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Foreword

This ETSI Technical Report has been produced by the Transmission and Multiplexing (TM) Technical Committee of the European Telecommunications Standards Institute (ETSI).

The document has been published with the aim of improving understanding of the three system concepts proposed for the next generation of high capacity radio systems.

ETSI would welcome comments on the matters raised in this report. These may be sent to the Standards Management Department of the ETSI Secretariat, at the address on the cover, for forwarding to the appropriate technical experts.

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1 Introduction

Three different system concepts for the new generation high capacity DRRS have been proposed:

The main aspects of each of these systems are listed in Annex A, in order to provide a better understanding of commonalities and difference between them.

The document also contains information on relative costs for the proposed system solutions compared to currently used radio systems. These are based on differing assumptions, and do not allow a direct cost comparison between systems A, B, and C.

They are repeated in this document in Annex B, together with the assumptions made for the calculations.

A list of systems parameters and the values which have been proposed for three systems, is attached as Annex C.

The topics mentioned as "under study" identify areas needing further investigation.

2 Consideration regarding the system proposals

2.1 Basic requirements and applications

All three system proposals have been produced based on certain requirements and applications as follows:

System A: The design of this system is primarily aimed at providing a high level of cost-competitiveness with other transmission media such as optical fibres. The use of four carries per transceiver is a large element of this cost-competitiveness. Although the number of available STM-1 channels in the U6 GHz band is less for this system than for the other proposals, the possibility exists of doubling the number of channels if frequency re-use is added when the necessary technology becomes available. This is acknowledged to be about 5 years from now, however.

Straight foward compatibility with existing analogue and digital systems has been considered to have a lower priority than cost-competitiveness. This has lead to the adoption of the non-standard channeling plan.

The system A proposal, also provides for a 2 carrier system operating in the 4 GHz band utilising the 30 MHz channel plan.

System B: The initial requirement for this system was to provide increased cost effectiveness and spectrum utilisation. It was also required to operate in for example, the 4 GHz band on the same hop as existing trunk 140 Mbit/s systems using the same RF branching equipment as a 16 QAM channel. The time schedule for introduction of such a system was also to be as short as possible. The utilisation of existing branching equipment, if available, is a contributor to the cost-effectiveness of the system, together with the transmission of two carries per tranceiver. The system concept was initially aimed at two 140 Mbit/s channels per tranceiver but after the CCITT agreement on the SDH, it was changed to the provision of two STM-1 channels.

The utilisation of frequency re-use is the primary factor which provides the increased spectrum utilisation compared to existing systems, as 64 QAM is the lowest order of modulation of the proposed systems. The achievement of acceptable performance for the system depends on the utilisation of adaptive cross-polar interference canceller (XPIC). With their use, the system proposers are confident that the required performance objectives will be met.

Recent rapid increases in the utilisation of high capacity optical fibre systems for trunk applications has reduced the level of requirements for trunk systems in some countries, and the consideration of compatibility with 16 QAM systems and their RF branching has therefore reduced in importance. However, application in regional networks, where nodal interference effects and limitations on space for antennas are more important, will exist. This type of application is considered by the system proposers to be more suited to 64 QAM, rather than a higher order modulation.

System C: Primary requirements for this system were to provide a cost-effective system whilst retaining a full compatibility with exsting analogue and digital systems operating in bands where 40 MHz channel spacings are utilized.

The proposed arragement of two carriers per transceiver was intended to use 256 QAM for two 140 Mbit/s signals. With the advent of the requiremt to transmit STM - 1 signals, the 512 TCM arrangement was adopted.

The system concept specifically relies on the use of a higher level modulation, rather than frequency re-use to achieve increased spectrum utilisation over existing systems. The reason for this is that the system proposers consider that dependance on XPD, even if a suitable XPIC could be provided, is dangerous because of a lack of reliable experimental data. The higher complexity of the proposed modulation scheme is considered to be achievable with existing technology using digital demodulation and equalisation techniques.

Moreover, the choice of TCM modulation together with the dual carrier transmission technique stems from the requirement that the out of band power emission should comply the I.T.U. and CCIR limits.

Annex A
Technical Concepts (page 1)

	System A	System B	System C
Frequency Bands	4GHz to CCIR 382 (29 MHz spacing) 3.8 - 4,2 GHz U6GHz to CCIR 384	4GHZ to CCIR 635 (10 MHz raster) 3.4 - 4.2 GHz U6GHz 11 GHz to CCIR 387	4GHz to CCIR 635 3.6 - 4.2 GHz U6 GHz to CCIR 384 11 GHz to CCIR 387
RF channel spacing	4 GHz : 58 MHz U6GHz : 100 MHz	80 MHz	40 MHz
Transmission capacity per transceiver	4 GHz : 2 x 155Mbit/s U6GHz : 4 x 155 Mbit/s	2 x 155Mbit/s	2 x 155 Mbit/s
RF channel arrangement (see fig.1 for U6GHz band)	Alternate, possibility extended to co-channel	co-channel	Alternate
Total Band Capacity U6GHz Band (for no protection channel) 4GHz Band (for no protection channel)	12 x 155 Mbit/s 24 x 155 Mbit/s 6 x 155 Mbit/s 12 x 155 Mbit/s	16 x 155 Mbit/s 14 x 155 Mbits	16 x 155 Mbit/s for all three Frequency Bands
Compatibility with analogue channels on the same route	4 GHz : yes, with 1260 v.f., adj. ch. x pol U6 GHz : Not compatible	4 GHz : Not relevant U6 GHz & 11 GHz : Yes for ≥ 80 MHz R.F channel separation	40 MHz alternate adjacent channel
Compatibility with 16 QAM systems on the same route	with a specific arrangement (see figure 2)	80 MHz separation between 16 QAM carrier and centre frequency for new channels	40 MHz separation between 16 QAM carrier and centre freq for new chans For 8-Fchans of U6GHz band suitable TX & RX filtering have to be used

Annex A
Technical Concepts (page 2)

	System A	System B	System C
Compatibility with analogue/digital systems at radio mode	To be examined	See note 4 of Annex 3	See note 5 of Annex 3
Number of carriers per transceiver	4 GHz : 2 U6 GHz : 4	2	2
Baseband Interfaces G.707 STM-1 Electrical G. 703	 155 Mbit/s 140 Mbit/s	 155 Mbit/s 140 Mbit/s	 155 Mbit/s 140 Mbit/s
Utilisation for SOH Bytes (1) for system international purpose e.g ATPC (2) For wayside Traffic	Our reference to document TM4 89/83	TM4 89/83	TM4 89/83
Modulation method	256 QAM	64 QAM	512 TCM-4D (TCM= Treillis coded modulation)
Type of FEC	Serial coding	Serial coding (Modulation Matched Coding)	TCM
Gross bit rate per sub carrier	163.2 Mbits Without SOH Utilisation	166 Mbit/s Approx.	155.52 Mbit/s
Roll-off factor	0.25	0.35 Approx.	0.2 Approx.
Use of ATPC (automatic TX power control)	Yes	Optional	Optional in regional applications typically foreseen for hops longer than 30 Km.
Type of Diversity Reception	Space diversity, > 35 Km Freq. div. optional	Space diversity, > 30 Km Freq. div. optional	diversity, ≥ 30 Km (space or frequency)

Annex A
Technical Concepts (page 3)

	System A	System B	System C
Type of combiner	IF (one common for all sub-carriers per Rx)	IF (one common for the 2 sub-carriers per Rx)	IF (one common for 2 s/carriers per Rx)
XPIC (cross-polar interference canceller)	Only in case of extension to co-chan plan)	Yes	No
Protection channel switching	Optional for 1 to 4 sub-carriers	Optional per sub-carrier	Per sub-carrier
System available for Network Introduction	Development depending on market requirements (after 1992)	1992, 1st quarter	1992

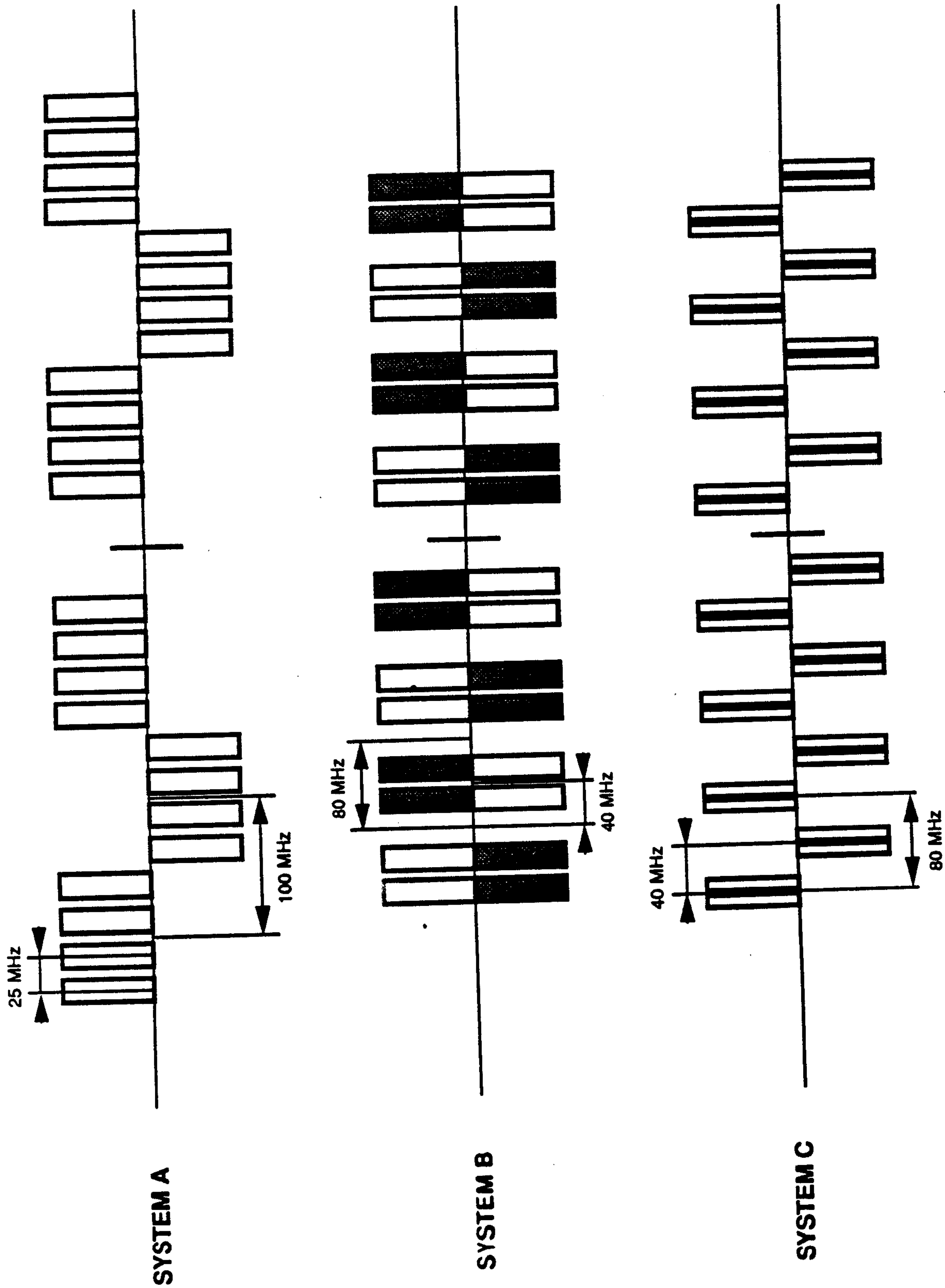


FIGURE 1: RF CHANNEL ARRANGEMENTS FOR THE UPPER 6GHz BAND

16 QAM+256 QAM: 10x140 Mbit/s OR 2x140 Mbit/s +8x155 Mbit/s

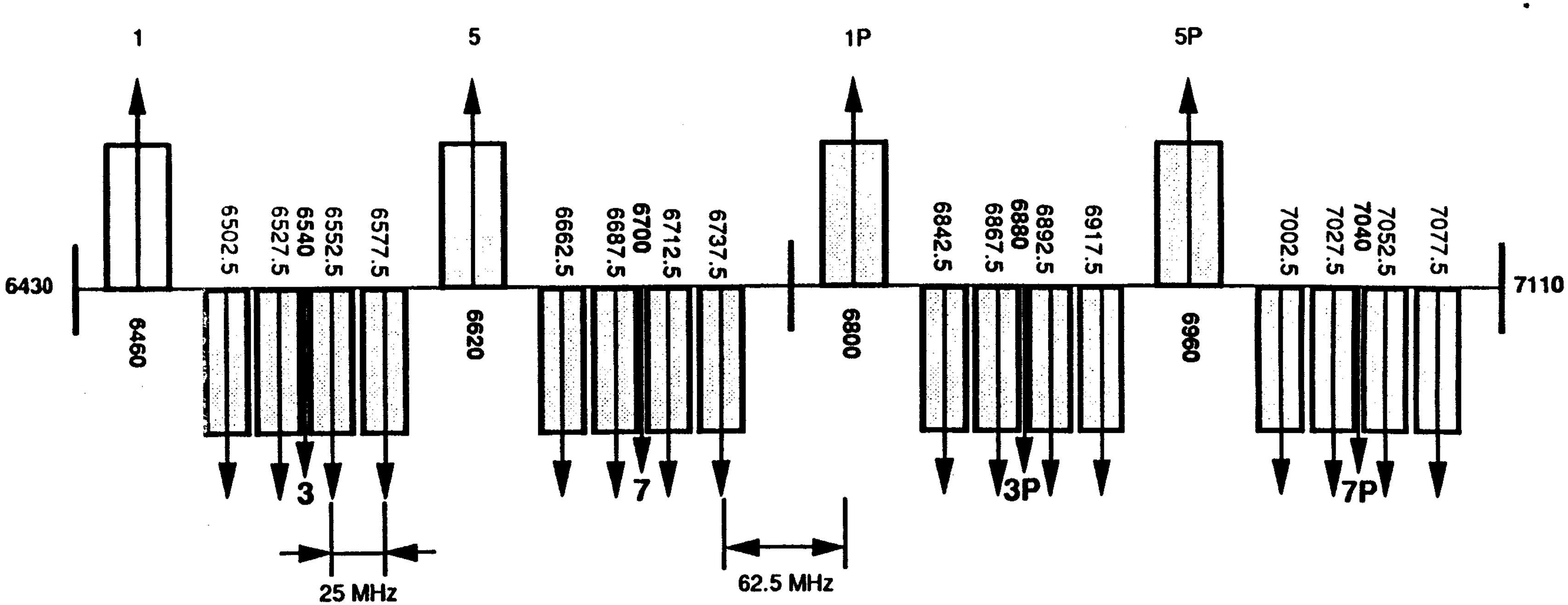


FIGURE 2: ANALOGUE/DIGITAL USAGE FOR SYSTEM A

Annex B: Relative cost indications.

System A

Modulation and capacity	Relative costs for 140 Mbit/s (against actual for 16 QAM)	Cost apportionment	
		RF	Modem
16 QAM	1	71%	29%
256 QAM 4x155 Mb/s	0.6	53%	47%
256 QAM 2x155 Mb/s	0.74	64%	36%

This figure refers to a completely utilised frequency band with interleaved channel operation without a protection channel. They include RF banching but not antennas and feeders. One combiner for up to four sub-carriers has been assumed. For the 16 QAM situation, it is assumed that only 50% of the installed systems utilise space diversity. It can be assumed that a 155 Mbit/s interface will produce the same results as for a 140 Mbit/s interface.

System B

For a one hop 155 Mbit/s radio link there will be a cost reduction of about 50% relative to current 16QAM equipment in the long distance network. A further reduction to about 40% may be realised for hops that are shorter than 30 km in the regional network operating without space diversity.

These figures refer to a completely utilised frequency band, and include antennas and feeders.

An economy assessment for the main equipment parts of the new system with reference to the current utilized 16 QAM-system is given in the table below

	DRRS 140/3900-16 (reference)*	DRRS 2x155/3900 -6400
Microwave transceiver (including space diversity and power supply for complete system)	45%	40%
Modem (including BB-processing)	30%	35% (with XPIC) 30% (without XPIC
Protection Switching (for fully equipped system 6+1/12+2)	10%	13%
Other (channel filters, RF connection, waveguide, antenna, racks)	15%	15%
Σ	100%	103% (with XPIC) 98% (Without XPIC

* current system, interleaved pattern

System C

Equipment	140 Mbit/s 64 QAM system (reference)	2x155 Mbit/s 512 TCM-4D C1 C2
Transceiver Modem+ Baseband Others + switching	45 25 30	45 x 1.2 = 55 25 x 0.9 x 2 = 45 30 = 30
Total	100	*130

* 65 for each sub-carrier

C1 = coefficient due to complexity (also considering the up-dating of technology

C2 = coefficient due to number of units

These figures apply for a completely utilised frequency band, including protection channel in both cases. The RF branching is included, but not the antennas and feeders.

Annex C
Technical Parameters

Parameter	System A	System B	System C
1. Capacity of the Transceiver	4 GHz : 2 x 155 Mbit/s U6 GHz : 4 x 155 Mbit/s	4 GHz : 2 x 155 Mbit/s U6 GHz : 4 x 155 Mbit/s 11 GHz : 2 x 155 Mbit/s	4 GHz : 2 x 155 Mbit/s U6 GHz : 4 x 155 Mbit/s
2.1 Frequency Bands	4 GHz : CCIR Rec. 382 U6 GHz : CCIR Rec. 384	4 GHz : CCIR Rec. 635 U6 GHz : 11 GHz : CCIR Rec.387	4 GHz : CCIR Rec. 635 U6 GHz : CCIR Rec. 384 11 GHz : CCIR Rec.387
2.2 Channelling Arrangements	4 GHz : Fig. 1 U6 GHz : Fig.2	4 GHz : Fig.3a U6 GHz : Fig. 3b	4 GHz : Fig. 4 U6 GHz : Fig. 5 11 GHz : Fig 6
3. Applications	Trunk Network Regional Network	Trunk Network Regional Network	Trunk Network Regional Network
4.1 Performance Objective	High Grade : Without Space Div. ≤ 35 Km Without Space Div. ≤ 60 Km	High Grade : Without Space Div. ≤ 30 Km Without Space Div. ≤ 60 Km	High Grade : Without Space Div. ≤ 30 Km Without Space Div. ≤ 60 Km
4.2 Performance Prediction Model	Under study, according to ETSI/TM4-04 project	Under study, according to ETSI/TM4-04 project	Under study, according to ETSI/TM4-04 project
5 Compatibility			
5.1 Same Route Analogue	4 GHz : 1260 ch. , adj. R.F ch. crosspol	4 GHz : Not Relevant U6 GHz : 2 700 ch. , R.F separation ≥ 80 Mhz	Refer to Note 1
5.2 Same Route Digital	Existing 16 QAM 140 Mbit/s U6 GHz	4 GHz and U6 GHz, Existing 16 QAM, RF separation ≥ 80 MHz	existing 16QAM 140Mbit/s
5.3 Modal Analogue/Digital	Yes, criteria under Study	See note 4 of Annex 3	See note 5 of Annex 3

Annex C
Technical Parameters

Parameter	System A	System B	System C
6.1 Type of installation	Indoor	Indoor	Indoor
6.2 Climate and E.N.C	In accordance with European Standards	In accordance with European Standards	In accordance with European Standards
7. Block Diagram	Fig. 7	Fig. 8	Fig. 8
8. General Characteristics			
8.1 Number of Carriers per Transceiver	4 GHz : 2 U6 GHz : 4	4 GHz : 2 U6 GHz : 2	4 GHz : 2 U6 GHz : 2 11 Ghz :
8.2 Intermediate frequencies	150 MHz + (Nx12.5)MHz where N = -3, -1, +1, +3	(140-17)MHz (140-17)MHz	(70 ± 10.5)MHz
8.3 Local Oscillator Arrangement	U6 GHz : Fig. 9	As per CEPT Rec. T/L04-04 Refer to Note 2	As per CEPT Rec. T/L04-04 Refer to Note 2
9. Baseband Parameters			
9.1 Bit Rates	G. 707 STM-1 : 155 Mbit/s G. 703 STM-1 : 140 Mbit/s	G. 707 STM-1 : 155 Mbit/s G. 703 STM-1 : 140 Mbit/s	G. 707 STM-1 : 155 Mbit/s G. 703 STM-1 : 140 Mbit/s
9.2 Electrical Interface	C.M.I as defined by CCITT S.G. XVIII	C.M.I as defined by CCITT S.G. XVIII	C.M.I as defined by CCITT S.G. XVIII
9.3 Optical Interface	Yes, in the longer term	Yes, in the longer term	Yes, in the longer term

Annex C
Technical Parameters

Parameter	System A	System B	System C
10. Transmitter Characteristics			
10.1 Transmit Output Power	U6 GHZ : 34 dBm Reference Point A' 28 dBm per sub-carrier	4 GHz & U6 GHz Reference Point A' 28 dBm per sub-carrier	All bands Reference Point B' Class 1 : S.S Amplifer 27 dBm per sub-carrier Class 2 : IWI Amplifier 30 dBm per sub-carrir
ATPC Range	15 dB	≤ 10 dB	≤ 10 dB
10.2 Limitation of Emitted spectrum	U6 GHz : Fig. 10 Reference B'	Fig. 21	All bands : Ref. point B' Fig.11a Normal ch.
10.3 Limitation of spurious Emission	TxLO < -70dBm Reference Point B'	Under study	Fig.11b Inner edge 8&1' -70dBm
10.4 Out of band power emission (XX)	Under study	Under study	≤ 0,5% of total 2xSTM-1 emitted power
10.5 Return Loss	26dB at point C'	26dB at point C	26dB at point C'
11 Receiver Characteristics			
11.1 Image Rejection	Under Study	Under Study	Under Study
11.2 Limitation of surplous Signals Generated by the receiver	Under Study	Under Study	Under Study
11.3 Imput Level Range per sub-carrier	BER < 10^{-3} : -67 dBm to -16 dBm BER < 10^{-6} : -61 dBm to -20 dBm Reference point A	BER < 10^{-3} : -72 dBm Lower Limit BER < 10^{-6} : -66dBm Lower Limit Upper limited, under study Reference point B	BER < 10^{-3} : -68 dBm to -20 dBm BER < 10^{-6} : -68 dBm to -23 dBm Refernce point B
11.4 Return loss	26 dB at point C	26 dB at point C	26 dB at point C

(XX) Note : according to Radio regulation (art. 1 No 147) and CCIR Rec. 328

Annex C.
Technical Parameters

Parameter	System A	System B	System C
12. Transmitter/Receiver Performance			
12.1 BER vs Receice-Signal Level	Fig.1 2 (Reference point A)	BER < 10^{-3} : -72 dBm (Reference point B) BER < 10^{-6} : -68 dBm	Fig.20 (reference point B)
12.2 Residual BER	< 10^{-10}	< 10^{-10}	< 10^{-10}
12.3 Interference Sensitivy	I.R.F = 50 dB for crosspolar channel	Under study	Fig 1 3 Co-channel Fig 1 4 Adj. channel
12.4 Distortion sensitivity (Signatures)	Fig 1 5 BER = 10^{-3}, Simulated Signature Min. and Non Min. Phase 6.3 nsec.	BER = 10^{-3} Width ± 16 MHz per carrier Min. and Non Min. Phase 6.3 nsec	Fig. 1 6 BER = 10^{-3} and BER = 10^{-6} Min. and Non Min. Phase 6.3 nsec
13. Diversity Systems	For space diversity : If combiner common to all sub-carriers	For space diversity : If combiner common to both sub-carriers	Space diversity : spacing ≥ 5m Freq. diversity : in band or out of band
14. XPIC Systems	taking into account an XPD of 25 dB for 80% of the time, objective XPIC improvement = 20 dB in non-fading conditions	XPIC improvement factor, ≥ 18 dB Under non fading condition	Not Applicable
15. Branching/Antenna/Feeder systo	Fig. 1 7 U6 GHz, whithout Freq. re-use Fig. 1 8 U6 GHz, with freq. re-use	Fig. 1 9	As per CEPT Rec. I/L 04-04 Refer to Note 3
16 TMN Interfaces	Under study	Under study	Under study

Annex C

NOTE 1: Compatibility requirements on the same route

The compatibility of system C with analogue and digital systems has been examined with the following input parameters:

- Output power of the 2 x 155 Mbit/s system P_{dTx} = 30 dBm[1)]
- Output power of a 1800 t.c. analogue system P_{aTx} = 37 dBm
- Output power of a 2700 t.c. analogue system P_{aTx} = 40 dBm
- XPD (Cross Polar Discrimination) = 28 dB

Noise interference level:

a) 2 x 155 Mbit/s 512 TCM ----> analogue radio system

Assuming the output RF spectrum mask reported in Fig. 1a), the following values have been evaluated for the noise introduced into the adjacent (40 MHz) cross-polar analogue system:

< 3 pWOp for a 1800 t.c. system

< 8 pWOp for a 2700 t.c. system

So in every case well within the objective of 10 pWOp specified in CEPT recommendation TM4/04 for the compatibility between a 1800 t.c. and a 140 Mbit/s 64 QAM system.

b) Analogue FM/FDM system ----> 2 x 155 Mbit/s 512 TCM

This case is less severe than the previous one and the level of the interference is so low with respect to the digital signal (C/I = 70 dB) to cause no degradation on the 2 x 155 Mbit/s system.

Frequency separation	Isolation for D to A interference	Isolation for A to D Interference	
		FFM=30 dB	FFM=40 dB
MHz	dB	dB	dB
0	55	61	71
20	56	72	82
40	54	47	57
60	2	-9	+1
80	-43	-56	-46

(FFM= Flat fade margin of digital link)

1) Referred to the class 2 transmitter

NOTE 2: Local Oscillator Arrangement

It is recommended for all bands considered that the LO frequencies for both transmitters and receivers should be arranged so that for channels in the lower half of each half of the band the frequency is higher than the channel-assigned frequency, and for channels in the upper half of each half band the LO frequency is lower than the channel-assigned frequency.

NOTE 3: Branching/Feeder/Antenna Requirements

The branching/feeder and antenna system utilised by the system must respect the following specification as measured on a real hop without any fading.

Cross-Polar Discrimination (XPD)

A minimum XPD of 28 dB is required.

Intermodulation Products

Intermodulation products that may arise within the antenna/feeder/branching system about - 106 dBm will increasingly degrade the RSL/BER characteristics. The level of intermodulation products should therefore be carefully controlled.

Interport Isolation (IPI)

A minimum value of 40 dB is required for each antenna

NOTE 4: Compatibility considerations for system

a) Relevant system parameters

Digital system:	2 x 155 Mbit/s transmit spectrum: output power per carrier:	 figure 22 28 dBm
Analogue system:	2700 voice channels transmit power + 43 dBm	

b) Interference for adjacent channel operation

The following interference levels result for parallel operation in the highest base band channel of the analogue system:

Channel separation	MHz	60	80
Noise power		pWOp 16	<0,1

For the less critical case of analogue into digital interference the following values for C/I result:

Channel separation	MHz	60	80
C/I	dB	66	123

c) Nodal interference

Nodal interference considerations are based on a permissible noise level in the analogue system of 10 pWOp and a maximum threshold degradation for the digital system of 1 dB (minimum C/I = 27 dB).

The required isolation values (to be provided by antenna angular discrimination) are given below versus carrier separation assuming identical path length and antenna gain for the interfering links.

NOTE 5: Compatibility between co-channel analogue/digital systems at radio nodes

The following hypotheses are assumed:

* Nominal received signal level	(2xSTM-1) : -35dBm - ATPC (dBm/carrier
*	(2700 tch): -22 dBm
*	(1800 tch): -25 dBm
* Acceptable BER 10^{-3} threshold degradation	(2xSTM-1) : δ thr = 2 dB
* Acceptable additional noise level on analogue systems	: 10 pW0p

The following compatibility cases have been examined

a) 2700 chs analog <---> 2 x 155 Mbit/s 512 TCM

b) 1800 chs analog <---> 2 x 155 Mbit/s 512 TCM

c) 140 Mbit/s 16 QAM <---> 2 x 155 Mbit/s 512 TCM

d) 2 x 155 Mbit/s 512 TCM <---> 2 x 155 Mbit/s 512 TCM

The results show that without ATPC the minimum antenna discrimination (for channels at the same frequency and same polarization) should be (dependently of the case) between 62 and 69 dB.

With present parabolic antennas this value is achieved at an angle between 85° - 90°.

In case ATPC is used the antenna discrimination can be reduced of about 5 dB.

4 GHz FREQUENCY BAND: 3.8 - 4.2 GHz (CCIR Recommendation 382-4) 29 MHz SPACING

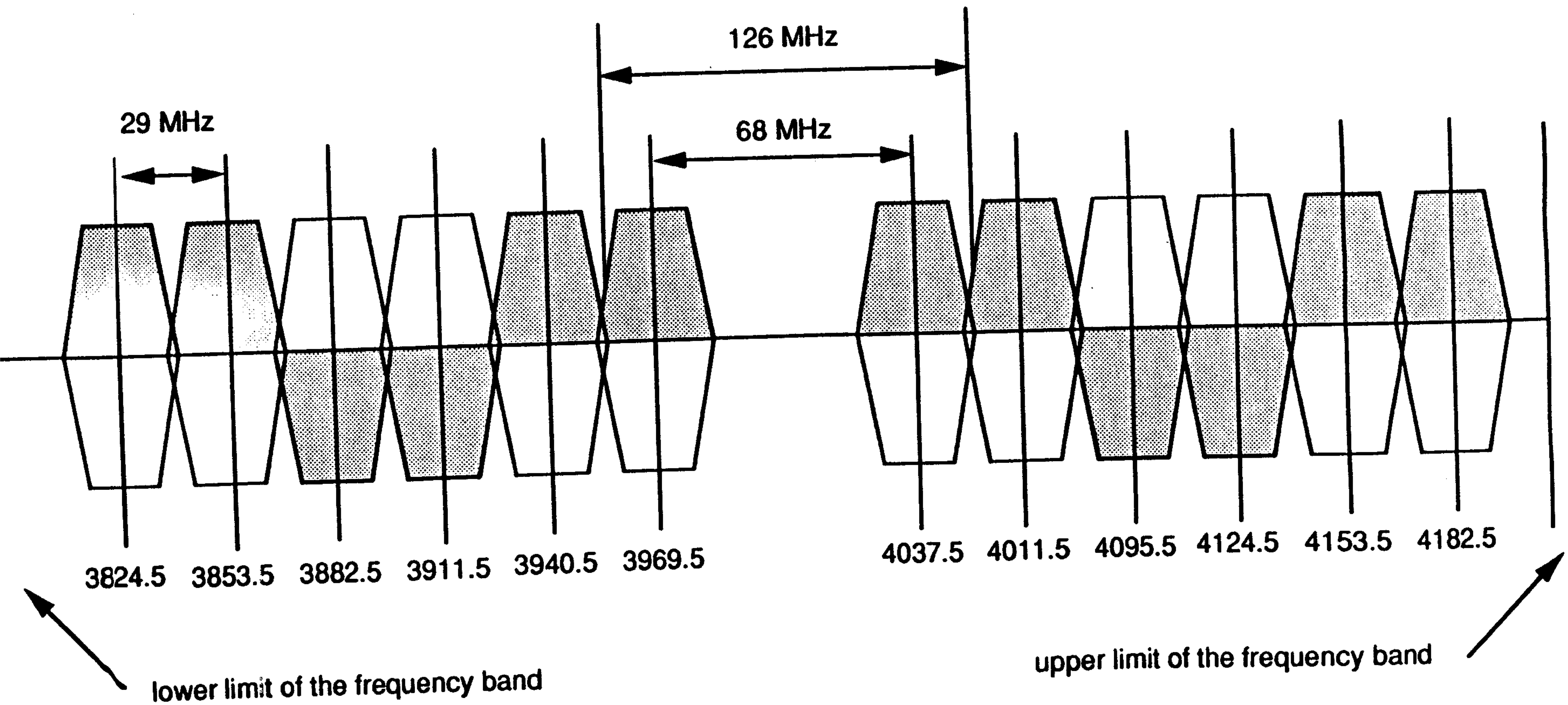


FIGURE 1

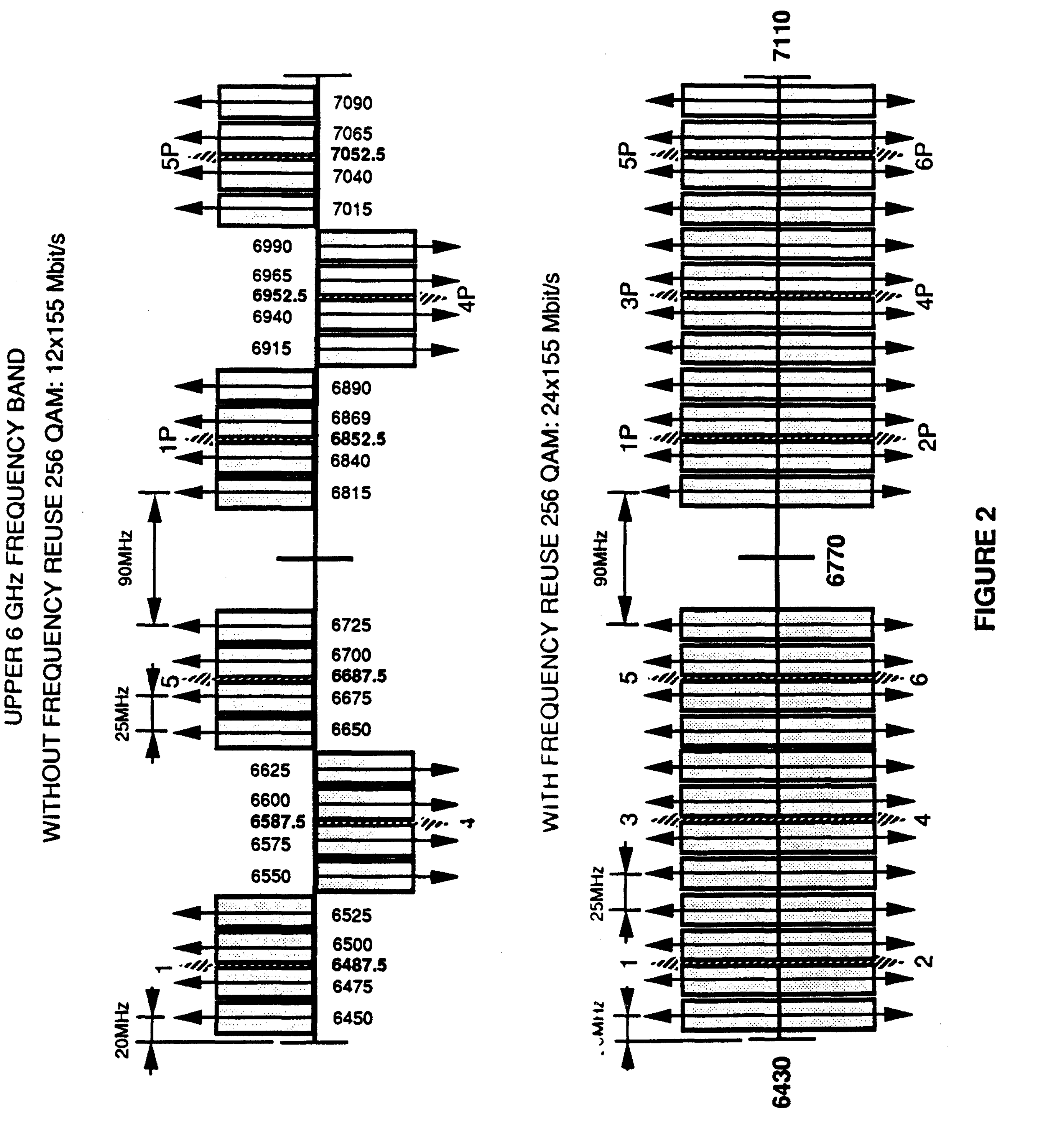
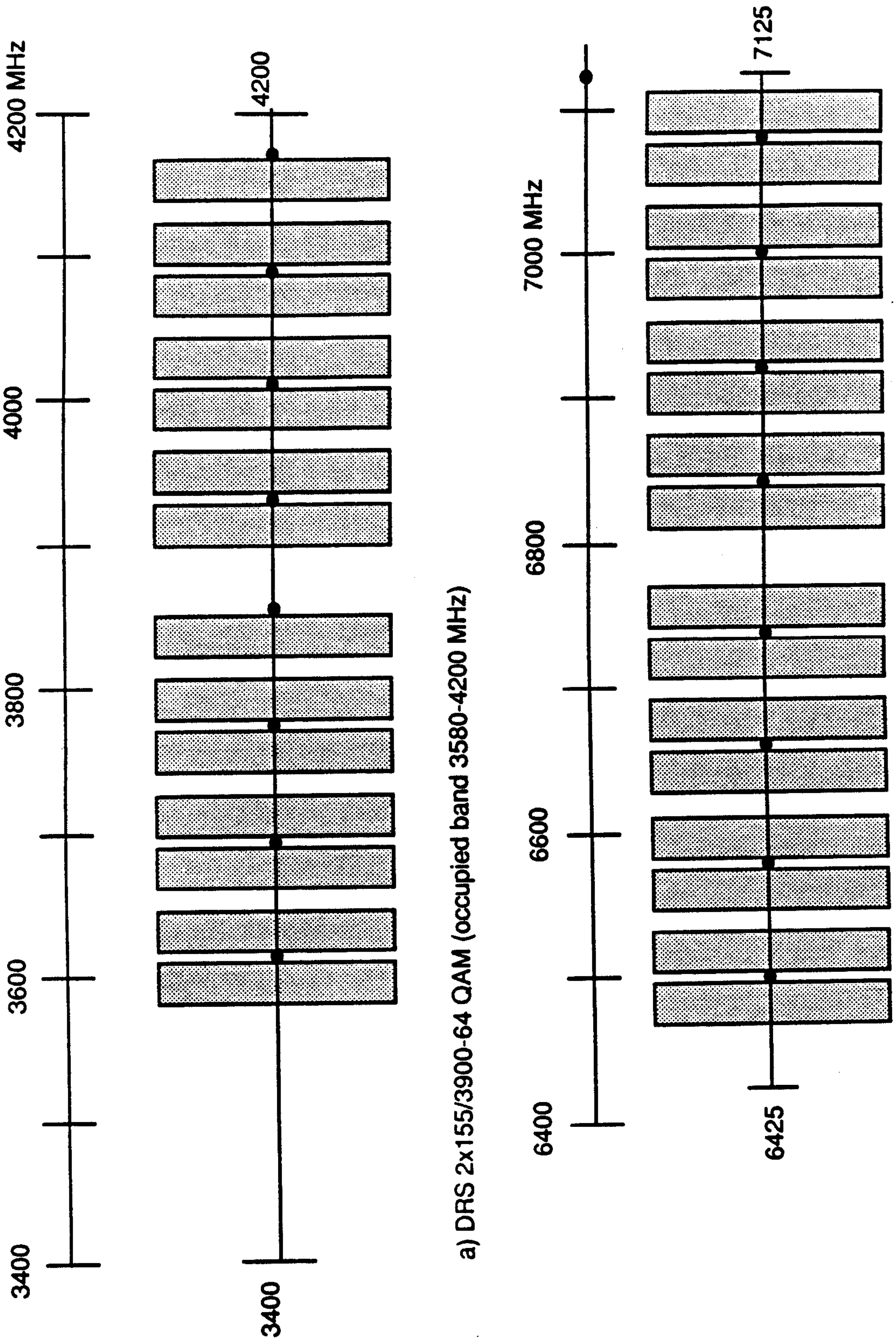

UPPER 6 GHz FREQUENCY BAND
WITHOUT FREQUENCY REUSE 256 QAM: 12x155 Mbit/s
20MHz
25MHz
90MHz
6450
6475
6487.5
6500
6525
6550
6575
6587.5
6600
6625
6650
6675
6687.5
6700
6725
6815
6840
6852.5
6869
6890
6915
6940
6952.5
6965
6990
7015
7040
7052.5
7065
7090
1
5
1P
5P
4P
WITH FREQUENCY REUSE 256 QAM: 24x155 Mbit/s
6430
6770
7110
1
2
3
4
5
6
1P
2P
3P
4P
5P
6P
25MHz
90MHz

FIGURE 2



a) DRS 2x155/3900-64 QAM (occupied band 3580-4200 MHz)

b) DRS 2x155/6700-64QAM BAND EDGES ACCORDING TO RR8-125

FIGURE 3: CHANNEL ARRANGEMENTS FOR SYSTEM B

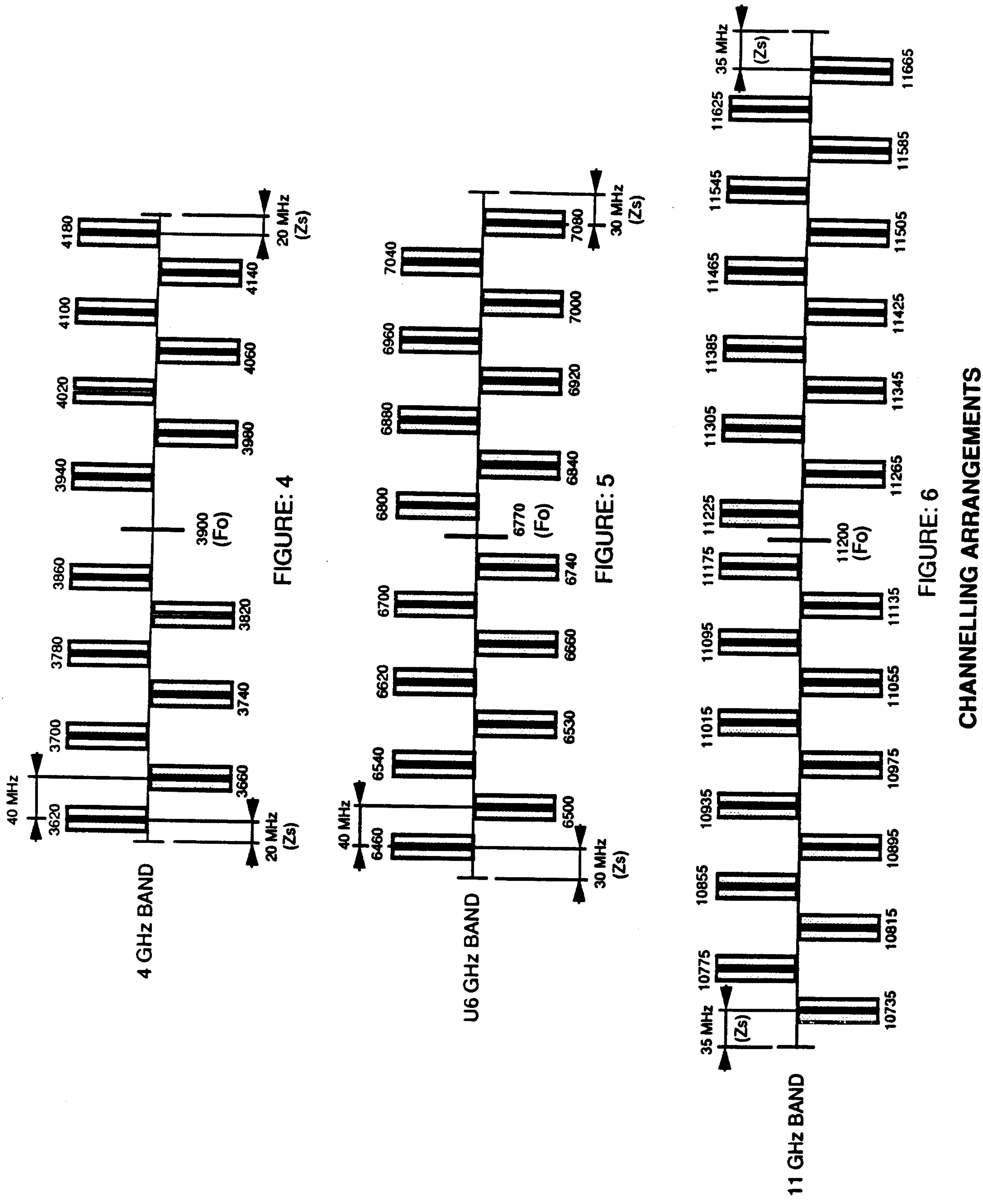
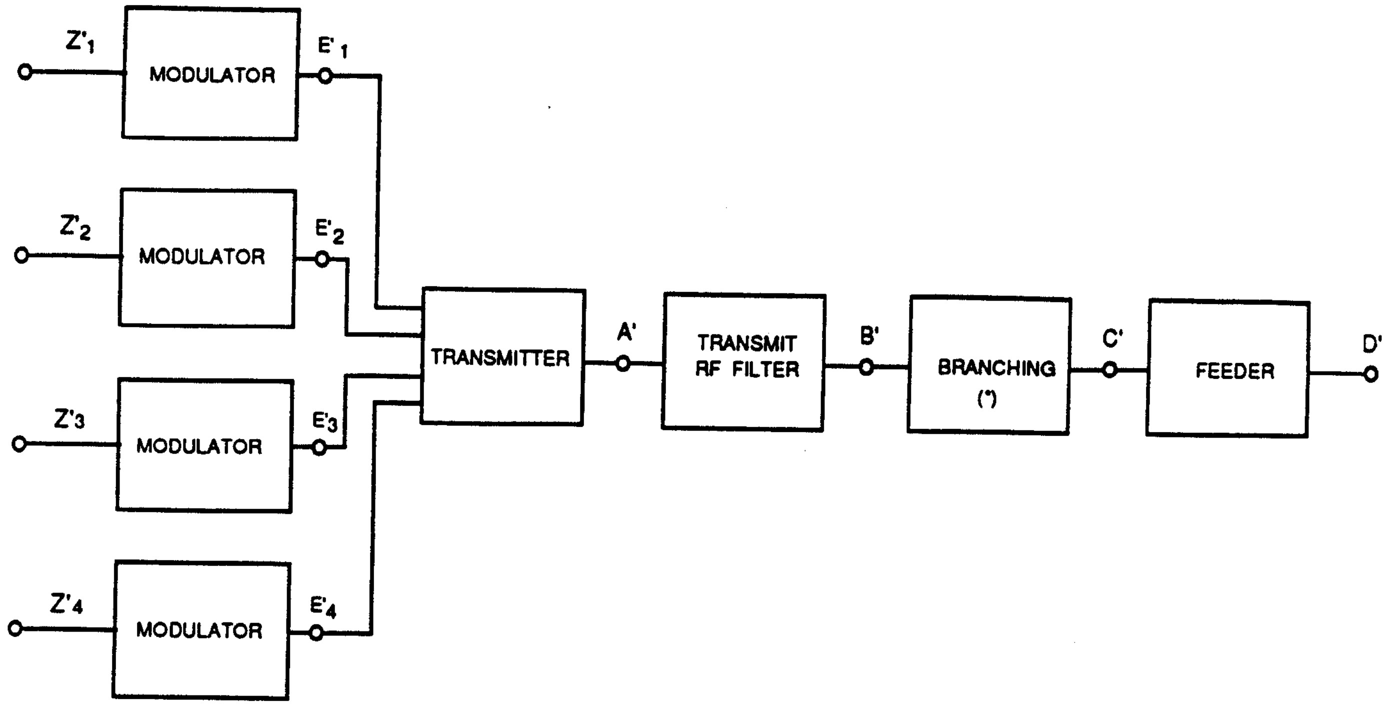


FIGURE: 4

FIGURE: 5

FIGURE: 6

CHANNELLING ARRANGEMENTS



A 155 Mbit/s INTERFACE IS USED AT Z_1, Z_2, Z_3, Z_4 POINTS AND Z'_1, Z'_2, Z'_3, Z'_4 POINTS

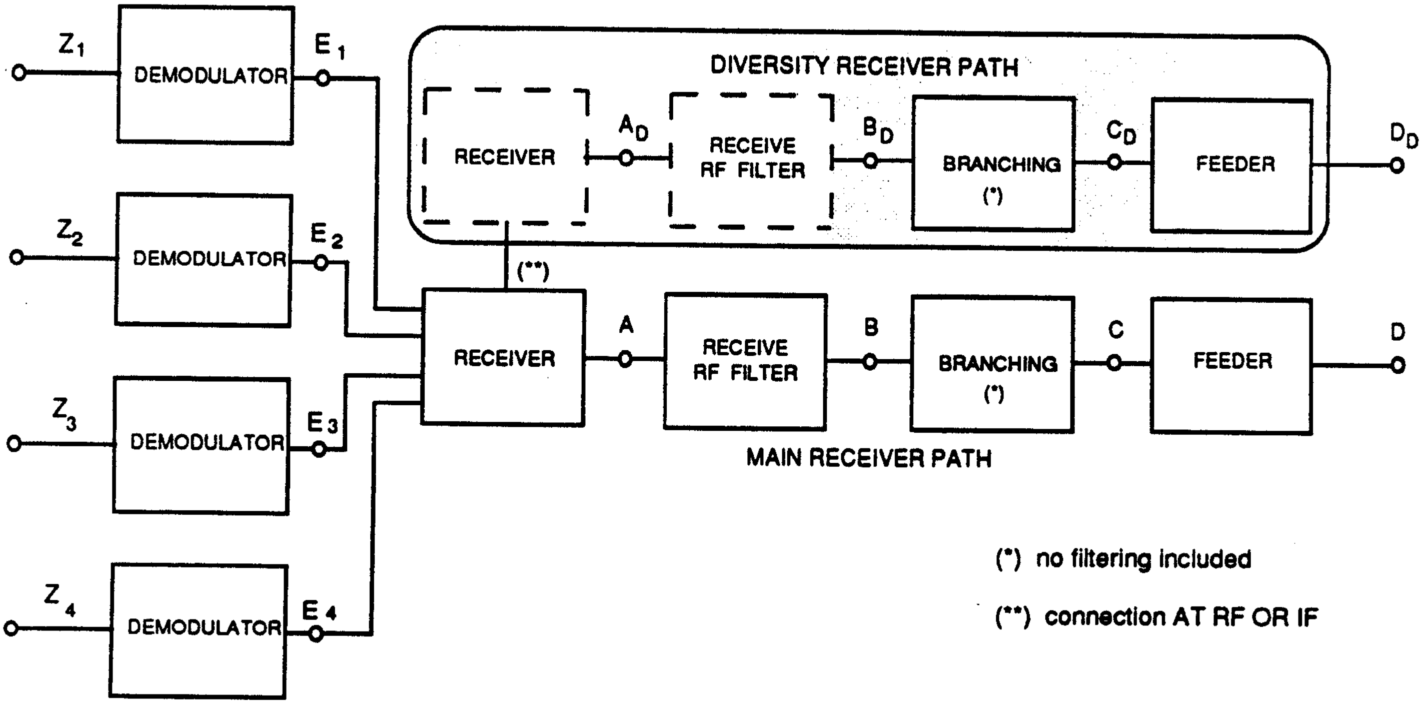
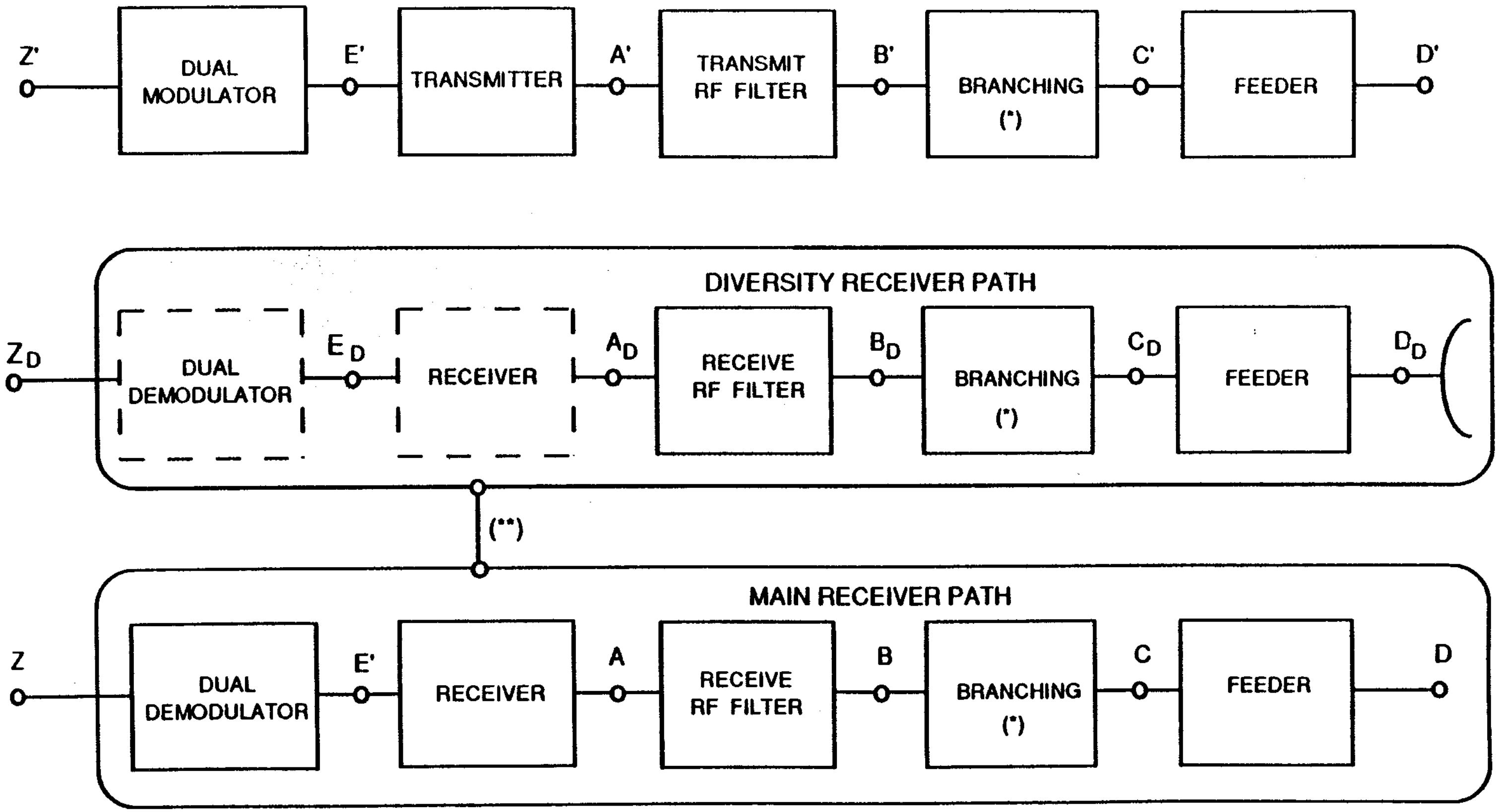


FIGURE 7: BLOCK DIAGRAM (4 CARRIER 256 QAM)



(*) no filtering included

(**) The connection may be made at RF, IF or baseband

FIGURE 8: TRANSMITTER AND RECEIVER BLOCK DGM

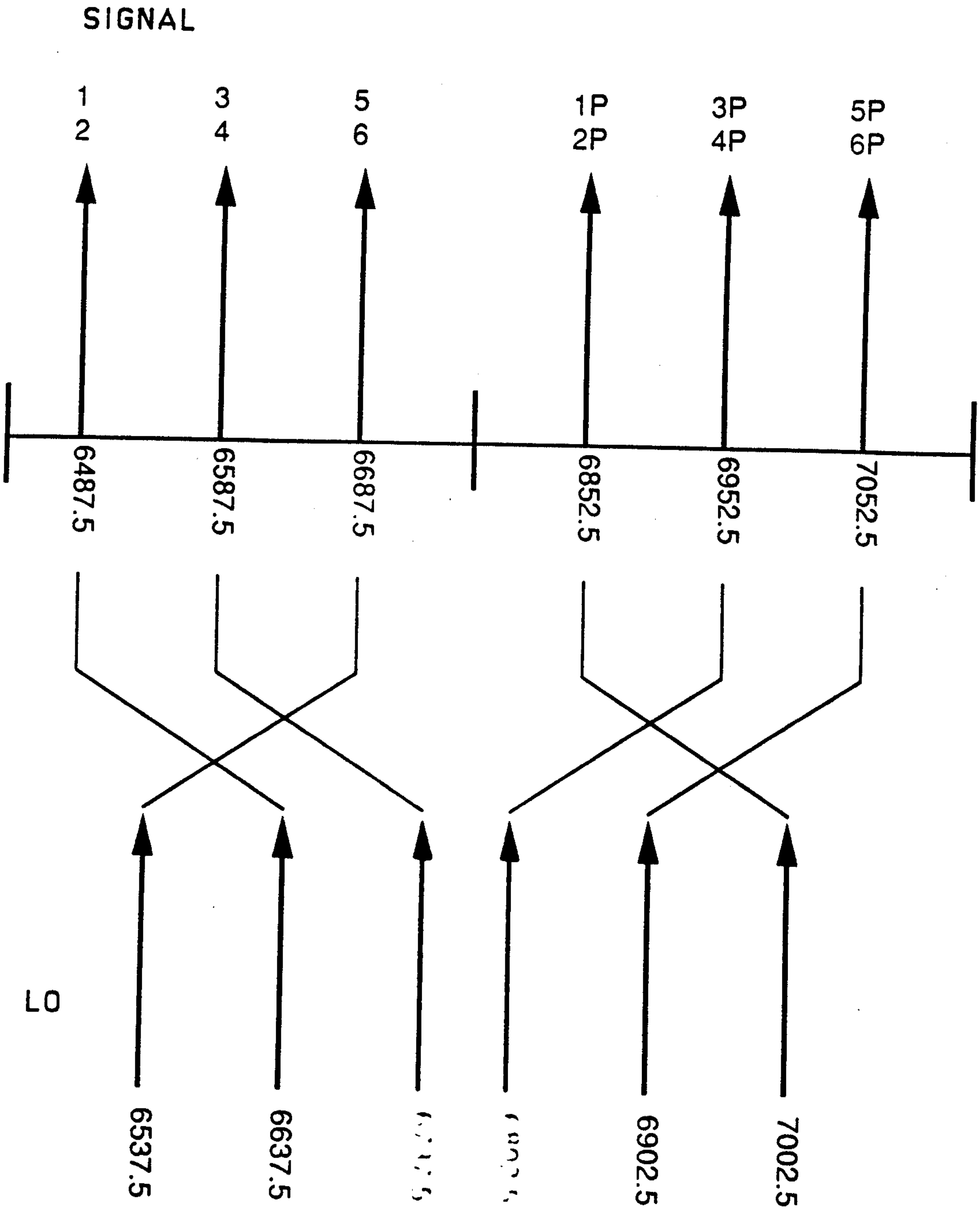


FIGURE 9: UPPER 6 GHz FREQUENCY BAND LO FREQUENCY ARRANGEMENT

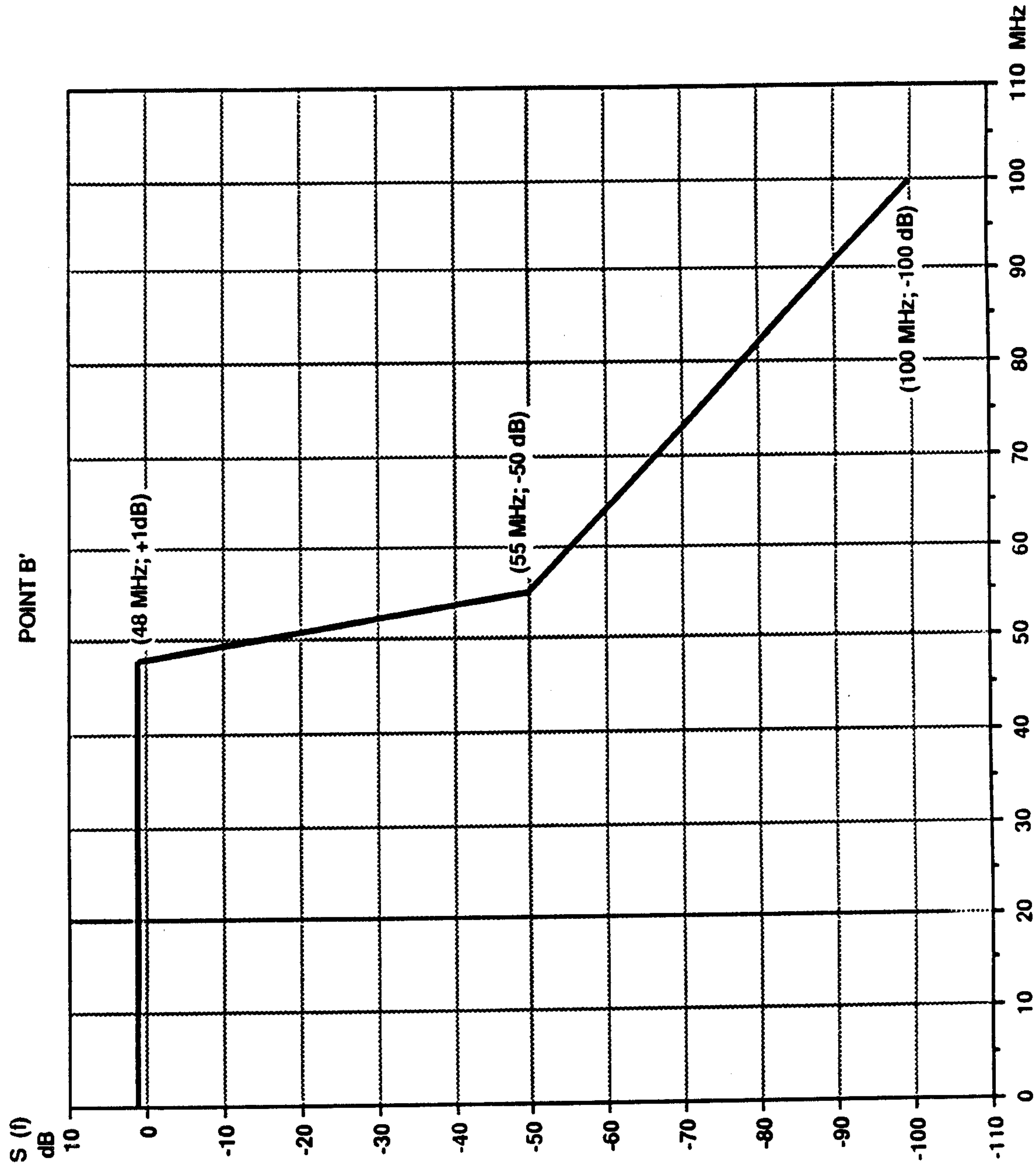


FIGURE10: POWER SPECTRAL DENSITY MASK REFERRED TO THE CHANNEL CENTRAL FREQUENCY

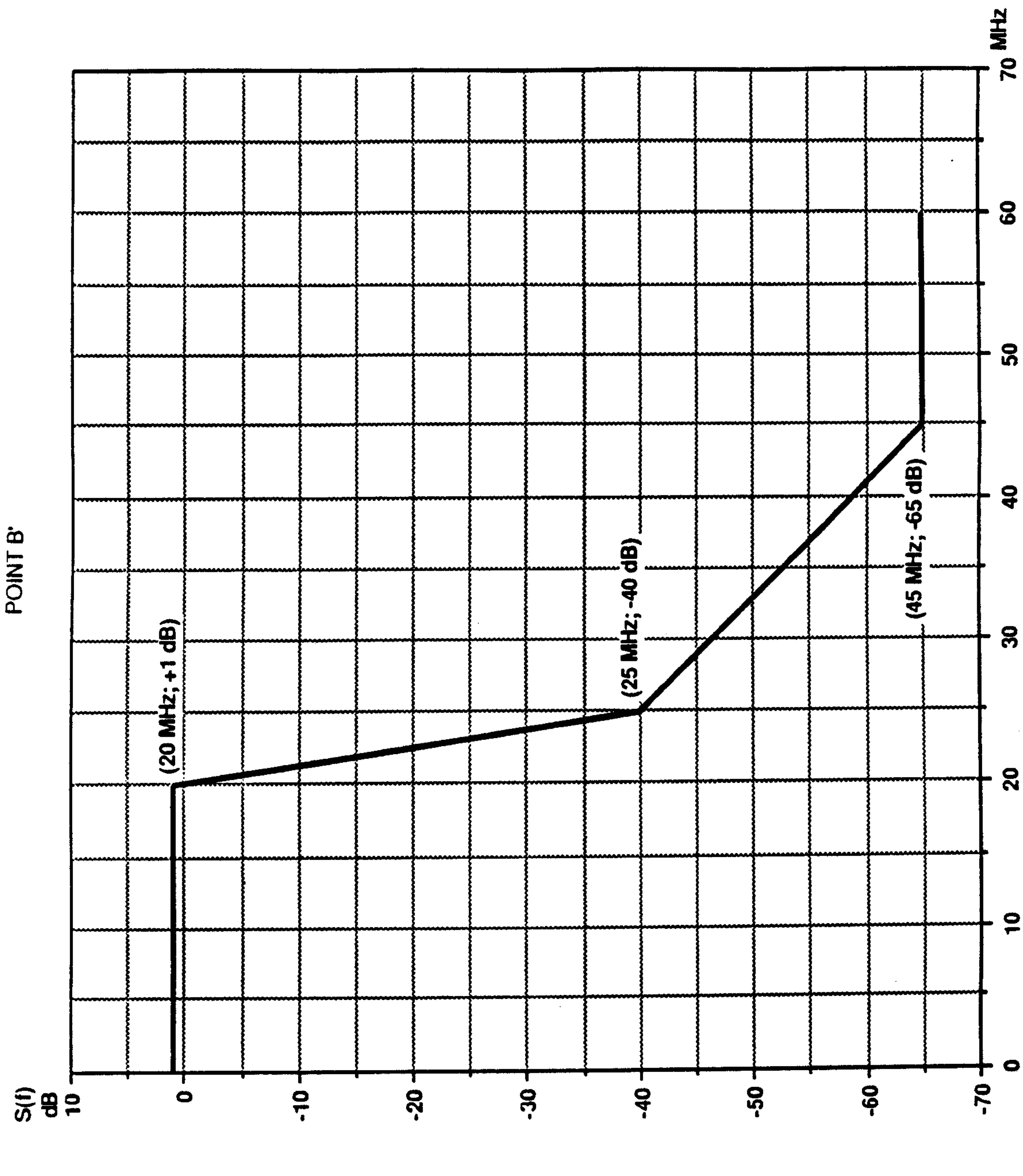


FIGURE 11a: POWER SPECTRAL DENSITY MASK REFERRED TO THE POWER DENSITY AT THE CHANNEL CENTRAL FREQUENCY

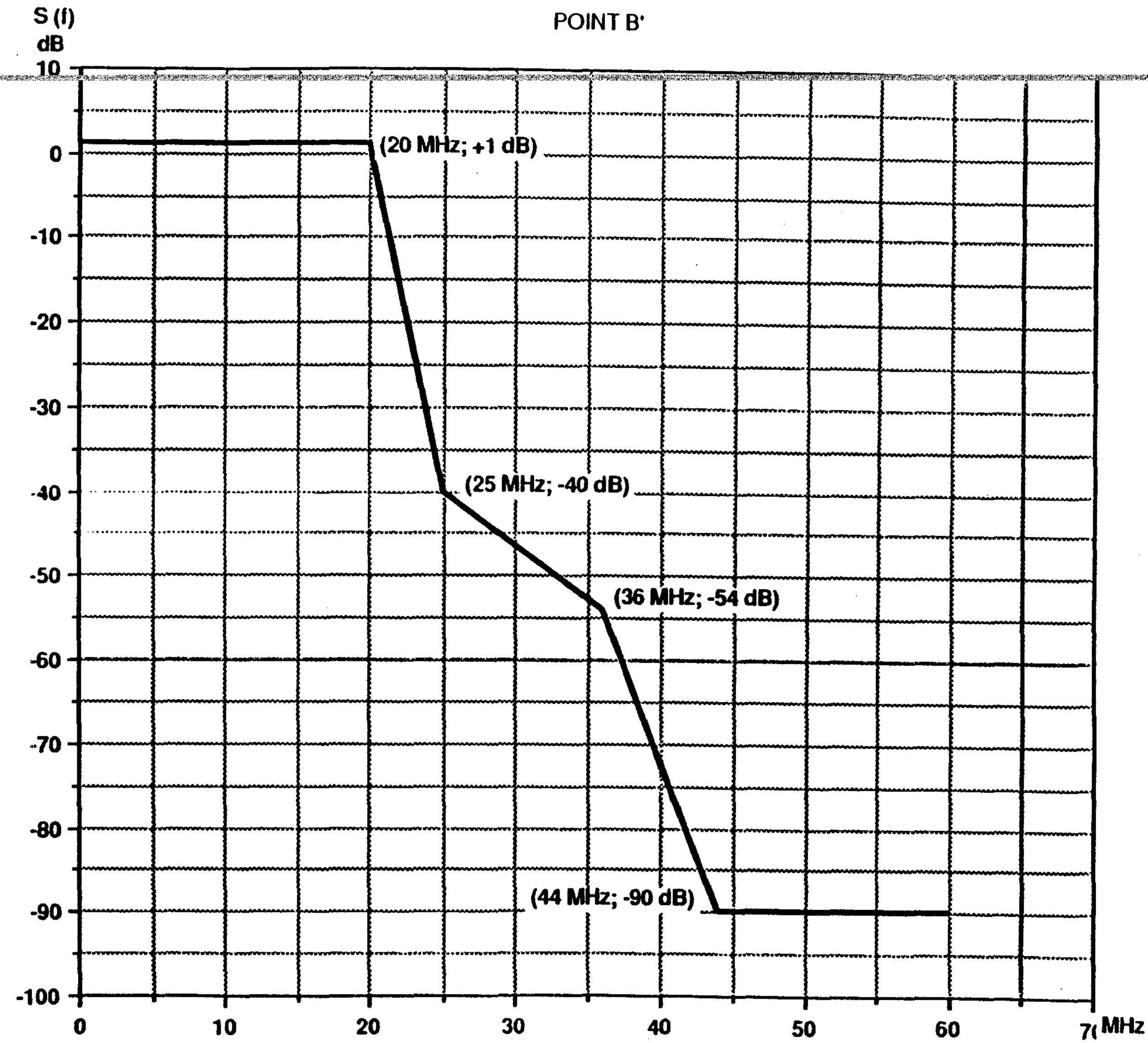


FIGURE 11b: POWER SPECTRAL DENSITY MASK REFERRED TO THE POWER DENSITY AT THE CHANNEL CENTRAL FREQUENCY FOR INNER EDGE OF CHANNELS 8 AND 1' (U6 GHz)

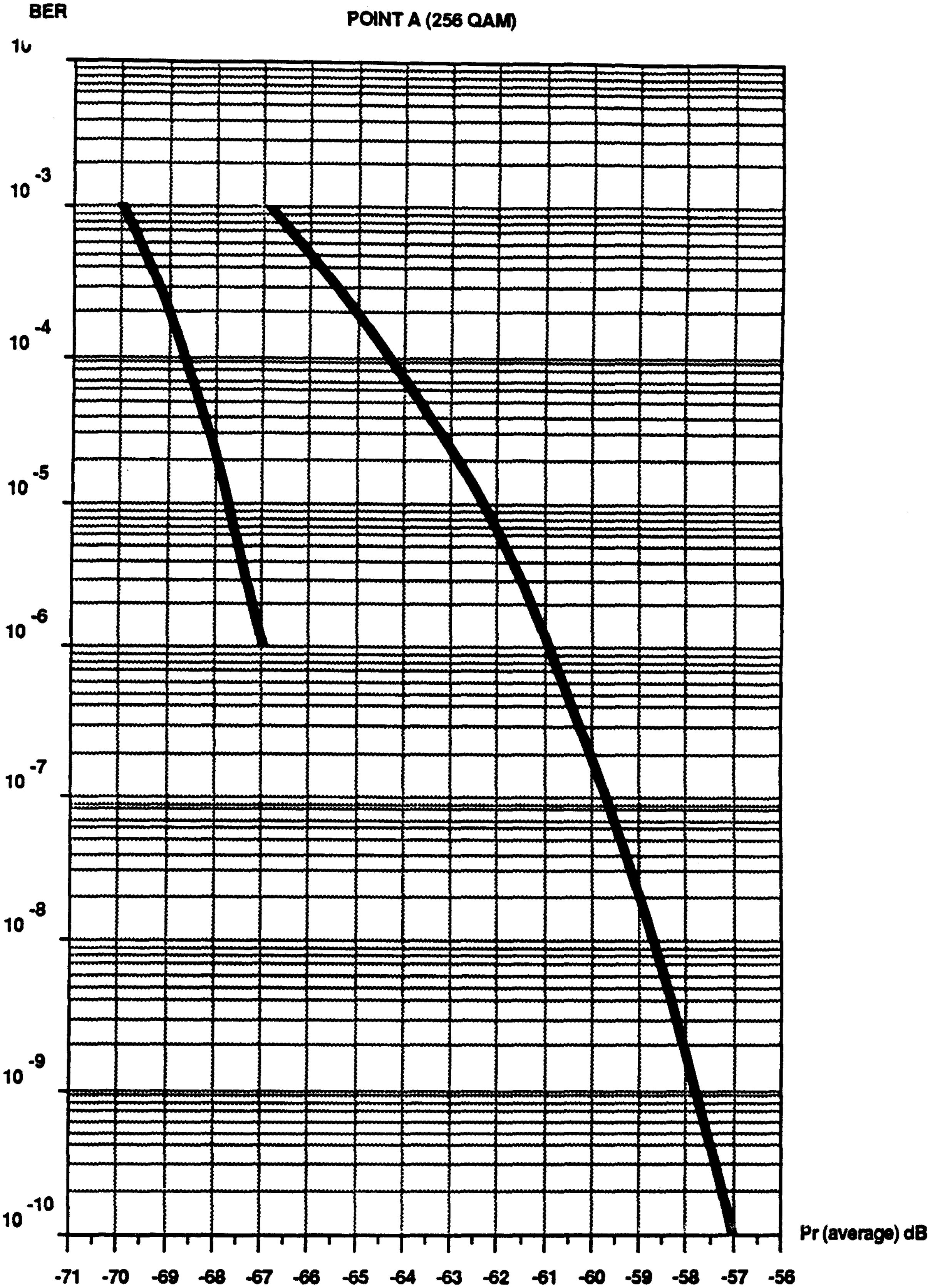


FIGURE 12: MASK FOR THE BIT ERROR RATIO VERSUS RECEIVE POWER LEVEL

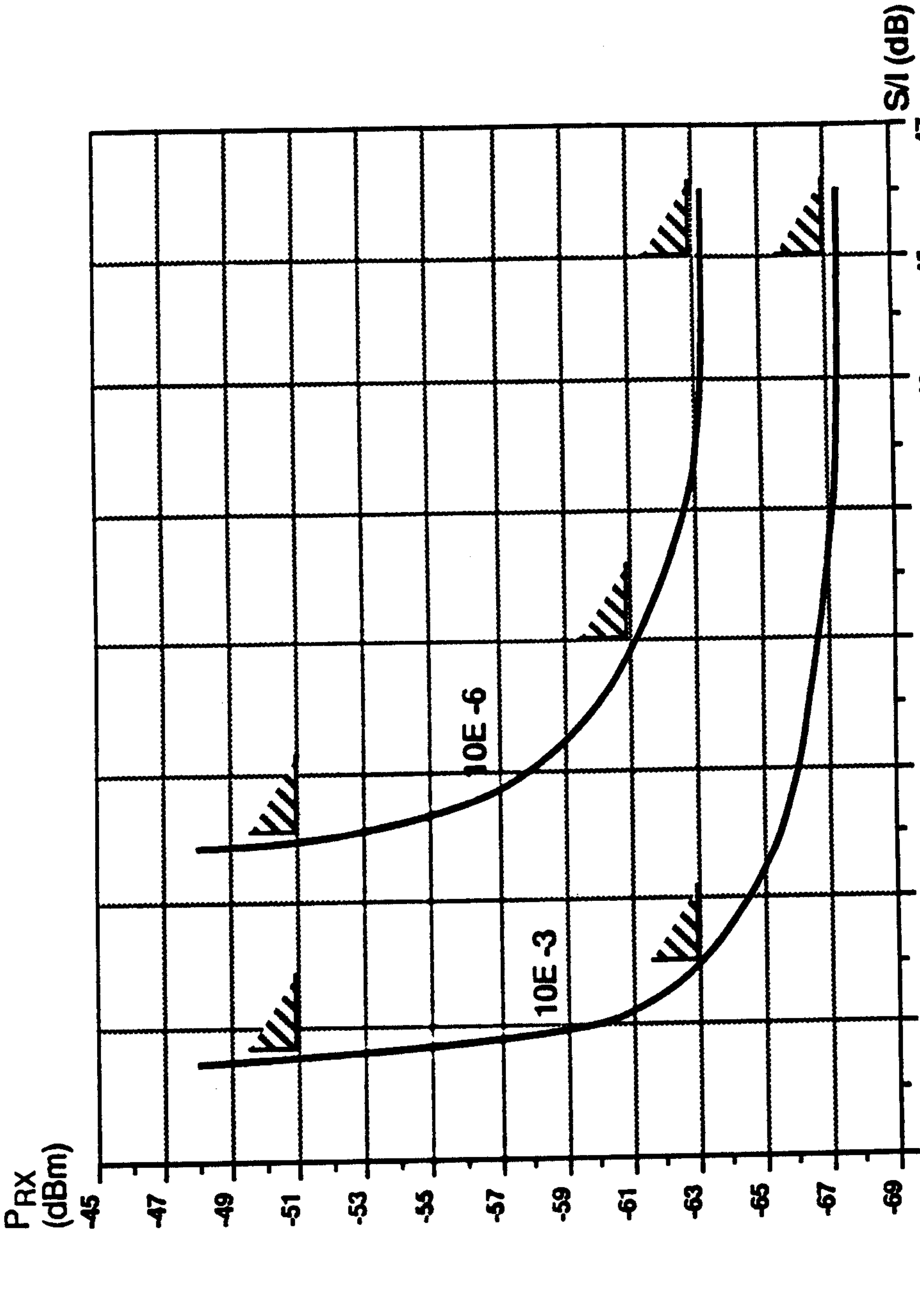


FIGURE 13: CO-CHANNEL DIGITAL INTERFERENCE

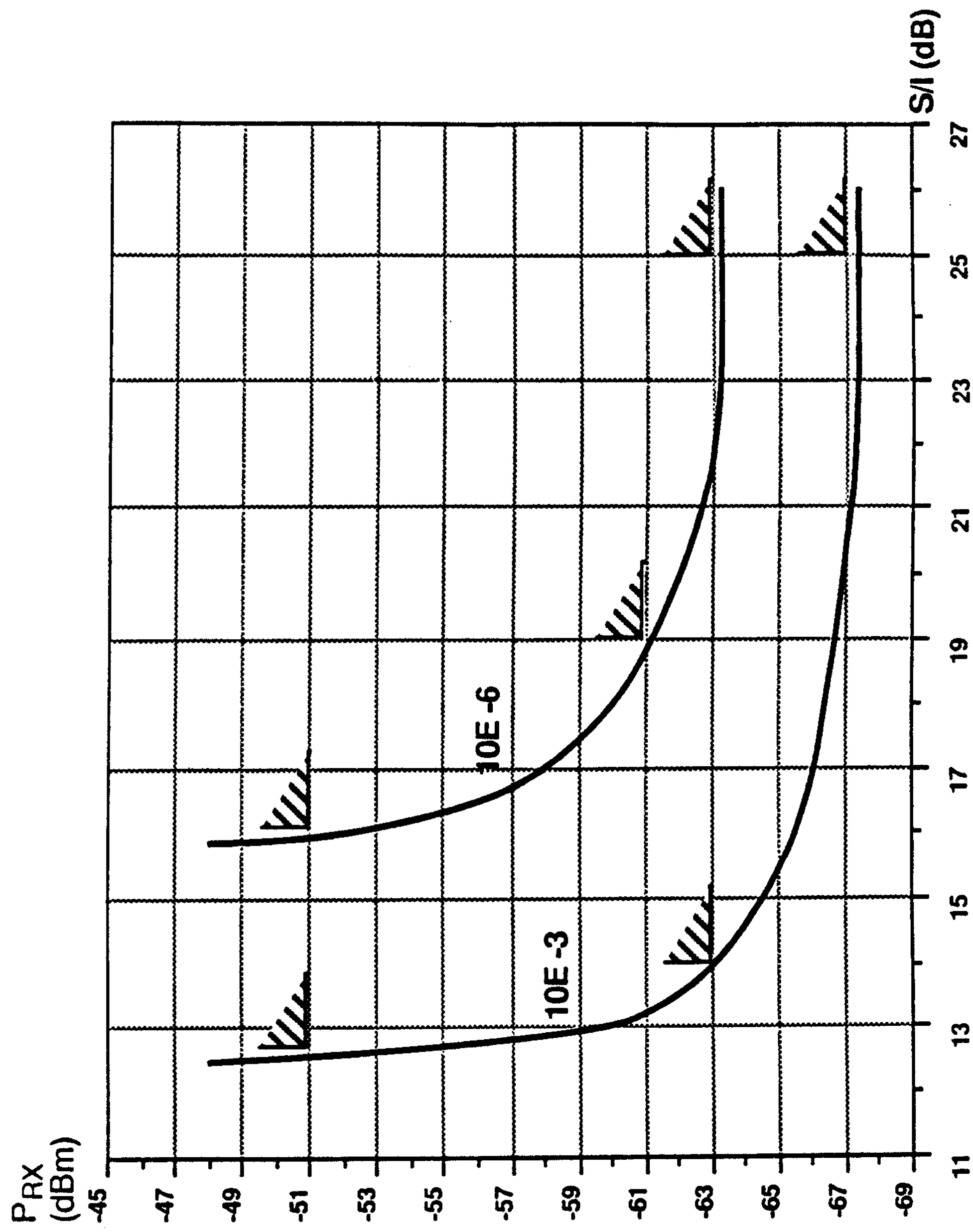


FIGURE 14: ADJACENT-CHANNEL DIGITAL INTERFERENCE

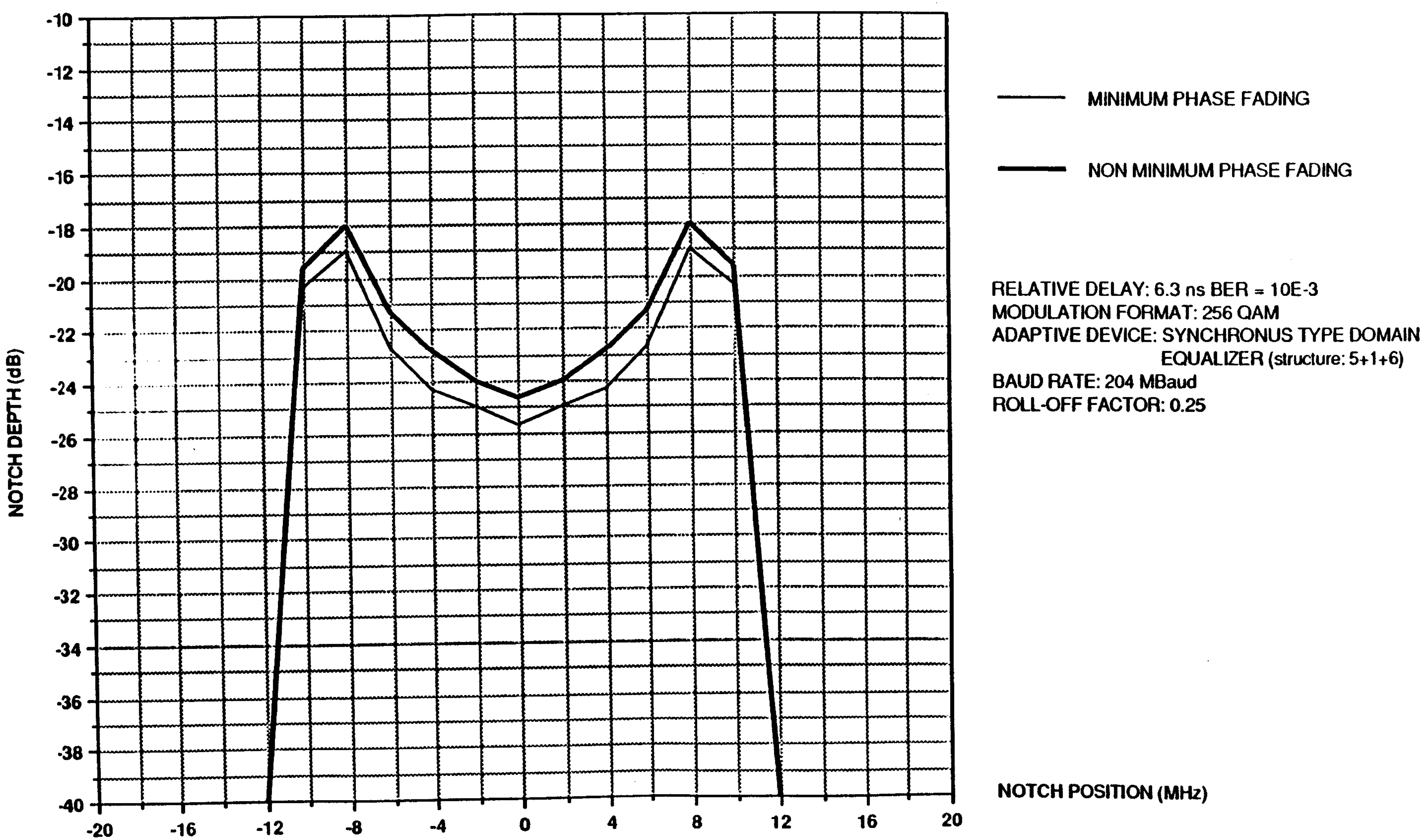


FIGURE 15: SIGNATURE SIMULATION FOR A TWO PATH FADING

(to compute the outage probability only one (right or left) sub carrier signature has to be considered)

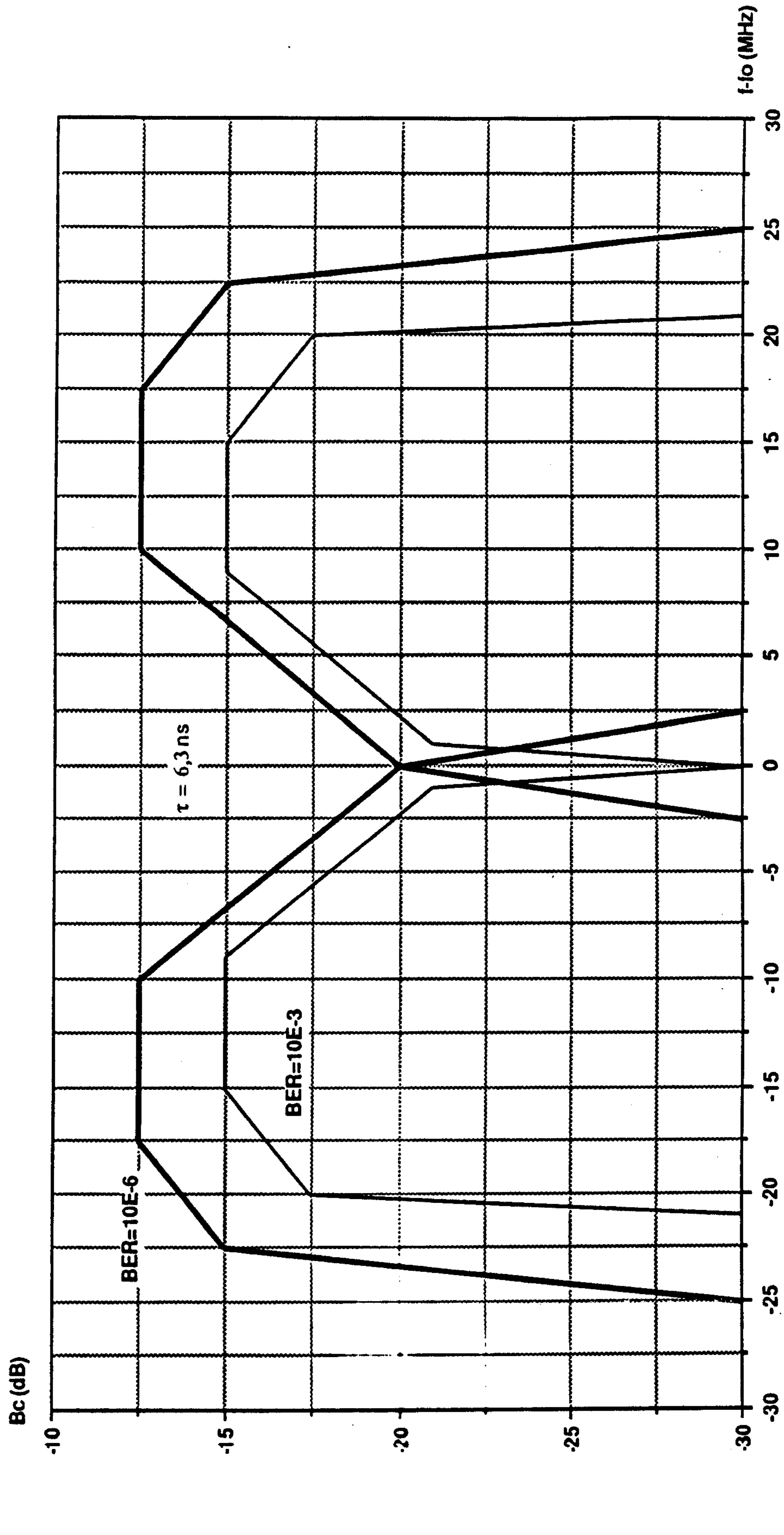


FIGURE 16: SIGNATURES OF THE RADIO SYSTEM

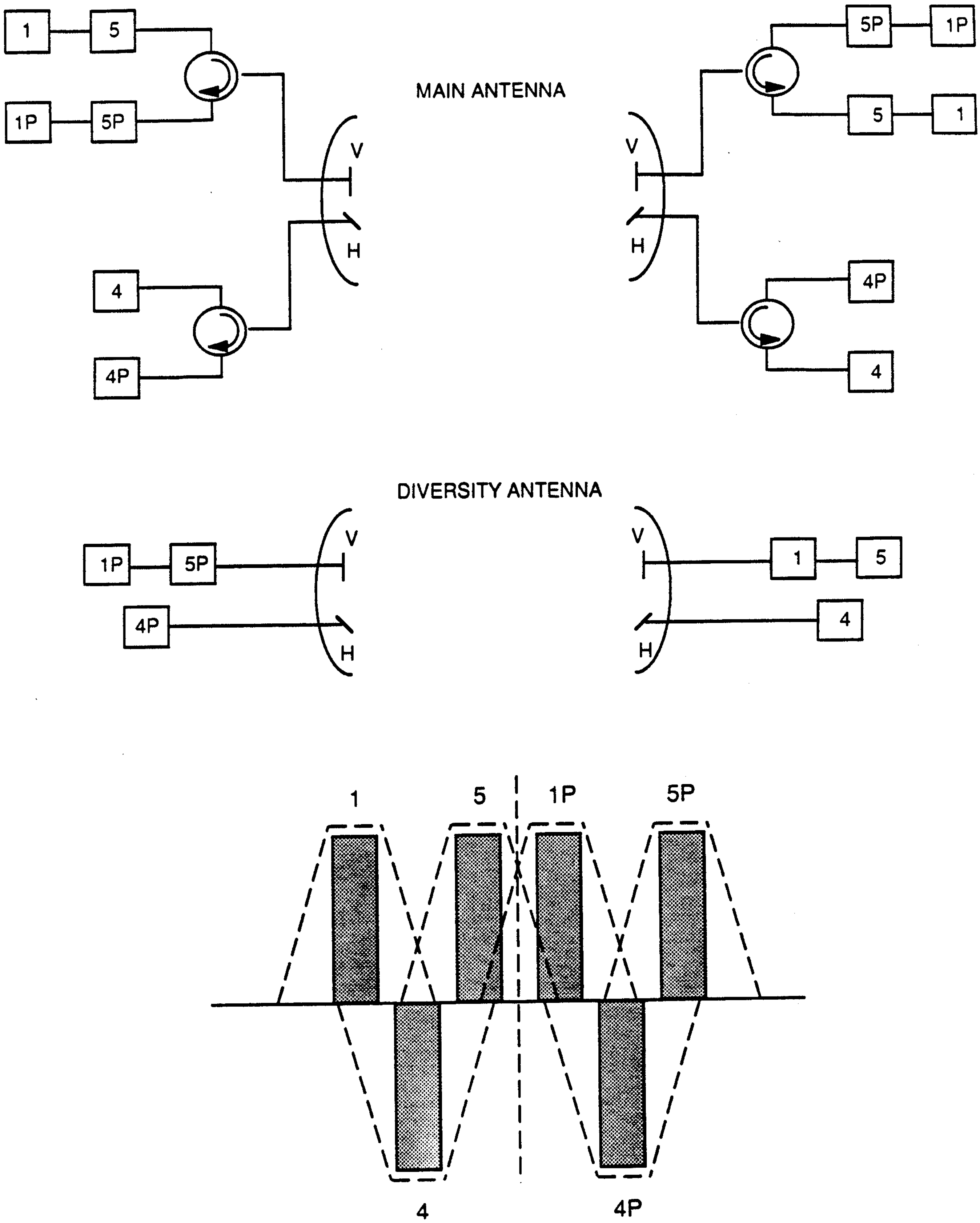


FIGURE 17: CHANNELLING ARRANGEMENT IN THE 6.4/7.1 FREQUENCY BAND TRASMISSION WITH FREQUENCY RE-USE

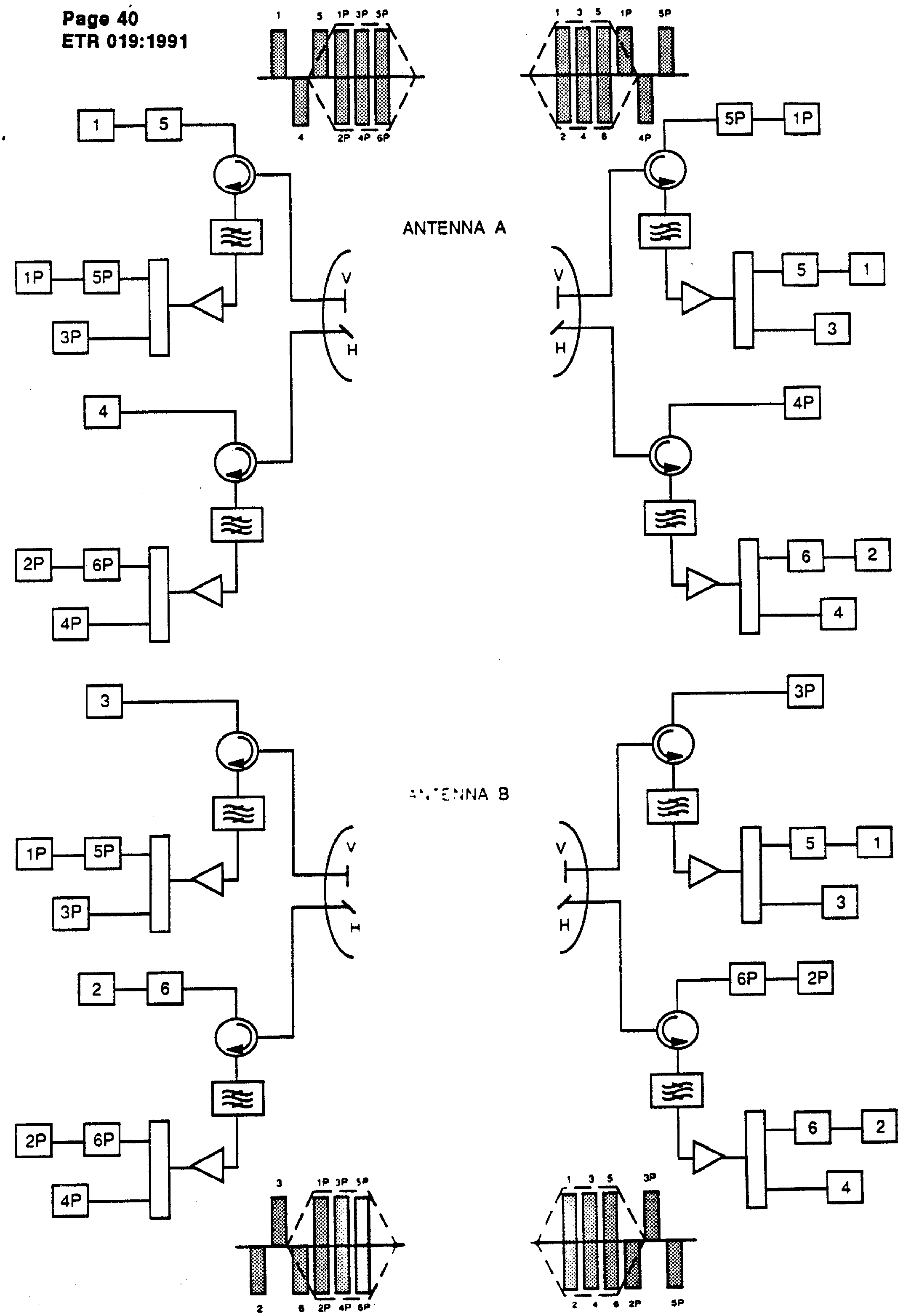


FIGURE 18: CHANNELLING ARRANGEMENT IN THE 6.4/7.1 FREQUENCY BAND TRASMISSION WITH FREQUENCY RE-USE

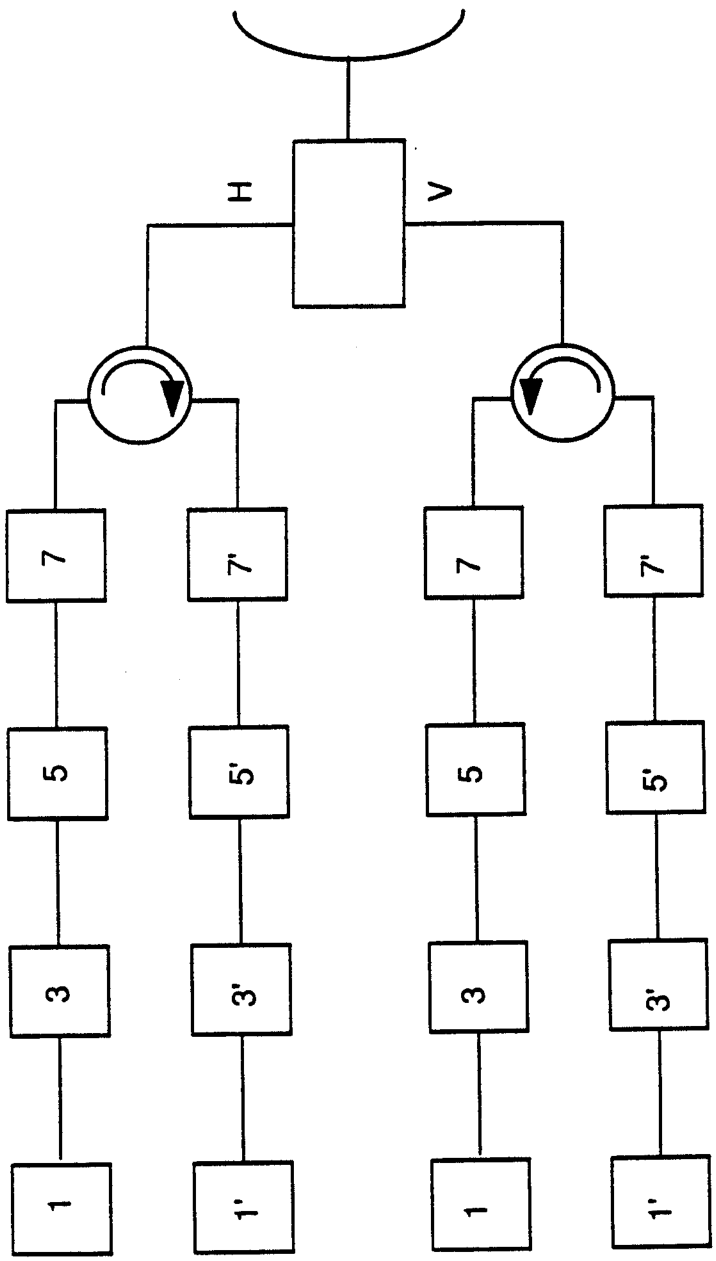


FIGURE 19: CHANNEL BRANCHING ARRANGEMENT FOR SYSTEM B

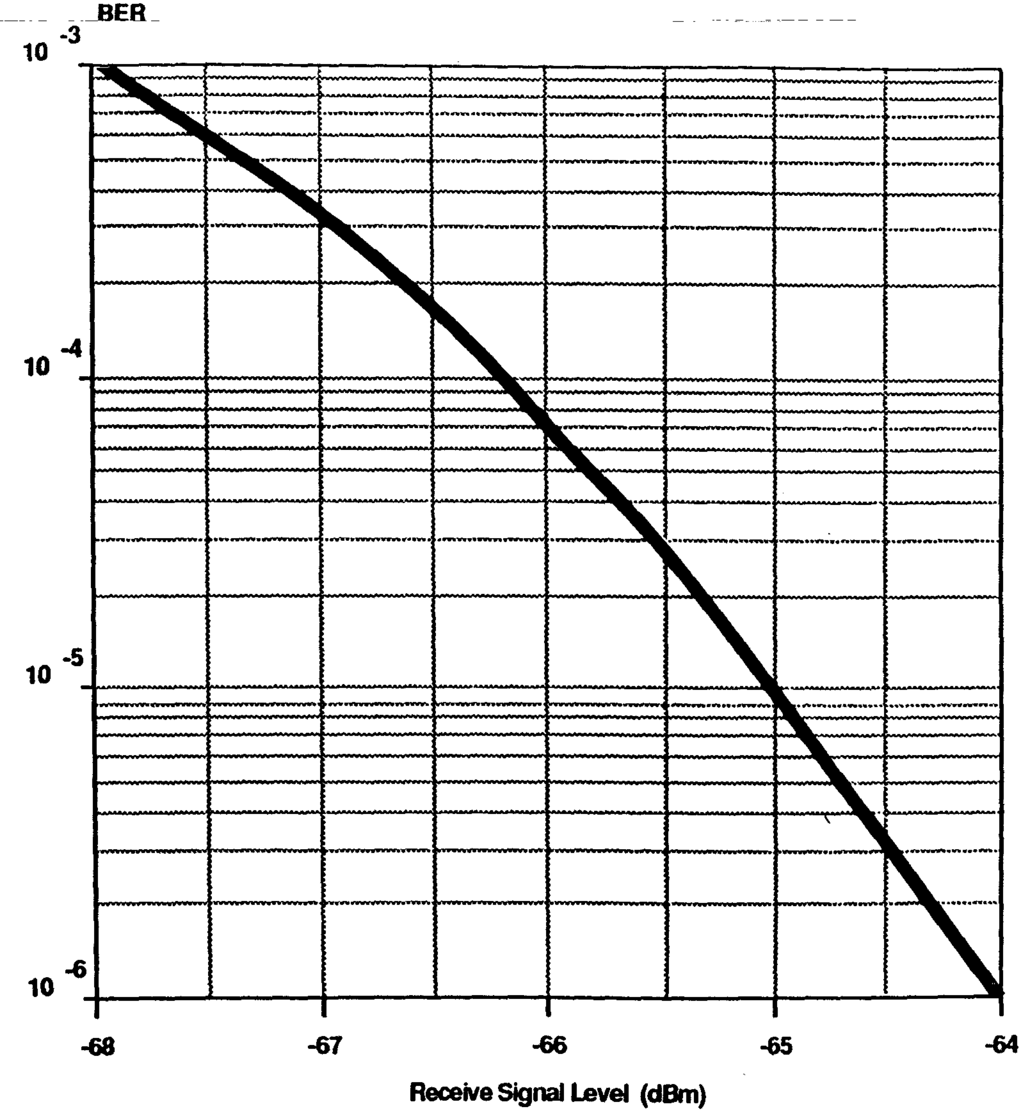
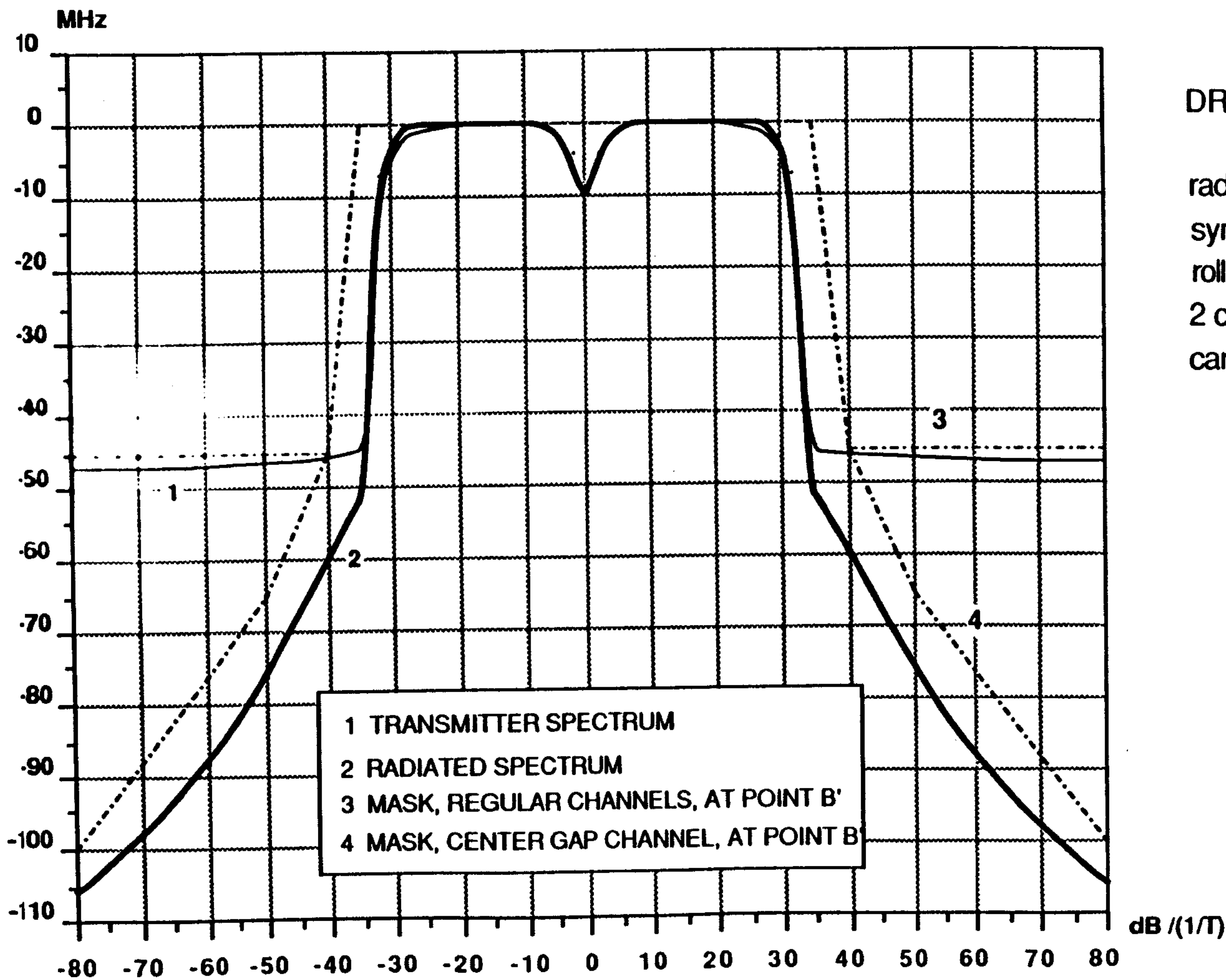


FIGURE 20: BER VS RECEIVE SIGNAL LEVEL LIMIT FOR EACH SUB-CARRIER OF A TWO-CARRIER SYSTEM



DRS 2x155/64QAM/.33/3900

radio frequency	3.9 GHz
symbol rate	2x27.7 Mbaud
roll off	.33
2 carrier per RF-Channel	
carrier separation	34 MHz

FIGURE 21: SPECTRA AND SPECTRUM MASKS

Document history		
March 1991	First published	