NESIC CAIRO OFFICE

DESCRIPTION ON HOW TO USE PATHLOSS SOFTWARE AS A COMPLETE MICROWAVE SYSTEM PLANNER

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1- Required Software

1.2- Necessary Data for Microwave Network Design & How to place it in your PATHLOSS Program

The followings data must be placed in PATHLOSS program folder to be able to use the program as a full Microwave system Planner

1- Rain File

- 2- Equipment File
- 3- Gopo30303 (Terrain Data File)



Fig. 1.2.1

How to place those data? & what must it contents

1- Rain files

This folder contents Rain data for each area of the world according to 4 standards (Canada, Crane, Crane_96 & ITU) as shown in Fig. 1.2.2 Usually we work according to ITU standard (ITU-R-P.530-7/8) which contents Rain Data for each area of the world according to the map shown in Fig. 1.2.3

THIS DATA WILL AUTOMATICALLY PLACED IN PATHLOSS FOLDER AFTER PROGRAM SET UP

EXPLANATION ABOUT HOW TO USE THIS DATA WILL COME IN (2.5 LINK BUDGET CALCULATIONS)



Fig. 1.2.2



Fig. 1.2.3

2- Equipment

This folder contents 4 folders but for our Microwave design we just use 2 folders as the followings

- 1- MAS which contents Microwave Antenna Data for different Antenna Manufacturer (Andrew , RFS , ERICSSON ,) as shown in Fig. 1.2.4
- 2- MRS which contents Microwave Radio Data for different Manufacturers

NOTE: We just concern of NEC Equipment which is not included with our PATHLOSS software.

NEC data will be attached with this documents as Soft copy so please kindly place it in your PATHLOSS folder (inside MRS folder) to be used As shown in Fig. 1.2.5

NOTE: EQUIPMENT FOLDER IS AVAILABLE ON PATHLOSS PROGRAM CD. SO PLEASE KINDLY COPY TO YOUR PATHLOSS FOLDER

EXPLANATION ABOUT HOW TO USE THIS DATA WILL COME IN (2.5 LINK BUDGET CALCULATIONS)

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Microwave Workshee	How to use PATHLOS	MAS	EN 🖮 🙎	n (16:23)

Fig. 1.2.4



Fig. 1.2.5

3- Gopo30303 (Terrain Data File)

This folder contents the Terrain data for all the world but this data is very big size so it will be better if you take only some areas where you expected to do your survey as shown in Fig. 1.2.6

WARNING

This data is not accurate so we usually get terrain data from contours maps or from path survey. Just we use this data for reference So it isn't allowed to use this data to create path profile

How to set this data?

- 1- Create new folder in your PATHLOSS folder & name it as Gopo30303
- 2- Copy inside it the necessary area files (each area has 2 files)
- 3- Run pathloss program
- 4- Go to configure menu & click terrain database as shown in fig. 1.2.7
- 5- Set Primary (No Selection) & Secondary (GTopo30 Global 30sec) as shown in Fig. 1.2.8
- 6- Click Set Up Secondary Set Directory choose Gtopo30303 folder then kick
 OK click Close click OK as shown in Fig.1.2.9



Fig. 1.2.6



Fig. 1.2.7





Darke 1800 228.0 Config GTopo30 (EIRP (UDIII) RX signal (dBm) ilobal 30 sec	-26.83
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Fig. 1.2.9

2- How to operate PATHLOSS

PATHLOSS program is full Microwave Network design software. For our work we shall use PATHLOSS for the following

- a) Make Network Configuration
- b) Make Path Profile to find antenna height in each station
- c) Calculate Link Budget to find Antenna diameters , RX level & Link Availability
- d) Frequency Plan for overall network
- e) Frequency Interference calculations for overall network

To do all the above we shall go as the followings step by step

2.1- Sites Data Entry & Creation of Network

To enter sites data to PATHLOSS program please follow the following steps

2.1.1- Run PATHLOSS & go to <mark>Module</mark> & Click <mark>Network</mark> or just Press <mark>Ctrl N</mark> to go to Network screen as per shown in Fig. 2.1.1

🎏 Pa	athloss 4.0				
Files	Module Configure Equipmen	t SDB Application Rep	ort Help		
	✓ Summary Ctrl U	Site 1	Site 2		
	Antenna Heights Ctrl A			Operator Code	
	Worksheets Ctrl W			Radio model	
	Diffraction Ctrl D			Code	
	Reflections Ctrl R Multipath Ctrl M			Emission designator	
	Print Profile Ctrl P			Traffic code	
	Network Ctrl N			TX power (dBm)	
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Fig. 2.1.1

2.1.2- In Network screen Click on Site Data & choose Site List as shown in Fig. 2.1.2



2.1.3- In Site List Page Click on Edit then Add as shown in Fig. 2.1.3

🎦 Network

🚵 Site List									\times
Import Edit U	pdate Files Repor	ts Mark Site Tra	nsform Coords.	Help		1			
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Fig. 2.1.3

2.1.4- Inter Site Name, Call Sign (Station ID. This is important for Frequency Interference calculations. So if there is not Station ID you can give numbers for each station as Example 1, 2, 3,...), Latitude & Longitude then click OK as shown in Fig. 2.1.4

Network											
iles Module	Configure	Print Defau	ilts Site Data Li	ayers Map Refere	ence Interferenc	:e Help					
		te List									
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Fig. 2.1.4

2.1.5- Repeat steps 2.1.3 & 2.1.4 to enter other sites data then close Site List Page. Then you get Map grid with locations, Names of the entered sites data as shown in Fig. 2.15



2.1.6- Connect between stations according to actual links configuration by press & drag from site to opposite site as shown in Fig. 2.1.6 Then repeat the above to connect all the links



Fig. 2.1.6 2.1.7- Save this network in pre prepared folder

2.2- Link by Link PATHLOSS Files Creation

After we finished of all sites data entry & making the link connections correct according to actual links configuration we have to go through link by link & create its pathloss file as the followings

2.2.1- Press on the link & click Summary as per shown in Fig. 2.2.1

2.2.2- In Summary Page Inter the design frequency band as shown in Fig. 2.2.2

2.2.3- Save this file in the same folder you saved the network

2.2.4- Repeat the above for the other links



Fig. 2.2.1



Fig. 2.2.2

2.3- Terrain Data & Obstruction Entry

This Terrain Data should be got from accurate Contour Map or from Actual Path Survey. Actual Obstruction Location, Height & Type should be get from Path Survey

How to enter Terrain Data & Obstruction?

2.3.1- Go to Terrain Data Page from Module Menu. Or by Pressing ctrl T

2.3.2- Enter you Terrain data according to Map Scale as shown in Fig. 2.3.2



2.3.3- Enter Obstructers by clicking on Structure position. Then choose structure type (Tree, Building or Water Tower). Enter this structure height in meters as per shown in Fig. 2.3.3

2.3.4- Repeat the above for the other obstacles



Fig. 2.3.3

2.4- Finding Suitable Antenna Heights

After we entered Terrain Data & Obstacles Heights we have to find the suitable Antenna heights in each sites to grantee clear Line Of Sight (LOS) as the following steps

2.4.1- Go to Antenna Height page from Modules menu or by pressing ctrl A as shown in Fig. 2.4.1

	errain Data										
Files	Module Configure	Coordinate	operations	Convert Report	Help						
	Summary	Ctrl U	Elev	Structure	Hght	Ground					
1	 Ferrain Data Antenna Heights 	CtrLA	211.6			Average	~				
1 1	Worksheets	Ctrl W	212.0			Average					
1	Diffraction	Ctrl D	212.5	Building	15	Average					
1	Reflections	Ctrl R	212.9			Average					
	Multipath Print Profile	Ctrl M	212.6			Average					
2	Network	Ctrl N	212.2			Average					
2	Map Grid	Ctrl G	211.0			Average					
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Fig. 2.4.1 2.4.2- In Antenna Height page click on Optimize to get optimize antenna height for reference only as shown in Fig. 2.4.2



Fig. 2.4.2

2.4.3- The above Antenna is only for reference while the final antenna height will be decided according to the actual tower conditions & space availability

2.4.4- Go to Summary page & enter antenna heights which you think it will have clear LOS according to your path survey (mirror test or any other physical check) as shown in fig. 2.4.3

2.4.5- Go to **Print Profile** page from **Module** menu or by pressing **ctrl P** to confirm that link Fresnel zone has clear LOS above obstacles as shown in Fig. 2.4.5

2.4.6- If antennas heights which you entered still low to get clear LOS. Increase antenna height again according to available tower height till you get clear LOS with enough margin above obstacles



Fig. 2.4.3



Fig. 2.4.5

2.5- Link Budget Calculations

After we already decided antenna heights for each link we should calculate link budget for each link to find antenna diameter, link RX & Availability as the following steps

2.5.1- Go to Worksheets from Modules menu or by pressing ctrl W. you get work sheet page as shown in Fig. 2.5.1



Fig. 2.5.1

2.5.2- Enter Point frequency & polarization at each site by pressing on Ch. Then click OK As shown in Fig. 2.5.1 & 2.5.2

Files Module Configure Operation	; Templ	late Report Hel	p									
[¶-					d		8					
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Fig. 2.5.2

2.5.3- Select Radio Equipment type by clicking on **TR** you will get Radio Equipment page as shown in Fig. 2.5.3

📅 Microwave Worksheet						🔳 🗗 🔀
Files Module Configure Operations	Template Report Help					
4	Radio Equipment					
r V1	OK Cancel Lookup C	ode Index View BER	Help			· ال
			Vika Sr	iuri	Nangoli	
		Badio model	1			
		Traffic code				
211.00	E	mission designator				
210.95		Code				
210.90		TX power (watts)				
210.86		TX power (dBm)				
Ch. 210.80 0 0.5	F	X threshold criteria				4.0 4.64 Ch.
	RX thr	reshold level (dBm)				
Free s	Maximum re	ceive signal (dBm)				
Atmospheric abso	RX Thresho	old BER 10-6 (dBm)				
Ne	Т	to I Cochannel (dB)				
P	t S	Signature delay (ns)				
Thermal fa	Sig	gnature width (MHz)				
Worst mont	l Signature de	epth min phase (dB)				
	Signature depth	nonmin phase (dB)				
Annua	Vika Spuri Radio m	odel :				
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Vika Spuri						kmm ITHE P 530.7/8 TB.TB Y Nangoli
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Fig. 2.5.3

2.5.4- click on Code Index then New Index. Go to your pathloss folder – Equipment – MRS – NEC (where you placed NEC equipment folder) as shown in Fig. 2.5.4



2.5.5- Select your radio according to Type (3000S, Pasolink, Pasolink+,), Frequency ban (7G, 8G, 11G,) Modulation (16 QAM, 32 QAM, 128 QAM,....) Capacity (PDH x E1, STM-0, STM-1) then click Both to set same Radio for both stations then Press OK as shown in Fig. 2.5.5



Fig. 2.5.5

2.5.6- Set Branching Circuit or Hybrid Loss by clicking on its Symbol (above TR) then press OK as shown in Fig. 2.5.6



Fig. 2.5.6

2.5.7- Enter Feeder Data & connection losses by pressing on Wave Guide symbol then kick <mark>OK</mark> as shown in Fig. 2.5.7

						\ \	
👫 Microwave '	Worksheet						
Files Module C	onfigure Operations Ten	mplate Report Help					
and la		Transmission Lir	ies TR - TR (0.0 - (0.0)			
		OK Cancel Looku	o Help				
				Vika Spuri		Nangoli	
_			TX line type				
211.00		TX TX	(line length (m)		0.60	000	
210.95		TX line unit lo	x line loss (dB)		0.60	0.001	(P)
210.90		Conn	ector loss (dB)		0.00	0.00	
210.85		Vika Spuri TX lir	e unit loss (dB/100)m):			
Ch. 0	0.5	L					4.0 4.64 Ch.
	E	IRP (dBm)					
	tmospheric absorption	Ploss (dB)	129.32				
	Net pati	h loss (dB)	0.13				
	RX sic	gnal (dBm)					
	Thermal fade m	hargin (dB)					
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Vika Spuri						How to use PATHLOSS	Microsoft Word
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Fig. 2.5.7

2.5.8- Select antenna type for each station by clicking on antenna symbol then press as shown in Fig. 2.5.8

🚰 Microwave Works	sheet						🔳 🗗 🗙
Files Module Configur	e Operations Tem	plate Report Help					
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d d		Antennas IX - IX	Code Textus - House	1015			
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211.00		Antenna	diameter (m)				
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TR 210.85		Rado	ome loss (dB)				TR
210.80			Code				
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Atmos	pheric absorptior	Anten	na Azimuth (")				
	Net pati	Antenn	a Downtilt (±°)				
	RX sig	Orientat	tion Loss (dB)				
	Thermal fade m	Vika Spuri Anteni	na model :				
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Fig. 2.5.8

2.5.9- Press on Code Index then New Index then brows for pathloss folder (where you placed it) – Equipment – MAS – Antenna manufacturer (Andrew, RFS,) – Frequency Range (102-132, 122 – 132, 142 – 153,)then press OK as shown in Fig. 2.5.9



Fig. 2.5.9

2.5.10- Select antenna for site 1 & press on Site 1 & select antenna for site 2 & press Site 2 or in case of both sites have same antenna press on Both. The press Close – OK as shown in Fig. 2.5.10



Fig. 2.5.10

2.5.11- Set Reliability Method

In worksheet page go to Operation Menu – reliability Methods as per attached in Fig. 2.5.11

🏙 Microwave	Worksheet - Vika Spi	uri-Nangoli. pl4					- 7 🛛		
Files Module	Configure Operations Te	emplate Report Help							
Reliability Methods Diversity Calculation Interference Cochannel XPD Interference Options									
	Create Passi	ive Repeater							
211.00	1111111111111								
210.95			///////////////////////////////////////		<u> </u>				
210.85									
Ch. 0	0.5	1.0	1.5 2.0	2.5	3.0	3.5 4.0	4.64 Ch.		
	E	EIRP (dBm)	55.30 55.3)					
	Free spac	ce loss (dB)	129.32						
	Atmospheric absorptic	on loss (dB)	0.13						
	Netpa	th loss (dB)	51.85 51.8	5					
	RX si	ignal (dBm) -	35.35 -35.3	5					
	Thermal fade i	margin (dB)							
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Fig. 2.5.11

Set Reliability criteria as per shown in Fig. 2.5.11-1 for SDH or as Project & Customer requirement & press <mark>OK</mark>

🎇 Microwave Worksheet - Vika Spuri-Nangoli.pl4				_ 7 🗙
Files Module Configure Operations Template Report Help				
	4			Ð
211.00 210.05 210.80 210.80 Ch EIRP (dBm) Free space loss (dB) Atmospheric absorption loss (dB) Net path loss (dB) R× signal (dBm) Thermal fade margin (dB) Worst month - multipath (%) (sec) Annual - multipath (%) (sec) (% - sec)	Reliability Options Reliability Method Vigans - Barnett ITU-R P.530-6 ITU-R P.530-7/8 KQ factor KQ Frequency Exponent L20 KQ Distance Exponent S0 Calculation Method Total Annual Time Below Level ITU-T G.821 (PDH) SES - Unava Dispersive outage calculation Dispersive fade margin Equipment signature Cochannel operation	Ime percentages © 99,3997 / © 0.0001 // Cancel Help Mathematical SDH Narrow band digital SDH	2.5 4.9	4.84 Dh
Vika Spuri			km·m ITU-R P.530-7	78 TR-TR 🗶 Nangoli
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Fig. 2.5.11.1

2.5.12- Set of Rain factor

Press on Rain symbol – select ITU-R-P-530. 6/8 – press Load Rain File – Select Rain area according to ITU-530 Map Fig. 1.2.3 (Rain Files are placed in Pathloss folder – Rain) – Press Close as per shown in Fig. 2.5.12

Microwave Worksheet - Vika Spuri-Nangoli.pl4	
Files Module Configure Operations Template Report Help	
	Rain
211.00	Method Polarization
210.95 -////////////////////////////////////	777 C Crane C Vertical
210.90	Par 0.017 (nor /ku) DE 0. C Horizontal
210.85 -	
Ch. 210.80 0 0.5 1.0	0 3.5 4.0 4.64 Ch.
EIBP(dBm)	C 110-H P.5308
Free space loss (dB)	Latitude 28.7
Atmospheric absorptionoss (dB)	
Net path loss (dB)	Load Rain File
PX signal (dBm)	- Rain File ITU_N.RAI
Thermal fade margin (dB)	Rain region ITU Region N
Worst month - multipath (²)	Close Reset Help
(sec)	
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Fig. 2.5.12

2.5.13- Set Geoclimatic Factor

Press on the Ground Symbol (as shown in Fig. 2.5.13-1) – Set Geoclimatic Factor according to ITU-R-P-453 as Shown in Fig. 2.5.13-2)

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	EIRP (dBm	i) E	5.30	Path Profile Data					
Free	space loss (dE	0		OK Cancel Geo Clim	Help				
Atmospheric abs	orption loss (dE	i) N E	1 05		Frequency (MHz)	15000.00			
	et path loss (de RX signal (dRm	0) S	01.05		Path length (km)	4.64			
Thermal	iada margin (dE	0 ~~ N	13.33		Field margin (dB)				
Worst mo	nth - multipath (2	mildigin (dD) Diffraction loss (dB)			1 775 04				
	ísec	2		- Do	the inclination (mr)	1.776-04			
Ann	ual - multipath (⁾	6			temperature (*C)	30.00			
	(sec	3							
	(X - sec	3		Frequency (MHz) :					
	Rain regio	n 🗆	ru Re	gion N					
	Polarizatio	n	Vert	ical					
0.01%	rain rate (mm/h	n)							
F	Rain rate (mm/h	0							
Flat fade r	nargin - rain (dE	0							
Rain	attenuation (dE	0							
Annual multin	nuai rain (4-sec	3							
Annuai muliop	ain + rain (^-sec	9		×					
Vika Spuri							km-m I	TU-R P.530-7/8 T	R-TR 💢 Nangoli
🥙 start 🔰 🕼 Inbox - G	Dutlo 💿 W	indows Medi		Manuals 🛛 🖻	How to use PA	🂏 Microwave Wo.	EN 🖮 🕻	₽₿₡₡₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽₽	9) 🔋 ⁄ 20:48

Fig. 2.5.13-1



Percent of Time Gradient \leq 100 N units / km - November

Fig. 2.5.13-2

2.5.14- Make sure of either our Path Calculation is correct or we need to revise again. To do that please check the followings

- Make sure that your worksheet page has Green Correct sign in Right Bottom of screen. If it is wrong sign that's mean there are some data mistake

, Have a look to RX Signal, Fade Margin & (Annual Availability with rain) Percentage as per shown in Fig. 2,5.14



Fig. 2.5.14

- If any of (RX, Margin, Availability) is less than the required to meet the Spec. & recommendations. You have to increase antenna diameter or add Space Diversity Radio to reach to the required Spec.
- So you go to step 2.5.10 again & select new antennas

2.5.15- After finish of path calculations go to <mark>Report</mark> Menu in <mark>Worksheet page</mark> – click <mark>Full Report</mark>

You will get full path calculation report as below one. You can copy it to Word or Excel sheet & save it for reference & submitting with your survey report

Microwave Worksheet - Vika Spuri-Nangoli.pl4

		Vika Spuri	Nangoli	
	Elevation (m)	211.00	210.84	
	Latitude	28 38 24.30 N	28 40 54.20 N	
	Longitude	077 04 28.80 E	077 04 11.20 E	
	True azimuth (°)	354.09	174.09	
	Vertical angle (°)	-0.02	-0.01	
	Antenna model	VHP6-142	VHP6-142	
	Antenna height (m)	0.00	0.00	
	Antenna gain (dBi)	46.00	46.00	
	TX line length (m)	0.60	0.60	
	TX line unit loss (dB /100 m)	100.00	100.00	
	TX line loss (dB)	0.60	0.60	
	Circ. branching loss (dB)	3.50	3.50	
	Frequency (MHz)	15000.00		
	Polarization	Vertica		
	Path length (km)	4.64		
	Free space loss (dB)	129.32		
	Atmospheric absorption loss (dB)	0.13		
	Net path loss (dB)	45 65	45 65	
	Radio model	PASOLINK+ 15G 155MB	PASOLINK+15G	
155MB				
1001112	TX power (watts)	0.04	0.04	
	TX power (dBm)	16.50	16.50	
	FIRP (dBm)	58 40	58 40	
	TX Channels	1 14543 0000	1' 14963 0000V	
	RX threshold criteria	BER 10-6	BFR 10-6	
	RX threshold level (dBm)	-67 50	-67 50	
	RX signal (dBm)	-29 15	-29 15	
	Thermal fade margin (dB)	38.35	38.35	
	Geoclimatic factor	1 77F-04	00100	
	Path inclination (mr)	0.03		
	Average annual temperature (°C)	30.00		
	Worst month - multipath (%)	99,99993	99,99993	
	(sec)	1 88	1 88	
	Annual - multinath (%)	99 99997	99 99997	
	(sec)	8 48	8 48	
	(% - sec)	99 99995 - 1	16.95	
	Rain region	n ITU Region N 95.00 38.35		
	0.01% rain rate (mm/hr)			
	Flat fade margin - rain (dB)			
	Rain rate (mm/hr)	186.44		
	Rain attenuation (dB)	38.35		
	Annual rain (%-sec)	99 99916 - 2	64 20	
	Annual multipath + rain (%-sec)	99 99911 - 2	81 15	
		00.00011 2		
· · ·				

ÇáÇÍÎ, ÑÈÍÚ ÇáÇæá 10 1424 Reliability Method - ITU-R P.530-7/8 Rain - ITU-R P530-7 2.6- Frequency Interference Calculations for the Network

After completing all the above processes for all the link you should calculate if there will be any frequency interference cases in the designed Network (if there are any existing links working with the same frequency band you have to add it to your network before calculating interference)

How to Calculate frequency Interference





Have a look to your network & make sure that all links Frequencies & Polarizations are correct according to your plan. If there is any mistake in any link please go to its work sheet & make it correct

2.6.2- Go to Interference Menu & Click Calculate Intra as per shown in Fig. 2.6.2



Fig. 2.6.2

2.6.3- Set the Interference Calculation criteria according to Specs. & press Calculate as per shown in Fig. 2.6.3



Fig. 2.6.3



2.6.4- Go to Interference Menu – Report – Cross Reference as shown in Fig. 2.6.4



2.6.5- You will get Interferences cases as below example.

Study carefully those interference cases & if any one of them is dangerous case please re-plan you network frequencies or change your antenna type to higher XPD antennas. Also you can use ATPC function to keep lower TX power which will help to avoid some interference cases

Interference Cross Reference - Bharti Delhi (final).gr4

Coordination Distance (km)	100.00	obj	Interference level
objective (dBm)		-	
Maximum frequency Separation (MHz)	28.00	v-i	Victim to interferer
path length (km)			
Default Minimum Interference Level (dBm)	-105.00	tad	Total antenna
discrimination (dB)			
Margin (dB)	10.00	ifl	Interfering Signal
(dBm)			
Threshold degradation objective (db)	3.00	td	Threshold
Degradation (dB)			
Total number of cases calculated	87	*	OHLOSS
Calculation made on ÇáÇÍÏ, ÑÈÍÚ ÇáÃæá	10 1424	09:46:00 ã	
Casa 1 Champing and (Oldela) \///DAA 140	1 1000 00	000LL CTN44 40	00414

Case 1 Charmwood (Okhla), VHP4A-142, 14963.0000H, STM1-128QAM, obj = -98.6 1-1 Faridabad (Charmwood), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.3, tad = 70.0 (i 0.0° v -191.9°), ifl = -102.0 (3.5), td = 1.6

1-2 Okhla (Sarita Vihar), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.5, tad = 68.0 (i 128.8° v 0.0°), ifl = -100.2 (1.7), td = 2.2

Case 2 Okhla (Charmwood), VHP2-142, 14543.0000H, STM1-128QAM, obj = -98.6 2-1 Charmwood (Faridabad), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 3.5, tad = 67.0 (i 191.9° v 0.0°), ifl = -99.1 (0.5), td = 2.7 2-2 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 11.0,

2-2 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 11.0, tad = 52.2 (i -5.7° v -2.3°), ifl = -100.3 (1.7), td = 2.2 *

2-3 Sarita Vihar (Okhla), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 2.0, tad = 68.0 (i 0.0° v -128.8°), ifl = -101.4 (2.9), td = 1.8

- Case 3 Faridabad (Charmwood), VHP2-142, 14543.0000V, STM1-128QAM, obj = -98.6 3-1 Charmwood (Okhla), VHP4A-142, 14543.0000H, STM1-128QAM, v-i = 3.3, tad
- = 70.0 (i -191.9° v 0.0°), ifl = -101.8 (3.2), td = 1.7 3-2 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 4.2,
- tad = 62.0 (i 0.0° v -164.7°), ifl = -102.0 (3.4), td = 1.6 3-3 Shalimar Bagh (Wazipur), VHP4A-142, 14543.0000V, STM1-128QAM, v-i =
- 31.4, tad = 30.1 (i 9.4° v 1.0°), ifl = -81.5 (-17.0), td = $17.1 \times 10^{\circ}$
- 3-4 Kamal Hotel (Gopala Tower), VHP2-142, 14543.0000H, STM1-128QAM, v-i = 25.2, tad = 48.3 (i -38.8° v -0.5°), ifl = -103.8 (5.2), td = 1.1 *
- Case 4 Charmwood (Faridabad), VHP4A-142, 14963.0000V, STM1-128QAM, obj = -98.6 4-1 Okhla (Charmwood), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 3.5, tad = 67.0 (i 0.0° v 191.9°), ifl = -99.3 (0.8), td = 2.6
- 4-2 Faridabad (Faridabad19), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.3, tad = 62.0 (i 164.7° v 0.0°), ifl = -94.1 (-4.4), td = 5.7
- Case 5 Faridabad19 (Faridabad), VHP2-142, 14963.0000V, STM1-128QAM, obj = -98.6 5-1 Okhla (Charmwood), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 11.0, tad =
- 52.2 (i -2.3° v -5.7°), ifl = -100.5 (2.0), td = 2.1 * 5-2 Faridabad (Charmwood), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 4.2, tad = 62.0 (i -164.7° v 0.0°), ifl = -102.2 (3.7), td = 1.6
- 5-3 Touch Tel (Faridabad19), VHP4A-142, 14963.0000H, STM1-128QAM, v-i = 4.4, tad = 68.0 (i 0.0° v -170.3°), ifl = -102.5 (3.9), td = 1.5
- 5-4 Mayur Vihar Ph-3 (Noida Sec10), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 20.6, tad = 50.3 (i 1.3° v -341.0°), ifl = -104.2 (5.6), td = 1.0 *
- Case 6 Faridabad (Faridabad19), VHP2-142, 14543.0000V, STM1-128QAM, obj = -98.6 6-1 Charmwood (Faridabad), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 3.3, tad = 62.0 (i 0.0° v 164.7°), ifl = -93.9 (-4.7), td = 5.9
- 6-2 Faridabad19 (Touch Tel), VHP2-142, 14543.0000H, STM1-128QAM, v-i = 4.2, tad = 02.0 (i 170 28 \times 0.0%) iff = 100.0 (0.4) td = 0.5
- tad = 68.0 (i 170.3° v 0.0°), ifl = -108.0 (9.4), td = 0.5
- Case 7 Touch Tel (Faridabad19), VHP4A-142, 14543.0000H, STM1-128QAM, obj = -98.6 7-1 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 4.4, tad = 68.0 (i -170.3° v 0.0°), ifl = -102.2 (3.7), td = 1.5
- 7-2 Vaishali (Mayur Vihar Ph-3), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 28.5, tad = 50.7 (i 0.7° v -352.4°), ifl = -95.1 (-3.5), td = 5.1 *
- Case 8 Faridabad19 (Touch Tel), VHP2-142, 14963.0000H, STM1-128QAM, obj = -98.6 8-1 Faridabad (Faridabad19), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 4.2, tad = 68.0 (i 0.0° v 170.3°), ifl = -108.2 (9.7), td = 0.4