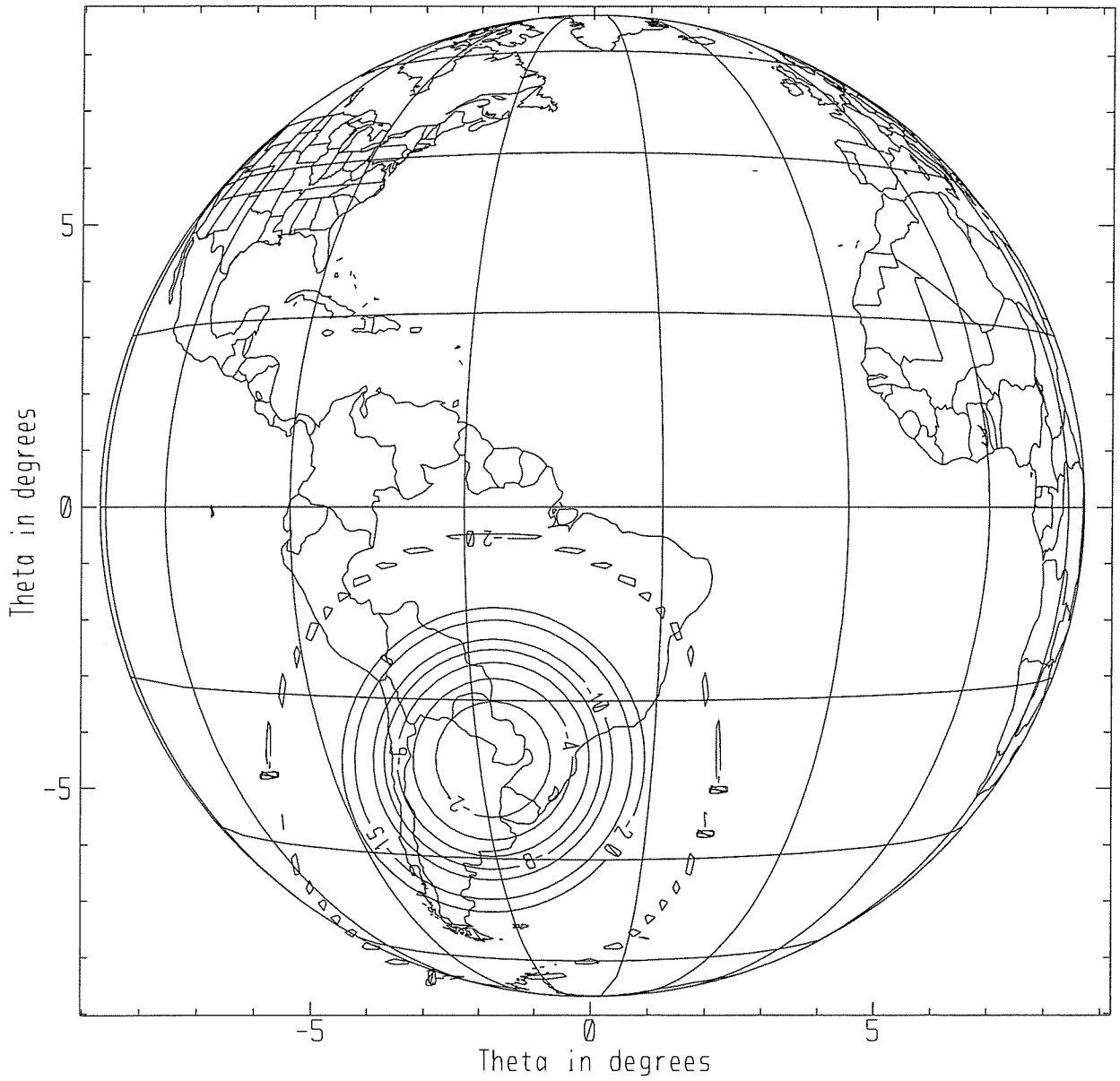
FIGURE 6 - SATELLITE RECEIVE ANTENNA GAIN CONTOURS STEERABLE SPOT-BEAMS (S1 and S2) (V and H Polarization)



Contours are -2, -4, -6, -8, -10, -15 and -20 dB
relative to peak gain (+33.0 dBi)

6. TRANSPONDER CONNECTIVITY

The COLUMBIA-ATL-47W satellite coverage is provided by two distinct fixed beams and two steerable spot beams on both uplink and downlink. The connectivity of the transponders to these various coverage beams is defined in Table 4.

TABLE 4 - TRANSPONDER CONNECTIVITY

Transponder # (Note 1)	UPLINK				DOWNLINK			
	East	West	S1	S2	East	West	S1	S2
1A, 1C	√	√	√		√		√	
1B, 1D	√	√		√		√		√
2A, 2C	√	√	√		√		√	
2B, 2D	√	√		√		√		√
3A, 3C	√	√	√		√		√	
3B, 3D	√	√		√		√		√
4A, 4C	√	√	√		√		√	
4B, 4D	√	√		√		√		√
5A, 5C	√	√	√		√		√	
5B, 5D	√	√		√		√		√
6A, 6C	√	√	√		√		√	
6B, 6D	√	√		√		√		√
7A, 7C	√	√	√		√		√	
7B, 7D	√	√		√		√		√
8A, 8C	√	√	√		√		√	
8B, 8D	√	√		√		√		√
9A, 9C	√	√	√		√		√	
9B, 9D	√	√		√			√	√
10A, 10C	√	√	√				√	√
10B, 10D	√	√		√	√			√
11A, 11C	√	√	√		√		√	
11B, 11D	√	√		√		√		√

Notes: 1: Re-use creates four transponders per frequency pair.
2: √ indicates connection to this beam is available.
3. Shading indicates spectrum not permitted to be used in this beam

All 32 of the transponders operating in the conventional C-band frequency ranges (transponders #1 to #8), as well as four transponders operating in part of the extended C-band (transponders #11), are switchable to provide either symmetrical trans-Atlantic connectivity or regional (i.e., east-to-east or west-to-west) connectivity. Transponders #9 and #10 are not able to downlink in the West-Atlantic beam, consistent with the U.S. regulatory constraints described in section 3 above. In addition, all transponders are switchable to either spot beam S1 or S2, or in some cases, both.

Note that, in cases where there are two entries (√) in any of the boxes of Table 4, full frequency re-use is maintained by ensuring that the transponder pairs are switched in unison (e.g., #1A and 1C must both be switched for trans-Atlantic service, or they must both be switched for regional service).

From Table 4 note that the switching is limited to two-way only at the transponder outputs, where the signal is high power and where low loss is important. At the transponder inputs, where the switching function is easier to implement, three-way switching is provided.

The TT&C transponder will be connected to receive telecommands from the West-Atlantic beam of the communications antenna for normal on-station operation. Telemetry/beacon signals will be transmitted via all beams of the communications antennas in this mode of operation. During the launch and early operations phase, and during emergencies, the TT&C transponder will be connected, for both receive and transmit, to a lower gain omni-directional antenna system on the spacecraft.

7. TRANSPONDER GAIN CONTROL AND SATURATION FLUX DENSITY

The gain of each transponder is independently controllable by telecommand over a 20 dB range, in 1 dB gain steps.

The range of Saturation Flux Density (SFD), related to the G/T value (in dB/K) contour, is as follows:

SFD (maximum) = -(75 + G/T) dBW/m^2
SFD (minimum) = -(95 + G/T) dBW/m^2

The corresponding linear gain of each transponder, measured between the output of the receiving antenna and the input of the transmitting antenna, varies from 115 dB to 135 dB depending on the transponder gain setting.

8. SATELLITE TRANSPONDER FILTER RESPONSE

The specification for the overall transponder in-band filter response is given in Figures 7(a) and 7(b), for 54 MHz and 92 MHz bandwidth transponders respectively. The in-band attenuation, relative to the peak in-band gain, will not exceed the limit line given.

The corresponding specification for the overall transponder out-of-band attenuation is given in Figures 8(a) and 8(b) below, for 54 MHz and 92 MHz

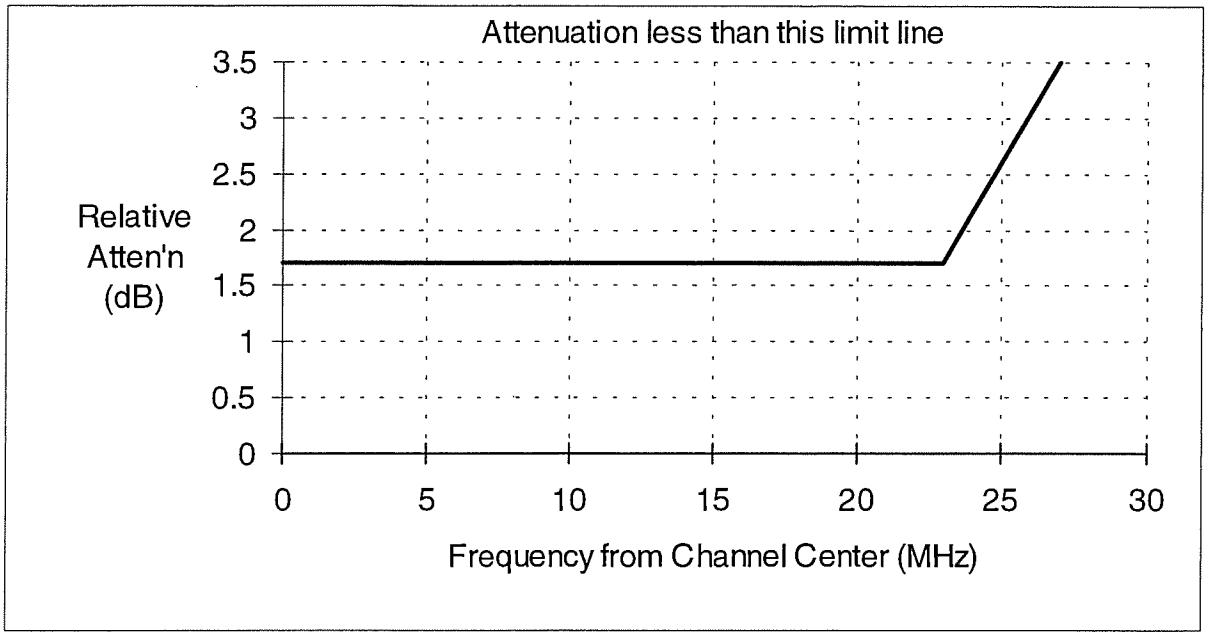
bandwidth transponders respectively. The out-of-band attenuation, relative to the peak in-band gain, will always exceed the limit line given.

9. UNWANTED EMISSIONS

The out-of-band emissions will not exceed the mask given in Figures 9(a) and 9(b) below, for 54 MHz and 92 MHz bandwidth transponders respectively.

FIGURE 7 - IN-BAND TRANSPONDER FILTER RESPONSES

(a) 54 MHz TRANSPONDERS



(b) 92 MHz TRANSPONDERS

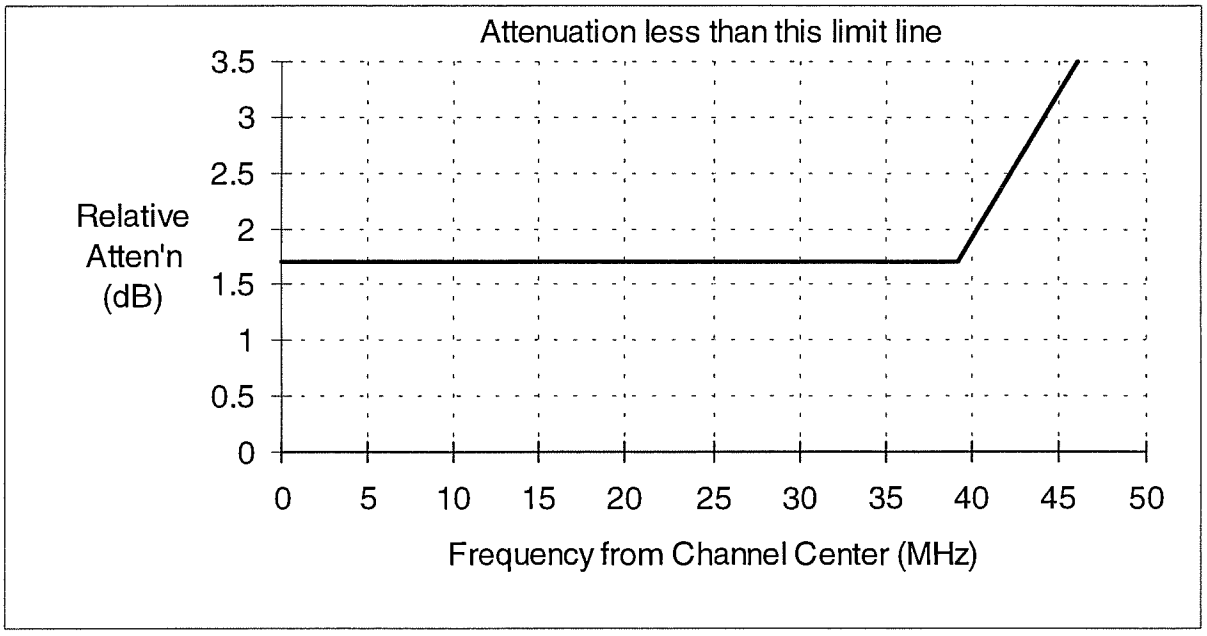
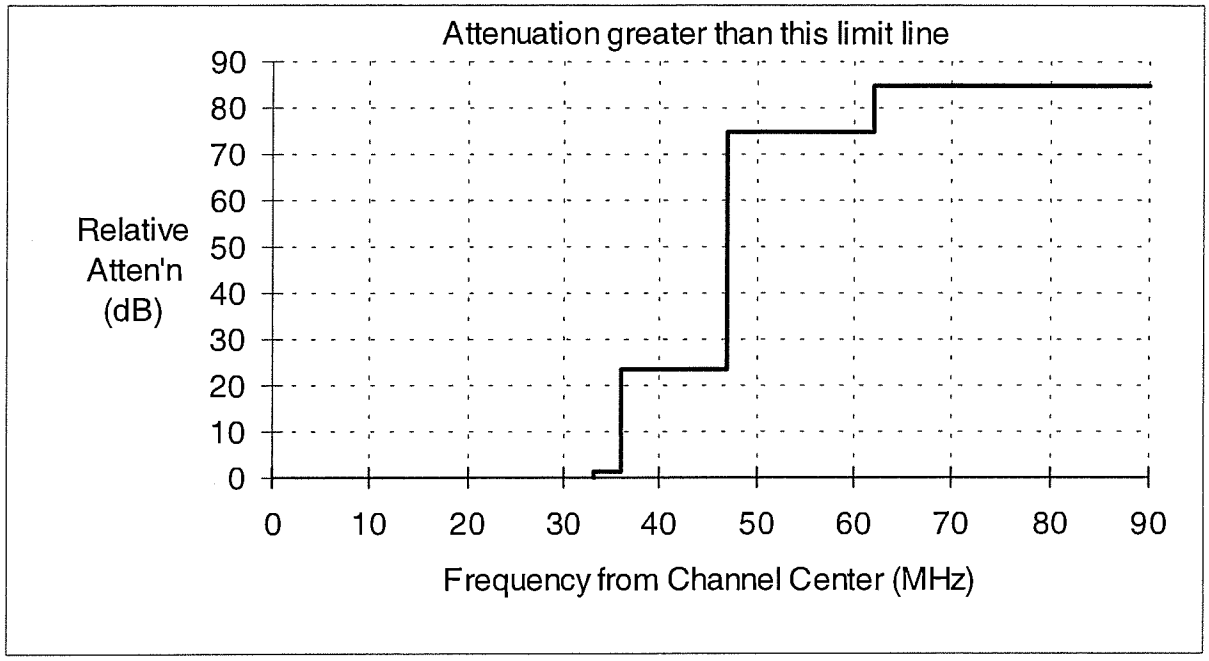


FIGURE 8 - OUT-OF-BAND TRANSPONDER FILTER RESPONSES

(a) 54 MHz TRANSPONDERS



(b) 92 MHz TRANSPONDERS

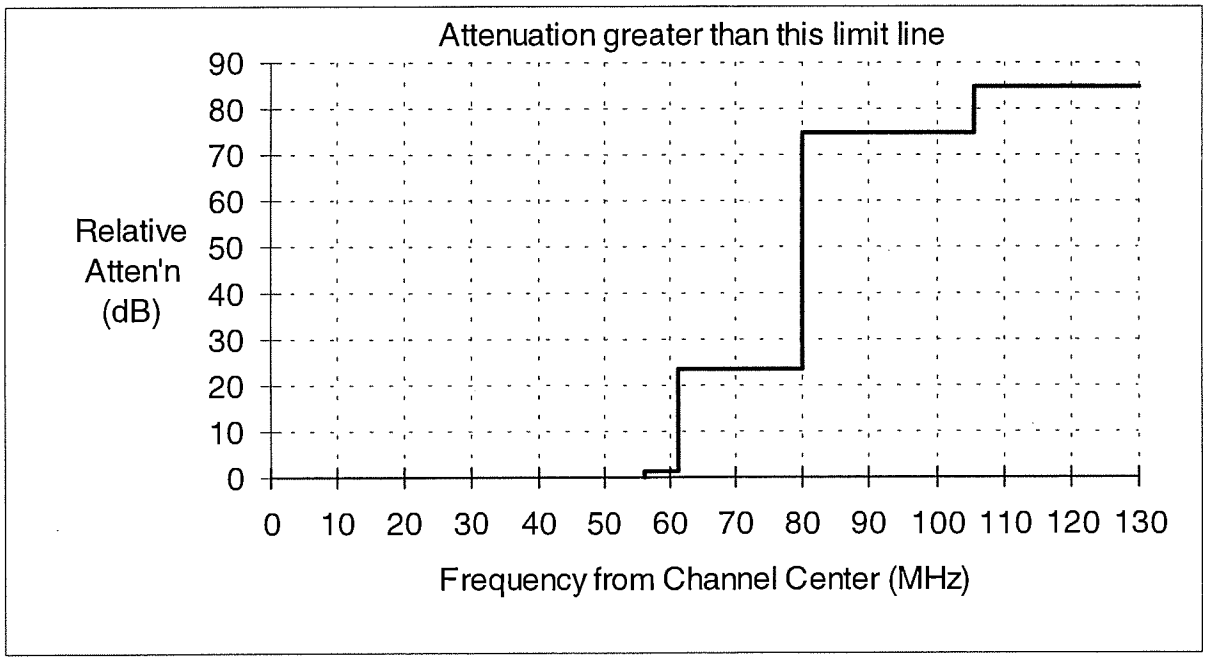
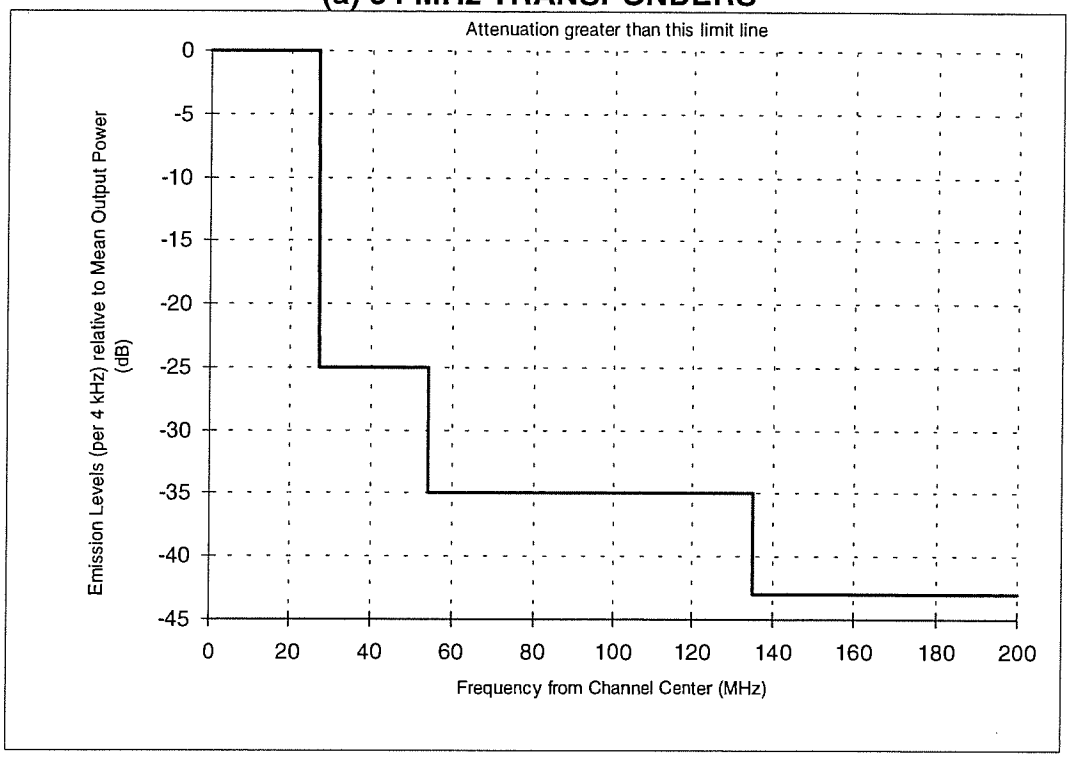
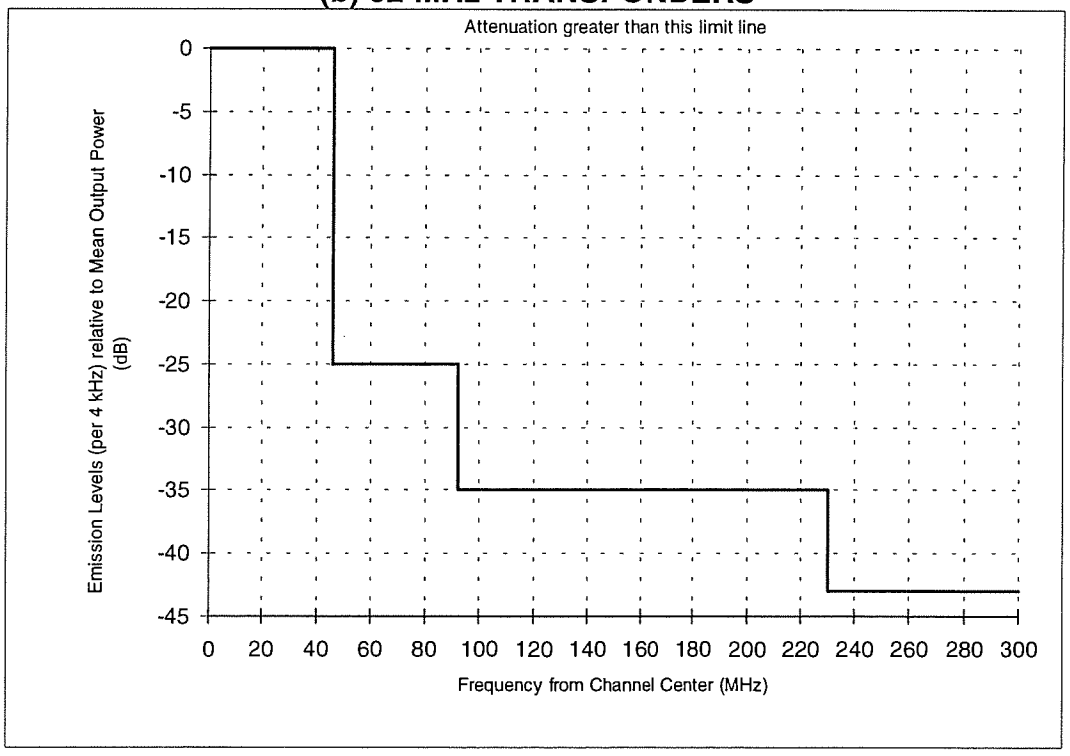


FIGURE 9 - OUT-OF-BAND EMISSIONS

(a) 54 MHz TRANSPONDERS



(b) 92 MHz TRANSPONDERS



10. EMISSION DESIGNATORS AND ALLOCATED BANDWIDTH OF EMISSION

Table 5 provides a representative list of the most likely emissions together with their internationally recognized emission designators. The first four letters of the designator defines the allocated bandwidths of these emissions.

TABLE 5 - EMISSION DESIGNATIONS

Transmission Type	Design'n	Description
Digital Carriers	50K0G1W	56 kbps QPSK, rate 3/4 FEC
(FDMA and TDMA)	58K0G1W	64 kbps QPSK, rate 3/4 FEC
	1M30G1W	1.544 Mbps QPSK, rate 3/4 FEC
	1M70G1W	2.048 Mbps QPSK, rate 3/4 FEC
	7M00G1W	8.448 Mbps QPSK, rate 3/4 FEC
	30M0G1W	34 Mbps QPSK, rate 3/4 FEC
	36M0G1W	45 Mbps QPSK, rate 3/4 FEC
	18M0G1W	45 Mbps QAM, rate 3/4 FEC
	92M0G1W	155 Mbps 8PSK, rate 3/4 FEC
Analog Television	36M0F3F	Analog TV in 36 MHz bandwidth
	30M0F3F	Analog TV in 30 MHz bandwidth
	17M5F3F	Analog TV in 17.5 MHz bandwidth
TT&C TC and Ranging	1M50FXD	
TT&C TM and Ranging	850KGXD	

11. EARTH STATIONS

Types of Earth Stations:

The COLUMBIA-ATL-47W satellite is capable of operating with a wide range of earth station apertures and communications service types with optimum performance using earth stations in the range 2.4 to 3.5 meters antenna diameter. In many cases the satellite will operate into existing teleport antennas (6 to 12 meters), but will also operate with customer premises earth stations in the range 2.4 to 6 meters. Even smaller antenna diameters are possible using spread spectrum techniques to reduce spectral densities for interference mitigation. Based on specific customers' network operational requirements,

stations will include various configurations of redundant transmission components to meet different levels of system availability.

All video uplinks operating through the COLUMBIA-ATL-47W satellite will be equipped with an automatic transmitter identification system ("ATIS") system, to be monitored by the COLUMBIA Monitoring & Control Center (CMCC), located in Denver, Colorado.

Estimated Number of Earth Stations:

It is expected that there will be a very large number of earth stations in total distributed over the full service area. The exact number of stations will depend upon market demand and customer network configurations.

Geographical Distribution of Earth Stations:

The earth stations will be located at commercial teleports and directly on the premises of COLUMBIA's customers, and distributed at sites throughout the service area of the satellite. Although the primary service area is within the -6 dB contour, service may be provided to locations also within the secondary service area of the East-Atlantic and West-Atlantic coverage beams, which extends down to the -15 dB satellite antenna gain contour (relative to beam peak).

Operational Procedures for Earth Station Access:

Earth stations bringing up new carriers on the COLUMBIA-ATL-47W satellite will be obliged to adhere strictly to COLUMBIA's established operational procedures. These require coordination by means of a voice communications link between the suitably trained operator at the earth station location where the new carrier is being introduced, and the CMCC personnel. The CMCC then monitors the frequency and power level of the new carrier to ensure that it is within specification and that no interference occurs.

All operational procedures of the COLUMBIA-ATL-47W satellite network will be compliant with §25.271-277 of the Commission's rules.

12. COMMUNICATIONS SERVICES AND LINK BUDGETS

A full range of communications services, for which there is a recognized demand, are anticipated for COLUMBIA-ATL-47W, including but not limited to the following:

Digital Transmission Services:

The main type of communications traffic expected to operate in the COLUMBIA-ATL-47W network will be digital. Digital techniques have now become the standard for a wide range of communications services, including the following:

- Digital point-to-point circuits ranging from 56 kbps (or lower) to 45 Mbps
- SCPC/FDMA and TDMA access techniques
- Star and mesh VSAT networks
- Spread-spectrum networks using CDMA
- Digitally-compressed video ranging from 128 kbps teleconferencing quality, through 3 Mbps entertainment quality, to 8 - 20 Mbps broadcast quality
- Digital audio
- High data rate digital circuits (up to 155 Mbps) for applications such as cable restoration.

Analog Transmission Services:

There will be some analog services in the COLUMBIA-ATL-47W network, consisting mainly of analog TV/FM, although it is expected that this will progressively be replaced by digital video transmissions. The analog TV schemes most likely to be used are as follows:

- TV/FM 27 MHz to 36 MHz RF bandwidth (4 MHz energy dispersal)
- TV/FM 17.5 MHz RF bandwidth (2 MHz energy dispersal)

Link Budgets:

Figures 10 to 14 provide sample link budgets for some of the links likely to be carried by the COLUMBIA-ATL-47W network. The assumptions common to all these link budgets, which are conservatively representative but not absolute worst case, are as follows:

- The transmit and receive earth stations are assumed to be located at the edge of the primary service area (i.e., -6 dB gain contour). The EIRP and G/T performance is the lower of the two fixed beams (West-Atlantic). These are very conservative assumptions.
- Uplink and downlink rain fades are assumed to be 2 dB, which is representative of excellent availability in the majority of the coverage areas.
- The link range is that corresponding to 10° elevation from the earth station to the satellite.

- Uplink frequency of 6.000 GHz and downlink frequency of 4.000 GHz.
- 60% efficiency earth station antenna gains.
- Earth station system noise temperature (clear sky) of 90K.
- Mid-range transponder gain setting (Saturation Flux Density).
- 3/4 rate FEC coding and QPSK modulation, with a receive filter "alpha" factor of between 20% and 30%, depending on the type of link and hence the cost of the modem equipment.
- Capacity calculations based upon the use of a 54 MHz bandwidth transponder, with between 15% and 20% guard bands between carriers (depending on carrier bandwidth) and 3 dB output backoff for multi-carrier operation.

Figure 10 gives the link budget for a 64 kbps link between two small 2.4 meter antennas. This link requires only 3 Watts RF power into the uplink antenna, which can be economically provided with a low-cost 5 Watt SSPA. Overall the link still has a residual 0.5 dB margin (worst case) under downlink fading conditions, in addition to the 2 dB power margin included for rain fades. By comparing the "bandwidth-limited" versus "power-limited" transponder capacities, it can be seen that links of this type are slightly power limited (530 carriers per 54 MHz transponder). However, in practice, there will be a mix of earth station sizes and locations, and overall the transponder should be simultaneously bandwidth and power limited.

Figure 11 gives the link budget for a T1 (1.544 Mbps) link between two 3 meter antennas. In this case 30 Watts of RF power is required, which can still be economically and conveniently provided using an SSPA. Similar link margins are provided as for the previous link. In this case, because of the use of a slightly larger receive earth station, the link is simultaneously bandwidth and power limited in terms of the transponder capacity (34 carriers).

Figure 12 gives the link budget for a digital video link at 8.448 Mbps between two 4.5 meter antennas. In this case, due to the larger size of the earth station, only 40 Watts of RF power is required, which can still be provided using an SSPA. Similar link margins are provided as for the previous links. In this case, because of the use of a larger receive earth station, the link is bandwidth limited in terms of the transponder capacity (6 carriers).

Figure 13 gives the link budget for an SNG digital video link at 8.448 Mbps between a remote 2.4 meter SNG terminal and a 9 meter receive earth station (at a teleport or TV station). In this case, due to the larger size of the receive earth station, still only 60 Watts of RF power is required, which can also be provided using an SSPA. Slightly lower link margins, especially on the uplink, are provided compared to the previous links, which is probably acceptable for the SNG type of application. In this case, because of the use of a larger receive earth station, the link is heavily bandwidth limited in terms of the transponder capacity (6 carriers).

Figure 14 gives a link budget for a half-transponder (27 MHz) analog TV distribution service to 3.5 meter receive antennas. In this case the available transponder power (with approximately 2 dB output backoff for linearity) is divided between two such carriers. Overall C/N ratios of 10 dB are achieved under rain faded conditions. Note that improved performance or smaller receive earth stations could be used nearer the center of the beam. Operation with smaller receive earth stations could also be provided if the full transponder power was used for a single TV carrier, subject to complying with the PFD constraints.

FIGURE 10 - 64 kbps LINK BETWEEN 2.4m EARTH STATIONS

COLUMBIA-ATL-47W Link Budget

25-Sep-95

Earth stations: Tx (2.4m) to Rx (2.4m)
64Kbps / 3/4 FEC / QPSK Modulation / Alpha = 30

Link Parameters		Clear Sky	Uplink Fade	Downlink Fade
Link Geometry:				
Tx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Rx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Uplink (per carrier):				
Carrier Frequency	(MHz)	6000	6000	6000
Tx E/S Antenna Diameter	(m)	2.4	2.4	2.4
Tx E/S Power to Antenna	(W)	3.00	3.00	3.00
Tx E/S Antenna Gain (60% eff.)	(dB)	41.3	41.3	41.3
Tx E/S EIRP per Carrier	(dBW)	46.1	46.1	46.1
Atmospheric and Other Losses	(dB)	0.2	2.0	0.2
Satellite:				
Total PFD at Satellite	(dBW/m2)	-117.2	-119.0	-117.2
Sat'n PFD towards Tx E/S (mid-range)	(dBW/m2)	-81.0	-81.0	-81.0
G/T towards Tx E/S (-6 dB contour)	(dB/K)	-7.0	-7.0	-7.0
Sat'd EIRP towards Rx E/S (-6 dB contour)	(dBW)	38.0	38.0	38.0
EIRP per Carrier towards Rx E/S	(dBW)	7.8	6.0	7.8
Downlink (per carrier):				
Carrier Frequency	(MHz)	4000	4000	4000
Atmospheric and Other Losses	(dB)	0.2	0.2	2.0
Rx E/S Antenna Diameter	(m)	2.4	2.4	2.4
Rx E/S Antenna Gain (60% eff.)	(dB)	37.8	37.8	37.8
Rx E/S G/T	(dB/K)	18.3	18.3	18.1
System (LNA+Sky) Noise Temp.	(K)	90	90	95
Total Link:				
Information Bit Rate (w/o coding)	(kbps)	64.0	64.0	64.0
FEC Rate	(fraction)	3/4	3/4	3/4
Modulation Type	(? PSK)	QPSK	QPSK	QPSK
Rx filter "alpha" factor	(%)	30.0	30.0	30.0
Carrier Noise Bandwidth	(kHz)	55.5	55.5	55.5
B/W (54 MHz) Limited Transponder Capacity	(# carriers)	811	811	811
Power Limited Transponder Capacity	(# carriers)	530	530	530
(C/N) - Thermal Uplink	(dB)	19.9	18.1	19.9
(C/N) - Thermal Downlink	(dB)	10.4	8.6	8.3
(C/I) - Other Link Degradations	(dB)	22.0	22.0	22.0
(C/N) - Total Actual	(dB)	9.6	7.9	7.9
(Eb/No) - Total Actual	(dB)	9.0	7.3	7.2
(Eb/No) - Total Required @1E-7BER	(dB)	6.7	6.7	6.7
Excess Margin	(dB)	2.3	0.6	0.5

FIGURE 11 - T1 (1.544 Mbps) LINK BETWEEN 3 m EARTH STATIONS

COLUMBIA-ATL-47W Link Budget

25-Sep-95

Earth stations: Tx (3m) to Rx (3m)
1544Kbps / 3/4 FEC / QPSK Modulation / Alpha = 30

Link Parameters		Clear Sky	Uplink Fade	Downlink Fade
Link Geometry:				
Tx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Rx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Uplink (per carrier):				
Carrier Frequency	(MHz)	6000	6000	6000
Tx E/S Antenna Diameter	(m)	3.0	3.0	3.0
Tx E/S Power to Antenna	(W)	30.00	30.00	30.00
Tx E/S Antenna Gain (60% eff.)	(dB)	43.3	43.3	43.3
Tx E/S EIRP per Carrier	(dBW)	58.1	58.1	58.1
Atmospheric and Other Losses	(dB)	0.2	2.0	0.2
Satellite:				
Total PFD at Satellite	(dBW/m2)	-105.3	-107.1	-105.3
Sat'n PFD towards Tx E/S (mid-range)	(dBW/m2)	-81.0	-81.0	-81.0
G/T towards Tx E/S (-6 dB contour)	(dB/K)	-7.0	-7.0	-7.0
Sat'd EIRP towards Rx E/S (-6 dB contour)	(dBW)	38.0	38.0	38.0
EIRP per Carrier towards Rx E/S	(dBW)	19.7	17.9	19.7
Downlink (per carrier):				
Carrier Frequency	(MHz)	4000	4000	4000
Atmospheric and Other Losses	(dB)	0.2	0.2	2.0
Rx E/S Antenna Diameter	(m)	3.0	3.0	3.0
Rx E/S Antenna Gain (60% eff.)	(dB)	39.8	39.8	39.8
Rx E/S G/T	(dB/K)	20.2	20.2	20.0
System (LNA+Sky) Noise Temp.	(K)	90	90	95
Total Link:				
Information Bit Rate (w/o coding)	(kbps)	1544.0	1544.0	1544.0
FEC Rate	(fraction)	3/4	3/4	3/4
Modulation Type	(? PSK)	QPSK	QPSK	QPSK
Rx filter "alpha" factor	(%)	30.0	30.0	30.0
Carrier Noise Bandwidth	(kHz)	1338.1	1338.1	1338.1
B/W (54 MHz) Limited Transponder Capacity	(# carriers)	34	34	34
Power Limited Transponder Capacity	(# carriers)	34	34	34
(C/N) - Thermal Uplink	(dB)	18.0	16.2	18.0
(C/N) - Thermal Downlink	(dB)	10.4	8.6	8.4
(C/I) - Other Link Degradations	(dB)	22.0	22.0	22.0
(C/N) - Total Actual	(dB)	9.5	7.7	7.8
(Eb/No) - Total Actual	(dB)	8.8	7.1	7.1
(Eb/No) - Total Required @1E-7BER	(dB)	6.7	6.7	6.7
Excess Margin	(dB)	2.1	0.4	0.4

FIGURE 12 - DIGITAL TV (8.448 Mbps) LINK BETWEEN 4.5 m EARTH STATIONS

COLUMBIA-ATL-47W Link Budget

25-Sep-95

Earth stations: Tx (4.5m) to Rx (4.5m)
8448Kbps / 3/4 FEC / QPSK Modulation / Alpha = 30

Link Parameters		Clear Sky	Uplink Fade	Downlink Fade
Link Geometry:				
Tx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Rx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Uplink (per carrier):				
Carrier Frequency	(MHz)	6000	6000	6000
Tx E/S Antenna Diameter	(m)	4.5	4.5	4.5
Tx E/S Power to Antenna	(W)	40.00	40.00	40.00
Tx E/S Antenna Gain (60% eff.)	(dB)	46.8	46.8	46.8
Tx E/S EIRP per Carrier	(dBW)	62.8	62.8	62.8
Atmospheric and Other Losses	(dB)	0.2	2.0	0.2
Satellite:				
Total PFD at Satellite	(dBW/m2)	-100.5	-102.3	-100.5
Sat'n PFD towards Tx E/S (mid-range)	(dBW/m2)	-81.0	-81.0	-81.0
G/T towards Tx E/S (-6 dB contour)	(dB/K)	-7.0	-7.0	-7.0
Sat'd EIRP towards Rx E/S (-6 dB contour)	(dBW)	38.0	38.0	38.0
EIRP per Carrier towards Rx E/S	(dBW)	24.5	22.7	24.5
Downlink (per carrier):				
Carrier Frequency	(MHz)	4000	4000	4000
Atmospheric and Other Losses	(dB)	0.2	0.2	2.0
Rx E/S Antenna Diameter	(m)	4.5	4.5	4.5
Rx E/S Antenna Gain (60% eff.)	(dB)	43.3	43.3	43.3
Rx E/S G/T	(dB/K)	23.7	23.7	23.5
System (LNA+Sky) Noise Temp.	(K)	90	90	95
Total Link:				
Information Bit Rate (w/o coding)	(kbps)	8448.0	8448.0	8448.0
FEC Rate	(fraction)	3/4	3/4	3/4
Modulation Type	(? PSK)	QPSK	QPSK	QPSK
Rx filter "alpha" factor	(%)	30.0	30.0	30.0
Carrier Noise Bandwidth	(kHz)	7321.6	7321.6	7321.6
B/W (54 MHz) Limited Transponder Capacity	(# carriers)	6	6	6
Power Limited Transponder Capacity	(# carriers)	11	11	11
(C/N) - Thermal Uplink	(dB)	15.4	13.6	15.4
(C/N) - Thermal Downlink	(dB)	11.3	9.5	9.3
(C/I) - Other Link Degradations	(dB)	22.0	22.0	22.0
(C/N) - Total Actual	(dB)	9.6	7.9	8.2
(Eb/No) - Total Actual	(dB)	9.0	7.3	7.5
(Eb/No) - Total Required @1E-7BER	(dB)	6.7	6.7	6.7
Excess Margin	(dB)	2.3	0.6	0.8

FIGURE 13 - SNG DIGITAL TV (8.448 Mbps) LINK FROM 2.4 m SNG TERMINAL TO 9 m TELEPORT

COLUMBIA-ATL-47W Link Budget

25-Sep-95

Earth stations: Tx (2.4m) to Rx (9m)
8448Kbps / 3/4 FEC / QPSK Modulation / Alpha = 20

Link Parameters		Clear Sky	Uplink Fade	Downlink Fade
Link Geometry:				
Tx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Rx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Uplink (per carrier):				
Carrier Frequency	(MHz)	6000	6000	6000
Tx E/S Antenna Diameter	(m)	2.4	2.4	2.4
Tx E/S Power to Antenna	(W)	60.00	60.00	60.00
Tx E/S Antenna Gain (60% eff.)	(dB)	41.3	41.3	41.3
Tx E/S EIRP per Carrier	(dBW)	59.1	59.1	59.1
Atmospheric and Other Losses	(dB)	0.2	2.0	0.2
Satellite:				
Total PFD at Satellite	(dBW/m2)	-104.2	-106.0	-104.2
Sat'n PFD towards Tx E/S (mid-range)	(dBW/m2)	-81.0	-81.0	-81.0
G/T towards Tx E/S (-6 dB contour)	(dB/K)	-7.0	-7.0	-7.0
Sat'd EIRP towards Rx E/S (-6 dB contour)	(dBW)	38.0	38.0	38.0
EIRP per Carrier towards Rx E/S	(dBW)	20.8	19.0	20.8
Downlink (per carrier):				
Carrier Frequency	(MHz)	4000	4000	4000
Atmospheric and Other Losses	(dB)	0.2	0.2	2.0
Rx E/S Antenna Diameter	(m)	9.0	9.0	9.0
Rx E/S Antenna Gain (60% eff.)	(dB)	49.3	49.3	49.3
Rx E/S G/T	(dB/K)	29.8	29.8	29.5
System (LNA+Sky) Noise Temp.	(K)	90	90	95
Total Link:				
Information Bit Rate (w/o coding)	(kbps)	8448.0	8448.0	8448.0
FEC Rate	(fraction)	3/4	3/4	3/4
Modulation Type	(? PSK)	QPSK	QPSK	QPSK
Rx filter "alpha" factor	(%)	20.0	20.0	20.0
Carrier Noise Bandwidth	(kHz)	6758.4	6758.4	6758.4
B/W (54 MHz) Limited Transponder Capacity	(# carriers)	7	7	7
Power Limited Transponder Capacity	(# carriers)	26	26	26
(C/N) - Thermal Uplink	(dB)	12.1	10.3	12.1
(C/N) - Thermal Downlink	(dB)	14.0	12.2	12.0
(C/I) - Other Link Degradations	(dB)	22.0	22.0	22.0
(C/N) - Total Actual	(dB)	9.6	7.9	8.8
(Eb/No) - Total Actual	(dB)	8.7	7.0	7.8
(Eb/No) - Total Required @1E-7BER	(dB)	6.7	6.7	6.7
Excess Margin	(dB)	2.0	0.3	1.1

FIGURE 14 - HALF-TRANSPONDER (27 MHz) TV DISTRIBUTION TO 3.5 m TVRO

COLUMBIA-ATL-47W Link Budget

25-Sep-95

Earth stations: Tx (6m) to Rx (3.5m)
40500Kbps / 3/4 FEC / QPSK Modulation / Alpha = 0

Link Parameters		Clear Sky	Uplink Fade	Downlink Fade
Link Geometry:				
Tx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Rx E/S Range to Satellite (10° elevation)	(km)	40586	40586	40586
Uplink (per carrier):				
Carrier Frequency	(MHz)	6000	6000	6000
Tx E/S Antenna Diameter	(m)	6.0	6.0	6.0
Tx E/S Power to Antenna	(W)	200.00	200.00	200.00
Tx E/S Antenna Gain (60% eff.)	(dB)	49.3	49.3	49.3
Tx E/S EIRP per Carrier	(dBW)	72.3	72.3	72.3
Atmospheric and Other Losses	(dB)	0.2	2.0	0.2
Satellite:				
Total PFD at Satellite	(dBW/m2)	-91.0	-92.8	-91.0
Sat'n PFD towards Tx E/S (mid-range)	(dBW/m2)	-81.0	-81.0	-81.0
G/T towards Tx E/S (-6 dB contour)	(dB/K)	-7.0	-7.0	-7.0
Sat'd EIRP towards Rx E/S (-6 dB contour)	(dBW)	38.0	38.0	38.0
EIRP per Carrier towards Rx E/S	(dBW)	33.8	32.1	33.8
Downlink (per carrier):				
Carrier Frequency	(MHz)	4000	4000	4000
Atmospheric and Other Losses	(dB)	0.2	0.2	2.0
Rx E/S Antenna Diameter	(m)	3.5	3.5	3.5
Rx E/S Antenna Gain (60% eff.)	(dB)	41.1	41.1	41.1
Rx E/S G/T	(dB/K)	21.6	21.6	21.3
System (LNA+Sky) Noise Temp.	(K)	90	90	95
Total Link:				
Carrier Noise Bandwidth	(kHz)	27000.0	27000.0	27000.0
B/W (54 MHz) Limited Transponder Capacity	(# carriers)	2	2	2
Power Limited Transponder Capacity	(# carriers)	2	2	2
(C/N) - Thermal Uplink	(dB)	19.2	17.4	19.2
(C/N) - Thermal Downlink	(dB)	12.8	11.1	10.8
(C/I) - Other Link Degradations	(dB)	25.0	25.0	25.0
(C/N) - Total Actual	(dB)	11.7	10.1	10.0

13. STATION-KEEPING AND ANTENNA POINTING ACCURACY

The COLUMBIA-ATL-47W orbital inclination and longitudinal drift will be maintained within ±0.05° of nominal. The antenna axis attitude will be maintained within ±0.1° of nominal during normal mode and ±0.15° of nominal during orbit maneuvers (i.e., station-keeping).

14. POWER FLUX DENSITY AND ENERGY DISPERSAL CONSIDERATIONS

The FCC's PFD limit, given in §25.208, applies in the frequency range 3.700-4.200 GHz. Similar PFD limits are given in 2566 of the ITU Radio Regulations for the frequency range 3.400-7.750 GHz. This limit, which is applicable to all COLUMBIA-ATL-47W downlinks, is defined as follows:

> In the band 3,400-7,750 MHz, the power flux density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:
> - -152 dB(W/m^2) in any 4 kHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
> - -152 + (δ-5)/2 dB(W/m^2) in any 4 kHz band for angles of arrival δ (in degrees) between 5 and 25 degrees above the horizontal plane;
> - -142 dB(W/m^2) in any 4 kHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.
>
> These limits relate to the power flux density which would be obtained under assumed free-space propagation conditions.

The worst case analysis is to assume satellite beam-peak EIRP in the direction of locations on the Earth corresponding to elevation angles of 5° or less, where the criteria of -152 dB(W/m^2/4kHz) applies. In order to meet this PFD limit, the maximum permissible EIRP per 4 kHz, is given by the following equation:

$$EIRP_{max/4kHz} \leq PFD_{max/4kHz} + \text{Spreading Loss}$$
$$EIRP_{max/4kHz} \leq -152\,(dBW/m^2/4kHz) + 163.2$$
$$EIRP_{max/4kHz} \leq +11.2\,(dBW/4kHz)$$

The maximum saturated transponder EIRP is +45.5 dBW (East-Atlantic fixed beam), as given in section 4 above. In order for this total radiated EIRP to comply with the above EIRP spectral density limit (+11.2 dBW / 4kHz), the power should be spread evenly over not less than 10.8 MHz. As this is only 20% and 11.8% of the usable bandwidth of the 54 MHz and 92 MHz transponders respectively, compliance with the PFD limit will be assured when the transponders are operated in a bandwidth efficient mode with any type of digitally modulated signal, which is expected to be the prime mode of operation in the

future. In the case of analog TV/FM signals, some additional output power back-off will be required in some cases, as shown in the list of typical operating configurations, given in Table 6 below.

TABLE 6 - OUTPUT BACK-OFF FOR ANALOG TV TRANSMISSIONS

Analog TV/FM Transmissions	Output Back-off (relative to saturation)	
	Required for linearity	Additional required for PFD compliance
54 MHz transponder:		
• 1 x 36 MHz with 4 MHz e.d.s.	0 dB	4.3 dB (Note 1)
• 2 x 27 MHz with 4 MHz e.d.s.	2 dB	0 dB
• 3 x 17 MHz with 2 MHz e.d.s.	2 dB	0.6 dB
92 MHz transponder:		
• 2 x 36 MHz with 4 MHz e.d.s.	2 dB	0 dB
• 3 x 30 MHz with 4 MHz e.d.s.	2 dB	0 dB
• 5 x 17 MHz with 2 MHz e.d.s.	3 dB	0 dB

Note 1: This mode is highly inefficient and is unlikely to be required.

The TV/FM energy dispersal signals for all beams will consist of either a 25 or 30 Hz triangular waveform superimposed on the baseband video waveform.

In all cases, carriers will be authorized by COLUMBIA only when they meet the above PFD limit constraints.

15. FREQUENCY TOLERANCE

The local oscillator frequency stability in the COLUMBIA-ATL-47W communications payload will determine the accuracy of the frequency conversion between uplink and downlink transmissions. This frequency conversion error shall not exceed ± 5 in 10^6 under all circumstances.

16. CESSATION OF EMISSIONS

Each transponder on the COLUMBIA-ATL-47W satellite can be individually turned on and off by ground telecommand, thereby causing cessation of emissions from the satellite, as required.

17. LAUNCH VEHICLES

The COLUMBIA-ATL-47W spacecraft is compatible with a wide range of available commercial launch vehicles, such as the Atlas series, the European Ariane and the Russian Proton vehicles. A decision on the actual launcher to be used has not yet been made.

18. TT&C ARRANGEMENTS

COLUMBIA Communications Corporation will establish its own Spacecraft Operations Center and TT&C earth station in the USA, in order to control the COLUMBIA-ATL-47W satellite.

19. SPACECRAFT PHYSICAL CHARACTERISTICS

The spacecraft manufacturer for the COLUMBIA-ATL-47W satellite has not yet been selected, and COLUMBIA does not wish to show preference by providing any data specific to any one manufacturer in this application. The design of the satellite has been based around the known characteristics of the latest spacecraft available from all three major US suppliers (Hughes, Lockheed Martin and Loral). Therefore the feasibility of implementing the COLUMBIA-ATL-47W satellite is assured.

The COLUMBIA-ATL-47W communications payload requires approximately 5 kW d.c. power, which is well within the capability of all three candidate suppliers, including sufficient margin at end of life and full eclipse capability. The communications payload mass of the COLUMBIA-ATL-47W satellite will be in the range 450 to 500 kg. The total spacecraft mass is in the range 3,000 to 3,500 kg at launch. The satellite operational lifetime will be between 12 and 15 years.

COLUMBIA will provide the FCC with full and precise spacecraft physical characteristics when the final supplier and product has been selected.

20. INTERFERENCE ANALYSIS

It will be necessary to coordinate the COLUMBIA-ATL-47W network with adjacent satellites in the geostationary orbit arc. The only other US filed systems in close proximity are PanAmSat satellites located at both 45°W (2° spacing) and 43°W (4° spacing). In addition, there is an Intelsat orbit location at 50°W (3°

spacing). There are also other foreign orbit filings with which coordination may be required.

International satellite systems, including COLUMBIA/TDRS, have been successfully coordinated with Intelsat satellites at 3° orbit spacing, and there is every reason to believe that this coordination with Intelsat can also be concluded without major problems.

Coordination with the existing PanAmSat network at 45°W should similarly not be a major problem. Although the satellite spacing is only 2°, several features of the two systems and their likely future usage contribute towards their mutual compatibility. These are as follows:

1. The PanAmSat network is well established and reportedly heavily loaded. Thus its carrier characteristics should be well known and the interference analyses can be based upon PanAmSat's specific parameters rather than using hypothetical, and usually conservative, carrier parameters.
2. One of COLUMBIA's major markets at present, and likely to be into the foreseeable future, is international teleports using relatively large earth station antennas. This generally makes for easier coordination, as the carrier power densities required are lower.
3. There will be increasing utilization of digital video transmission in the future in preference to analog TV/FM. These digital signals have significantly lower spectral densities (typically by 10 dB or so) than their analog counterparts. This simplifies coordination with adjacent satellites.
4. Digital signals are more robust and operate typically down to much lower C/N ratios than analog signals. They are therefore more tolerant to interference, thereby improving the ability coordinate at 2° orbit spacing.
5. The gain of each transponder on the COLUMBIA-ATL-47W satellite can be independently set over a wide (20 dB) range with a small (1 dB) gain step increment. The transponder gain setting will significantly impact the balance of uplink interference between adjacent satellites. In an interference limited environment, as might exist with 2° spacing, it will be possible to optimize the transponder gain setting in order to most effectively balance, and hence minimize the interference between two adjacent networks.
6. The COLUMBIA-ATL-47W network will use earth stations that meet, and where possible exceed, the established standard of $29-25\log(\theta)$, not only in the USA but in other countries served. This will reduce both the potential uplink interference from the COLUMBIA-ATL-47W network into other satellites and the potential downlink interference from other satellites into the COLUMBIA-ATL-47W network.
7. The COLUMBIA-ATL-47W satellite employs wide bandwidth transponders (54 MHz and 92 MHz) designed to support multi-carrier transmissions. As such, there will be considerable flexibility in frequency planning the carriers within the transponder bandwidth.

The type of detailed information concerning PanAmSat's carriers, which is required to perform a meaningful interference analysis, is not available to COLUMBIA at this time. COLUMBIA is keen to start coordination discussions with PanAmSat representatives at the earliest possible time to allow these detailed analyses to be performed.

In the meantime, for the purpose of this application, the following analysis will demonstrate in a generic way that the COLUMBIA-ATL-47W network is compatible with a co-coverage, co-frequency satellite, spaced 2° away, such as PanAmSat at 45°W. This analysis focuses on the use of digital signals in both networks, as that is likely to be the dominant means of transmission in the time-frame of the two networks operating simultaneously. Accommodation of the more problematic analog TV/FM carriers can be coordinated on a case by case basis.

Scenario 1: This scenario addresses uplink interference between digital carriers in both the wanted and victim satellite networks. Assume that transponder gains can be matched to give similar wanted input signal spectral density levels at the two satellites. Uplink C/I will be a function of the difference between the gain at boresight and the gain at 2° off boresight (actually 2.2° topocentric) of the transmitting earth stations. The gain 2.2° off boresight for an antenna that meets 29-25log(θ) is 20.4 dBi. The boresight gain will be a function of the size of the transmitting earth station. The following table lists the boresight gain, and the corresponding C/I that would result in this interference scenario:

UPLINK:

Transmit earth station antenna diameter (meters)	Typical boresight gain (65% efficiency) (dBi)	Resulting C/I (29-25log(θ)) (dB)
9.0 m	53.2 dBi	32.8 dB
6.0 m	49.7 dBi	29.3 dB
4.5 m	47.2 dBi	26.8 dB
3.5 m	45.0 dBi	24.6 dB
2.4 m	41.7 dBi	21.3 dB

Assuming that the minimum (i.e. threshold) C/N for a digital service is 8 dB, the effect of the C/I (21.3 dB) from the 2.4 meter earth station in the table above would only degrade the C/N by 0.21 dB, equivalent to an increase of 4.7% in the victim system's noise temperature. This is significantly less than the internationally accepted 6% single entry interference threshold normally applied in such situations.

Scenario 2: This scenario addresses downlink interference between digital carriers in both the wanted and victim satellite networks. Assume that the

received carrier signal power spectral density (at the earth station antenna output) is similar between the two satellites. This is a reasonable assumption, as a larger receive earth station antenna will be compensated by a lower EIRP spectral density from the satellite. In this case, downlink C/I will again be a function of the difference between the gain at boresight and the gain at 2.2° off boresight of the receiving earth stations (20.4 dBi assuming 29-25log(θ)). The following table lists the boresight gain, and the corresponding C/I that would result in this interference scenario:

DOWNLINK:

Receive earth station antenna diameter (meters)	Typical boresight gain (65% efficiency) (dBi)	Resulting C/I (29-25log(θ)) (dB)
9.0 m	49.7 dBi	29.3 dB
6.0 m	46.1 dBi	25.7 dB
4.5 m	43.6 dBi	23.2 dB
3.5 m	41.5 dBi	21.1 dB
2.4 m	38.2 dBi	17.8 dB

Again, assuming that the minimum (i.e. threshold) C/N for a digital service is 8 dB, the effect of the C/I (17.8 dB) into the 2.4 meter earth station in the table above would only degrade the C/N by 0.48 dB, equivalent to an increase of 10.5% in the victim system's noise temperature. Although this does exceed the normal criteria of 6%, the victim system's link degradation is still less than 0.5 dB, which is significantly less than the likely link margin.

Engineering Certification

I hereby certify that I am the technically qualified person responsible for the preparation of the engineering information contained in the Technical Exhibit of this Application, that I am familiar with Part 25 of the Commission's rules, and that the technical information is complete and accurate to the best of my knowledge.

Richard J. Barnett, PhD, BSc
4806 Fort Sumner Drive
Bethesda, Maryland 20816
(301) 229-0204

Dated: September 25, 1995

ATTACHMENT 2

ESTIMATED COSTS OF PROPOSED CONSTRUCTION

Space Station Authorization & Construction	$	90,000,000
Ground Segment/TT&C (Construction)	$	5,000,000
Launch Services	$	65,000,000
Launch Insurance	$	30,000,000
System Operating Expenses/First Year	$	5,000,000
TOTAL	$	195,000,000

ESTIMATED ANNUAL REVENUES

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Number of transponders sold	10	14	18	21	23	25	27	29	31	33	34	35	36	36	36
Revenue per year	18	25.2	32.4	37.8	41.4	45	48.6	52.2	55.8	59.4	61.2	63	64.8	64.8	64.8
Cumulative Revenue	18.0	43.2	75.6	113.4	154.8	199.8	248.4	300.6	356.4	415.8	477	540	604.8	669.6	734.4
% Fill Factor	23%	32%	41%	48%	52%	57%	61%	66%	70%	75%	77%	80%	82%	82%	82%
Transponder Price per Year	1.8														
Total # transponders per satellite	44														

All dollar values expressed in millions.

Assumptions: Transpoonders are 54 MHz and 92 MHz bandwidth, yielding higher price.
Early build-up of traffic due to transfer from TDRSS 41° W.L.

ATTACHMENT 3
LICENSEE QUALIFICATION REPORT
(FORM 430)

FCC 430

FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

Approved by OMB
3060-0105
Expires 2/28/96

LICENSEE QUALIFICATION REPORT

See reverse side for information regarding public burden statement.

INSTRUCTIONS

A. The "Filer" of this report is defined to include: (1) An applicant, where this report is submitted in connection with applications for common carrier and satellite radio authority as required for such applications; or (2) A licensee or permittee, where this report is required by the Commission's Rules to be submitted on an annual basis.

B. Submit an original and one copy (sign original only) to the Federal Communications Commission, Washington, DC 20554. If more than one radio service is listed in Item 6, submit an additional copy for each such additional service. If this report is being submitted in connection with an application for radio authority, attach it to that application.

C. Do not submit a fee with this report.

1. Business Name and Address (Number, Street, State and ZIP Code) of Filer's Principal Office:
Columbia Communications Corporation
1088 Bishop Street
Suite 2912
Honolulu, HI 96813

2. (Area Code) Telephone Number:
(808) 523-8100

3. If this report supercedes a previously filed report, specify its date:
July 15, 1994

4. Filer is (check one):
☐ Individual ☐ Partnership ☐ Corporation
☐ Other (Specify):

5. Under the laws of what State (or other jurisdiction) is the Filer organized?
Delaware

6. List the common carrier and satellite radio services in which Filer has applied or is a current licensee or permittee: Columbia Communications Corporation is the licensee of two space stations in the international fixed-satellite service (see File Nos. CSS-90-01 and CSS-90-011), and also holds conditional construction permits for a space station and ground spare in the international fixed-satellite service (see File No. CSS-86-002-LA).

7(a) Has the Filer or any party to this application had any FCC station license or permit revoked or had any application for permit, license or renewal denied by this Commission? ***If "YES", attach as Exhibit I a statement giving call sign and file number of license or permit revoked and relating circumstances.*** ☒ Yes ☐ No
See Exhibit I

(b) Has any court finally adjudged the Filer, or any person directly or indirectly controlling the Filer, guilty of unlawfully monopolizing or attempting unlawfully to monopolize radio communication, directly or indirectly, through control of manufacture or sale of radio apparatus, exclusive traffic arrangement, or other means of unfair methods of competition? ***If "YES", attach as Exhibit II a statement relating the facts.*** ☐ Yes ☒ No

(c) Has the Filer, or any party to this application, or any person directly or indirectly controlling the Filer ever been convicted of a felony by any state or Federal Court? ***If "YES", attach as Exhibit III a statement relating the facts.*** ☐ Yes ☒ No

(d) Is the Filer, or any person directly or indirectly controlling the Filer, presently a party in any matter referred to items 7(b) and 7(c)? ***If "YES", attach as Exhibit IV a statement relating the facts.*** ☐ Yes ☒ No

8. Is the Filer, directly or indirectly, through stock ownership, contract or otherwise, currently interested in the ownership or control of any other radio stations licensed by this Commission? ***If "YES", submit as Exhibit V the name of each such licensee and the licensee's relation to the Filer.*** ☐ Yes ☒ No

If Filer is an individual (sole proprietorship) or partnership, answer the following and Item 11:

9(a) Full Legal Name and Residential Address (Number, Street, State and ZIP Code) of Individual or Partners:

(b) Is individual or each member of a partnership a citizen of the United States? ☐ Yes ☐ No

(c) Is individual or any member of a partnership a representative of an alien or of a foreign government? ☐ Yes ☐ No

If Filer is a corporation, answer the following and Item 11:

10(a) Attach as Exhibit VI the names, addresses, and citizenship of those stockholders owning of record and/or voting 10 percent or more of the Filer's voting stock and the percentages so held. In the case of fiduciary control, indicate the beneficiary(ies) or class of beneficiaries.

See Exhibit VI

(b) List below, or attach as Exhibit VII the names and addresses of the officers and directors of the Filer.

See Exhibit VII

(c) Is the Filer directly or indirectly controlled by any other corporation? ☐ Yes ☒ No

If "YES", attach as Exhibit VIII a statement (including organizational diagrams where appropriate) which fully and completely identifies the nature and extent of control. Include the following: (1) the address and primary business of the controlling corporation and any intermediate subsidiaries; (2) the names, addresses, and citizenship of those stockholders holding 10 percent or more of the controlling corporation's voting stock; (3) the approximate percentage of total voting stock held by each such stockholder; and (4) the names and addresses to the president and directors of the controlling corporation.

(d) Is any officer or director of the Filer an alien? ☐ Yes ☒ No

(e) Is more than one-fifth of the capital stock of the Filer owned of record or voted by aliens or their representatives, or by a foreign government or representative(s) thereof, or by a corporation organized under the laws of a foreign country? ☐ Yes ☒ No

(f) Is the Filer directly or indirectly controlled: (1) by any other corporation of which any officer or more than one-fourth of the directors are aliens, or (2) by any foreign corporation or corporation of which more than one-fourth of the capital stock is owned or voted by aliens or their representatives, or by a foreign government or representatives thereof. ☐ Yes ☒ No

(g) If any answer to questions (d), (e) or (f) is "YES", attach as Exhibit IX a statement identifying the aliens or foreign entities, their nationality, their relationship to the Filer, and the percentage of stock they own or vote.

11. CERTIFICATION

This report constitutes a material part of any application which cross-references it, and all statements made in the attached exhibits are a material part thereof. The ownership information contained in this report does not constitute an application for, or Commission approval of, any transfer of control or assignment of radio facilities. The undersigned, individually and for the Filer, hereby certifies that the statements made herein are true, complete and correct to the best of Filer's knowledge and belief, and are made in good faith.

WILLFUL FALSE STATEMENTS MADE ON THIS APPLICATION ARE PUNISHABLE BY FINE AND IMPRISONMENT (U.S. Code, Title 18, Section 1001) and/or REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION PERMIT (U.S. Code, Title 47, Section 312(a)(1)).	Date	Filer *(Must correspond with that shown in Item 1)*	Typed or Printed Name
	9/29/95	Columbia Communications Corporation	Kenneth Gross
	Signature 		Title Chief Operating Officer

NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT OF 1974 AND THE PAPERWORK REDUCTION ACT OF 1980

The solicitation of personal information requested in this form is to determine if you are qualified to become or remain a licensee in a common carrier or satellite radio service pursuant to the Communications Act of 1934, as amended. No authorization can be granted unless all information requested is provided. Your response is required to obtain the requested authorization or retain an authorization.

Public reporting burden for this collection of information is estimated to average 2 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Federal Communications Commission, Office of Managing Director, Washington, DC 20554, and to Office of Management and Budget, Paperwork Reduction Project (3060-0105), Washington, DC 20503.

EXHIBIT I

In Columbia Communications Corp., FCC 85-408 (released August 29, 1985), the Commission denied Columbia's application (File Nos. 932/933-DSS-P/L-84) for authority to construct, launch, and operate two hybrid satellites in the domestic fixed-satellite service upon finding that Columbia had failed to establish its financial qualifications.

In Columbia Communications Corp., File No. 932-DSS-P/L-84, slip op. (Common Carrier Bur., released March 7, 1986), the Common Carrier Bureau, citing an outstanding freeze on space station applications for orbital locations between 30° W.L. and 60° W.L., refused to accept for filing an amendment to Columbia's application for a domestic satellite at 45° W.L. that would have converted the proposal to an international satellite application at 49° W.L.

EXHIBIT VI

The Laughton Estate Trust, of which Clifford Laughton is the sole trustee, owns 85 percent of the outstanding shares of Columbia Communications Corporation. The business address for the Laughton Estate Trust is the same as the business address of Columbia Communications Corporation:

1088 Bishop Street
Suite 2912
Honolulu, Hawaii 96813

National Strategies, Inc., a District of Columbia corporation owned entirely by United States citizens, owns 10 percent of the outstanding shares of Columbia Communications Corporation. The business address of National Strategies, Inc., is:

888 Seventeenth Street, N.W.
Twelfth Floor
Washington, D.C. 20006

EXHIBIT VII

Clifford Laughton is the Chairman, Chief Executive Officer and Secretary of Columbia Communications Corporation. Mr. Laughton is also the sole director of Columbia Communications Corporation. Mr. Laughton's address is:

Mr. Clifford Laughton
Chairman and Chief Executive Officer
Columbia Communications Corporation
1088 Bishop Street
Suite 2912
Honolulu, HI 96813

Kenneth Gross is Chief Operating Officer and Treasurer of Columbia Communications Corporation. His business address is:

Columbia Communications Corporation
7200 Wisconsin Avenue
Suite 701
Bethesda, MD 20814

ATTACHMENT 4

SYSTEM MILESTONE DATES

Satellite RFP Issued	January 1996
Satellite Contractor Selected	April 1996
Satellite Contract Executed	June 1996
Satellite Construction Commences	July 1996
Satellite Construction Completed	January 1999
Satellite Launch	April 1999
Commencement of Service	July 1999