

## PowerHelp! HyperGraphic Assistance

PowerLink ver 1.0 Beta

File Configuration Utilities Help

Operating Band  
 L-Band  S-Band  C-Band  
 X-Band  Ku-Band  Ka-Band

Satellite Used  
Anik E1 Parameters  
New

Link Model  
 Simplex Link  
 Duplex Link

Base Station Info (Uplink)  
Test Base

Latitude		45° 0' 0"N	↕
Longitude		75° 0' 0"W	↕
Antenna Size (m)		9	
Antenna Tx Gain (db)		45	
Antenna Rx Gain (db)		40	
Climatic Zone (A,B,..P)		C	
Rain Level (mm/hr)		?	
SGT G/T (db/K)		30	↕

Map Load Save Print

Remote Station Info (Downlink)  
Test Remote

Latitude		50° 0' 0"N	↕
Longitude		85° 0' 0"W	↕
Antenna Size (m)		9	
Antenna Tx Gain (db)		55	
Antenna Rx Gain (db)		50	
Climatic Zone (A,B,..P)		C	
Rain Level (mm/hr)		?	
SGT G/T (db/K)		40	↕

Map Load Save Print

Link Information  
 Manual Parameters  
 Calc Effects of Rain  
Link Avail. 99.9%  
C/No Req (dB/Hz) 52  
Operating Point  
IPBO (db) 8 OPBO (db) 4

Frequencies (GHz)  
Uplink 14  
Downlink 12

Data Rate Required 10  Mbps  kbps  
Coding  Uncoded  3/4 Coded  1/2 Coded  
Modulation  BPSK  QPSK  
Bit Error Rate 10E-6

Exit Load System Save System Compute Analysis

### Main Program Help

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## PowerLink Menu Items

This section describes the various items found in PowerLink's menu bar on top of the screen.

File

Configuration

Utilities

Help

## Operating Bands

Operating Band

L-Band    S-Band    C-Band  
 X-Band    Ku-Band    Ka-Band

PowerLink covers all the major satellite communication operating band for a maximum flexibility. The frequency attribution for PowerLink is as follows:

BAND	FREQUENCY (Ghz)
L	1-2
S	2-4
C	4-6
X	8-12
Ku	12-14
K	18-27
Ka	27-40

The user can use specific uplink and downlink frequencies by selecting the "Manual Parameters" option in the main section of the program. By doing so, the numbers in the frequency box become blue, which indicates that the user can directly modify these parameters. The user can therefore manually enter the frequencies in the frequency boxes.

## Satellite Used

This section allows the user to select, edit or create a satellite data file.

Parameters - Allows the user to change various satellite parameters.

**New Satellite** - Allows the use to create a new satellite file (\*.SAT).

**Satellite Selection** - Allows the user select a satellitte data file from the satellite data bank.

## Link Model

This section allows the user to select a simplex or duplex link calculation. This parameter tells PowerLink the kind of results required by the user. This parameter will affect the link budget calculation and the analysis routines. The "DB" and "DQ" result codes will be added in a duplex analysis to identify the best Duplex BPSK or Duplex QPSK solution.

## Station Information

Base Station Information			
Base Station Name			
Latitude		0° 0' 0" N	↑
Longitude		0° 0' 0" W	
Antenna Size	(m)	0	
Antenna Tx Gain	(db)	0	
Antenna Rx Gain	(db)	0	
Humidity Factor	(1,2,3)	0	
Rain Level	(mm/hr)	0	
SGT G/T	(db/K)	0	↓

Map Load Save Print

This section of the main program allows the user to load, save or modify parameters for a ground station to be used in the link calculations.

**Load Button** - Allows the user to load a saved station file (\*.SGT)

**Save Button** - Allows the user to save the current settings in a station file (\*.SGT)

**Print Station** - Allows the user to print the current station settings.

**Map Button** - Allows the user to select the station coordinates by pointing the station location on a map. Remember that these coordinates are only APPROXIMATIONS of the actual location. The map service is provided to give the user approximate coordinates in cases where the actual location is unknown. The user can select which map is to be displayed by choosing the "Map Display" option in the configuration menu.

**Changing Station Parameters** - The user can change one or more station parameters by clicking on the station grid box. A parameter window will pop-up giving the user access to all the station parameters. Once all the changes have been made, click on the "Done" button.

## Link Information

The screenshot shows a dialog box titled "Link Information". It contains the following elements:

- A checkbox labeled "Manual Parameters" which is currently unchecked.
- A checked checkbox labeled "Calc Effects of Rain".
- A text field labeled "Link Avail." containing the value "99%", with up and down arrow buttons to its right.
- A text field labeled "C/No Req" containing the value "52.79", with a "Change" button to its right.
- A section titled "Operating Point" containing two text fields: "IPBO (db)" with the value "8" and "OPBO (db)" with the value "4".
- A large empty text area at the bottom labeled "Frequencies (GHz)".

This section of PowerLink allows the user to configure the link he requires, and provides information on the link parameters that PowerLink will use. This includes the following:

**Manual Parameters** - This check box allows the user to select a manual mode of entry for certain parameters. Depending on the required data rate, selected coding, link availability and modulation, PowerLink automatically computes the required C/No for your link. The automatic parameter selection follows the Eb/No chart provided in the Utilities menu. If the user selects the "Manual Parameters" option, he is now able to manually input the uplink frequency, downlink frequency, coding rate and Eb/No.

The screenshot shows a section with four sub-panels:

- Data Rate Required:** A text field containing "10" and two radio buttons: "Mbps" (unchecked) and "Kbps" (checked).
- Coding:** Three radio buttons: "Uncoded" (checked), "3/4 Coded" (unchecked), and "1/2 Coded" (unchecked).
- Modulation:** Two radio buttons: "BPSK" (checked) and "QPSK" (unchecked).
- Bit Error Rate:** A text field containing "10E-7" with up and down arrow buttons to its right.

**Change Button** - This option is only available when the Manual Parameters option is selected. The user is then able to enter a desired data rate, Eb/No, equipment imperfection (NOT A LINK MARGIN), and FEC coding rate.

**Calculate Effects of Rain** - This check box enables the user to determine if the effects of rain will be included in the rain calculations. If this option is disabled, the link availability box will no longer be accessible, and rain attenuations and thermal noise increase will have a zero value in the detailed link results.

**C/No Required** - This read-only box shows the threshold C/No required by the system to sustain the user's defined link.

**Transponder Operating Point** - These values show the operating point of the satellite amplifier.



**These values vary weather the satellite uses a Solid-State Power Amplifier (SSPA), Travelling Wave Tube Amplifier (TWTA), or a Klystron Power Amplifier (KPA). Knowledge of these parameters is essential in order to compute acceptable input and output back-offs (IPBO,OPBO). The values for the operating point can be modified in the "Satellite Parameters" function. Each frequency band has a specific transponder operating point.**

## **Data Rate Required**

**This parameter is the actual required information data rate to be communicated. This parameter should not include redundant bits added from FEC coding. This parameter directly affects C/No required and transponder bandwidth requirements. Due to frequency jitter, modulation ripples and other parameters, the equivalence ratio for PowerLink is preset at 1.4 Hz per bit per second (bps). This factor is used in the computation of the total bandwidth requirement.**

## Coding

Forward Error Correction (FEC) coding allows the user to add redundant information to the transferred data. This additional information is used to increase the probability of error detection or correction at the receive site. This entails that a same bit error rate performance can be achieved using less power. Although power requirements are reduced, the added redundant information increase the bandwidth of the signal, increasing the transponder bandwidth requirement.

In automatic mode, the user can choose one of three FEC coding modes: uncoded, 1/2 coded, and 3/4 coded. In "manual parameters" mode, the user must enter the FEC coding rate as a fraction, and the associated Eb/No for the desired bit error rate (BER). The automatic parameters used by PowerLink can be retrieved by consulting the Eb/No chart in the "Utilities" menu.

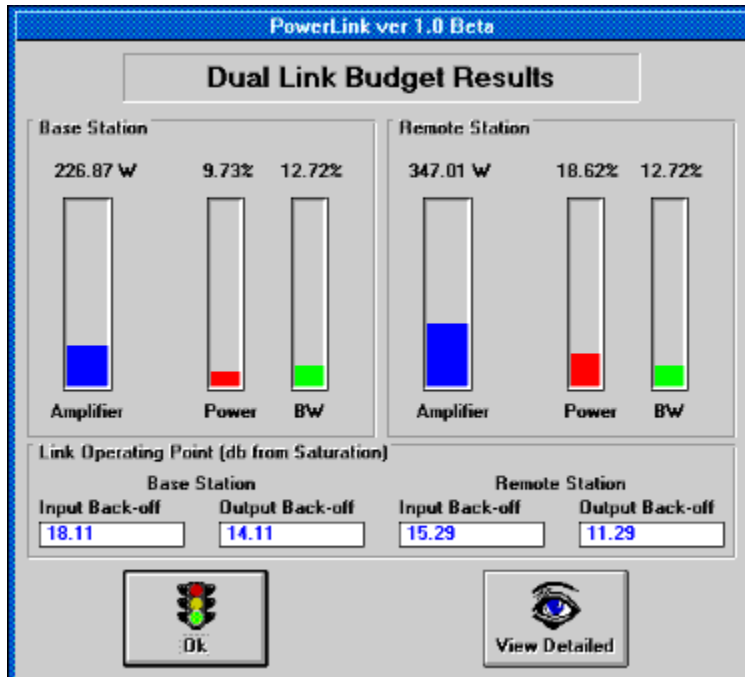
## **Modulation**

The modulation technique used by PowerLink is limited to Binary Phase Shift Keying (BPSK) and Quaternary Phase Shift Keying (QPSK). In manual mode, BPSK modulation is assumed. No other modulation scheme is presently supported by PowerLink.

## Bit Error Rate

The bit error rate (BER) figure describes the rate of transmission errors that will not be detected at the receiving end. The value is expressed in factors of 10. For example, a BER of  $10^{-6}$  means that no more than 1 bit per 1 000 000 bits will go undetected. This parameter is set by the user and is usually part of any link requirement. A standard of  $10^{-6}$  is usually an accepted standard.

## Compute A Link Budget



This option allows the user to compute a single link budget from the station, satellite and link parameters entered. The following information is directly provided:

**Amplifier Requirements** - This parameter defines the point of operation of the transmit station's power amplifier. This is particularly important in choosing appropriate satcom equipment.

**Transponder Requirements** - This section is divided in two sections: power and bandwidth. these parameters describe the bandwidth and power requirements at the satellite transponder in order to sustain the required link.

**Bandwidth Requirement** - This parameter is given as a percentage figure relatively to the total useable bandwidth of the satellite transponder.

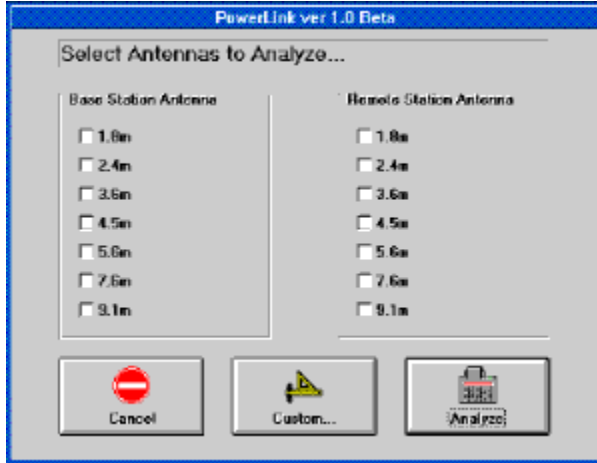
**Power Requirement** - This parameter is given under two formats: as a satellite input and output back-off, or as a percentage figure of total useable power at the satellite transponder. This percentage figure is calculated in relation with the transponder operating point.

**View Detailed** - This option gives the user detailed information on the various link parameters, calculated values and end results. This feature is particularly important for link engineers. This detailed display can easily be printed out by choosing the "Print Detailed" option.

**Back-Offs** - This displays the IPBO and OPBO FROM SATURATION for the required link. The calculations for the percentages is done from the satellite amplifier operating point.

## Analysis Routines

This portion of the program is specific to PowerLink. It allows the user to run an automated series of link budget in order to determine the best antenna combination for a given system.



PowerLink will use the antennas selected by the user to run a series of link budgets using the three preset FEC coding rates and the two modulation schemes for each antenna combination. The results of these calculations are then displayed in a graphical and tabular format. The best BPSK solution is identified with a "B" in the code column, and the best QPSK solution is identified by a "Q". When a duplex link mode is selected, the overall best solution is identified with "DB" and "DQ" for duplex BPSK and QPSK.

Code	Antenna Combination	Coding	% Power	% BW BPSK	% BW QPSK	Pwr Req	
1 B	2.4m to 2.4m	Uncoded	34.45%	38.18%	19.09%	475.71 W	
	2.4m to 2.4m	3/4 Coded	11.69%	50.9%	25.45%	161.4 W	
	2.4m to 2.4m	1/2 Coded	9.7%	76.36%	38.18%	133.98 W	
2 Q	2.4m to 3.6m	Uncoded	18.96%	38.18%	19.09%	261.77 W	
	2.4m to 3.6m	3/4 Coded	6.41%	50.9%	25.45%	88.58 W	
	2.4m to 3.6m	1/2 Coded	5.35%	76.36%	38.18%	73.91 W	
3	2.4m to 4.5m	Uncoded	fail	38.18%	19.09%	fail	
	2.4m to 4.5m	3/4 Coded	51.98%	50.9%	25.45%	717.65 W	

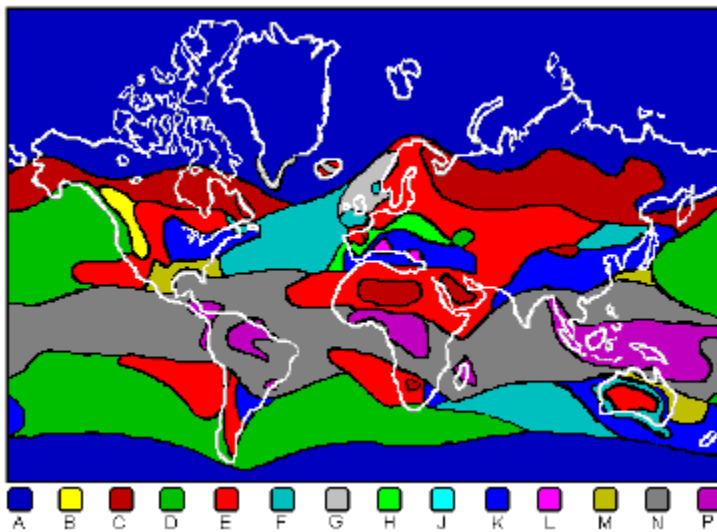
PowerLink uses a standard set of antenna values for the analysis routines. The values for C-band and Ku-band antennas are given as per Andrew Canada catalog #35. Values for antenna at L,S,X and Ka-band were extrapolated from the C and Ku-band data using PowerLink's own antenna gain determination utility. These values are approximations only! The user is cautioned as to the exactitude of these values.

The antenna parameters can be modified directly from PowerLink by using the "Custom" button. By saving the new values as "default", the user OVERWRITES the previous data file.

## Rain Model

PowerLink uses the CRANE model to compute increase in thermal noise at the receive station, and uplink and downlink rain attenuation. A Climatic Zone map is included in the Utilities menu to determine sustained rain levels at specific location. These rain levels are computed from the climatic zone code and required link availability selected by the user. Rain levels can be imputed manually by choosing "Use User's Rain Rates" in the Configuration menu.

**Availability** - The required link availability directly computes the rain levels to be used in the link calculations. While in "User's Rain Rates", PowerLink reverses the process by calculating the link availability from the given rain rates. The rain rates are determined using CCIR standard precipitation charts.





## **How To Register This Copy Of PowerLink**

**PowerLink is distributed by ERE Info Corporation. For registration information, please call (418) 648-6299.**

**To register PowerLink, choose the "Register" option at the start of the program. Enter your name AS IT APPEARS ON YOUR REGISTRATION FORM. Please note that the program is caps sensitive. Enter the registration code given on your registration form by clicking on the corresponding numbers on the validation grid. Once all the information is entered, click the "done" button to complete the registration. From then on, the "analysis" option will be available, and the "annoyance factor" interlude will be removed.**

## **The Origin of PowerLink**

**PowerLink was originally developed by Pegasus Engineering for the Department of National Defence of Canada in response to a lack of an adequate tool to perform satellite link calculations.**

**Over 1000 hours of work, 143 recompiled beta versions, 23 bugfixes and 300 diet cola cans came into the conception of this program.**

**PowerLink was developed in the spirit of "user-friendliness" for satcom engineers. It is a well known fact that each engineering firm usually has their own "in-house" link budget program, made by some link guru who is usually the only one to truly understand his program. These software usually offer a disappointing user interface and lack in flexibility and output quality. PowerLink offers an easy to use interface with a maximum built in flexibility. PowerLink also offers "Report-Ready" outputs in a tabular or graphical format. Small things that make a big difference.**

**PowerLink was developed to meet YOUR needs.**

## PowerLink Customer Support

There are many ways to get support for PowerLink. First and foremost, ERE Info Corporation can answer questions that you may have that this help file might not have covered.

**ERE Info Corporation** - (418) 648-6299

You can also contact Pegasus Engineering to get engineering information on how PowerLink works, as long as these questions do not jeopardize the intellectual property of PowerLink.

**Pegasus Engineering:**

Internet: [benoit.durand@synapse.org](mailto:benoit.durand@synapse.org)

Compuserve: 74140,3534

Please report any anomalies to ERE Info Corporation. If there is a problem, we will correct the situation and send you an updated package at no extra charge.

## File

The file section allows the user to perform basic I/O functions.

**Open Base Station** - Allows the user to open a station file (\*.SGT) as the base station to use for the link calculations.

**Open Remote Station** - Performs the same task as Open Base Station but uses the station file as the remote station to be used in the link calculations.

**Open a Complete System** - Allows the user to open a save system. Unlike a station file, a system file contains the data for both stations, the link parameters and satellite used.

**Save Base Station** - Saves the current setting of the base station in a station file.

**Save Remote Station** - Save the current settings of the remote station in a station file.

**Save a Complete System** - Saves the current system to a \*.SST file.

**Print System information** - prints out the various parameters for the base station, remote station, satellite parameters and required link information. This information is printed in "Report-Ready" format.

**Exit** - Exits PowerLink and returns the user to the Windows environment.

## Configuration

This menu allows the user to set operating parameters of PowerLink.

**Map Display** - This menu allows the user to select which map should be displayed when the "Map" button is pressed in the station information section. PowerLink comes with two standard maps: Canada and United States. Other map display are available through ERE Info Corp.

**Rain Rate Determination** - This option allows the user to decide which parameter to use in the rain attenuation calculations. By choosing "Use Standard Rain Rates from Selected Availability", PowerLink will compute the rain level that the link must sustain in order to meet the availability selected by the user. These rain levels are computed from the climatic region entered for a specific site and the link availability. The user can also enter his/her own rain rates by selecting "Use User's Rain Rates". By selecting this option, PowerLink assumes that the user has a good knowledge of the climatic zone where the station is located and that the value entered will meet the user's required availability.

**Load Stations at Start** - Tells PowerLink to load the stations saved in the configuration file the next time PowerLink is loaded. If you wish for the current stations to be loaded, you must save your current configuration.

**Save Configuration** - This option will save the settings of "Map Display", "Rain Rate Determination", "Operating Band" and "Satellite Used". This is done in order to provide the user with a personalized interface.

## Utilities

This section of PowerLink offers additional satellite communication utilities.

**Determine Antenna Gains** - This section allows the user to compute the approximate transmit and receive gains of an antenna given its diameter and efficiency, or to find the tx and rx gains at a certain operating band given gains at a different band. Please note these results are relatively accurate, but remain approximations. They are provided for engineers who wish to work in a less common operating band (L,S,X or Ka), and are not provided with antenna parameters.

**Antenna Gain Determination**

Antenna Information

Antenna Size (m) Efficiency (%) Uplink Gain (db) Downlink Gain (db)

Operating Band

L-Band  X-Band

S-Band  Ku-Band

C-Band  Ka-Band

Manual Frequency

Frequencies

Uplink (GHz) Downlink (GHz)

14 12

Gain at Other Frequency

Gain Frequency

Tx Gain (db) Uplink (GHz)

0 14

Rx Gain (db) Downlink (GHz)

0 12

Find Gain Given Gain at Another Frequency

Find Gain Given The Efficiency of an Antenna

Done Compute


**Standard Eb/No Curves** - These curves are provided as reference only. Values extrapolated from the practical curve are used by PowerLink in automatic mode. These curves are the typical curves for a NEC IDR/IBS modem.


**Pointing Information** - This option provides Azimuth, Elevation and Polarization (for linear systems). Feed polarization information may vary by a factor of 90° depending on the polarization used by the user's system. PowerLink gives a reference rotation factor from which the feed polarization can be derived.

**PowerLink Pointing Information**

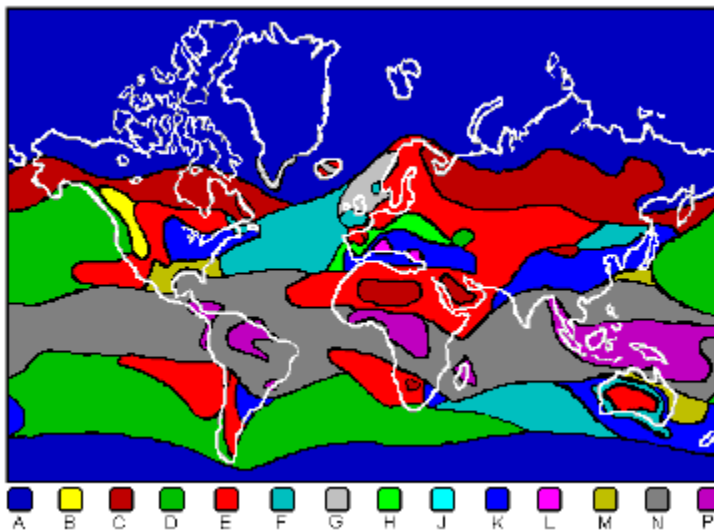
Pointing Information to Test Satellite from:

<p><b>Azimuth</b>  <input style="width: 90%;" type="text" value="90 * True"/></p> <p><b>Elevation</b>  <input style="width: 90%;" type="text" value="-28.72 *"/></p> <p><b>Polarization</b>  <input style="width: 90%;" type="text" value="89.99 * Clockwise"/></p>	<p><b>Azimuth</b>  <input style="width: 90%;" type="text" value="90 * True"/></p> <p><b>Elevation</b>  <input style="width: 90%;" type="text" value="-28.72 *"/></p> <p><b>Polarization</b>  <input style="width: 90%;" type="text" value="89.99 * Clockwise"/></p>
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**Climatic Zone Map** - This option allows the user to determine the climatic zone to use for the rain rate determination of a station. By clicking at a specific location on the map, PowerLink will describe the selected region. Unlike "Map Display", this parameter is not automatically routed to the station parameters section.



## Help

What are you doing here?!? It should be easy enough for you to navigate through the topics without needing help on help! What's next? Help on Help on Help? Sheesh! Get outa here! <GRIN FROM THE PROGRAMMER>



## Parameters

The satellite parameter section allows the user to change the various satellite parameters used in the link calculations. The user can create, modify or save these parameters in a satellite data file (\*.SAT).

**Change Satellite Parameters**

Satellite Name: Empty - Ku-Band

Satellite Category: none

Satellite Filename: test.SAT

Operating Band:  L-Band  X-Band  Ku-Band  S-Band  C-Band  Ka-Band

Satellite Location: Deg: 111, Min: 6, Sec: 0, Quad: W

Transponder Bandwidth (MHz): 22

Satellite Amplifier Operating Point: IPBO (dB): 8, OPBO (dB): 4

Satellite Transmission Parameters:

**Uplink Parameters:**

HPA Intermodulation (Base): Use  102 (dB-Hz)

Adjacent Satellite Interference: Use  107 (dB-Hz)

Cross-Polarization Interference: Use  105 (dB-Hz)

**Downlink Parameters:**

Adjacent RF Channel Interference: Use  110 (dB-Hz)

Adjacent Satellite Interference: Use  5 (dB-Hz) +  $G_{rx}$  +  $EIRP_{sat}$

Cross-Polarization Interference: Use  103 (dB-Hz)

Buttons: Restore Defaults, Done, Save As Default

**Operating Band** - This section allows the user to modify satellite parameters in the various band of operations. The band selection in this mode does not affect the selected band in the main program. It only allows the user to navigate within the satellite data file in order to modify the various parameters.

**Satellite Location** - This tells PowerLink the location of the satellite to be used.

**Satellite Name** - Each satellite can be individually named in each band. It is recommended that the nomenclature "Skynet C-Band" or "GStar Ku-band" be used to identify both the satellite and the operating band.

**Satellite Category** - This text box, like "Satellite Name" gives additional information on the satellite system. Typical values for this field would be "military", "commercial", "private", etc. It is only used for informational purposes.

**Satellite Transponder Bandwidth** - This figure should represent the total useable bandwidth of the transponder used. This parameter is used in determining bandwidth requirements. If the required link requires a bandwidth greater than the total useable bandwidth of the transponder, the link will be considered as exceeding the satellite's capabilities.

**Satellite Amplifier Operating Point** - These values represent the operating point of the amplifier used by the satellite transponder. This operating point is then considered as the 100% power value for this transponder. The values are entered as input back-off (IPBO) and output back-off (OPBO) in db. If a link requires an OPBO smaller than the amplifier's OPBO, the link will be considered as exceeding the satellite's capabilities.

**Satellite Transmission Parameters** - These parameters are satellite specific and describe the level of various interference sources. These values can be ignored by removing the check mark

beside a specific parameter. By saving the satellite data file, PowerLink saves the setting of these check boxes as well.

**Restore Defaults** - This option will restore the saved values for the satellite file in use.

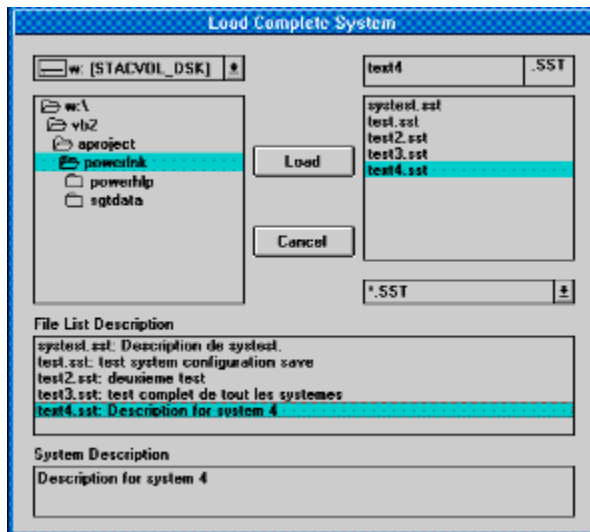
**Save** - Saves the satellite parameters to the satellite file.

## Changing Station Parameters

<b>Satellite Name</b> Empty - Ku-Band	<b>Operating Band</b> <input type="radio"/> L-Band <input type="radio"/> X-Band <input type="radio"/> S-Band <input checked="" type="radio"/> Ku-Band <input type="radio"/> C-Band <input type="radio"/> Ka-Band	<b>Satellite Location</b>			
<b>Satellite Category</b> none	<b>Transponder</b>	<b>Deg</b>	<b>Min</b>	<b>Sec</b>	<b>Quad</b>
<b>Satellite Filename</b> test.SAT	<b>Bandwidth (MHz)</b> 22	111	6	0	W
		<b>Satellite Amplifier Operating Point</b>			
		<b>IPBO (db)</b> 8	<b>OPBO (db)</b> 4		

This section allows the user to Change one or all the station parameters. Press the "Done" button when all the changes are completed

## System Load and Save



Allows the user to save or load the current satellite, stations and link parameters settings into a system (\*.SST) file. In "Save" mode, the user **MUST** enter a brief description of the system file save. This is required in order to quickly locate system files when loading them.

