Pathloss Radio and Antenna Data Files

This documentation describes the radio and antenna data ASCII file formats used in Pathloss version 5 program. These ASCII files can be created programmatically, or individually with a text editor. A stand alone utility program “ant_rad.exe” is supplied to create and edit these files. This utility also converts the ASCII files to the binary format required for the Pathloss program.

All version 4.0 radio and antenna files can be used unchanged with the version 5 program. The version 5 format offers more flexibility for new data files and is required for adaptive modulation and land mobile radio data files. The ant_rad utility can be used to convert version 4 files to the version 5 format.

Version 5 Radio Data Files

The Pathloss version 5 program uses a proprietary ASCII radio data file format for conventional microwave, adaptive modulation and land mobile radio applications. Version 4 radio data files are only applicable to conventional microwave radio. These files can be used in version 5 microwave applications without modification.

The ASCII files can be created programmatically, or individually with a text editor. A stand alone utility program AntRad is available to create and edit these files. This utility also converts the ASCII files to the binary format required for the Pathloss program.

File naming convention

The radio data file name without the extension is used as a key field in a lookup table. Therefore, file names must be unique. The maximum radio file name length is 47 characters. File naming strategy becomes an important issue in this arrangement. A suggested format is given by the example “ACMELINK-6GHz-16E1-QPSK. This name consists of a manufacturer - model, frequency band, capacity and modulation.

The radio data file name is also used as an identifier for T to I and IRF curves. For example, an IRF curve could be identified as follows:

IRF_same 24 File_name1, File_name2, File_name3

This means this IRF curve is applicable to an interfering radio with the same file name as the radio being defined. In addition the curve is applicable to radios with file names File_name1, File_name2 and File_name3. The number 24 is the number of points in the curve.

File Formats

The first line in the file is PL50_ASCII_RADIO_SPEC_04. This is used as the file identifier and the revision number for the specific file format. Each successive line begins with a descriptive mnemonic followed by a semicolon and one or more data fields separated by a comma. A single data entry does not have any commas. Comments are denoted by a double forward slash //. All text after the // on the same line is ignored. A description of each mnemonic follows.

Fields designated as information only can be used for any specific purpose. All information in the radio data file except the curve data is also saved in the individual PL5 files

General Information

MANUFACTURER: radio equipment manufacturer
text - 47 characters - required field

MODEL: radio model
text - 47 characters - required field

RELEASE_DATE: original radio data release date
text 23 characters - information only

REVISION_NUM: radio data revision number
text 35 characters - information only

REVISION_DATE: radio data revision date
text 23 characters - information only

RADIO_ID: manufacturers radio identification
text 47 characters - information only

PL50_RADIO_CODE: the file name of the radio data file less the extension
file name 47 characters - this field is automatically created in the AntRad program using the file name

APPLICATION_TYPE: the type of application
integer 1 - microwave 2 - adaptive modulation 3 - land mobile - required field

RADIO_TYPE: radio type description e.g SDH, PDH, Digital Video
text 23 characters - information only

FREQUENCY_RANGE: low frequency in MHz, high frequency in MHz
real number, real number - required fields

EMISSION_DESIGNATOR: radio equipment emission designator
text 23 characters - used for default radio data files in interference calculations using the MDB

TXDATA_RATE_MBS: payload data rate in Mbits/second
real number - required field

RXDATA_RATE_MBS: payload data rate in Mbits/second
real number - required field

RADIO_CAPACITY: number of lines, signal standard e.g. 4, E1
text 15 characters - required field

MODULATION: modulation type e.g. 128TCM
text 15 characters - required field

BANDWIDTH_FCC_MHZ:- Bandwidth used to calculate the FCC spectrum mask in MHz
real number - information only

BANDWIDTH_99PC_MHZ: Bandwidth containing 99% of the transmitter power
real number - information only

BANDWIDTH_3DB_TX_MHZ: 3 dB transmit power bandwidth
real number - required field - used to calculate the default transmitter emission mask for interference calculations

BANDWIDTH_3DB_RX_MHZ: 3 dB receiver selectivity bandwidth
real number - required field - used to calculate the default receiver selectivity mask for interference calculations

BANDWIDTH_CHANNEL_MHZ: the assigned channel bandwidth in MHz
real number - information only

Transmitter Specifications

The specifications described in this section only apply to conventional microwave and land mobile applications. Adaptive modulation applications are separate and require specifications for each modulation state.

A total of 5 transmitter power options can be specified. This applies to discreet power options. Each option consists of the following parameters:

- option name
- maximum transmit power
- minimum transmit power
- automatic transmit power control range

The order must be the same on each line. The first option is the default TX power option.

TX_POWER_OPTIONS_NAME:

text 15 characters for each option - A maximum of 5 options can be specified on a single line separated by a single comma. e.g. Standard, Low, High, ,

The same power option names are used for all radio types: conventional microwave, adaptive modulation and land mobile

TX_POWER_OPTIONS_DBM:
real numbers - discreet transmit power options in dBm separated by commas. This is the maximum power for the specific option. At least one value of transmit power is required unless TX_POWER_RANGE_DBM is used.

TX_POWER_MIN_OPTIONS_DBM:
real numbers - This is the corresponding minimum TX power to the above maximum values

ATPC_OPTIONS_DB:
real numbers - This is the fixed ATPC values corresponding maximum and minimum TX powers above

An example of the 5 transmit power options format is given below

```
TX_POWER_OPTIONS_NAME   : Hi,    Std,   Lo,    Extra Hi, Extra Lo
TX_POWER_OPTIONS_DBM    : 32.00, 30.00, 28.00, 34.00,    26.00
TX_POWER_MIN_OPTIONS_DBM: 25.00, 24.00, 23.00, 22.00,    21.00
ATPC_OPTIONS_DB         : 15.00, 14.00, 13.00, 12.00,    11.00
```

TX_POWER_RANGE_DBM: This option is used for radios with a single adjustable transmit power range
real numbers - low power and high power in dBm separated by a comma - required field unless TX_POWER_OPTIONS_DBM is used - This is not used in adaptive modulation applications

ATPC_RANGE_DB:
real number - ATPC value corresponding the TX_POWER_RANGE_DBM above

ATPC_STEP_SIZE_DB:
real number - information only

REQUIRED_RXSIGNAL_DBM:
real number - All ATPC specifications presented above represent a fixed transmit power reduction, which will be applied in an interference calculation. The resultant power level cannot be less than the minimum power specified. In the case of the REQUIRED_RXSIGNAL option, the transmit power of the associated transmitter will automatically be reduced to meet the specified RX signal level. This option is only active if a value is specified for this option.

TX_STABILITY_PERCENT: transmitter frequency stability in percent
real number - information only

Receiver Specifications

Receiver specifications are keyed to a specific bit error rate. Provision for four bit error rates are available. These are operated by commas on the same line. The default BER values are 10-3, 10-6, the residual BER and the special SES BER used in SDH radio performance calculations.

These receiver specifications are not used in adaptive modulation applications; however, some noise floor calculation methods require the RX threshold level

RX_THRESHOLD_DESCRIPTION: a description of the receiver threshold e.g. BER 1E-3, 12 dB SINAD...
text 15 characters - used in some reports

RX_THRESHOLD_BER: the numerical value of the BER e.g 1.0E-3
real number - required for some ITU availability algorithms

RX_THRESHOLD_DBM: the receiver threshold level in dBm corresponding to the above threshold description
real number - required for microwave and land mobile applications

MAXIMUM_RXSIGNAL: the maximum receive signal level in dBm corresponding to the above threshold description
real number - optional field

DISPERSIVE_FM: dispersive fade margin in dB corresponding to the above threshold description
real number - required field for selective fade calculations using the dispersive fade margin

SIGNATURE_DELAY_NS: signature delay in nanoseconds corresponding to the above threshold description
real number - required field for selective fade calculations using the equipment signature method

SIGNATURE_WIDTH_MHZ: signature width in MHz
real number - required field for selective fade calculations using the equipment signature method

SIGNATURE_MINPHASE_DB: signature null depth in dB in the minimum phase condition
real number - required field for selective fade calculations using the equipment signature method

SIGNATURE_NONMINPHASE_DB: signature null depth in dB in the non-minimum phase condition
real number - required field for selective fade calculations using the equipment signature method

Specifications used for Noise Floor calculations

Calculating threshold degradation due to interference requires the receiver noise floor level. This parameter can be specified directly or calculated from several parameters. The noise floor is used for all radio types.

NOISE FIGURE_DB: receiver noise figure in dB
real number - The BANDWIDTH_3DB_RX_MHZ must be specified

TtoI_RATIO C/I for a 1 dB degradation to the 10-6 BER RX threshold
real number - the RX_THRESHOLD_DBM field must include a value for the 10-6 BER

CtoI_RATIO_BER10-6_3DB: C/I for a 3 dB degradation to the 10-6 BER RX threshold
real number - the RX_THRESHOLD_DBM field must include a value for the 10-6 BER

CtoI_RATIO_BER10-3_3DB: C/I for a 3 dB degradation to the 10-3 BER RX threshold
real number - the RX_THRESHOLD_DBM field must include a value for the 10-3 BER

See the section “Noise Floor Calculations” for specific details

Miscellaneous Specifications

SIMULCAST_CAPTURE_RANGE: receiver simulcast capture range in dB real number - required for simulcast delay calculations in land mobile applications - the default value is 15 dB.

BITS_BLOCK: bits per block in an SDH radio
integer - required for BBER and ESR in SDH radio systems

BLOCKS_SEC: blocks per second in SDH radio
integer - required for BBER and ESR in SDH radio systems

ALPHA_VALUES: parameters describing the number of errors per burst in a an SDH radio
3 integer values separated by commas where:

- *a1* - number of errors per burst for a BER in the range 10-3 to the SES BER - typical values 10 to 30
- *a2* - number of errors per burst for a BER in the range from the SES BER to the residual BER - typical values are 1 to 10
- *a3* - number of errors per burst for a BER lower than the residual BER - a typical value is 1

COCHANNEL_OPERATION: enables or disables cochannel operation
integer 0 - disable cochannel operation, 1 - enable cochannel operation

COCHANNEL_XPIF: cochannel improvement factor
real number - applicable only if the radio is equipped with a cochannel improvement device

COCHANNEL_XPD_XPI: cross polarized discrimination of the cochannel improvement device
real number - applicable if the cochannel improvement device is a hardware implementation.

SELECTIVE_FADING: sets the selective fading calculation method
integer 0 use dispersive fade margin, 1 use equipment signature, 2 do not calculate selective fading

Space Diversity Improvement Parameters

SPACE_DIV_OPERATION: sets space diversity operation to either baseband switching or IF combining
integer 0 baseband switching, 1 IF combining

GAIN_WIDTH-DEPTH three parameters used in space diversity using IF combining. The improvement to the selective fading can only be evaluated when the equipment signature is used.

- *gain* - default value is 2.6 dB. The gain is added to the thermal fade margin
- *width factor* - the signature width is multiplied by the width factor
- *depth factor* - both the signature minimum phase and non-minimum phase null depth are multiplied by this factor

Minimum Frequency Separation

T-T_FREQ_SEP_1ANT_CPOL: minimum transmitter to transmitter spacing using 1 antenna same polarization
real number - optional - information only

T-T_FREQ_SEP_1ANT_XPOL: minimum transmitter to transmitter spacing using 1 antenna cross polarized
real number - optional - information only

T-T_FREQ_SEP_2ANT_CPOL: minimum transmitter to transmitter spacing using 2 antenna same polarization
real number - optional - information only

T-T_FREQ_SEP_2ANT_XPOL: minimum transmitter to transmitter spacing using 2 antennas cross polarized
real number - optional - information only

T-R_FREQ_SEP_1ANT_CPOL: minimum transmitter to receiver spacing using 1 antenna same polarization
real number - optional - information only

T-R_FREQ_SEP_1ANT_XPOL: minimum transmitter to receiver spacing using 1 antenna cross polarized
real number - optional - information only

T-R_FREQ_SEP_2ANT_CPOL: minimum transmitter to receiver spacing using 2 antennas same polarization
real number - optional - information only

T-R_FREQ_SEP_2ANT_XPOL - minimum transmitter to receiver spacing using 2 antennas cross polarized
real number - optional - information only

T-R_FIXED: fixed transmitter to receiver spacing
real number - optional - information only

Adaptive Modulation Specifications

Effective Threshold Concept

Adaptive modulation specifications use the concept of dynamic switching thresholds illustrated in the diagram on the right.

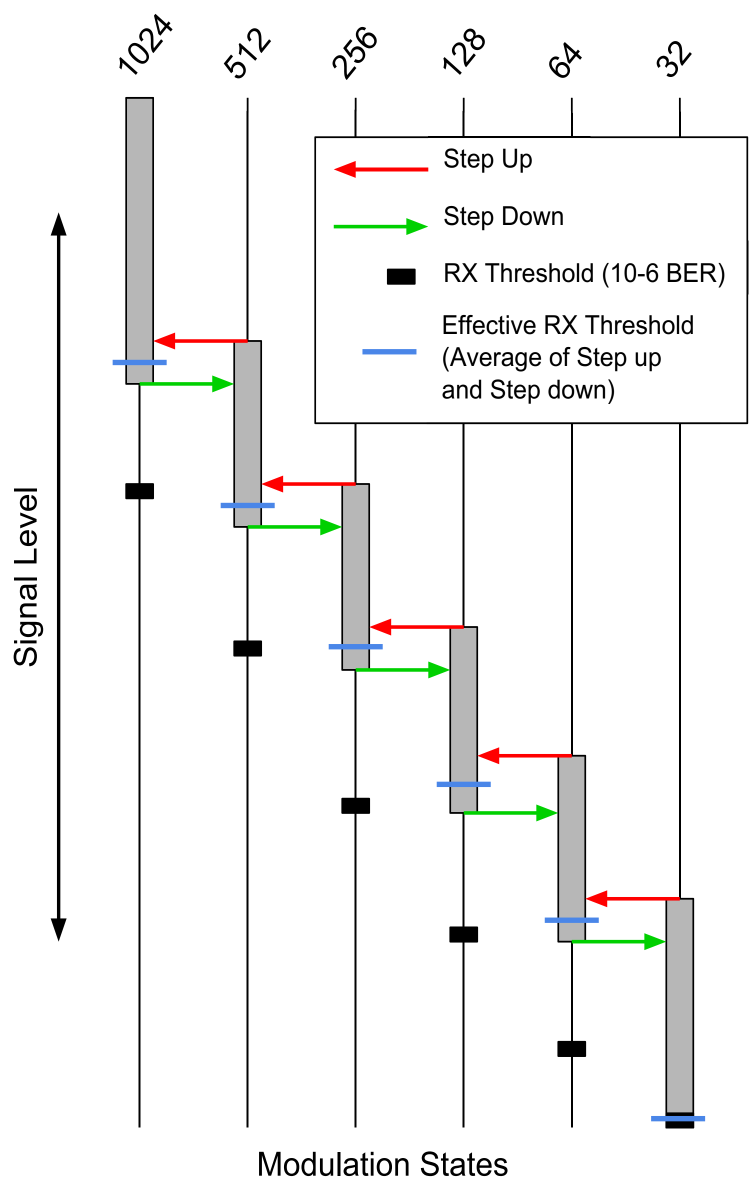
Suppose the system is in the 1024QAM state and begins to fade. At what signal level will the radio switch down to 512QAM? If the switch does not occur until the signal level reaches the 1024QAM threshold level, errors will occur during the transition. Therefore there must be some margin which will depend on the fade rate and the modulation state switching time.

The green line shows the transition between states as the signal level continues to fade.

When the system recovers from the fade, the reverse situation occurs. At what signal level would a signal in the 512QAM state switch to the 1024 state. If the switch occurred at the 1024QAM threshold level, errors would occur and again a similar margin is necessary. This is referred to the switch up level. The red line shows the transition states as the signal returns to its unfaded state.

Note that the signal can never reach its 10-6 BER RX threshold except at the lowest modulation state (32 QAM) in the diagram.

For all other states, it is necessary to define an effective threshold as the average of the step down level of a modulation and the step up level of the next lower modulation state. These are the thresholds used in all performance calculations



Modulation	10-6 BER RX threshold level dBm	Step Down Level dBm	Step Up Level dBm	Effective RX Threshold dBm
1024QAM	-62	-59		-59.5
512QAM	-65	-62		-62.5
256QAM	-68	-65	-63	-65.5
128QAM	-71	-68	-66	-68.5
64QAM	-74	-71	-69	-71.5
32QAM	-77		-72	-77

In addition to the RX threshold level, the selective fading parameters (dispersive fade margin, and equipment signature are also affected by this margin. Provision has been made to provide specifications at both the 10-6 BER and the step levels.

Adaptive Modulation File Format

The adaptive modulation starts with the mnemonic

NUM_ACM_STATES: the number of adaptive modulation states
integer -there is no limit to the number of modulation states

The data is organized in three sections using the labels ADMOD_A, ADMOD_B and ADMOD_C. Each section must have the specified number of ACM states. Lines within a section are labelled with sequential numbering e.g ADMOD_A01, ADMOD_A02, ADMOD_A03

ADMOD_A
Modulation - description e.g. 128 QAM - text 15 characters

RSEC (Radio spectrum efficiency class -ETSI requirement) - text 15 characters

RX Threshold - 10_6 BER - real number dBm

Step up level - real number - dBm

Step down level - real number - dBm

Minimum carrier to Interference - real number - this term is not used

Throughput description - text 15 characters

```
// ADMOD_A:    Mod, RSEC, BER10-6, SwUp, SwDown, Min C/I, Capacity
ADMOD_A01: 128QAM,   5B,     -65,  -55,    -61,        ,      154
```

ADMOD_B

Dispersive fade margin -10_6 BER threshold - dB

Dispersive fade margin - step level - dB

Signature width - real number - MHz

Signature delay - real number - nanoseconds

Signature depth minimum phase -10_6 BER threshold - real number - dB

Signature depth non-minimum phase -10_6 BER threshold - dB

Signature depth minimum phase - step level - dB

Signature depth non-minimum phase - step level - dB

Maximum RX signal real number - dBm

XPIF - dB Cross polarized improvement factor

```
// ADMOD_B:dfm10_6, dfm_step, sig_del, width, minph10_6, nminph10_6,
ADMOD_B01:     45,      48,     6.3,   28,      25,       24,

 minph_step, nminph_step, max_rxsig, XPIF
    28,       27,     -16,   12
```

ADMOD_C

Five transmit power options can be assigned to each modulation state Each power option consists of a maximum and minimum transmit power, and the top level ATPC.

```
// ADMOD_C: TXmax, TXmin, ATPC top,    ,    ,    ,    ,    ,    , , , , , ,
ADMOD_C01:    30,    20,       10, 25, 15, 10, 32, 10, 10, , , , , ,
```

Radio Configuration and Antenna Coupling Unit

This section specifies the available radio configurations (e.g. monitored hot stand-by, space diversity..) and the associated antenna type and antenna coupling unit losses. Any number of configurations can be specified. There is no fixed limit.

Each configuration consists of a description, the antenna type (TR, TD, TH, TX and RX, and the associated losses in dB separated by commas. This information is used as a radio configuration lookup table in the transmission analysis section. For microwave and adaptive modulation applications the loss coding is as follows:

- CRC: Circulator branching loss
- TXS: TX switch loss
- TXF: TX filter loss
- RXH: RX hybrid loss
- RXF: RX filter loss
- DRC: Diversity RX circulator loss

For land mobile applications the loss coding is as follows:

- CRC: Duplexer loss
- TXS: TX combiner loss
- TXF: TX filter loss
- RXH: RX multicoupler loss (use negative values for gain)
- RXF: RX filter loss

configuration text 31 characters - real numbers representing loss values separated by commas

```
NUM_ACU_CONFIG:
//ACU:       Configuration, ANT,  CRC,  TXS,  TXF,  RXH,  RXF,  DRC
ACU_CNFG_01:  Unprotected,  TR, 1.10,     , 1.20,     , 1.30,
ACU_CNFG_02:  Hot Standby,  TR, 1.10, 1.20, 1.30, 1.40, 1.50,
```

Miscellaneous:

COMMENT_1 - 6 general comments
text 47 characters - information only

Interference Curves - Conventional Microwave Radio

If the bandwidth or frequency of an interfering signal is different than the victim receiver, the filter improvement factor must be calculated. Two types of curves can be used to handle the case of different frequencies with the same bandwidth:

- TtoI curves - threshold to interference
- IRF curves - Interference reduction factor

Either format can be used. The curves can be single sided (0 to f_max) or double sided (f_min to f_max).

The general formats are as follows:

The interfering radio is the same as the radio specified in this file
TtoI_Same
IRF_Same

Suppose this same curve is valid for other several other radios

TtoI_Same other_radio_file1, other_radio_file2, . . .
IRF_Same other_radio_file1, other_radio_file2, . . .

where the names other_radio_file1 and other_radio_file2 are the interfering radio data file names i.e. the binary file names less extension of the interfering radio data files.

Suppose curves are required for several other different radios interfering with the radio specified in this file
TtoI_Other other_radio_file1, other_radio_file2, . . .
IFR Other other_radio_file1, other_radio_file2, . . .

In the case of bandwidth, a wide band transmitter interfering with a narrow band receiver is different than a narrow band transmitter interfering with a wide band receiver even if the frequencies are the same

The file format starts with a mnemonic (TtoI_Same, IRF_Same, TtoI_Other or IRF_Other) followed a colon and the number of points in the curve on the same line. If this curve is applicable to other radios, then list these on the same line separated by a comma. The data points follow with the frequency and the response in dB separated by a comma. Partial examples of a T to I curve and an IRF curve are given below:

```
TtoI_Same: 45, optional_other_filename1, optional_other_filename2
0.0, 28.0
0.5, 28.0
1.0, 28.0
```

```
2.0, 26.0
3.0, 23.0
4.0, 17.9
5.0, -7.1
10.0, -19.5
```

```
IRF_Same: 81, optional_other_filename1, optional_other_filename2
0.00, 0.00
1.00, -0.03
2.00, -0.11
3.00, -0.24
4.00, -0.42
5.00, -0.64
6.00, -0.91
7.00, -1.21
8.00, -1.56
```

The main advantage of TtoI and IRF curves is the speed of calculating the filter improvement as this can be read directly from the curve. The disadvantage is the large number of curves required for an interference calculation in a large network.

Transmitter Emission and Receiver Selectivity Curves

Any combination of bandwidth, modulation and frequency difference can be calculated with these two curves. The calculation is more complex; however with new computers, the time difference is not significant. Transmitter emission

The file format is the mnemonic TX_EMISSION followed by a colon and the number of points in the curve. The TX emission curve will be normalized for a total power of one watt based on a measurement bandwidth of 4 kHz.

The file format is the mnemonic RX_SELECTIVITY followed by a colon and the number of points in the curve. The RX selectivity curve represents the composite receiver selectivity including RF, IF and baseband filtering

Examples of the file format for these curves are given below.

```
TX_EMISSION:   52
0.0, -3.9
11.1, -3.9
11.3, -4.5
11.8, -5.6
.
.
34.9, -63.5
35.2, -64.6
35.5, -65.8
36.0, -66.0
120.0, -66.0
```

```
RX_SELECTIVITY: 95
0.0, -1.9
11.9, -1.9
```

```
12.0, -1.2
12.7, 0.0
.
.
24.4, -78.4
24.5, -80.0
25.4, -79.0
25.8, -80.0
```
120.0, -80.0

Default TX Emission and RX Selectivity Masks

Default TX emission and RX selectivity masks are automatically generated when the ASCII file is saved in the binary format. There must be values specified in the BANDWIDTH_3DB_TX_MHZ and BANDWIDTH_3DB_RX_MHZ fields respectively.

CW Interfering Signal

A special T to I curve format is used for the case of an unmodulated carrier wave interfering signal. This curve is used for an analog interfering signal. In addition, this curve provides an approximation to the receiver selectivity and is used for this curve as a default. The format is:

TtoI_CW: 36

Transmit and receive filter characteristics

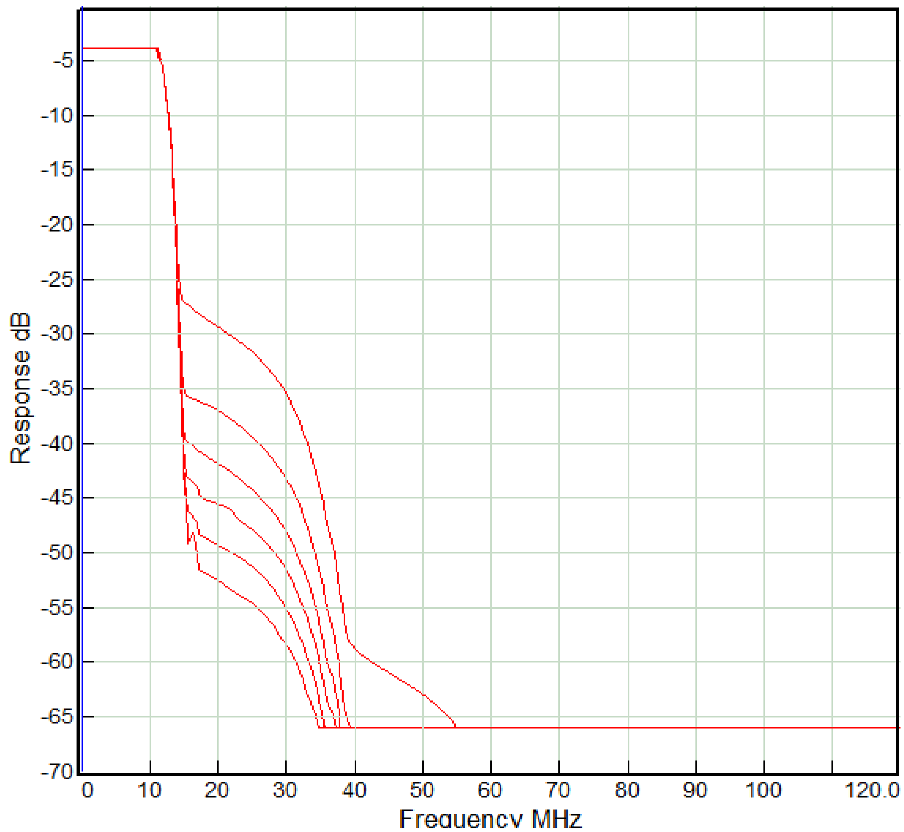
These curves are for information purposes and are not used in the program. The file format is the mnemonic followed by a colon and the number of data points in the curve

RX_FILTER: 32
TX_FILTER: 24

Interference Curves for Adaptive Modulation Radios

TtoI and IRF curves are not used in adaptive modulation radio files. Transmit spectrum and receiver selectivity curves are required for these applications.

The diagram at the right shows the TX emission curves for several different modulation states in an adaptive modulation radio.



The differences between the curves start below the 25 dB point and the effects of

Noise floor calculations

The radio noise floor level is required to calculate receiver threshold degradation due to interference or cochannel operation. This is required for all applications - microwave, adaptive modulation and land mobile.

Provision is made for direct entry of the receiver noise floor. This is the preferred method. The noise floor can also be calculated indirectly using the receiver threshold and the corresponding CtoI ratio. In practice, these calculations result in slightly different values for each modulation state.

The following noise floor calculation methods are used in the program

Receiver data	10-3 BER	10-6 BER
RX_THRESHOLD_DESCRIPTION	BER 1e-3	BER 1e-6
RX_THRESHOLD_BER	1.00E-003	1.00E-006
RX_THRESHOLD_DBM	-66.00	-65.00
MAXIMUM_RXSIGNAL_DBM	-17.00	-19.00
DISPERSIVE_FM_DB	49.00	47.00
SIGNATURE_DELAY_NS	6.30	6.30
SIGNATURE_WIDTH_MHZ	26.00	28.00
SIGNATURE_MINPHASE_DB	23.00	22.00
SIGNATURE_NONMINPHASE_DB	23.00	22.00
NOISE FIGURE_DB		
Ttol_RATIO	32.00	
Ctol_RATIO_BER10-6_3DB	29.00	
Ctol_RATIO_BER10-3_3DB	28.00	
NOISE_FLOOR_KTBF_DBM	-92.00	

Threshold to Interference ratio:

A modulated test signal is connected to the receiver and its level is adjusted to produce a BER of 1.0E-6. Denote this signal level as T dBm. Increase this level by 1 dB. An interfering signal using the same modulation and frequency is injected into the system and the level is adjusted so that the BER returns to 1.0E-6. Denote this interfering signal level as I dBm. The T/I ratio is then given by T - I.

The noise floor can be calculated as T - T/I + 5.886 dBm

Carrier to interference ratio for a 3 dB degradation to the 10-6 BER receiver threshold:

A modulated test signal is connected to the receiver and its level is adjusted to produce a BER of 1.0E-6. Denote this signal level as T dBm. Increase this level by 3 dB. An interfering signal using the same modulation and frequency is injected into the system and the level is adjusted so that the BER returns to 1.0E-6. Denote this interfering signal level as I dBm. The C/I ratio is then given by T - I.

The noise floor can be calculated as T - C/I dBm

Carrier to interference ratio for a 3 dB degradation to the 10-3 BER receiver threshold:

A modulated test signal is connected to the receiver and its level is adjusted to produce a BER of 1.0E-3. Denote this signal level as T dBm. Increase this level by 3 dB. An interfering signal using the same modulation and frequency is injected into the system and the level is adjusted so that the BER returns to 1.0E-3. Denote this interfering signal level as I dBm. The C/I ratio is then given by T - I.

The noise floor can be calculated as T - C/I dBm

Noise Figure:

The noise floor can be calculated from the noise figure using the relationship KTBF where:

K is Boltzman’s constant, T is the absolute temperature in degrees Kelvin, B is the 3 dB bandwidth in Hertz and F is the noise figure expressed as a ratio

AntRad Utility

The AntRad utility is used to create and edit radio data files. The main data entry form uses the same mnemonics as the ASCII text file described above. Lines with multiple entries have column separators.

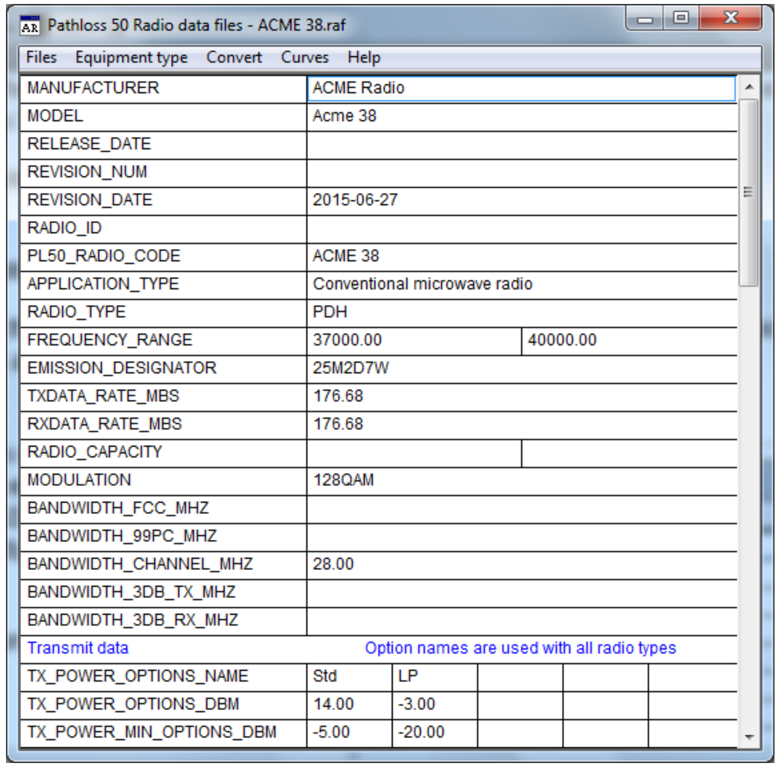
The Files-Open menu selection will open all radio file versions including:

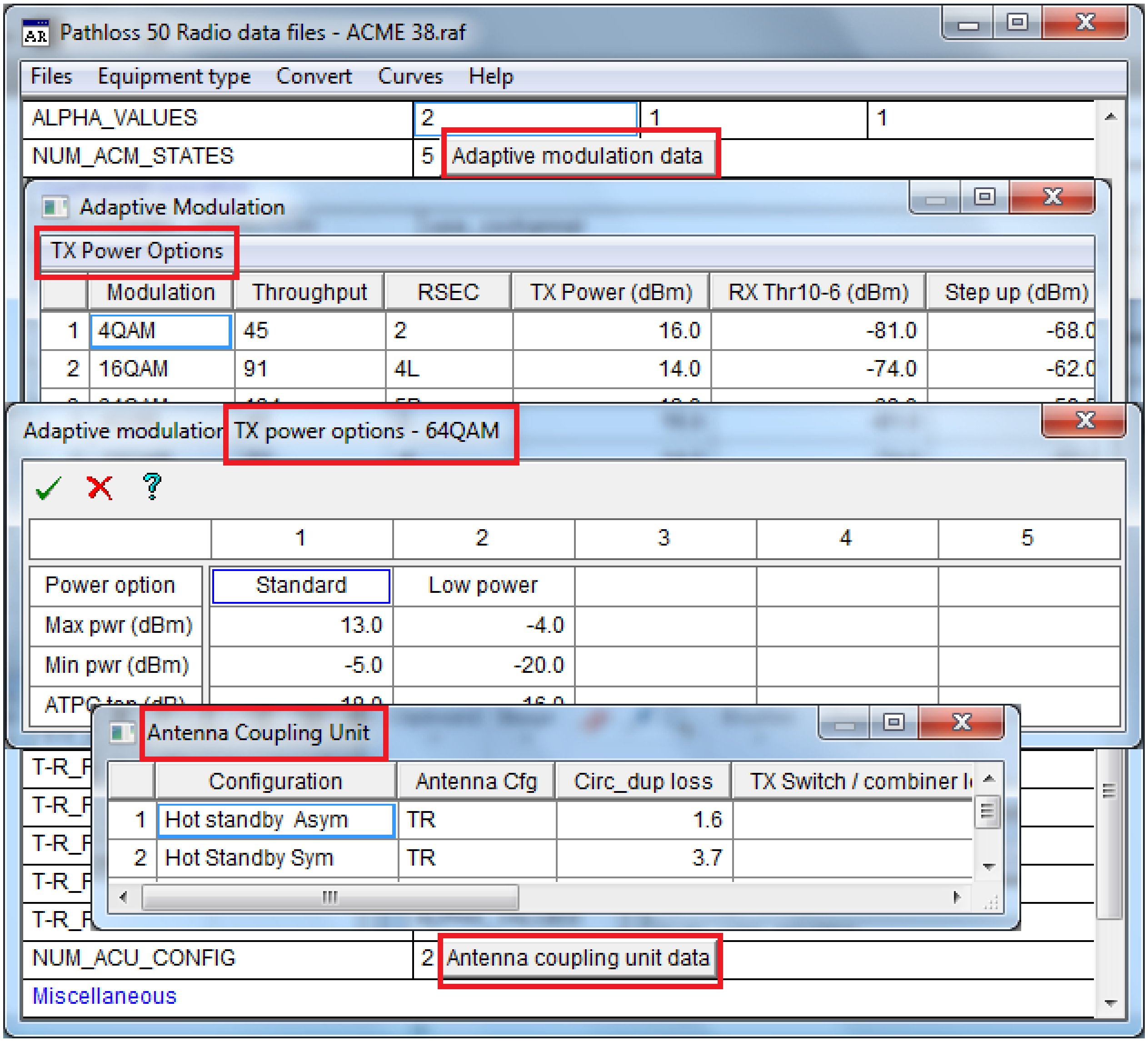
- version 4 ASCII raf files
- version 5 ASCII raf files
- version 4 binary mrs microwave radio files
- version 5 binary rsd radio files

Separate file save menu items are provided for ASCII and binary formats. Both of these use the version 5 formats.

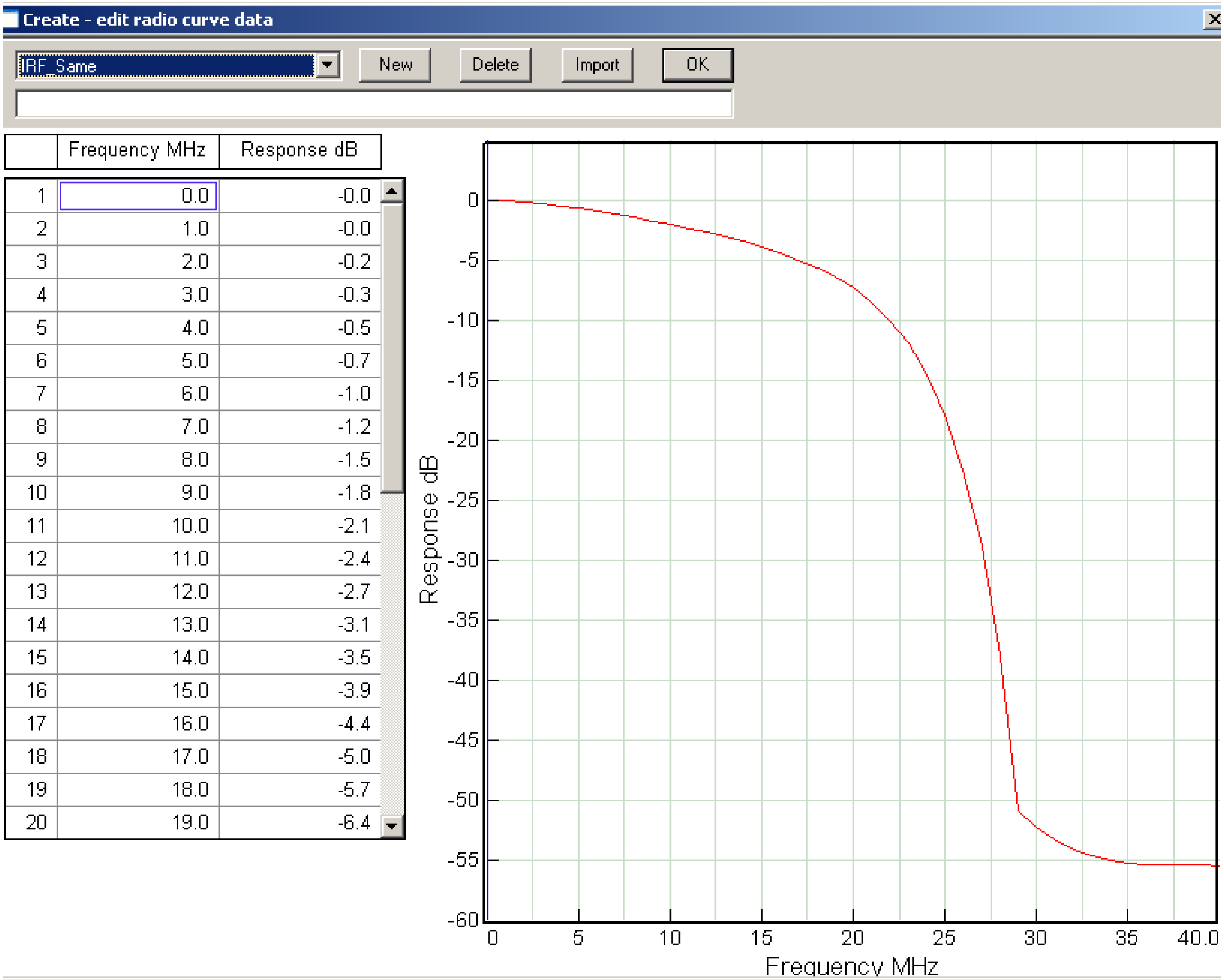
To save in version 4 formats, use the Equipment type - Version 4 Radio data files menu item.

Access to the adaptive modulation and antenna configuration unit data entry forms is by clicking the appropriate buttons as shown in the diagram below.




Pathloss 50 Radio data files - ACME 38.raf
Files
Equipment type
Convert
Curves
Help
ALPHA_VALUES
2
1
1
NUM_ACM_STATES
5
Adaptive modulation data
Adaptive Modulation
TX Power Options
Modulation
Throughput
RSEC
TX Power (dBm)
RX Thr10-6 (dBm)
Step up (dBm)
1 4QAM 45 2 16.0 -81.0 -68.0
2 16QAM 91 4L 14.0 -74.0 -62.0
Adaptive modulation
TX power options - 64QAM
1 2 3 4 5
Power option
Standard
Low power
Max pwr (dBm)
13.0
-4.0
Min pwr (dBm)
-5.0
-20.0
Antenna Coupling Unit
Configuration
Antenna Cfg
Circ_dup loss
TX Switch / combiner l
1 Hot standby Asym TR 1.6
2 Hot Standby Sym TR 3.7
NUM_ACU_CONFIG
2
Antenna coupling unit data
Miscellaneous

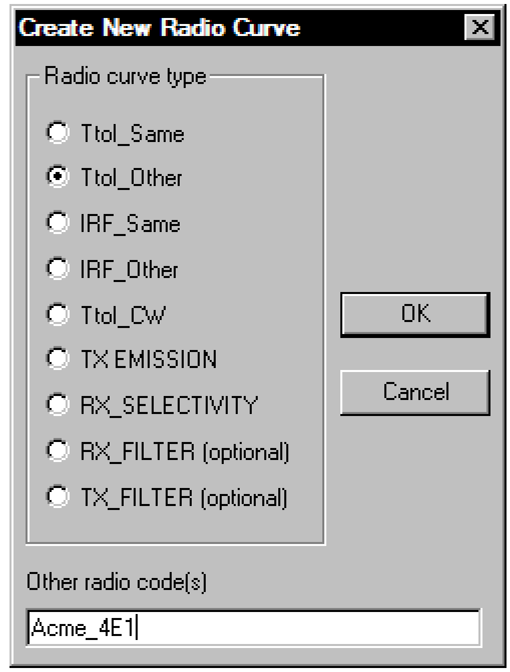
Radio Curves



	Frequency MHz	Response dB
1	0.0	-0.0
2	1.0	-0.0
3	2.0	-0.2
4	3.0	-0.3
5	4.0	-0.5
6	5.0	-0.7
7	6.0	-1.0
8	7.0	-1.2
9	8.0	-1.5
10	9.0	-1.8
11	10.0	-2.1
12	11.0	-2.4
13	12.0	-2.7
14	13.0	-3.1
15	14.0	-3.5
16	15.0	-3.9
17	16.0	-4.4
18	17.0	-5.0
19	18.0	-5.7
20	19.0	-6.4

Select the Curves menu item to create or edit curves. The first step is to specify the specific type of curve. Click the new button, select the curve type and click the OK button.

If a TtoI_Other or IRF_Other curve has been specified, then enter the name of the corresponding radio data file name. Multiple file names can be entered separated by a comma.



Editing Version 4.0 Interference curves

Version 4.0 used the concept of a traffic code to identify interference curves. This consisted of a concatenation of the channel capacity and the modulation e.g. 8E1-QPSK. The TtoI curve of this radio would be coded as TtoI_8E1-QPSK.

When a version 4.0 file is loaded into the AntRad program, a traffic code will be generated using the channel capacity and the modulation specified in the file. This will be compared to the coding on the TtoI curves. If the TtoI curve is coded with the same traffic code, the curve will be interpreted as a TtoI_Same curve.

If the T to I curve coding does not match the traffic code, the curve will be interpreted as a TtoI_Other curve.

Consider the example of a version 4 radio with a 8E1 capacity and QPSK modulation. The resulting traffic code is 8E1-QPSK. The data file has the following TtoI curves:

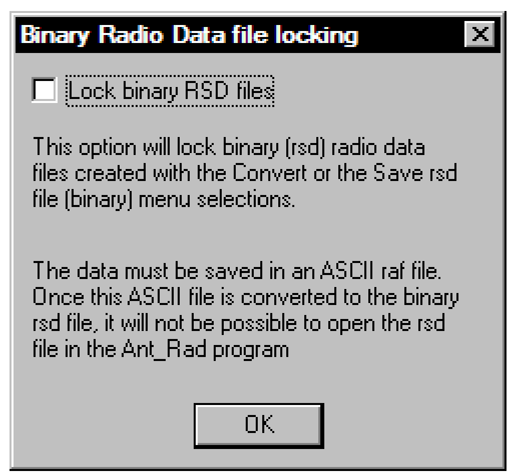
TtoI_8E1-QPSK - interfering radio has the same channel capacity and modulation. This curve will be coded as TtoI_Same

TtoI_4E1-QPSK - interfering radio has a different channel capacity or modulation. This curve will initially be coded as TtoI_Other 4E1-QPSK. The user must change the other code designation of 4E1-QPSK to the corresponding radio code i.e. the name of the binary file less suffix of the 4E1-QPSK radio.

The above step must be carried out for each TtoI_Other or IRF_Other curve. Select the curve in the drop down list and change the corresponding other codes in the edit control below the drop down list. The names in the drop down list will not change until the Create - edit radio curve dialog is closed and re-opened

Radio data file locking

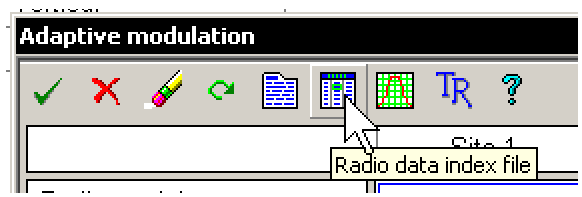
The AntRad program can open and edit binary and ASCII files. Provision has been made to inhibit opening and editing of binary files. In this case the master data record must be an ASCII file.



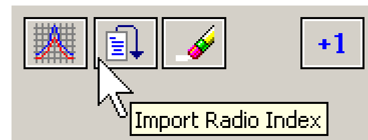
Select the Files - Lock binary rsd files menu selection. Click the Lock binary rsd files box and then click OK. When the binary file is saved, a "file locked" message will be present on the windows save file dialog.

Using Radio Data Files in the Pathloss Program

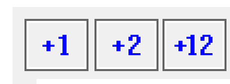
The first step is to add the converted binary radio data files into the *Radio File Index*. This index can be accessed from any radio data entry form in the program. The file index is used for all application types (conventional microwave, adaptive modulation and land mobile)



Click the *Import Radio Index* button and follow the procedures to create an index for the selected. Creating an index is a necessary step for adaptive modulation radios. If a radio lookup table is required, the table must be populated using the *Radio File Index* as it is not possible to enter the specifications manually in the lookup table.



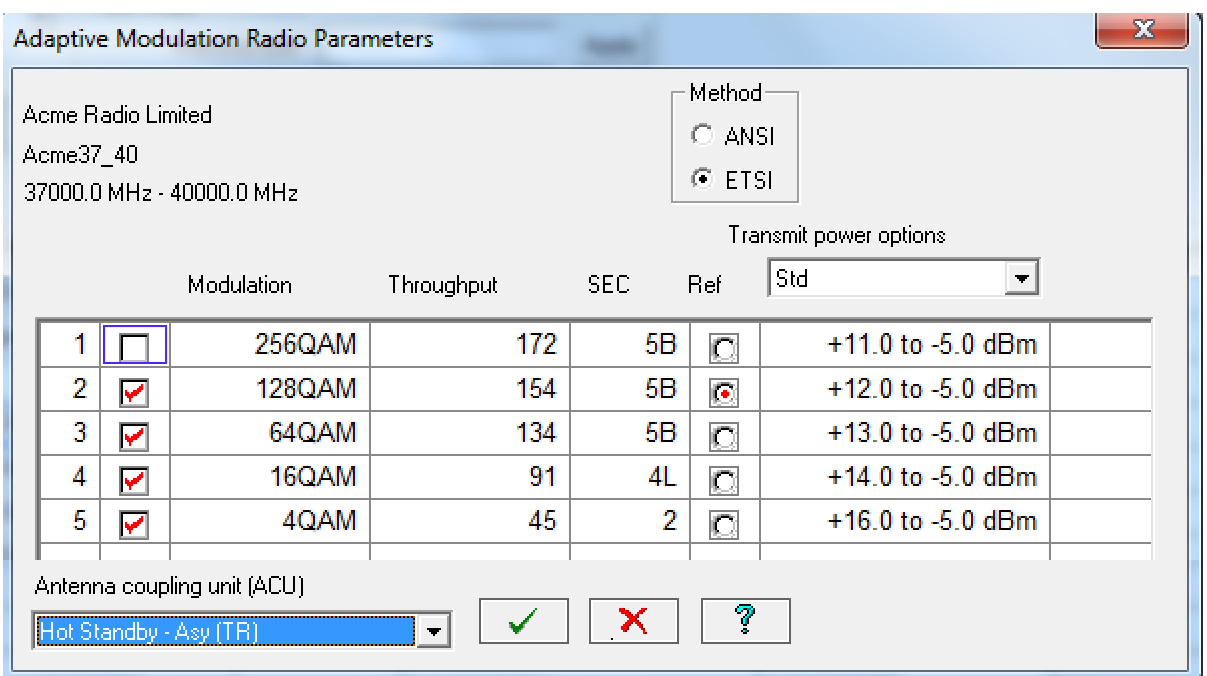
Once the radio data files have been indexed, these can be loaded into the program from any radio data entry form in the program. Click +1 /+2/ or +12 to add the radio file to site 1, site 2, or both sites respectively. Note that the main application must be set to that of the radio data file. For example if the program application type is set to Adaptive modulation, only adaptive modulation radio data files can be loaded.



A secondary window will appear depending on the application type

For adaptive modulation, the user must select / set the following parameters to be used in the calculation:

- Modulation / throughput SEC states. Note that the selection is not necessarily contiguous
- Reference state. This must be set to an active modulation state
- Transmit power option
- Antenna coupling unit (radio configuration)
- ANSI / ETSI calculation method

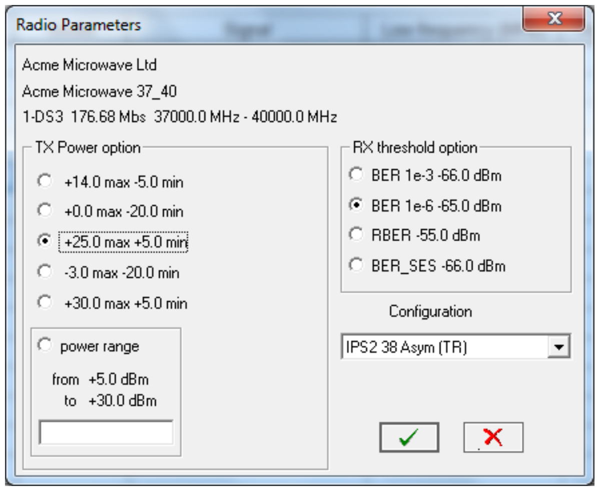


For both ANSI and ETSI, the reference state determines the parameters to be used in an interference calculation and the state to be used for the detailed display format. In the summary display for all modulation states, the reference state is hilighted.

In the ETSI method, the reference state determines the maximum transmit power for all modulation states. For example, if the reference state is set to 128 QAM, the maximum power for this state becomes the maximum power for all modulation states. This power level is strictly enforced. In the ANSI method, there are no restrictions on the transmit powers

In the adaptive modulation summary display, using total time below level calculation option, the annual results are 2 way for the ANSI option and 1 way for the ETSI option

For conventional microwave and land mobile applications, the user must select / set the following parameters to be used in the calculation



- Transmit power option - if the radio data file includes a transmit power range specification, the user will enter the specific transmit power
- Receive threshold option
- Antenna coupling unit (radio configuration)

Version 4 Radio Data Files

This section describes the Pathloss version 4 ASCII file format. These files use the suffix "raf" and must be converted to a binary format to used in the program. The file suffix of the binary file is always "mrs". The conversion can be carried out in the Pathloss version 4 program or with the ANT_RAD program.

The ASCII file consists or a Mnemonic and a value separated by a space or tab. The file format is given in the following table.

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
PLW40_RADIOSPECS	*	raf file identifier	
MANUFACT	* char[35]	radio manufacturer	Acme Radio
MODEL	* char[23]	radio model	ASDH-64

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
COMMENT_1	char[35]	optional comment	
COMMENT_2	char[35]	optional comment	
COMMENT_3	char[35]	optional comment	
COMMENT_4	char[35]	optional comment	
COMMENT_5	char[35]	optional comment	
EMDESIG	char[23]	emission designator	2M50D7W
RADIO_ID	char[23]	optional radio identifier	ACM-64-01
MODULATION	* char[23]	modulation - see below	64TCM
CAPACITY	* char[23]	channel capacity	STM1
DATA_RATE	numeric	data rate	155.52
STABILITY_PRC	numeric	frequency stability in percent	
STABILITY_PPM	numeric	frequency stability in parts per million	5
SPECTRMBW_MHZ	* numeric	spectrum 3db bandwidth in MHz used to create default TX emission and RX sensitivity masks	18
CHANNELBW_MHZ	numeric	channel bandwidth in MHz	20
MAXRXSIG_10-3	numeric	maximum receive signal at BER 10^{-3}	-12
MAXRXSIG_10-6	numeric	maximum receive signal at BER 10^{-6}	-10
TtoI_COCHAN_LIKE	** numeric	threshold to interference ratio like modulation (dB)	26.8
TtoI_COCHAN_CW	numeric	threshold to interference ratio CW modulation (dB)	25.0
TXPOWER_DBM	* numeric	transmit power (dBm)	30.0
FREQ_LO_MHZ	* numeric	lower frequency limit (MHz)	5900

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
FREQ_HI_MHZ	* numeric	upper frequency limit (MHz)	6400
ATPC_RANGE	numeric	automatic TX power control range (dB)	10
NUM_ATPCSTEPS	numeric	number of steps in the ATPC range	5
DIGRADIO_TYPE	PDH, SDH or NB_DIGITAL	digital radio type -PDH, SDH or narrow band digital default is PDH	SDH
SD_OPERATION	BBS or IFC	space diversity type baseband switching or IF combining default is BBS	IFC
COCHANNEL_OPERATION	YES or NO	calculate using cochannel operation - default is NO	YES
USE_SIGNATURE	YES or NO	use signature (YES) or dispersive fade margin (NO) to calculate the selective outage default is NO	YES
XPIF	numeric	the XPD improvement factor of the XPIC device in cochannel operation	17.0
XPD_XPI	numeric	the residual XPD of the XPIC device in cochannel operation	42.0
IF_COMB_GAIN	numeric	the thermal fade margin improvement in dB produced by IF combining in space diversity	3.0
LCOMB_FACTOR	numeric	the selective outage improvement factor produced by IF combining in space diversity	10.0

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
BITS_BLOCK	*** numeric	bits per block (SDH)	19940
BLOCKS_SEC	*** numeric	blocks per second (SDH)	8000
ALPHA1	*** numeric	errors per burst in the BER range from 10^{-3} to BER_{SES} (SDH)	10 to 30 20 typical
ALPHA2	*** numeric	errors per burst in the BER range from BER_{SES} to the residual bit error rate (SDH)	1 to 10 5 typical
ALPHA3	*** numeric	errors per burst below the residual bit error rate (SDH)	1
SIGNATURE_DELAY_10-3	numeric	signature echo delay in nanoseconds for a 10^{-3} BER	6.3
SIGNATURE_WIDTH_10-3	numeric	signature bandwidth width in MHz for a 10^{-3} BER	28.0
SIGNATURE_MINPH_10-3	numeric	signature null depth for a minimum phase echo at 10^{-3} BER	23.4
SIGNATURE_NONMINPH_10-3	numeric	signature null depth for a nonminimum phase echo at 10^{-3} BER	23.4
SIGNATURE_DELAY_10-6	numeric	signature echo delay in nanoseconds for a 10^{-6} BER	6.3
SIGNATURE_WIDTH_10-6	numeric	signature bandwidth width in MHz for a 10^{-6} BER	28.3

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
SIGNATURE_MINPH_10-6	numeric	signature null depth for a minimum phase echo at 10^{-6} BER	21.7
SIGNATURE_NONMINPH_10-6	numeric	signature null depth for a nonminimum phase echo at 10^{-6} BER	21.7
SIGNATURE_DELAY_RBER	numeric	signature echo delay in nanoseconds for the residual BER	6.3
SIGNATURE_WIDTH_RBER	numeric	signature bandwidth width in MHz for the residual BER	28.7
SIGNATURE_MINPH_RBER	numeric	signature null depth for a minimum phase echo at the residual BER	19.5
SIGNATURE_NONMINPH_RBER	numeric	signature null depth for a nonminimum phase echo at the residual BER	19.5
SIGNATURE_DELAY_SES	numeric	signature echo delay in nanoseconds for the SES BER	6.3
SIGNATURE_WIDTH_SES	numeric	signature bandwidth width in MHz for the SES BER	28.0
SIGNATURE_MINPH_SES	numeric	signature null depth for a minimum phase echo at the SES BER	23.4
SIGNATURE_NONMINPH_SES	numeric	signature null depth for a nonminimum phase echo at the SES BER	23.4
DISPFM_10-3	numeric	dispersive fade margin for the 10^{-3} BER	48
DISPFM_10-6	numeric	dispersive fade margin for the 10^{-6} BER	45

Table 1: Version 4 Radio Data File Format

Mnemonic	Size	Description	Example
DISPFM_SES	numeric	dispersive fade margin for the SES BER	46.2
DISPFM_RBER	numeric	dispersive fade margin for the residual BER	43
RXTHRESH_10-3	* numeric	receive threshold level (dBm) at the 10^{-3} BER	-73.5
RXTHRESH_10-6	* numeric	receive threshold level (dBm) at the 10^{-6} BER	-70.0
RESIDUAL_BER	*** numeric	residual bit error rate	1.0E-10
RXTHRESH_RBER	*** numeric	receive threshold level (dBm) at the residual BER	-66.0
SES_BER	*** numeric	SES bit error rate	4.6E-4
RXTHRESH_SES_BER	*** numeric	receive threshold level (dBm) at the SES BER	-73.1
TtoI_	data	threshold to interference curve	
TX_EMISSION	data	transmit emission curve	
RX_SELECTIVITY	data	receive selectivity curve	
RX_FILTER	data	receive filter curve information only	
TX_FILTER	data	transmit filter curve informtion only	
IRF_	data	interference reduction factor curve. Use either T to I or IRF	

Several equipment / calculation options are included in the radio data file:

DIGRADIO_TYPE SDH - Permissible values are PDH, SDH or NB_DIGITAL(narrow band digital). These options only affect the formatting of the data entry forms in the microwave worksheet. For example, signature data or the dispersive fade margin cannot be accessed with the NB_DIGITAL radio type set.

SD_OPERATION - Permissible values are IFC for IF combining and BBS for baseband switching. This option automatically set the space diversity improvement calculation to IF combining or baseband switching. The default value is baseband switching.

COCHANNEL_OPERATION - Permissible values are YES or NO. This sets the Cochannel operation option in the Reliability Options dialog box. The default value is NO.

USE_SIGNATURE - Permissible options are YES for selective fading calculations using the equipment signature or NO to use the dispersive fade margin and dispersive fade occurrence factor. Note that this options has the effect of calculating diversity improvement is strict accordance with P.530.

The ASCII file is created by adding the entry or value after the mnemonic. Leave at least one space between the mnemonic and the entry.

- The mnemonic lines can be in any order and blank lines are allowed in the file; however the file identifier "PLW40_RADIOSPECS" must be the first entry in the file.
- If there is no entry after the mnemonic, the line is ignored. Therefore, it is not necessary to erase any unused entries.
- If a duplicate mnemonic line exists, the value of the last one in the file will be used. Frequency stability can be expressed as either a percent or in parts per million. The value used will be the last one in the file.

Modulation

The modulation is used to determine default threshold to interference curves. The format must be as follows:

[number of levels][modulation type] e.g. 64QAM

No spaces or dashes are allowed. The modulation type must be one of the following:

FSK	frequency shift keying
CPSK	coherent demodulation phase shift keying
DPSK	differential demodulation phase shift keying
QAM	quadrature amplitude modulation
QPR	quadrature partial response
TCM	trellis code modulation - this is interpreted as QAM
QPSK	quadrature phase shift keying - this is interpreted as 4DPSK
MSK	minimum shift keying - this is interpreted as 2FSK

Channel Capacity

Channel capacity is expressed in terms of the digital hierarchy, (e.g. 1DS3, 8E1).

Traffic Code

The channel capacity and modulation are combined to form a unique radio descriptor using the following format:

[channel capacity]-[modulation] e.g. 1DS3-64QAM

This identifier is used to compare the characteristics of an interfering transmitter with the receiver.

The traffic code does not appear in the radio data file as a unique entry. It is derived from the channel capacity and modulation.

In the case of analog radios, the traffic code must be specified using the format below:

[CAPACITY]-ANALOG e.g. 600CH-ANALOG

The capacity prefix (600CH) is not used.

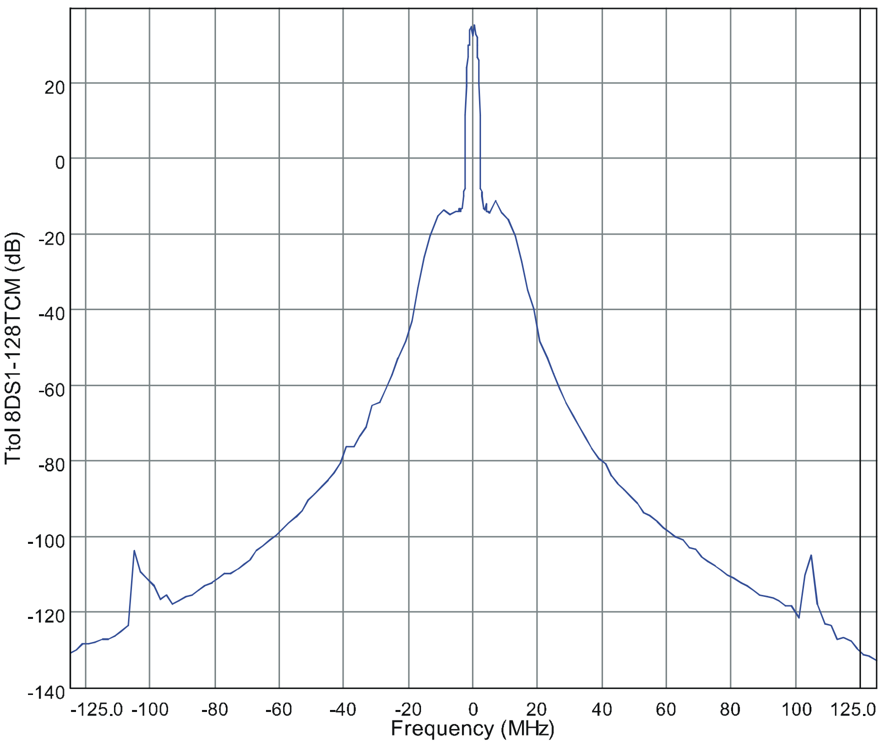
Threshold to Interference Curves

The mnemonic ToI_ indicates that T to I data follows. There can be any number of T to I curves in a radio data file. Each curve can represent the interfering effects of different transmitter modulations and channel capacities. In order to differentiate between these curves, the TtoI_ mnemonic is followed by the traffic code of the interfering transmitter.

For the special case of a T to I curve for a carrier wave interfering transmitter, the traffic code must be CW.

The number of points of data follows the mnemonic - traffic code combination. The data must be in ascending order of frequency and there must not be any duplicate frequencies or blank lines. Each line contains a frequency followed by the T to I value. The frequency must be relative to the operating frequency. The data can be symmetrical or asymmetrical. The following is an example of the data entry format of an 8DS1 receiver using 128TCM modulation interfered with by a similar radio.

```
TtoI_8DS1-128TCM 171
 -125.000  -143.6
 -123.000  -142.8
 -121.000  -141.0
     ....
   -1.000    30.0
   -.800     34.0
   -.600     35.0
   -.400     34.3
   -.200     32.4
   0.000     34.0
    .200     33.0
    .400     35.5
    .600     35.5
    .800     33.0
   1.000     33.0
     ....
  121.000  -142.9
  123.000  -143.8
  125.000  -145.1
```



The first line "TtoI_8DS1-128TCM 171" indicates that this is a T to I curve of 171 points. The interfering transmitter has the same modulation and channel capacity as the receiver.

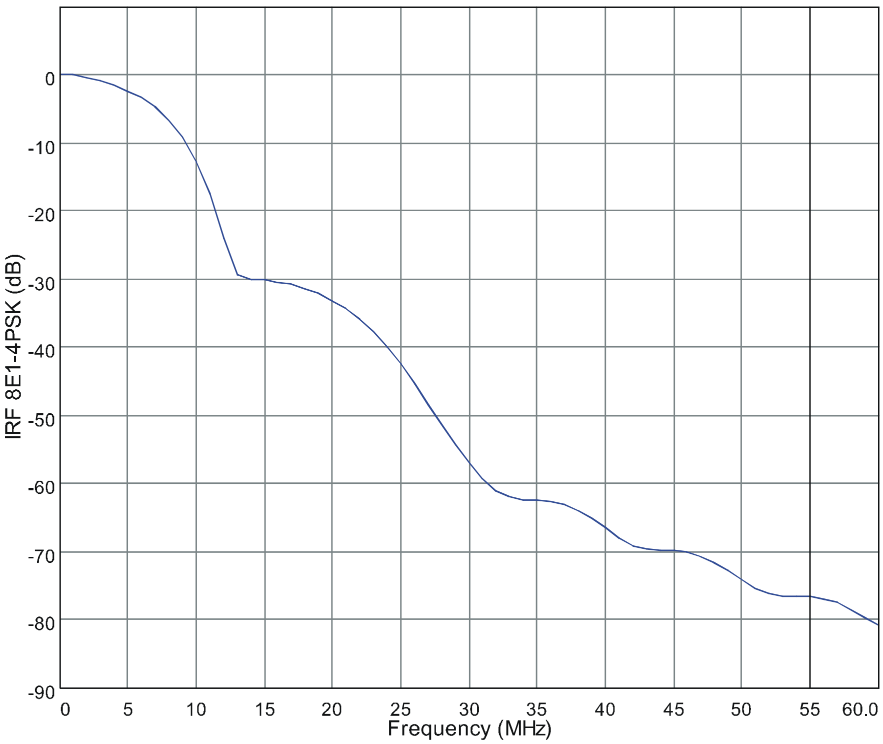
Interference Reduction Factor Curves

The mnemonic IRF_ indicates that interference reduction factor (IRF) data follows. There can be any number of IRF curves in a radio data file. Each curve can represent the interfering effects of different transmitter modulations and channel capacities. In order to differentiate between these curves, the IRF mnemonic is followed by the traffic code of the interfering transmitter.

The number of points of data follows the mnemonic - traffic code combination. The data must be in ascending order of frequency and there must not be any duplicate frequencies or blank lines. Each line contains a frequency followed by the IFR value. The frequency must be relative to the operating frequency. The data can be symmetrical or asymmetrical. The following is an example of the data entry format for a 8E1 4PSK receiver (8E1-4PSK) interfered with similar modulation:

```
IRF_8E1-4PSK                    61

      0.0          0.00
      1.0         -0.11
      2.0         -0.42
        .....
     58.0        -78.55
     59.0        -79.70
     60.0        -80.90
```



The first line "IRF_8E1-4PSK 61" indicates that this is an IRF curve of 33 points. The interfering transmitter has the same modulation and channel capacity as the receiver.

Transmitter Emission Data

The mnemonic TX_EMISSION indicates that the data for the transmitter emission spectrum follows. The absolute values of the power density or the measurement bandwidth are not important. The file conversion process will normalize the data such that the total power over the frequency band is equal to unity. The chart display of the spectrum is based on a total power of one watt and a measurement bandwidth of 4 KHz. This means that the data values in the ASCII file may not be the same as the displayed values.

The number of points follows the mnemonic TX_EMISSION on the same line. The data must be in ascending order of frequency and there must not be any duplicate frequencies or blank lines. Each line contains a frequency followed by the emission level. The frequency must be relative to the operating frequency. The data can be symmetrical or asymmetrical.

Receiver Selectivity

The mnemonic RX_SELECTIVITY indicates that the receiver selectivity data follows. This is the composite receiver selectivity including RF, IF and Nyquist filtering. Do not use RF or IF filtering alone.

The number of points follows the mnemonic RX_SELECTIVITY on the same line. The data must be in ascending order of frequency and there must not be any duplicate frequencies or blank lines. Each line contains a frequency followed by the selectivity expressed in dB. The frequency must be relative to the operating frequency. The data can be symmetrical or asymmetrical.

Default Interference Parameters

In many cases, the required T to I and TX emission curves will not be available. This section describes the techniques used to handle these situations. The analysis uses the 3 dB bandwidth of the transmit spectrum and the type of modulation. Both of these must be specified in the radio data file.

When a radio data file is generated from the user's ASCII text file, a default transmit emission mask and a default receiver selectivity mask is always created in accordance with Annex B of TIA /EIA Telecommunications Systems Bulletin TSB-10G (Interference Criteria for Microwave Systems). These masks are based on the FCC Rules and Regulations, § 101.111 - emission limitations for digital fixed point to point operation below 15 GHz as stated below:

For operating frequencies below 15 GHz, in any 4 KHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 250 percent of the authorized bandwidth: As specified by the following equation but in no event less than 50 decibels: (Attenuation greater than 80 decibels is not required.)

$$A = 35 + 0.8 \cdot (P - 50) + 10 \cdot \log_{10}(B) \tag{1}$$

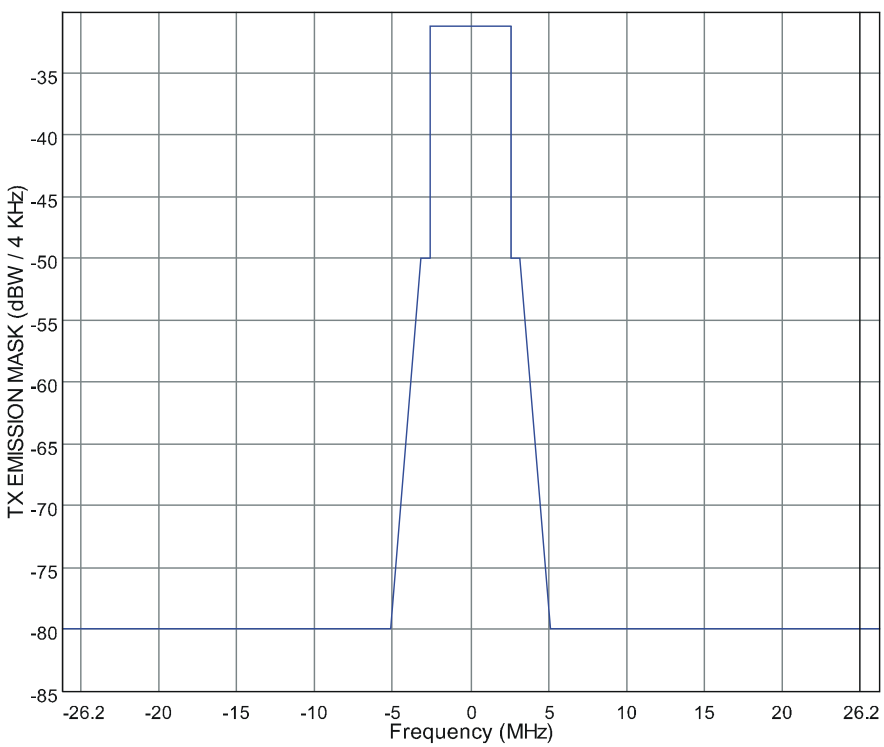
where:

A = Attenuation (in~ decibels) below the mean output power level

P = Percent removed from the carrier frequency

B = Authorized bandwidth in MHz

Default TX Emission Mask



In place of the authorized bandwidth (channel bandwidth), the 3 dB bandwidth of the transmit spectrum is used. For frequencies from 50 percent to 250 percent removed from the carrier frequency, the power spectral density of the interference follows the FCC Mask. In other words, each 4 KHz of spectrum contains -A dBW of power. To complete the definition of the default TX emission mask, the following assumptions are made:

- emission is -80 dBW/4kHz for frequencies from 250 percent to 500 percent removed from the carrier frequency
- the emission is zero for frequencies more than 500 percent removed from the carrier frequency,
- for frequencies from 0 to 50 percent removed from the carrier frequency, each 4 kHz of spectrum contains an equal amount of power such that the total power in the signal (from 0 to 500 percent removed from the carrier frequency) is 1 Watt.

The mask is generated from the following break points:

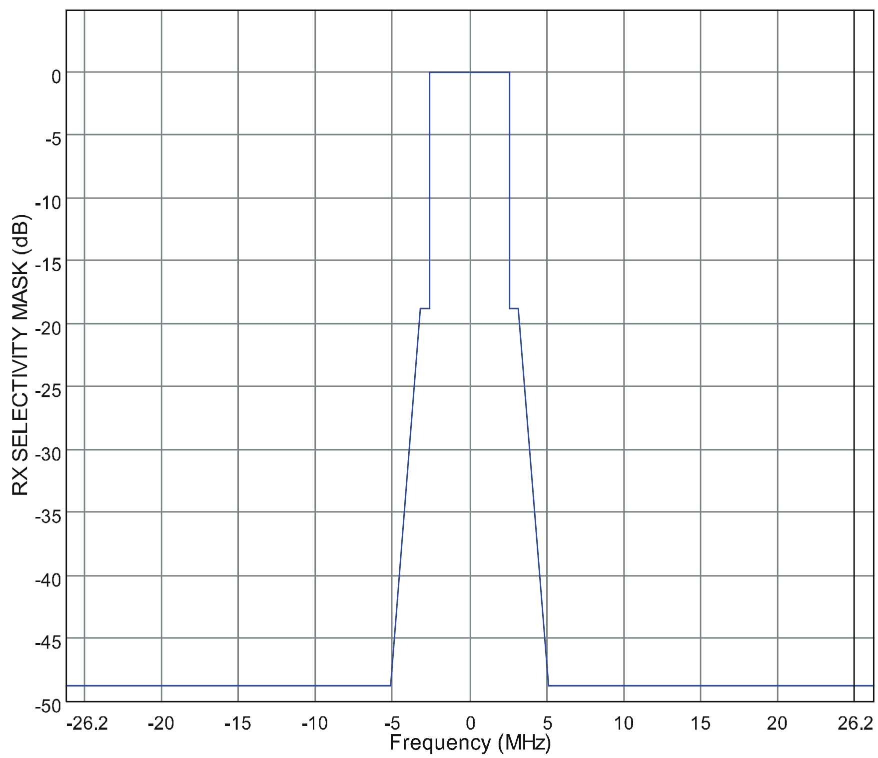
$$
\begin{aligned}
bp_1 &= 50 \\
bp_2 &= 68.75 - 12.5 \cdot \log_{10}(bw) \\
bp_3 &= 106.25 - 12.5 \cdot \log_{10}(bw) \\
bp4 &= 500 \\
&\text{where} \\
bw &= \text{transmit spectrum 3 dB bandwidth in MHz}
\end{aligned}
\tag{2}
$$

and the equations below:

$$
\begin{aligned}
& if(P \le bp_1) \\
& A = 10 \cdot \log_{10}\left(\frac{0.004}{bw}\right) \\
& if(P > bp_1) and (P \le bp_2) \\
& A = -50 \\
& if(P > bp_2) and (P \le bp_3) \\
& A = -35 - 0.8 \cdot (P - 50) - 10 \cdot \log_{10}(bw) \\
& if(P > bp_3) and (P \le bp_4) \\
& A = -80
\end{aligned}
\tag{3}
$$

Default Receiver Selectivity Mask

The default receiver selectivity mask has the identical shape as the default TX emission mask. However, it is shifted so that for frequencies from 0 to 50 percent removed from the carrier frequency, the filter attenuation is zero.



Using the ANT_RAD Utility to create Version 4 Radio Data Files

Pathloss 40 Radio data files - 6706-8.RAF

Files Equipment type Convert raf-mrs Curves Help

MANUFACT	Alcatel Network Systems	Manufacturer (char[31])
MODEL	MDR-6706-8	Radio model (char [23])
COMMENT_1	T/I Data for 6425-7125 band use	Comment (char[31])
COMMENT_2		Comment (char[31])
COMMENT_3		Comment (char[31])
COMMENT_4		Comment (char[31])
COMMENT_5		Comment (char[31])
COMMENT_6		Comment (char[31])
EMDESIG	2M50D7W	Emission designator (char[15])
RADIO_ID	JF6-9406	radio id (char[15])
MODULATION	128TCM	Modulation QPSK, 128QAM (char[7])
CAPACITY	8DS1	Capacity 4E1, 28DS1, STM1 (char[7])
DATA_RATE	12.40	Data rate Mb/s
STABILITY_PRC	1.00E-003	Frequency stability percent or
STABILITY_PPM	10.00	Frequency stability parts per million
SPECTRMBW_MHZ	2.50	3 dB spectrum bandwidth (MHz) used for default curves
CHANNELBW_MHZ		Channel bandwidth (MHz)
MAXRXSIG_10-3	-8.00	Maximum receive signal for 10-3 BER (dBm)
MAXRXSIG_10-6	-10.00	Maximum receive signal for 10-6 BER (dBm)
Ttol_COCHAN_LIKE	34.00	Threshold to interference ratio like modulation (dB)
Ttol_COCHAN_CW	33.80	Threshold to interference ratio CW modulation (dB)
TXPOWER_DBM	29.00	Transmit power (dBm)
FREQ_LO_MHZ	5850.00	Lower frequency limit (MHz)
FREQ_HI_MHZ	7125.00	Upper frequency limit (MHz)
ATPC_RANGE	10.00	Automatic TX power control range (dB)
NUM_ATPCSTEPS		Number of steps in the power control range
DIGRADIO_TYPE	PDH	PDH, SDH or NB_DIGITAL narrow band digital
SD_OPERATION	BBS	BBS or IFC baseband switch or IF combiner
COCHANNEL_OPERATION	NO	YES or NO
USE_SIGNATURE	NO	YES or NO use equipment signature
XPIF		Cochannel XPD improvement factor

The ANT_RAD utility is used to create and edit Version 4 and 5 radio data files. Select the *Equipment type - Version 4 radio data files* menu item. The data entry form uses the same mnemonics as the ASCII text file described above. A third column is provided for additional information.

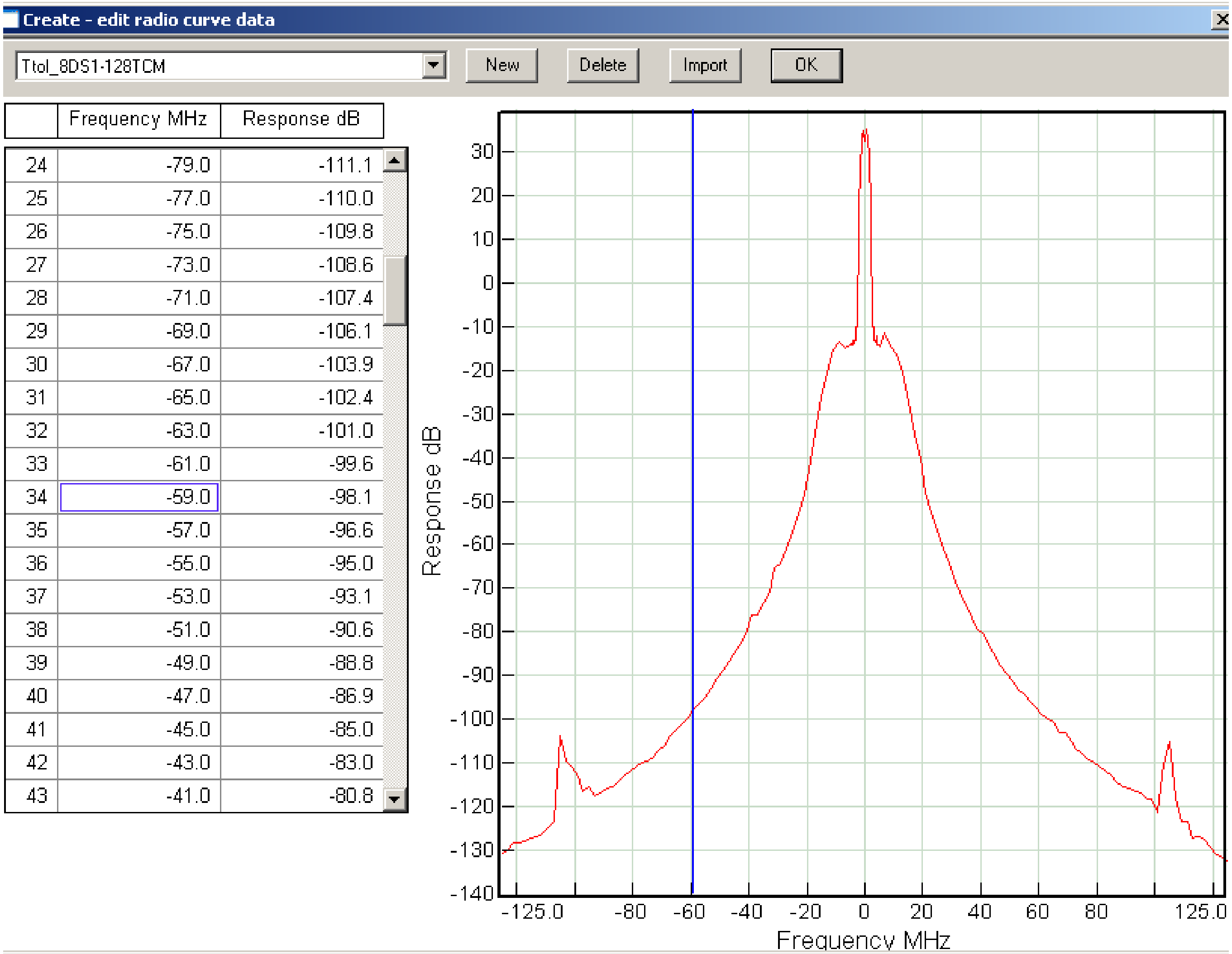
A single data entry per line is used. The Files-Open menu selection will open all radio file versions including:

- version 4 ASCII raf files
- version 5 ASCII raf files
- version 4 binary mrs microwave radio files
- version 5 binary rsd radio files

Separate file save menu items are provided for ASCII and binary formats. Both of these use the version 4 formats.

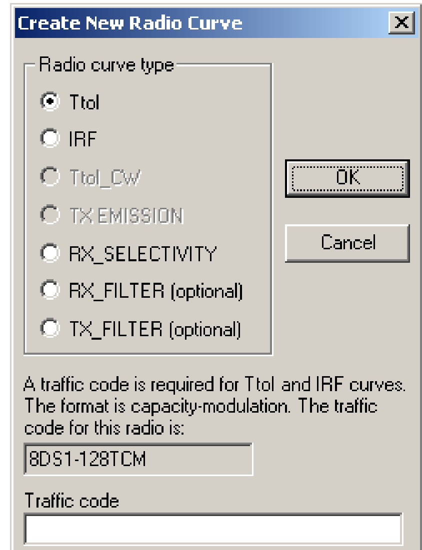
Radio Curves

Select the Curves menu item to create or edit curves. The first step is to specify the specific type of curve. Click the new button, select the curve type and click the OK button.



	Frequency MHz	Response dB
24	-79.0	-111.1
25	-77.0	-110.0
26	-75.0	-109.8
27	-73.0	-108.6
28	-71.0	-107.4
29	-69.0	-106.1
30	-67.0	-103.9
31	-65.0	-102.4
32	-63.0	-101.0
33	-61.0	-99.6
34	-59.0	-98.1
35	-57.0	-96.6
36	-55.0	-95.0
37	-53.0	-93.1
38	-51.0	-90.6
39	-49.0	-88.8
40	-47.0	-86.9
41	-45.0	-85.0
42	-43.0	-83.0
43	-41.0	-80.8

If a TtoI_Other or IRF_Other curve has been specified, then enter the name of the corresponding radio data file name. Multiple file names can be entered separated by a comma.



TtoI and IRF Interference curves

A traffic code is used to identify the characteristics of the interfering transmitter. This consists of a concatenation of the channel capacity and the modulation e.g. 8E1-QPSK. The TtoI curve of this radio would be coded as TtoI_8E1-QPSK.

Antenna Data Files

Antenna data files use and industry standard NSMA - TIA standard for ASCII antenna data files. This is the same format used in Pathloss version 4.0 for microwave and VHF-UHF antennas. Version 5.0 uses a single binary format for all application types.

File naming convention

The antenna data file name without the extension is referred to as an antenna code. This code is used as a key field in a lookup table which implies that the file names must be unique. The maximum antenna code name length is 47 characters.

File Formats

Antenna data files use the industry standard format defined by:

National Spectrum Managers Association (NSMA)
Antenna Systems
Standard Format for Digitized Antenna Patterns
Recommendation WG16.99.050

and

TELECOMMUNICATIONS INDUSTRY ASSOCIATION
Terrestrial Land Mobile Radio ---
Antenna Systems ---
Standard Format for Digitized Antenna Patterns
TIA-804-A

The two documents are essentially the same and copies of these are provided in the Pathloss program directory under Equipmnt \ Asd \ nsma wg16_99_050.pdf and tia 804-a.pdf

In addition the program also supports the older NSMA "Standard Format for Electronic Transfer of Terrestrial Antenna Pattern Data", details of which are provided later in this section.

The antenna data files must be converted to a binary format to be used in the Pathloss program. This operation is carried out in the “ant_rad.exe” utility program. The file name less the suffix is used as a unique identifier or key field in the “antenna index utility”. Therefore all antenna data files must have a unique file name. The maximum file name length not including the suffix is 48 characters. Antenna files with the same name but located in different directories cannot be used.

Version 4.0 used different binary file formats for microwave and VHF-UHF antenna data files with the file suffixes “mas” and “vas” respectively. Version 5.0 uses a single binary file for all antennas with the suffix “ads”. To accomplish this, one of the “reserved for future use” fields FIELD5 is used for the antenna technology. These technologies are loosely defined as aperture (parabolic) and dipole. The difference between the two definitions is in the antenna orientation. Aperture antennas are assumed to be oriented in both azimuth and elevation which results in zero orientation loss as the default. Dipole antenna are assumed to be oriented in azimuth only with the elevation in a horizontal plane. The program calculates the orientation loss using the vertical antenna pattern and the actual vertical angle of the signal.

All existing version 4.0 binary antenna data files can be used in the version 5.0 program without modification.

Alternate NSMA Antenna Data File Format

The file consists of ten header lines followed by the data for the various polarization combinations. There must be exactly ten lines as a blank line is interpreted as "no entry" for that field.

Line	Description	Size
1	Antenna manufacturer	[30]
2	Model number	[30]
3	Comment	[30]
4	FCC ID number	[16]
5	Reverse pattern m number	[16]
6	Date of data	[16]
7	Manufacturer ID number	[16]
8	Frequency range	[16]
9	Mid-band gain	[16]
10	Half-power beam width	[16]

The header information is followed by the polarization combination and the number of data points. This is followed by the data expressed as the angle and response. The following polarization designators are used:

HH, HV, VV, VH in the horizontal plane

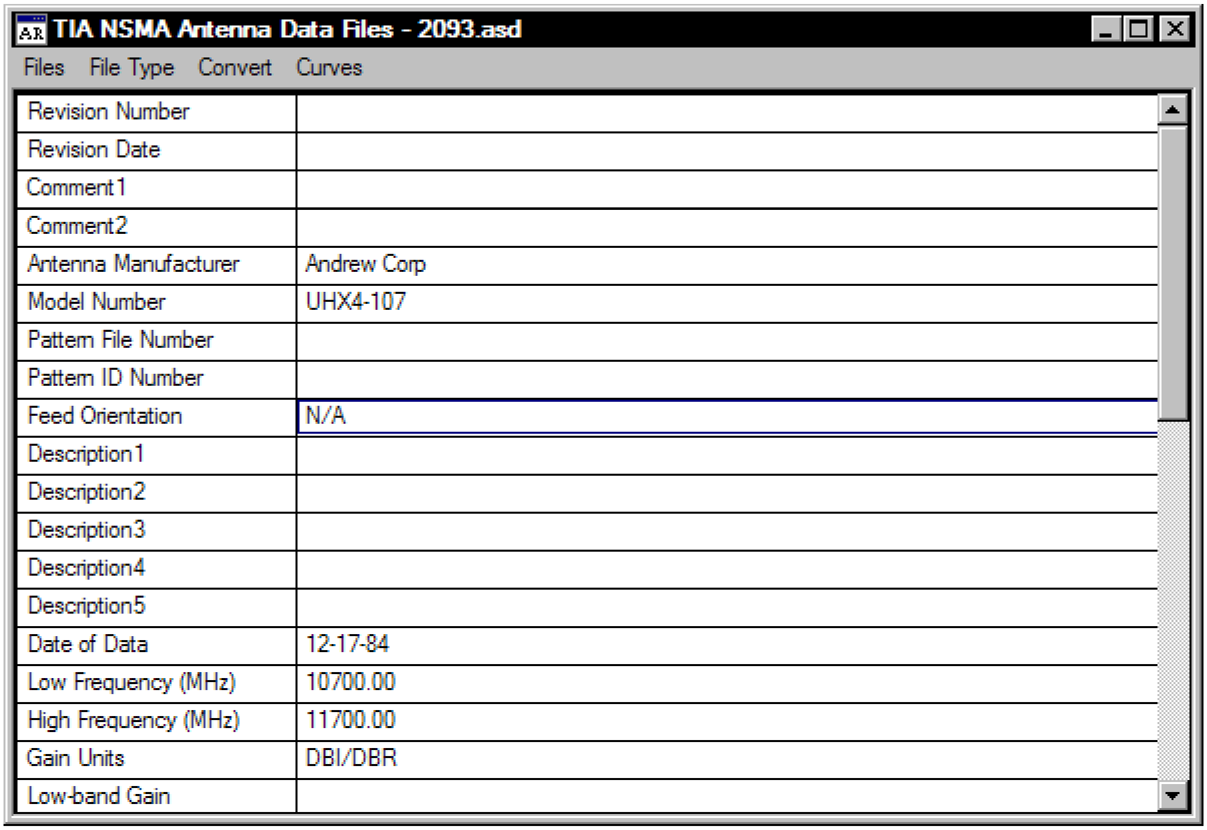
ELHH, ELHV, ELVV, ELVH in the vertical plane

The antenna response is listed as dB below the main lobe response and is a negative value. A partial example of an the antenna pattern file is shown below:

```
MARK ANTENNA PRODUCTS Inc.
MHP-100A120D
(none)
M15028
M15027
11-25-85
NONE
10700-11700 MHZ
48.4 dB
0.6 Deg
HH    39
-180  -88
-160  -88
```

↓	↓
0	0
↓	↓
160	-88
180	-88
HV	33
-180	-89
-170	-89
↓	↓
0	-36
↓	↓
170	-89
180	-89
VV	39
-180	-88
-160	-88
↓	↓
0	0
↓	↓
160	-88
180	-88
VH	33
-180	-89
-170	-89
↓	↓
0	-36
↓	↓
170	-89
180	-89
ELHH	7
-4	-36
↓	↓
0	0
↓	↓
4	-36
ELHV	11
-4.5	-63.4
↓	↓
0	-36
↓	↓
4.5	-63.4
ELVV	7
-4	-36
↓	

Using the Ant_Rad Utility to create Antenna Data Files



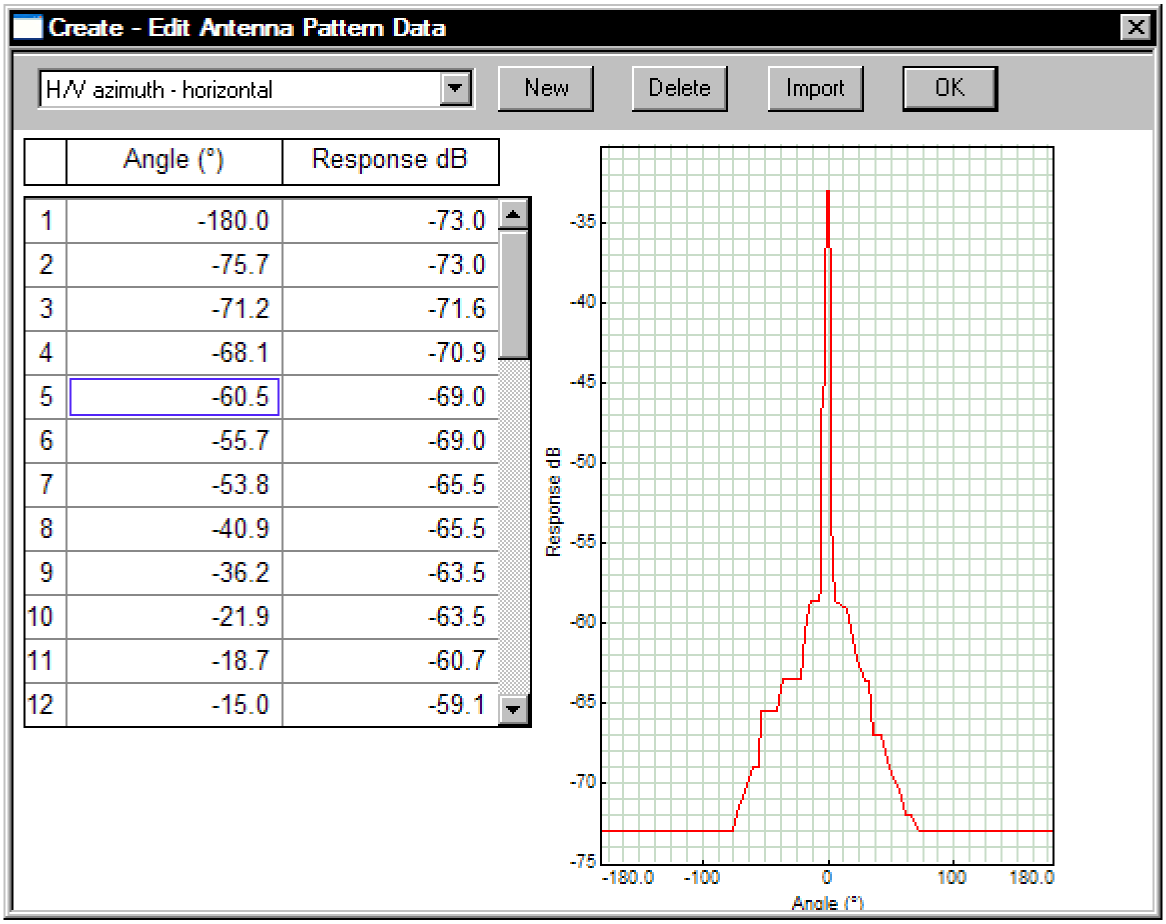
A separate utility program ant_rad.exe is used to edit, create and convert antenna data files. The program starts in the radio data files screen. Select File type - Antenna data files from the menu bar. There are several points to note in this data entry form:

- The description of the entry is used instead of the mnemonic. For example “Low-band Gain” is used instead of LWGAIN and “Azimuth Beam width (deg) is used instead of AZWIDT. The mnemonics are used in the ASCII files.
- The Revision number field (REVNUM) and the Revision date field (REVDAT) refer to revisions to the standard format. These are not used and serve only as file type identifiers
- The fields associated with antenna discrimination curves are not included in these forms. These are created - edited under the Curves section
- The Files - Open menu item opens all antenna file formats. These include the ASCII standard and the old ASCII standard, the version 4.0 binary mas and vas files and the version 5.0 asd files.
- The binary antenna data files do not contain all of the information in the ASCII file. Only the following items are included in the binary file.

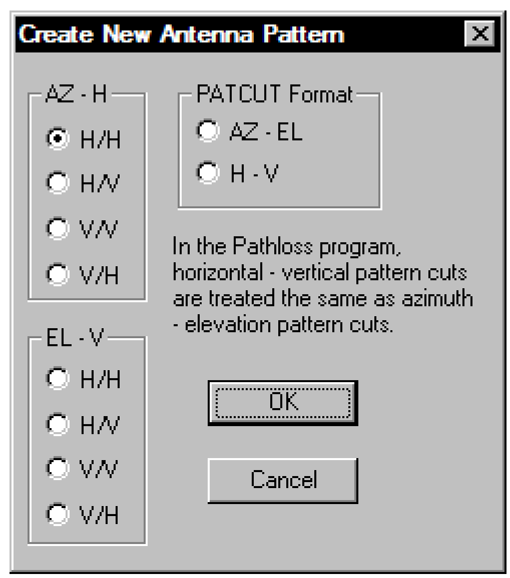
  manufacturer, model, description antenna technology, feed horn orientation and the date of the data file
  mid band gain, diameter, 3 dB beam widths, electrical downtilt, radome loss, frequency range
  the type of antenna pattern (typical or envelope) and all azimuth and elevation pattern data

- Files can be saved in the version 5.0 asd binary format or the ASCII standard format. Only the binary version can be used with the Pathloss program.

Create - Edit Antenna Pattern Data



Select Curves on the Antenna data files menu bar. The drop down list contains the names of the antenna patterns using the following naming convention:



- H/H - Horizontal polarized port response to a horizontally polarized signal
- H/V Horizontal polarized port response to a vertically polarized signal
- V/V Vertical polarized port response to a vertically polarized signal
- V/H Vertical polarized port response to a horizontally polarized signal

The above designations can be used in either the horizontal or vertical planes

The data is presented in two columns: angle followed by the antenna response.

In the horizontal plane, the angle starts from -180º (defined as the left side of the antenna) and increases to 0º on the antenna boresight. The angle then increases to +180º, thereby covering the full 360º of the antenna pattern.

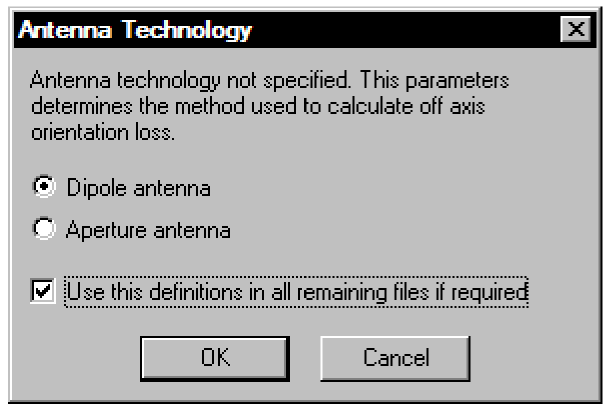
In the vertical plane, the angle starts at some negative value defined as the antenna response below the antenna boresight and increases to 0º on the antenna boresight. The angle then increases to some positive value which is above the antenna boresight. For microwave antennas the range is typically between -5º to +5º which results in a 10º range centered about the main beam. For dipole antennas, the elevation data is presented over -180º to +180º range.

The antenna response is listed as dB below the main lobe response and must be entered as a negative value.

To create a new curve, click the New button and define the type of curve. The curve data can be imported from a text file, Click the Import button and load the text file. The procedure uses the standard text import utility defined in the section on general program operation.

Note that the associated mnemonics are not used to create the antenna pattern curve. These are written to the standard ASCII file.

File Conversion ASCII ADF to binary ASD



In most cases, antenna manufacturers will supply the data files in the standard ASCII format and the ant_rad utility program will only be used to convert the files to the binary asd format.

In the case of a single file, the procedure is to open the ASCII file (Files - Open) and review the data for completeness. In particular, ensure that the antenna technology field is set and in the case of microwave antennas the antenna diameter has been entered in either the antenna width or height field.

For batch conversions, select the Convert menu item. A standard windows multi select file open dialog is used to select the required files. When the Open button is clicked a file save dialog appears. This allows the user to specify the directory to save the binary files in. The default is save the binary files in the same directory as the ASCII files. The file name in this dialog is not used. The binary file names will always be the same as the ASCII file names with the extension in a batch conversion.

If the antenna technology is not specified, the dialog on the left will appear prompting for the technology and to use this technology for all files in the conversion.