Nec2Go Users Manual

Nec2GO by Nova Plus software
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Nec Command Button (Con't.)

Acknowledgements:

Welcome to Nec2Go

Nec2Go is a graphical user interface (GUI) that was developed for ease of user in defining wire definitions/parameters needed by Nec to run.

Nec2Go is general purpose Nec2-d analysis tool for Windows. With Nec2Go, you create antenna geometry using simple algebraic text statements. True modeling by Equation !

Output consists of structure View, Gain, SWR, Zr/Zi, and Plot views.
The ability to Optimize or Sweep geometry variables provides a powerful method for optimizing design.

Nec2Go consists of the following general windows:

Main Screen

Edit

View

Plot

Plot3D

Options

Tools.

The windows themselves are intended to be self-explanatory. However, it is necessary that the user have some knowledge of the "Nec2 engine" to understand the output and limitations that may be present when analyzing a particular geometry.

Nec2Go uses the "Nec2 engine" to run the design. Through out his document when the term "Nec" is used it is referring to the Nec2 engine not Nec2Go. The all parameters/definitions use must be statement/format that is acceptable Nec2. Through out this manual the statements and formatting reflect the Nec2 requirements.

Context Sensitive **Help** is provided on all screens. Press the **F1** key for **Help.** Cursor positioning determines the **Help** context.

Main Screen Features

Nec2Go Operation

Using Nec2Go Demo Version

Dir – Edit -View - Nec - Plot – Optimize - Plot3 – Printing - Tools (command buttons)

Network Designer (not available with Demo version)

Ground Conditions Wire Conductivity

Coax and Ladder Line Table

Nec2Go Demo Program

The Demo Version of Nec2Go provides most of the functionality of the full version except that the total number of segments is restricted to 20. This will allow for modeling simple structures like dipoles, loops, and verticals. Because the total number of segments is limited to 20, the accuracy of the Nec results will also be limited. However, the Demo Version is provided to show the capabilities of Nec2Go and is not meant to provide accurate analysis in all cases.

When the total segment count exceeds 20, an error dialog box will be issued. Total segments are calculated by two factors. The Segs 'segments per half wave' parameter and the total length of all the wires in the model. Reducing the 'segments per half wave' will produce a lower total segment count that may allow a particular model to run.

Other restriction include: Printing is disabled; Network Designer analyzes load values only from the current antenna Nec out file and is not modifiable.; Tools/View fil**es** and Fig. 12 Sweep functionare disabled.

> Note: The SampYagi.ant file will not run under the Demo version due to excessive segments. It is provided only to show the capabilities of the program.

Highlight and click the Dir button, select each of the Sample antenna files and review how they are defined. To further understand the sample, select Edit, place the cursor under the field you want to analyze and press F1 for Help. The Help is "Context Sensitive" in that, where the cursor is located determines the Help information.

> **Note: N**ec2Go has extensive features and you are not expected to understand all of the capabilities in one setting. However, as you work with it, more will be revealed. In particular, use of variables in the definitions will open up the power of modeling.

Nec2Go Operation
Description and explanation of functions

Brief History of Development

Nec by itself is a Fortran main program that was designed for card image batch input. Providing a usable interface(GUI) is a very difficult undertaking. Without a user interface to Nec, the program is difficult to use.

Nec was originally developed in the early 1980's and is in the public domain. It uses the method-of-moments techniques for the electromagnetic response of antennas to currents induced on wire elements in the definition.

Nec2-d (double precision) is the Nec engine that provides the bases for Nec2Go antenna analysis.

Minimum System Requirements:

Intel Pentium 100+ MHz microprocessor or compatible cpu Microsoft Windows 95, 98, 2000, NT, XP, Vista

64 MB of RAM
VGA or SVGA Directx™ compatible Video card

Nec2Go creates a Graphical User Interface (GUI) for the Nec2-d engine (Nec). Allowing the user to enter text statements eliminating tedious tasks required to build input card image deck. Using text statements Nec2Go provides the user with relevant data for each Nec2-d run on the Main screen.

Note: For the balance of this document Nec will be used when referring to the "Nec@2-d" engine used by Nec2Go..

However, there are limitations built into Nec that the user should be aware of. Nec2Go text statements must be if a specified format to run the Nec engine.

Nec input a structure:

Wires, in a specified format.

Frequency, in Mhz.

Ground conditions, in a specified format.

Source, excitations in a specified format.

Plotting, Azimuth and Elevation angles, Loads, & Transmission Lines.

Networks analysis.

Plot data is created in tabular form from each Nec run for specific Azimuth and Elevation data. In addition, Nec specifics are determined by Nec2Go for each Nec run.

The Nec2Go Antenna file

Definition:

The basic definition of the antenna is contained in a file extension, xxxxxx **.Ant**, i.e. SampDipol.ant.

The information required by **Nec2Go** to analyze the structure is:

Frequency,

wire material,

dimension type, (in, ft, m, cm, etc), user defined.

ground information.

geometry of the antenna.

Source information.

Loads or Transmission Lines if any.

Variable substitutions allow for a very powerful way to define and modify antenna definitions.

The following two examples of a simple Dipole and G5RV antennas file definition illustrate how the antenna file (.ant) will be displayed. The first is a simple dipole with no variables.

Example 1 ; Simple Dipole antenna

Test Dipole antenna	; Title statement
Freq: 7.1 MHz Copper wires, feet dimensions	; frequency specification, and wire
Source: center origin) of wire #1	;defines the Source in center (X, Y, Z
1 0, -33, 50 0, 33, 50 #12 ; 66' long dipole, up 50', #12 wire	
Comments: Note that there were no variables used in this example.	

The G5RV example is more complicated because of the use of variables, see highlighted values. The advantage is using variables is that all variables can be Optimized/Swept to determine the best performance values.

Example 2; G5RV using variables

```
G5RV antenna - with coax                ;Title Info for G5RV
Freq:14.1 MHz              ; Frequency, (default wire dimensions, copper, feet)

h = 50                                    ;height
Len=52.5                                  ;G5RV - length of element/2
Source: center                            ;Source is located on center of next wire

1    0   -Len   h         0   Len   h  #10   ; dipole wire

Xlen=33                                   ;variable for Ladder Line length
Clen=66                                   ;variable for coax length


Xline: Type=LL450, Len=Xlen, Source=l        ;450 ohm Ladder line-connected to
        previous Source
Xline: Type=RG58, Source=l, Len=Clen        ;Coax Feed Line

Comments: This file defines a G5RV antenna showing Ladder line and
Coax feedline. The variables; h, Len, Xlen, and Clen.
```

Nec2Go Definition, Format & Statements

Definitions

Remember that Nec2Go uses the Nec engine to run model information. Therefore all data entry is in Nec engine format. Nec engine is the original Nec fortran format.

Wire Definitions:

As mentioned earlier Nec requires a Wire defined in a specified manner. Wire must have two end points, X_1, Y_1, Z_1, X_2, Y_2, Z_2 a wire radius, and the number of segments to subdivide the wire.

Wire connections can only occur at wire end points. Antenna elements that bend or change diameter will require multiple wire definitions.

> Note: The original Nec design was limited to 30 wire connections. This has been upgraded to 121 wire connections. A warning message is issued in the View when the number exceeds 30 execution will proceed with wire connections up to 121.

Nec2Go provides access to each wire on "End1", "End2", or "Center" so that absolute segment numbers are never referenced. Nec2Go automatically subdivides each wire into Segments based on the "Segments per Halfwave" parameter in the Nec2Go "Nec Run Parms" field.

> Note: Nec calculations are performed at the center of each segment. This has implications, the modeler needs to be aware.

Any Source, Load, or Transmission Line defined on the end of a wire will not be located correctly no matter how small the segments.

Nec2Go takes care of the segment calculations and alignment that alleviates the user from having to calculate the proper segment numbers. In addition, Sources, Loads, and Transmission Lines on a wire end are automatically redefined on a wire that spans the junction of two wires, if feasible.

> Note: A span wire cannot be defined when more than two wires connect at the junction.

> Adding more elements to a definition increases the segment count such, the more segments in the definition, the more computer memory and processing time is used to analyze the model.

Nec2Go will allow an unlimited number of segments in geometry. The limit will be determined by the amount of memory installed on the users personal computer. Using AST(Auto Segment Tapering) can reduce the total number of segments and may improve accuracy.

Accuracy is determined by the size of a segment but, accuracy can degrade when the segment size is less than .0001 (wavelengths). For long wires, the segment size can be quite large without accuracy problems.

Nec2Go will not create segments less than about .0005 in size. Critical areas of the geometry, e.g., on Source wires Necd special attention. Segments near a Source should be approximately the same size as the Source segment.

Ground Information:

Nec uses Ground information to determine antenna currents and plotting data. Conductivity and Dielectric Constant:

There are five different Ground conditions that can be specified.

> Ground information for Nec consists of conductivity in milliSiemens per meter.

> Dielectric Constant. Average values are: 5 mS/m and 13.

Nec2Go enables only the options that are valid for the selected antenna file. This prevents modeling errors when invalid ground options are set for a definition. See: Nec Run Parms

> **Nec Run Parms Ground Parameters**

> **Free Space - Fs:** No ground currents will be created. This is the fastest method for analysis and should be used during the initial design phase of the antenna definition, when possible.

> **Perfect Ground - Pg:** This is required when any wire element touches physical ground, i.e., any wire has one endpoint at **Z = 0.**

> **Sommerfeld-Norton Ground - Sn:** This is the most accurate method for wires above ground, but the most CPU intensive.

Wires can be as close as a few wire diameters from ground and still be accurate .

Nec requires Perfect Ground (Pg) analysis in this situation. Nec2Go automatically sets the Option field to "Pg" when this occurs.

Nec requires a separate ground definition file(Somnec) containing ground data prior to Nec execution Nec2Go generates the Somnec file and retains it for future use when like ground conditions and frequency are specified.

With Sommerfeld Norton ground, Frequencies within the default percent of a previous ground file will be re-used.

Ground Wave - Gw: This option is used for vertically polarized antennas to determine the

> ground wave field intensity in miilivolts per meter at a distance from the 0,0,0 reference point.

Reflection Coefficient Ground - Re: This is a fast ground method but is inaccurate if any horizontal wire is lower than about .2 above ground.

Note: This option is disabled unless checked in the Options screen as the default. If your PC is less than about 150 MHz processor, then you may want to enable this as your default ground option.

Ground Zones:

Nec2go has an option for defining a secondary ground zone with alternate conductivity and permeability. This **Ground Zone** is specified at a radial distance away from the 0,0,0 reference point and at a lower elevation value.

Source: Definitions:

Source defines where excitation occurs. An antenna definition must have one or more Sources. Excitation occurs on a single Segment on a referenced wire.

Note: Nec input requires a excitation to be specified on a Wire number and Segment on that Wire.

Nec2Go eliminates the need for specific segment numbers by referencing a "Wire segment location", End1, End2, or Center for the position of the Source on the wire. For best accuracy, it is necessary that the Source segment be approximately equal in size to adjacent segments.

Note: When a Source is defined on the end of a wire connected to another wire, Nec2Go creates a new short wire spanning the junction between the adjacent endpoints of the two wires, when possible.

A Source cannot be located on the end of an unconnected wire, except when connected to ground.

To ensure that a Source is centered on the source wire, Nec2Go creates an odd number of segments for the Source wire.

Loads and Transmission Lines

If a Load and Source are defined by the same location the Load is in series with the Source.

A Transmission Line or Network defined at the same location as the Source is in parallel with the Source.

Load: Definitions(optional)

Loads: Are any combinations of resistance, inductance, and capacitance, or a resistance in series with a reactance (Impedance Load) and are optional.

Each Load must be located on a Segment. The rules for the location of Loads is the same as for Sources. An inductance and resistance are always in series. This resistance can be input as a number or will be calculated from the Q parameter.

Q is defaulted from Options if not specified. The series resistance will be recalculated to a parallel resistance if a capacitance is also included. When inductance and capacitance are defined on the same segment, then they are paralleled to make a trap.

Note: Nec requires a paralleled L and C to also contain a parallel R term. Nec2Go calculates the correct R term when L and C are paralleled from the Inductance Q value. If a Load is defined at the same location as the Source, the Load is in series with the Source.

Transmission lines: (optional)

Are mathematical entities and do not enter into current calculations. They are used to define Feed lines and Stubs.

Feed lines can be defined connected to a Source wire or between two wires. Stubs connect to one wire only and the other end of the stub is defined as Shorted or unshorted.

Coax definitions:

Nec2Go has an added feature to define a *Coax* feed line. By specifying Type= on the Transmission Line statement, a feed line can be modeled using predefined Coax or Ladder Line definitions and **loss** will be calculated.

Type= can be connected between wires or refer to a Source definition number. The Nec source impedance(Zr, Zi) is transformed to a new value depending on the characteristics of the type of Coax or Ladder Line in the "Coax and Ladder LineTable"**.**

Networks: (optional)

Networks are Nec2 definitions that allow use of Inductors and Capacitors to define an impedance transformation. Networks are not simple to use and should be implemented only after modeling techniques are more advanced.

Nec2Go requires as input, the three short circuit admittance matrix elements. Nec2Go converts the Inductance and Capacitance of the Network Series and Shunt arms into the admittance matrix elements .. This feature provides the ability to create a tuner, for example, at either end of a feed line.

Network Designer features is enabled during Edit so that the selected Network type can be placed into the .ant file.

Plot Data:
Note: Nec outputs plotting information as tabular data by a specific Azimuth angle and Elevation angle. Each antenna definition will have maximum output at different angles.

Nec2Go provides the output at the optimum values of Azimuth and Elevation for each run. Nec2Go can determine the optimum angles much faster than a user can manually. However, manual input can be specified on theNec Run options.

Variable Definitions

Defining Variables is optional. The use of variables provides greater flexibility towards achieving maximum operational performance of a model.

Variables:
> Note: Variables can only be defined once.

> **Variables** are defined by: **var = val,** where **var** is any alphanumeric word, and **val** can be numeric, or any expression. Variables are non-case sensitive, eg, len, Len, and LEN are all the same variable.

> Variables can use dimension settings as part of the numeric such as feet('), inches ("), meters (m), millimeters)mm), centimeters(cm), wire number (#nn), but they are not valid *constant variables*.

>> For example:

>> Len1=66' Len2=20m Len3=200mm Sz=#16
>> ;66 feet ;20 meters ;200 millimeters
>> ;number 16 wire gauge(awg)

> Variable**s** defined with dimension qualifiers are **not** constant variables and do not appear in the Variables list. Use a constant definition that is multiplied or divided by the Wire definition type instead. For example:
> Len1 = 66*12 ; 66 feet when dimensioned in inches

> Variables can be included in Variables, Wires, Source, Load, Network, Transmission line, and Shift/Rotate statements. This allows for a very powerful way of creating antenna file definitions.

> When "Optimizing/Sweeping" a variable, the geometry of the antenna is continually regenerated prior to each Nec execution

> **Predefined Variables** are: Freq, Gnd_Conduc, and Gnd_Dielec.

>> Examples:

>>> Len=10.   ;set len to 10 in specified units

>>> Len=10m   ;set Len to 10 meters

>>> Len=10"   ;set len to 10 inches

>>> Len=10'   ;set len to 10 feet

>>> Ang=45   ;set Ang to 45 (for subsequent Sin or Cos function)
>>> Sz=#16   ;number 16 wire gauge(awg)

>>> Diam= #12   ;set Diam to # 12 wire gauge

Hgt= Len * Sin(Ang)   ;Hgt= sine of angle times Len
Y= Len*Cos(Ang)   ;Y= Cos(Ang) * 100m
    Y = Len times cosine of ang   ;Y = Cosine of ang times 100 meters

Reserved Words: The following variables names are reservedspecifically to Nec2Go:

Wire, Comments, Type, Freq, End1, End2, Center, Gnd_Conduc, Gnd_Dielec.

Constant Variable:

Constant variable is a defined as a variable with a constant value. Constant values are any numeric or expression that evaluates to numeric. See examples below.

Examples:

eg, Len=10
Len=133/2
Hgt=66*12.

Constant variables will be listed in the View 'Variables' panel and during Optimize/Sweep.

Arithmetic operators:

Arithmetic operations are:

+ (addition), - (subtraction), * (multiplication), / (division), ^n (power of n), Sin, Cos, Sqr, Tan, and Atn.

Expressions cannot be continued across lines. Blanks are removed, as are comments following a ;(semicolon).

Numeric values can be specified with the preceding indicators:

signifying wire gauge number(AWG)
"   signifying inches
'   signifying feet
m   signifying meters
cm   signifying centimeters
mm signifying millimeters

Freq:
Freq is the value taken from the Freq: statement. Freq is modified when doing a Frequency Sweep. The variable "Freq" is reserved to Nec2Go and can be used anywhere in an expression.

Secondary Ground Zone (SGZ): Optional

Specificatoins for secondary ground zone (SGZ) are as follows:
    Zone: C=nnn D=nnn H=nnn R=nnn

    Where:
        C is the Conductivity in milli-siemens per meter D is the dielectric constant
        H is the height below the X-Y plane
        R is the radius away from the Z-axis to begin the new zone

A secondary ground Zone defines terrain at a lower level away from the 0,0,0 axis of the antenna. Only one secondary ground can be defined. Note this is a Nec limitation.

      Example:

      Zone C=10, 0=25, H=20, R=100

Ground Conditions: See Table 1

Soil Description	Conductivity mS/mm	Permittivity Diel Const	Rel - Quality
Fresh water	1	80	
Salt Water	5000	81	
Pastoral: low hills, rich soil, typ from Dallas, TX to Lincoln, NE.	30.3	20	Very Good
Pastoral: low hills, rich soil, tpy OH & IL	10	14	Good
Flat Country, marshy, densely wooded, typ LA near Mississippi River	7.5	12	
Pastorial: medium hills, and forestation, typ MD, PA,NY exclusive of mountains and coastline	6	13	
Pastorial: medium hills and forestation, heavy clay soils typ central VA, SC exclusive of mountains and coastline.	5	13	Average
Rocky soil, steep hills typ mountainous	2	12-14	Poor
Cities, industrial areas	1	5	Very Poor
Cities, heavy industrial areas, high buildings	1	3	Extremely Poor

Table 1 General Ground Conditions for various locations.