## NEC Tutorial

- 1) Download the folder 4-nec2 from the class website.
- 2) Run the program 4nec2
- 3) Open a design eg: File> Open 4nec2 in-/output-file

				/		
			/	/		
🖞 N	Main [V5.7	7.0] (F2)	/			
File	Edit S	Settings	Calculate	Window	Show	Run
<	Open 4	nec2 in-/	output-file		Ctrl+0	
	Save NE	C output	file as		Ctrl+S	
	Print				Ctrl+P	٦Z
	Exit		Esc or	$\mathbf{X}$	Ctrl+Z	
	C:\4NE			3.NEC		4 A
	C:\4NE		ELS\WHEELE	R.NEC	<hr/>	pF
	C:\4NE		ELS\YAGI16.	NEC	$\mathbf{i}$	pF
	C:\4NE		ELS\MONO.	NEC		Ŵ
naur	aren. j	95.04	~ I	VELWOIK 1053	5 U	w l
RDF	[dB]	2.17	]	Radiat-powe	r   100	
Envir	onment					$\rightarrow$
FRE	E SPALE					
L Com	ment					N
Righ Cpn *.0u	nt-Circular verted with it loading-t	Dipole Pai h 4nec2 oi ime=0.219	r, by K6STI n 22-apr-02 }			
Seg': Patte Freq.	s/patches ern lines /Eval step	25 14641 8 1	Th Phi	start eta -180 i 0	stop cou 180 13 360 13	unt step 21 3 21 3

- 4) Step 3 takes you to a folder where there are many in built design.
- 5) Open one of the designs and save it again using **File> Save NEC output file as** and give it an apt file name.
- 6) Start your design:

### Example 1

Design a half-wave monopole antenna at 900 MHz.( Assuming that you have already calculated the wavelength and the length of the dipole in meters)

a) Select the Geometry edit from the drop- down menu as shown in the figure below



b) Press ctrl+F4, it will take you to the following window



- c) Define the wire parameters as shown above
- d) Define the voltage parameters as shown below



e) Define the frequency terms as shown below



f) Select the type of ground



- g) Save the design using **File > Save**
- h) Once you have saved the design then the following window will show up

👔 Main [V5.7.0] (F2)	🕲 Geometry (F3)
File Edit Settings Calculate Window Show Run Help	Show View Validate Currents Far-field Near-field Segm. Plot
<b>- 1 :</b> : : : : : : : : : : : : : : : : :	MONOPOLE.out 300 MHz
Filename MONOPOLE.NEI Frequency 900 Mhz Wavelength 0.333 mtr	
Voltage Current	
Impedance Series comp. Parallel form Parallel comp.	z
S.W.R. 50 Input power W Efficiency % Structure loss W Radiat-eff. % Network loss W Badiat-power W	Y
Environment	X
Free space	
Comment	
Example 1 : Dipole in free space See GetStarted.txt	
Seg's/patches 100 start stop count step Pattern lines Freq/Eval steps 1	Theta : 80 Axis : 0.05 mtr Phi : 280

i) Another method of designing antennas (Press F3, the following window will open)



j) Specify the voltage



# k) Specify the frequency and ground

	MONOPOLE.NEC - 4nec2 Edit
	File Cell Rows Selection Options
	Select antenna environment / ground approximation
	Symbols Geometry Source/Load Freq./Ground Others Comme
	Frequency Ground screen
efine the frequency	Frequency 900 Mhz Nr of radials
	Nr steps Sweep Radial length mts
	Stepsize Wire radius mm
	Environment Second ground
	Ground / Ground type
	Free-space Conductivity
	Connect w Fast ground Perfect and Diel constant
Select type	Main ground MinNec and Distance with
of ground	Ground type
0	Conductivity
	Diel constant
	Use ground-screen
	Use second ground
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MONOPOLE.NEC - 4ne File Cell Rows Sele	ec2 Edit
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MONOPOLE.NEC - 4nd File Cell Rows Sele [Select antenna environmen Symbols	ec2 Edit ection Options at / ground approximation Geometry Source/Load Freq./Ground Others Comment
MONOPOLE.NEC - 4nd File Cell Rows Sele [Select antenna environmen Symbols Frequency	ec2 Edit  ection Options  at / ground approximation  Geometry  Source/Load  Freq./Ground  Others  Comment  Ground screen
MONOPOLE.NEC - 4nd File Cell Rows Select Select antenna environmen Symbols Frequency Frequency 900 MH	ec2 Edit  ection Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  Ground screen  Nr of radials
MONOPOLE.NEC - 4nd File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Nr stens	ec2 Edit  eccion Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  hz Supers Supers Supers
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MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency 900 MH Nr steps Stepsize	ec2 Edit  ection Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  hz Sweep Sweep Sweep Second ground
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environment Symbols Frequency Frequency Nr steps Stepsize Environment Ground /	ec2 Edit  ection Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  hz Sweep Sweep Sweep Second ground Ground tree
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environment Symbols Frequency Frequency Stepsize Environment Ground / Free-space Real ground	ec2 Edit  ection Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  hz  Sweep  Sweep  Second ground screen  Nr of radials  Radial length mtr Wire radius mm  Second ground  Ground type
MONOPOLE.NEC - 4ne File Cell Rows Sele Select antenna environmen Symbols Frequency Frequency Frequency Stepsize Environment Ground / Free-space Real grout I     Connect wire(s) for Z=	ec2 Edit  ection Options  t / ground approximation  Geometry Source/Load Freq./Ground Others Comment  hz Sweep  Sweep  Sweep  Second ground Ground type Conductivity
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environment Symbols Frequency Frequency Frequency Stepsize Environment Ground / Free-space Real ground Free connect wire(s) for Z=	ec2 Edit ection Options t/ground approximation Geometry Source/Load Freq./Ground Others Comment hz Sweep Nr of radials Radial length mtr Wire radius mm Second ground Ground type Conductivity Diel constant
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Stepsize Environment Ground / Free-space Real ground Connect wire(s) for Z= Main ground	ec2 Edit ection Options t/ ground approximation Geometry Source/Load Freq./Ground Others Comment hz Sweep Nr of radials Radial length mtr Wire radius mm Second ground Ground type Conductivity Diel constant Distance mtr
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Frequency Stepsize Environment Ground / Free-space Main ground Ground type Moderate	ec2 Edit ection Options t/ ground approximation Geometry Source/Load Freq./Ground Others Comment hz Sweep Ground screen Nr of radials Radial length mtr Wire radius mm Second ground Ground type Conductivity Diel constant Distance mtr Dastb
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Frequency Stepsize Environment Ground / Free-space Main ground Ground type Moderate Conductivity 0.003	ec2 Edit ection Options It / ground approximation Geometry Source/Load Freq./Ground Others Comment
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Frequency Stepsize Environment Ground / Free-space Main ground Ground type Moderate Conductivity 0.003 Diël constant [4]	ec2 Edit ection Options t/ ground approximation Geometry Source/Load Freq./Ground Others Comment  hz Sweep Nr of radials Radial length mtr Wire radius mm Second ground Ground type Conductivity Diël constant Distance mtr Depth mtr C Circular boundary
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Frequency Stepsize Environment Ground / Free-space Freels for Z= Main ground Ground type Moderate Conductivity 0.003 Diël constant 4	ec2 Edit ection Options t/ ground approximation Geometry Source/Load Freq./Ground Others Comment  hz Sweep  nd Sweep Swe
MONOPOLE.NEC - 4ne File Cell Rows Select Select antenna environmen Symbols Frequency Frequency Frequency Frequency Stepsize Environment Ground / Free-space Main ground Ground type Moderate Conductivity Diël constant 4 Use ground-screen	ec2 Edit ection Options t/ ground approximation Geometry Source/Load Freq./Ground Others Comment  freq./Ground screen Nr of radials Radial length mtr Wire radius mm  Second ground Ground type Conductivity Diël constant Distance mtr Depth mtr C Circular boundary C Perpendicular to Y-axis
MONOPOLE.NEC - 4ne File Cell Rows Sele Select antenna environmen Symbols Frequency Frequency 900 MH Nr steps Stepsize Environment Ground / Real groun Connect wire(s) for Z= Main ground Ground type Moderate Conductivity 0.003 Diel constant 4 Use ground-screen Use second ground	ec2 Edit ection Options tt / ground approximation Geometry Source/Load Freq./Ground Others Comment nz Sweep Nr of radials Radial length mtr Wire radius mm Second ground Ground type Conductivity Diel constant Distance mtr Depth mtr C Circular boundary C Perpendicular to Y-axis

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-	
Frequency 1900 Mhz	
Nr steps Sweep	Radial length mtr
Stepsize	Wire radius mm
nvironment	Second ground
iround / Restauration -	Ground type Moderate
ree-space Real ground	
Connect wire(s) for Z=0 to ground	
Aain ground	
	Distance mtr
anductivitu Moderate	Depth mtr
Average	Circular boundary
Dry, sandy, coastal	C Perpendicular to Y-axis
Use groun Medium hills and forest	
Use secon Mountainous hills < 1000m	

If you specify real ground you can choose the ground type and specify the conductivity and dielectric constant for the ground

1) The next step is calculation of radiation pattern and other terms. Choose the option shown in the figure

-	💡 Main [V5	5.7.0] (F2)					x
	File Edit	Settings	Calc	ulate	Window	Show	Run
	Help			NEC	output-data	F7	
	🖻 🖬 🐧	1 30		L/Pi/	T Matching	F10	?
	Filename	MONOPO		Start	Optimizer	F12	
			_		Wavelength	0.333	mtr
	Voltage				Current		
	Impedance				Series comp.		
/	Parallel form				Parallel comp	·	
<b></b>	S.W.R. 50				nput power		
Select this	Efficiency Redict off	<u> </u>	~~ ~	:	Structure loss Mohuork loss		— <u>"</u>
option	naulat-ell.	1	10	i	Radiat-power		$-\ddot{\mathbb{w}}$
	Environment					,	
	Free space						
	Comment						
	Example 1 : See GetStar	Dipo ted.txt	ole in fr	ee spa	ice		
	Seg's/patche	es 100			start s	top cou	unt step
	Pattern lines Freq/Eval ste	eps 1					

m) Generating output parameters

Generate (F7) [Nec2d	XS1k5] 🛛 🖾					
C Use original file	Screen-data used					
<ul> <li>Far Field pattern</li> <li>Frequency sweep</li> <li>Near Field pattern</li> </ul>	Freq : 900 💌					
○ ItsHF 360 degree Ga ○ ItsHF Gain @ 30 free	ain table quencies					
● Full O Ver. O	Hor.					
Resol. <b>3</b> deg. E-fld Surf-wave	expert settings Run Average Gain Test					
<u>G</u> enerate Bat	ich E <u>x</u> it					

*Far Field pattern*: Used for calculating Far field antenna parameter *Frequency sweep*: Used for calculating antenna parameters for a range of frequencies *ItsHF 360 degree Gain table:* Generates gain table over 360 degree *ItsHF Gain @ 30 frequencies:* shows the gain at various frequencies

*n*) Far field pattern

If you choose this option in the figure above, enter the Resolution

*o) Frequency sweep* 

Set the start and stop frequency

000	Far F Fregu Near	ield pa	ttern								
¢		Far Field pattern     Freguency sweep     Near Field pattern									
C	○ ItsHF 360 degree Gain table ○ ItsHF Gain @ 30 frequencies										
¢	Gain	€V	er.	O Hor	. C	Full/3D					
Resol. 3 deg. expert settings E-fld Surf-wave Gain Test											
F	<u>R:</u> Star	t 290	Stop	310	Step	1					
G	raphs:	The	ta Ph	i	d-Thet						
F	orward	-90	) (		0						
	ackward	90	0		0						



💱 Main [V5.7.0] (F2)	
File Edit Settings C Help	alculate Window Show Run
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Filename MONO.out	Frequency 900 Mhz Wavelength 0.333 mtr
Voltage 69.4 + j 0 1	V Current 1.44 - j 0.66 A
Impedance         39.9 + j 18           Parallel form         48.2 // j 10           S.W.R. 50         1.59           Efficiency         100           Radiat-eff.         99.99           RDF [dB]         5.18           Environment         GROUND PLANE SPECIFI           GROUND PLANE SPECIFI         PERFECT GROUND           Comment         Comment	1     Series comp.     9.743     pF       106     Parallel comp.     1.671     pF       Input power     100     W       %     Structure loss     0     W       %     Network loss     0     W       Radiat-power     100     W
Example 1 : Dipole i See GetStarted.txt *.Out loading-time=0.531	in free space
Seg's/patches 100 Pattern lines 7381 Freq/Eval steps 1	start         stop         count         step           Theta         -90         90         61         3           Phi         0         360         121         3

## Example 2:

(F) Geometry (F3)	Main [V5.7.0] (F2)
Show View Validate Currents Far-field Near-field Segm.	File Edit Settings Calculate Window Show Run
DIPOLE.out 900 MHz	
	Wavelength 0.333 mtr
	Voltage 103 + j 0 V Current 0.97 - j 0.53 A
z	Impedance 81.7 + j 44.5 Series comp. 3.973 pF
	Parallel form   106 // j 195 Parallel comp.   0.909 pF
	5.W.H. 50 2.3 Input power 100 W
/Y	Radiat-eff. 100 % Network loss 0 W
<u>∽x</u>	RDF [dB] 2.17 Radiat-power 100 W
	Environment
	FREE SPACE
	Comment
	See GetStarted.txt
	*.Out loading-time=3.551
	Seg's/patches 100 start stop count step Pattern lines 43991 Theta 100 100 201 1
Theta : 80 Axis : 0.05 mtr Phi : 280	Freq/Eval steps 1 Phi 0 360 121 3
Generate (E7) [Nec2dVS1k5]	
Generate (F7) [Nec2dXS1k5]	3 Pattern (F4)
Generate (F7) [Nec2dXS1k5]	Pattern (F4) Show Farfield Nearfield Compare OpenPF Plot
Generate (F7) [Nec2dXS1k5]	Pattern (F4)     -     -     ×       Show Far field Near field Compare OpenPF Plot       Tot-gain [dBi]     .15     Vertical plane
Generate (F7) [Nec2dXS1k5]	Pattern (F4)  Show Far field Near field Compare OpenPF Plot  Tot-gain [dBi] -15 -5
Generate (F7) [Nec2dXS1k5] X C Use original file Far Field pattern Freq: 900 Near Field pattern	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz -30 -15 -0 -2 -2 -2 -2 -2 -2 -2 -2 -2 -2
Generate (F7) [Nec2dXS1k5]	Pattern (F4)     Pattern (F4)     Show Far field Near field Compare OpenPF Plot     Tot-gain [dBi]     -15     -5     -15     -30     -45     -45     -5
Generate (F7) [Nec2dXS1k5] ○ Use original file ○ Far Field pattern ○ Frequency sweep ○ Near Field pattern ○ ItsHF 360 degree Gain table ○ theUE Cain @ 20 for maning	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz -15 -0 Z -15 -0 Z -15 -0 Z -15 -0 Z -0
Generate (F7) [Nec2dXS1k5] C Use original file Far Field pattern Frequency sweep Near Field pattern C ItsHF 360 degree Gain table C ItsHF Gain @ 30 frequencies	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz -30 -15 -5 -5 -5 -5 -5 -5 -5 -5 -5 -
Generate (F7) [Nec2dXS1k5] C Use original file Far Field pattern Freq: 900 Near Field pattern C ItsHF 360 degree Gain table ItsHF Gain @ 30 frequencies Full C Ver. C Hor.	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz -30 -15 -0 -2 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5
Generate (F7) [Nec2dXS1k5] C Use original file Far Field pattern Freq: 900 Near Field pattern C Near Field pattern C ItsHF 360 degree Gain table C ItsHF Gain @ 30 frequencies Full C Ver. C Hor.	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 45 60 75 10 10 10 10 10 10 10 10 10 10
Generate (F7) [Nec2dXS1k5] Use original file Far Field pattern Frequency sweep Near Field pattern ItsHF 360 degree Gain table ItsHF Gain @ 30 frequencies Full C Ver. C Hor. Resol. 1 deg. expert settings	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 
Generate (F7) [Nec2dXS1k5] C Use original file Far Field pattern Frequency sweep Near Field pattern C ItsHF 360 degree Gain table ItsHF Gain @ 30 frequencies Full C Ver. Hor. Resol. 1 deg. expert settings E-fld Surf-wave Run Average	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz -50 -50 -50 -50 -50 -50 -50 -50
Generate (F7)       [Nec2dXS1k5]       X         Ouse original file       •       •         Far Field pattern       •       •         Frequency sweep       •       •         Near Field pattern       •       •         Near Field pattern       •       •         ItsHF 360 degree Gain table       •       •         ItsHF Gain @ 30 frequencies       •       •         •       Full       •       •         Resol.       •       expert settings       •         E-fid       Surf-wave       •       Run Average       •         Gain Test       •       •       •       •	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 45 45 45 45 45 45 45 45 45 45
Generate (F7)       [Nec2dXS1k5]       X         Use original file       •       •         Far Field pattern       •       Freq: 900 •         Frequency sweep       •       •         Near Field pattern       •       •         Near Field pattern       •       •         ItsHF 360 degree Gain table       •       •         ItsHF Gain @ 30 frequencies       •       •         •       Full       •       •         Resol.       1       deg.       expert settings         E-fld       Surf-wave       Run Average       Gain Test	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 45 -0 -15 -0 -0 -15 -0 -0 -15 -0 -0 -0 -0 -0 -0 -0 -0 -0 -0
Generate (F7)       [Nec2dXS1k5]       X         Use original file       •       •         Far Field pattern       •       Frequency sweep         Near Field pattern       •       •         Near Field pattern       •       •         Near Field pattern       •       •         ItsHF 360 degree Gain table       •       •         ItsHF Gain @ 30 frequencies       •       •         •       Full       •       •         Resol.       •       •       •         Besol.       •       •       •         Besol.       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •       •         •       •       •	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 45 -60 -10 -60 -75 -25 -60 -75 -25 -15 -0 Z -15 -0 Z -0
Generate (F7)       [Nec2dXS1k5]       X         Use original file       •       •         •       Far Field pattern       Freq: 900 •         •       Frequency sweep       •         •       Frequency sweep       •         •       Near Field pattern       •         •       Near Field pattern       •         •       Near Field pattern       •         •       ItsHF 360 degree Gain table       •         •       ItsHF Gain @ 30 frequencies       •         •       Full       •       •         •       Full       •<	Pattern (F4) Show Far field Near field Compare OpenPF Plot Tot-gain [dBi] 900 MHz 45 45 45 45 45 45 45 45 45 45

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Þ	File	Cell	Rows	Selecti	on Op	tions									
	Defa	ult straig	iht line w	ire-elemer	nt							🔲 Upd	<u>I</u> ns.	Del.	<u>i</u> (
		Symbo	ols	G	eometry		Sc	urce/Load	Y	Freq./Ground	I Y	Others	Ý	Comm	ient
Ш	Geo	ometry	(Scalir	ng=Meters	)								Π.	lse wire ta	apering
Ш	Nr	Туре		Tag	Segs		×1	Y1	Z	1 X2	Y2	Z2	Radiu	5	
Ш	1	Wire		1	100		0	0	-0.083	1 0	0	0.0831	.000		
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## Example 3





### Example 4





Example 5 ( Circular loop)



🏆 Main [V5.7.0] (F2)										
File Edit Settings Calcul	ate Window Show Run									
Help										
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Filename MONO.out	Frequency 900 Mhz									
	Wavelength 0.333 mtr									
Voltage 233 + j 0 V	Current 0.43 + j 0.72 A									
Impedance 143-j239	Series comp. 0.042 uH									
Parallel form 544 // - j 324	Parallel comp. 0.057 uH									
S.W.R. 50 11.1	Input power 100 W									
Efficiency 100 %	Structure loss 0 W									
Radiat-eff. 100 %	Network loss 0 W									
RDF [dB]   2.88	Radiat-power   100 W									
Environment										
FREE SPACE										
Comment										
Example 1 : Dipole in free space See GetStarted.txt * Out loading-time=0.648										
Seg's/patches	start stop count step									
Pattern lines 14641	Theta -180 180 121 3									
Freq/Eval steps 1	Phi 0 360 121 3									



To set parameters for the above circular loop:

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F	ile	Cell	Rows	Selectio	on Opti	ons									
ļ	Arc s	shaped v	vire-elen	nent							🔲 Upd	<u>I</u> ns.	<u>D</u> el.		
	Symbols Geometry Source/Load Freq./Ground										Others	Ϋ́	Co	mment	
	Ge	ometry	(Scali	ng=Meters	)								Use wire	e taperir	ng
	Nr	Туре		Tag	Segs	Arc-rad	Angl-1	Angl-2	Wire-rad						
Ш	1	Arc		1	100	0.1	-180	180	0.001						
					-								-		
	4														
Ľ	1														