulation options need to be set below.

Right-click Analysis>Add Solution Setup on the left side of the work interface, a solution option setting dialog box will pop up, which mainly sets the time and step size of the solution.

Force Plot 1