ELECTRONICA APLICADA III

CIRCUITOS DE RADIOFRECUENCIA

INTRODUCCIÓN

ELECTRONICA APLICADA III. INTRODUCCION

- GENERALIDADES
- INFORMACION
- CLASIFICACION DE LOS SISTEMAS DE COMUNICACIONES
- MEDIOS DE ENLACE
- EL RECEPTOR DE RADIO
- EL TRANSMISOR DE RADIO
- MODULACION
- REDES DE COMUNICACIONES
- ACCESORIOS

ELECTRONICA APLICADA III. INTRODUCCION

EA III = CIRCUITOS DE RADIOFRECUENCIA

PROFESOR: Ing. Jorge Rodríguez Mallo

Email: jorge.rodriguez-mallo@total.com

jorgermallo@hotmail.com

Tel.: 15-6670-0627

JTP: Ing. Carlos Navarro

Email: cnavarro@electron.frba.utn.edu.ar

Tel: 15-5567-9763

EAIII-INTRODUCCION-GENERALIDADES

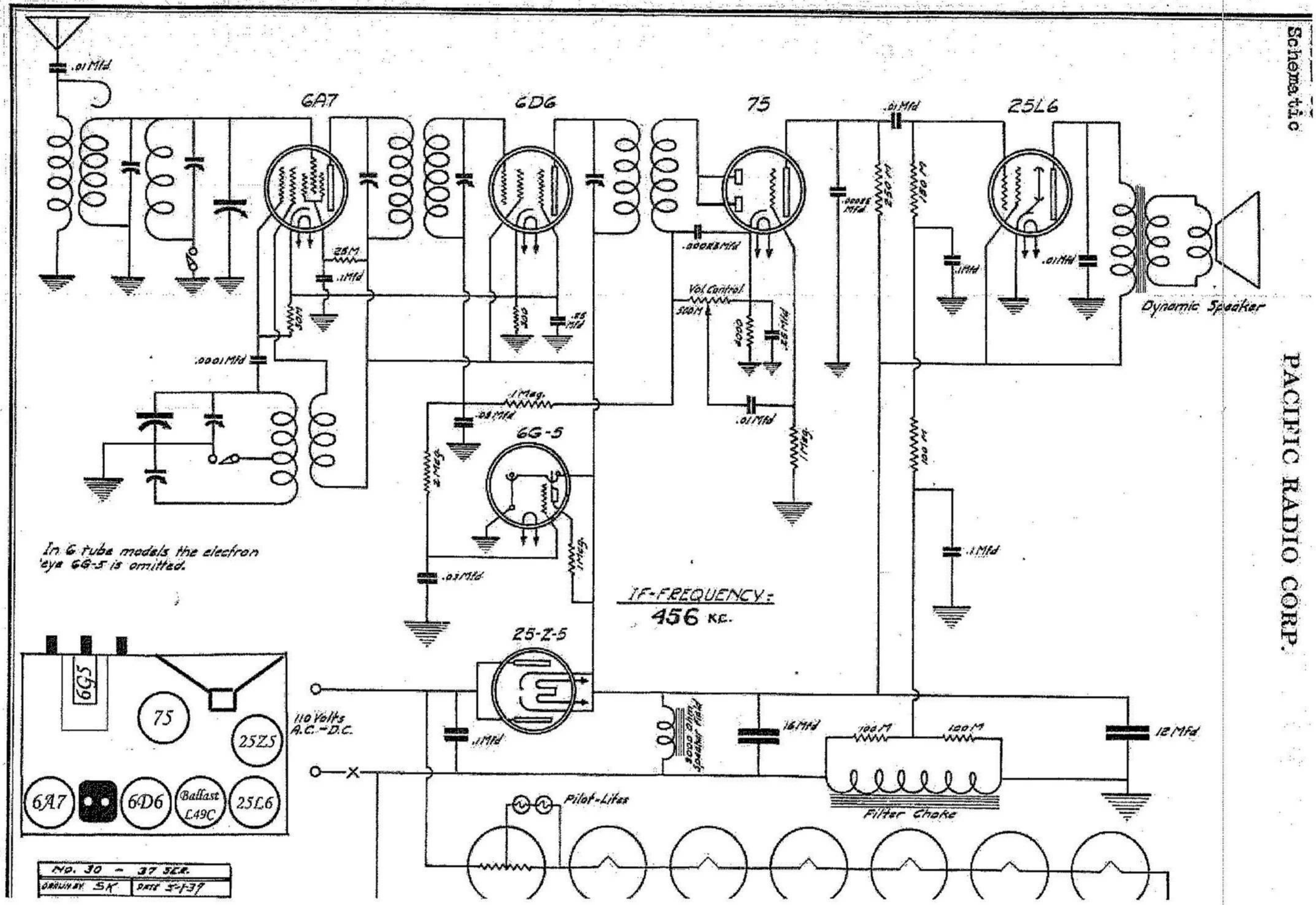
- **CURSADA:**
  - Anual con dos parciales sobre temas prácticos y cuatro fechas de recuperación (2 en Diciembre y 2 en Marzo)

- **PROGRAMA:**
  - Circuitos de Adaptación
  - Amplificadores Sintonizados
  - Amplificador Pasabanda Real
  - Detector de AM y AGC
  - Ruido
  - Amplificador Clase C
  - Osciladores
  - Mezcladores
  - Modulación Angular (Generación y detección)
  - PLL
  - BLU / Amplificadores de Alto Rendimiento

ATTENZIONE
PRIMA DI TOGLIERE LO SCHIENALE STACCARE LA SPINA DALLA PRESA DI CORRENTE
PER GARANTIRE L'EFFICENZA DEL RICEVITORE IN CASO DI RICAMBI APPLICARE SOLO VALVOLE ORIGINALI TELEFUNKEN
INTERNO 300
DM 70
UCH 81
UY85
EL 84
UCC85
UF89
EABC80
75Ω
300Ω
ASSICURARSI CHE LA VITE DEL CAMBIO TENSIONI SIA SULLA POSIZIONE CORRISPONDENTE AL VOLTAGGIO DELLA RETE
120 140 160 180 220

FT 0418240
120 140 160 180 220

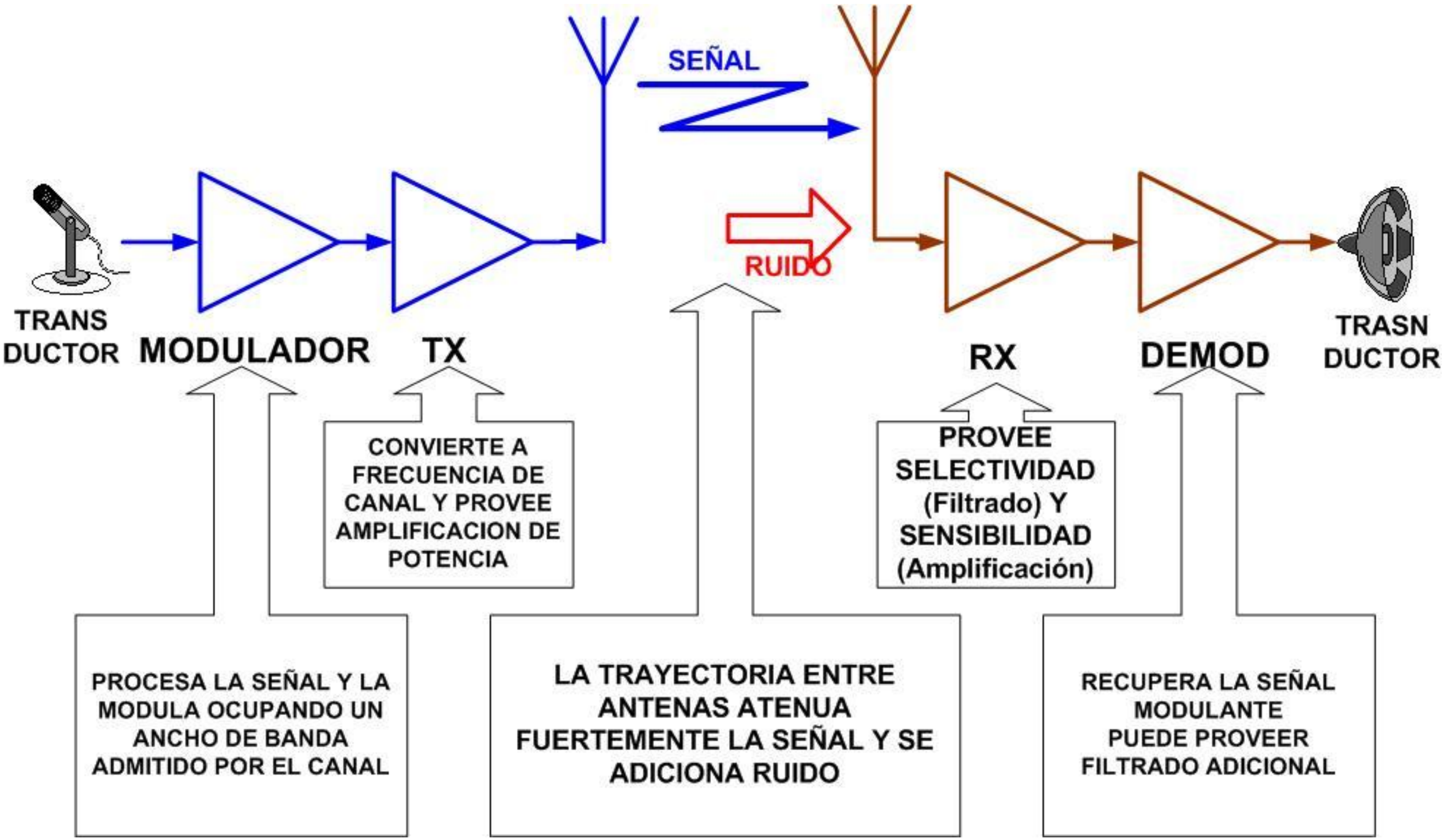

B MOVIL
3.2 OHMS
10%


Schematic
PACIFIC RADIO CORP.
6A7
6D6
75
25L6
6G-5
25-Z-5
.01 Mfd
25M
.1 Mfd
50 M
.0001 Mfd
300
.05 Mfd
Vol Control
500 M
4000
.25 Mfd
.00025 Mfd
.0005 Mfd
250 M
150 M
.01 Mfd
Dynamic Speaker
.1 Meg.
.05 Mfd
2 Meg.
1 Meg.
.03 Mfd
100 M
In 6 tube models the electron eye 6G-5 is omitted.
IF-FREQUENCY:
456 KC.
110 Volts A.C.-D.C.
3000 ohm Speaker Field
16 Mfd
12 Mfd
Filter Choke
Pilot-Lites
6G5
75
25Z5
6A7
6D6
Ballast L49C
25L6
NO. 30 - 37 SER.
DRAWN BY SK
DATE 5-1-37

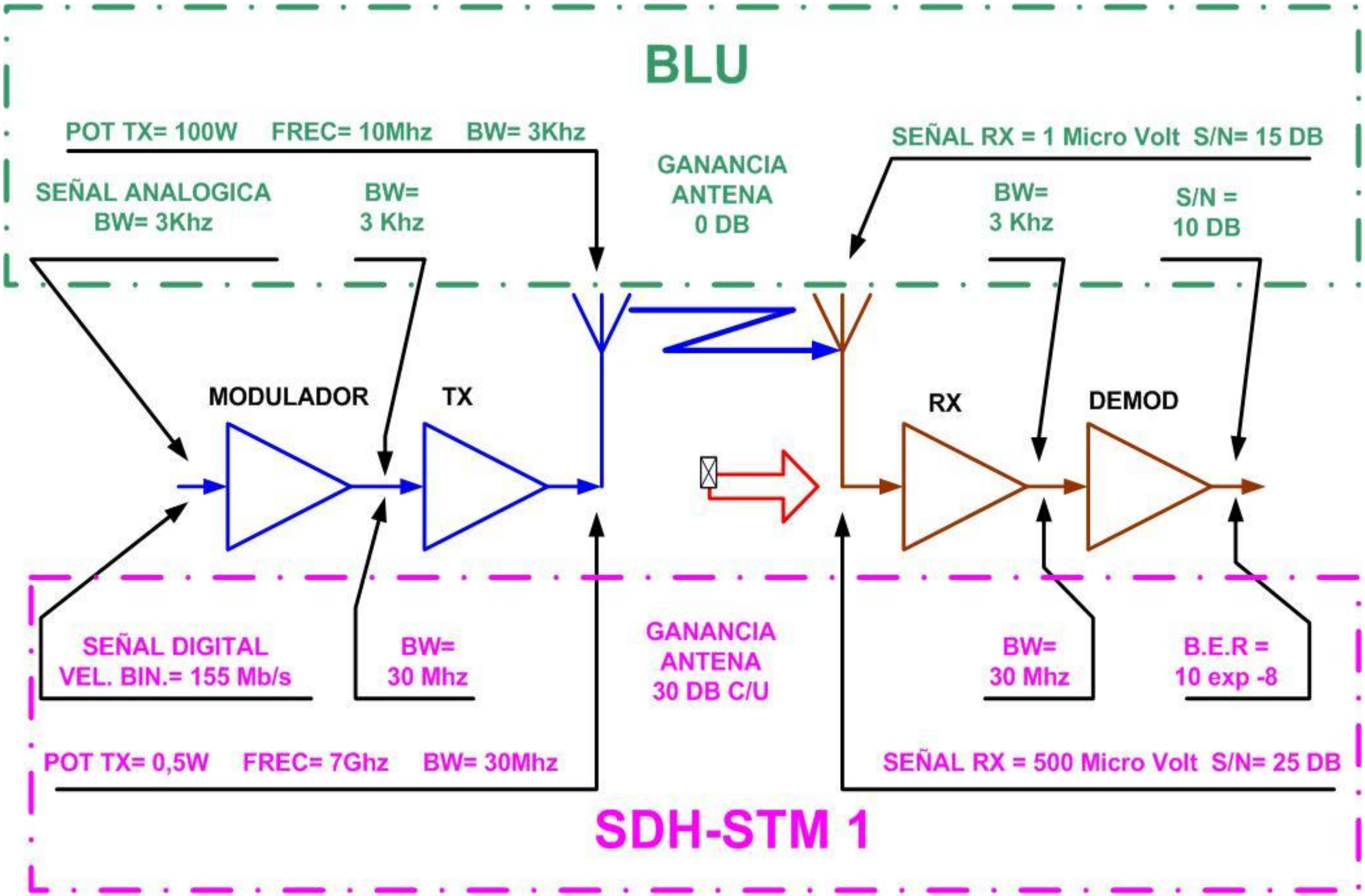
EAIII-INTRODUCCION- INFORMACION

- **INFORMACION**
  - Definicion
  - Formula de Hartley Shannon: $C = B \log_2(1+S/N)$
  - Tipos de Información
  - Velocidad de Información
- **EL CANAL DE COMUNICACION**
  - Esquema Básico
    - (Ver esquema en slide siguiente)
  - Calidad
    - S/N
    - BER

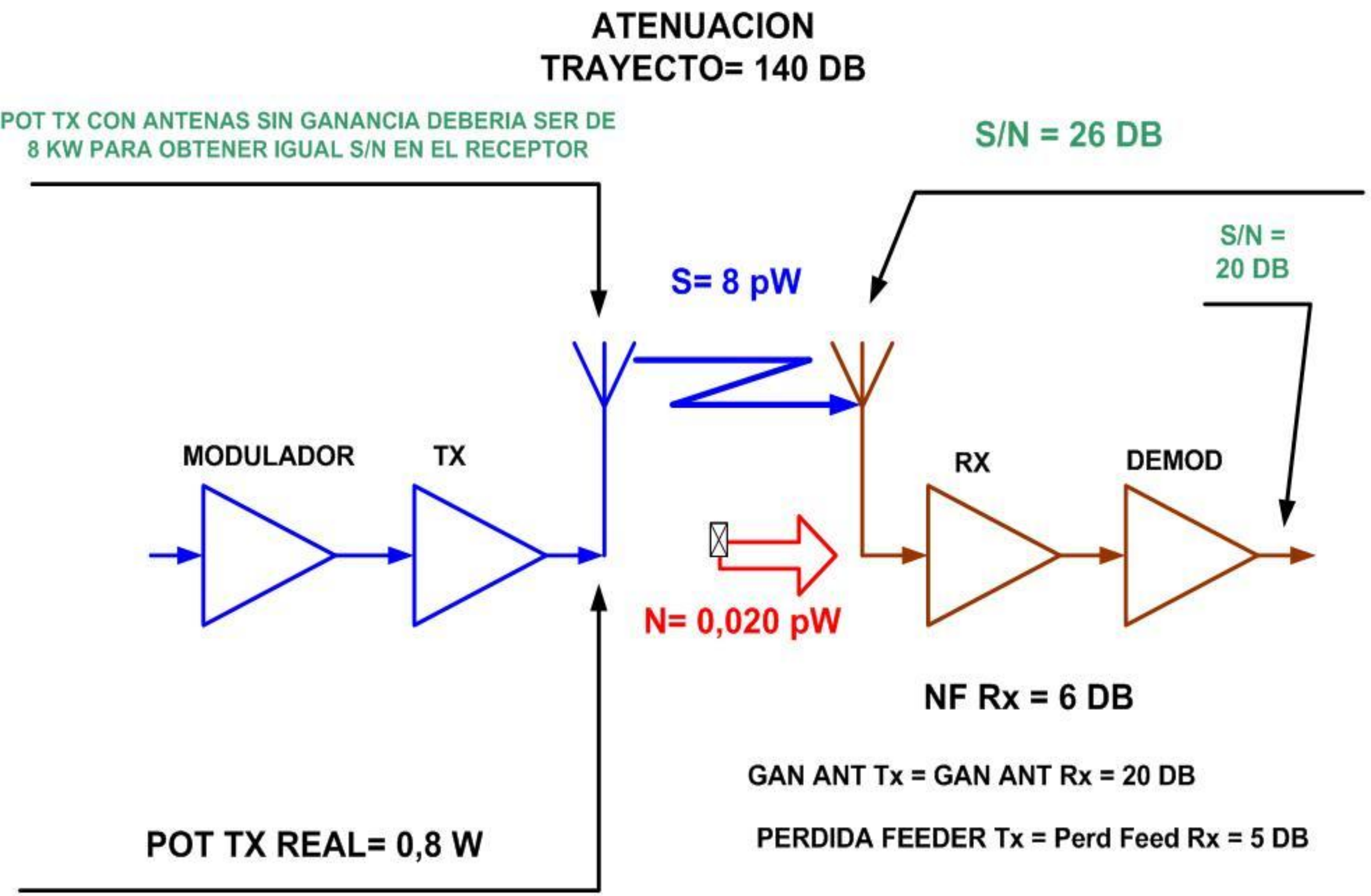
EAIII-INTRODUCCION- INFORMACION



EAIII-INTRODUCCION- INFORMACION



LOS VALORES EXPUESTOS EN EL PRESENTE GRAFICO SON REFERENCIALES, NO CORRESPONDEN A NINGUN ENLACE PARTICULAR Y SE INCLUYEN SOLO CON FINES DIDACTICOS



LOS VALORES EXPUESTOS EN EL PRESENTE GRAFICO SON REFERENCIALES, NO CORRESPONDEN A NINGUN ENLACE PARTICULAR Y SE INCLUYEN SOLO CON FINES DIDACTICOS

EAIII-INTRODUCCION- EL RECEPTOR DE RADIO

CARACTERISTICAS

- **SENSIBILIDAD**
- **SELECTIVIDAD**
  - Capacidad para recibir un canal determinado y rechazar los no deseados
- **SINTONIZABILIDAD**
  - Capacidad para cambiar de canal
  - Algunos receptores no la requieren
- **LINEALIDAD**
  - La falta de linealidad produce intermodulación y modulación cruzada
- **DEMODULACION**

SENSIBILIDAD RX

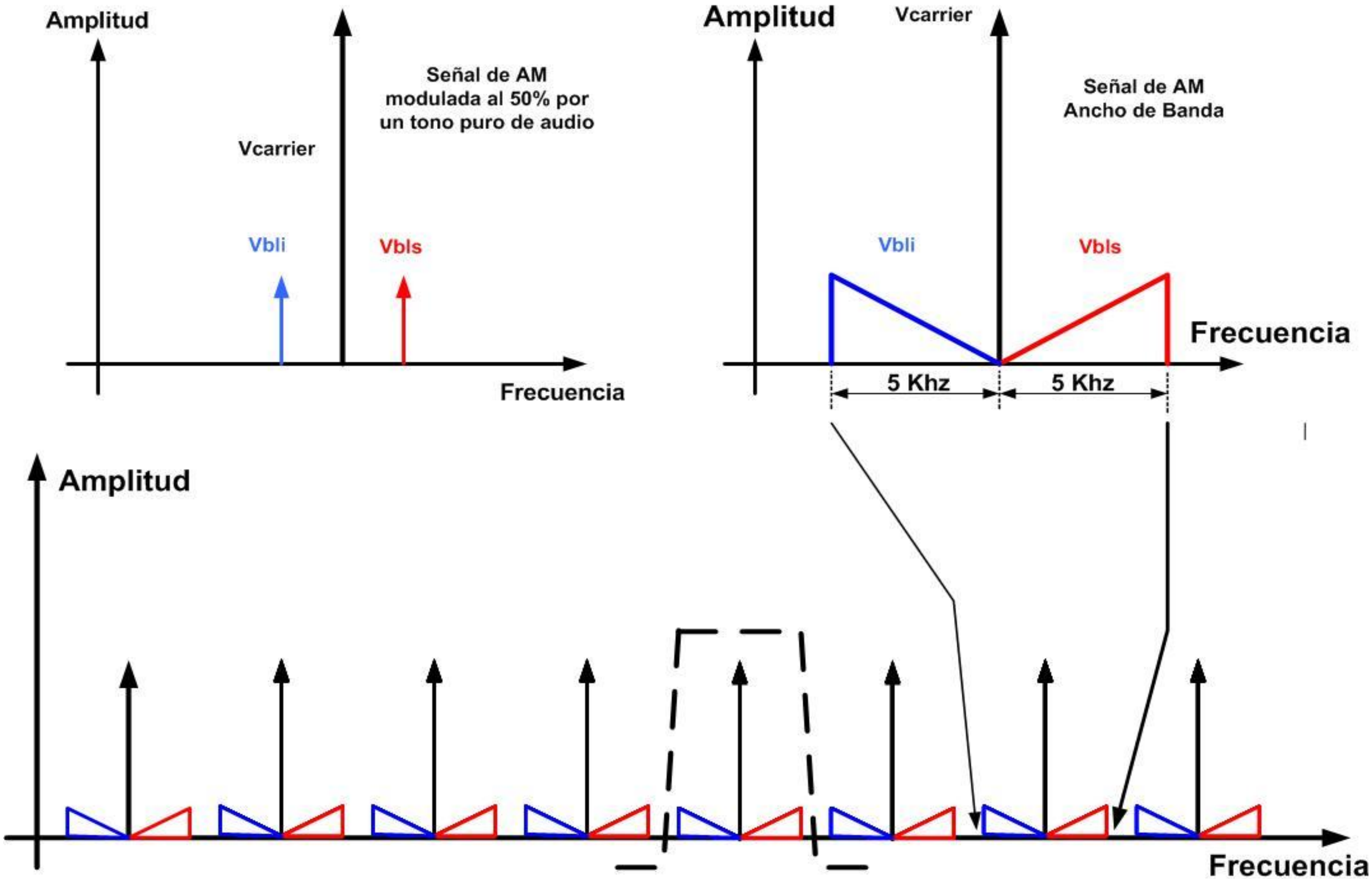
$$\bar{e}_n^2 = 4kTRB \qquad k = 1{,}38.10^{-23}\ Joule/{}^\circ Kelvin : Constante\ de\ Boltzmann$$

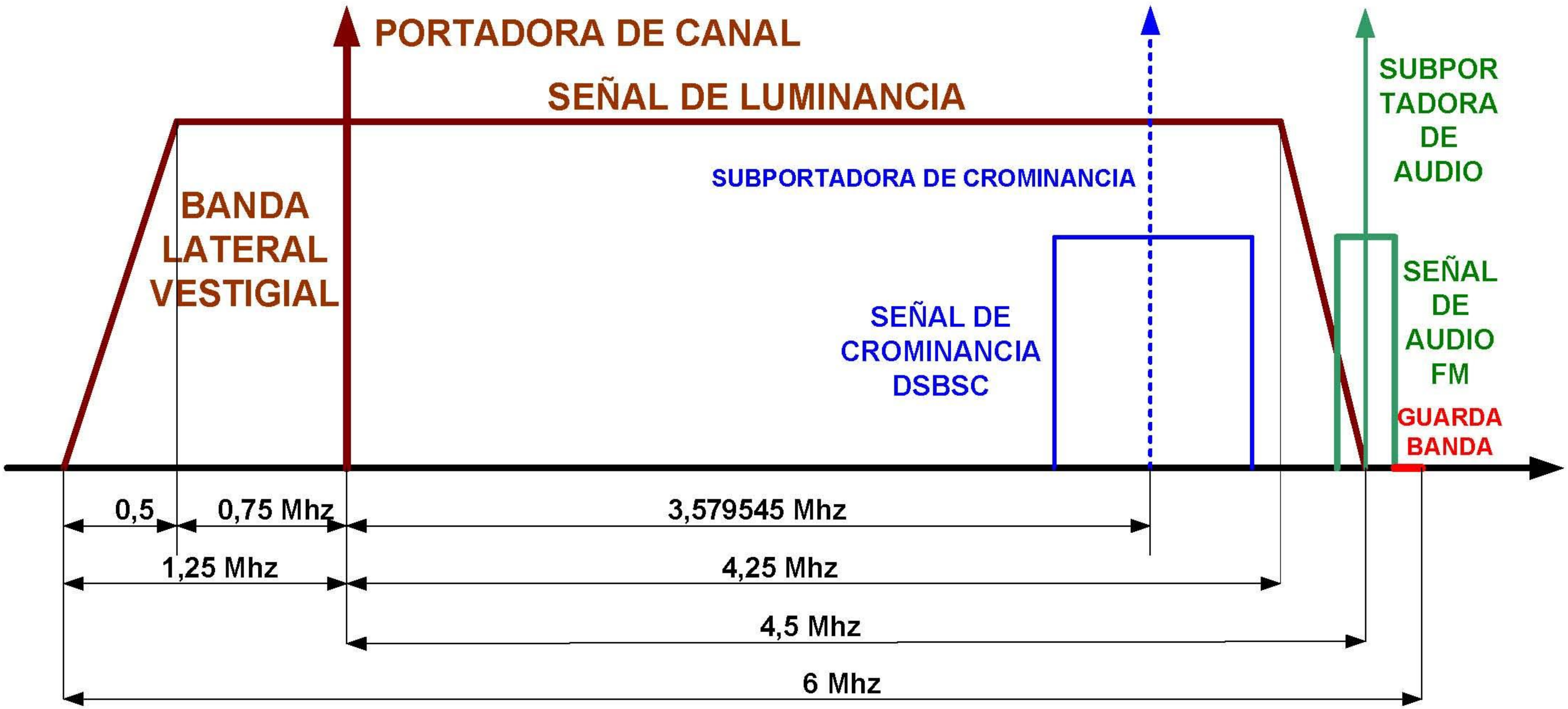
$$Potencia\ Disponible = Pa = kTB$$

$$Suponiendo\ T = 300^\circ Kelvin$$

	BW	Pa ruido	V de ruido	Vseñal 20Db	Pseñal	Pseñal
SERVICIO	KHZ	pW	MicroV/50 Ohms	MicroV	pW	Dbm
TELEGRAFIA	0,2	8,28E-07	0,00643	0,0643	0,0000828	-131
BLU	3	1,242E-05	0,02492	0,2492	0,001242	-119
AM	10	0,0000414	0,04550	0,4550	0,00414	-114
VHF	25	0,0001035	0,07194	0,7194	0,01035	-110
RADIO E1	2000	0,00828	0,64343	6,4343	0,828	-91
TV	6000	0,02484	1,11445	11,1445	2,484	-86
RADIO STM1	30000	0,1242	2,49199	24,9199	12,42	-79

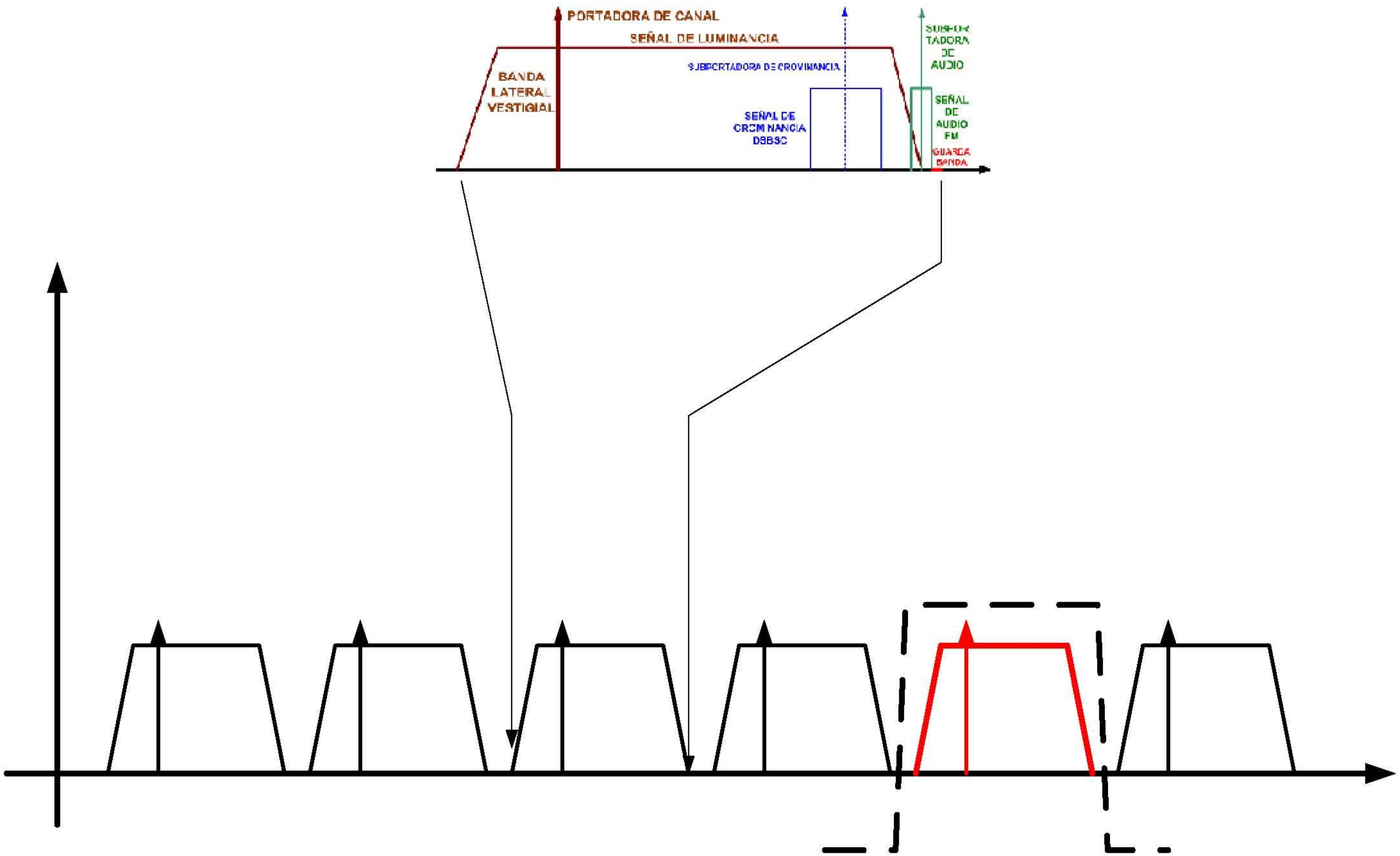
SELECTIVIDAD



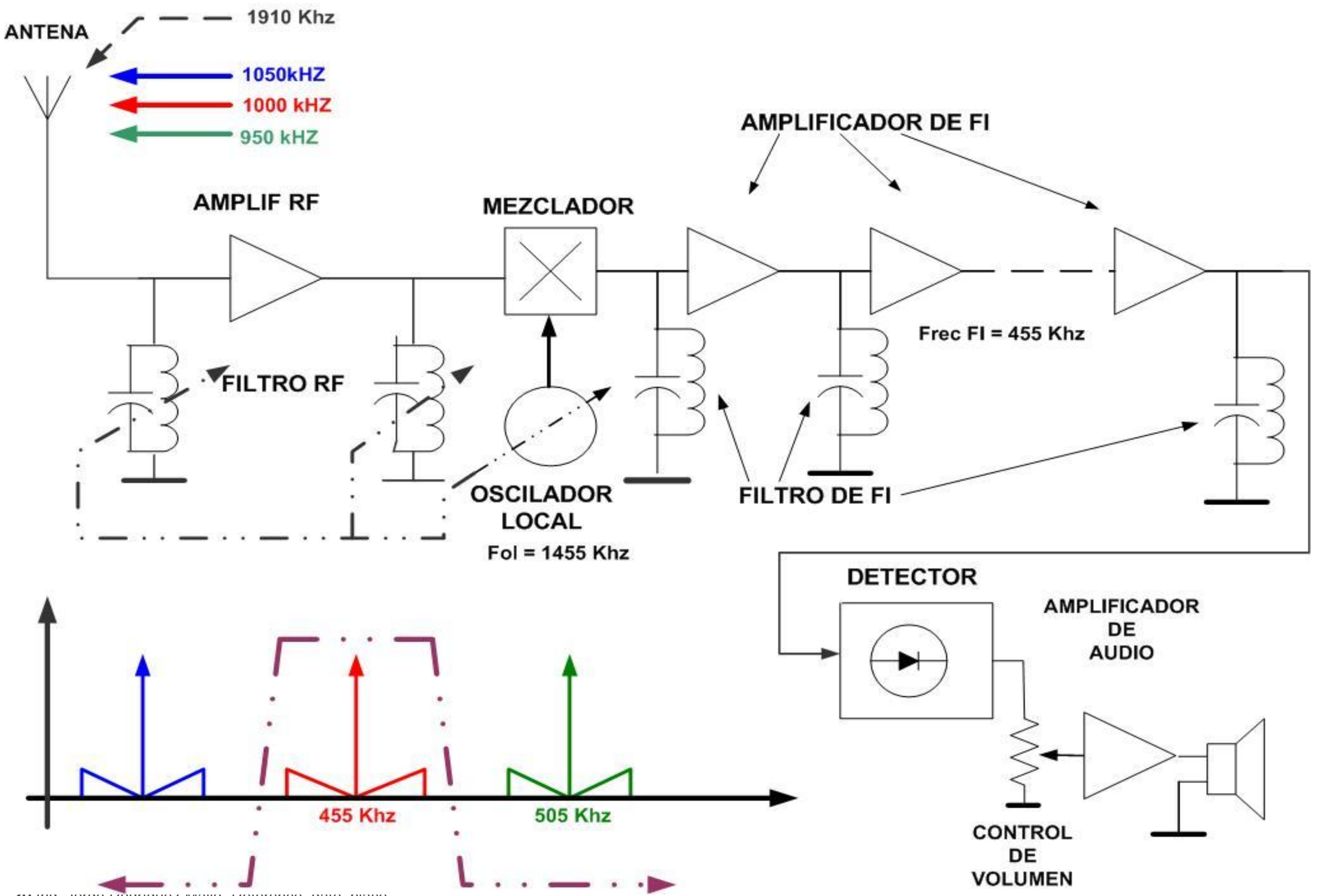


ESPECTRO DE CANAL DE TV
NORMA NORTEAMERICANA

SELECTIVIDAD



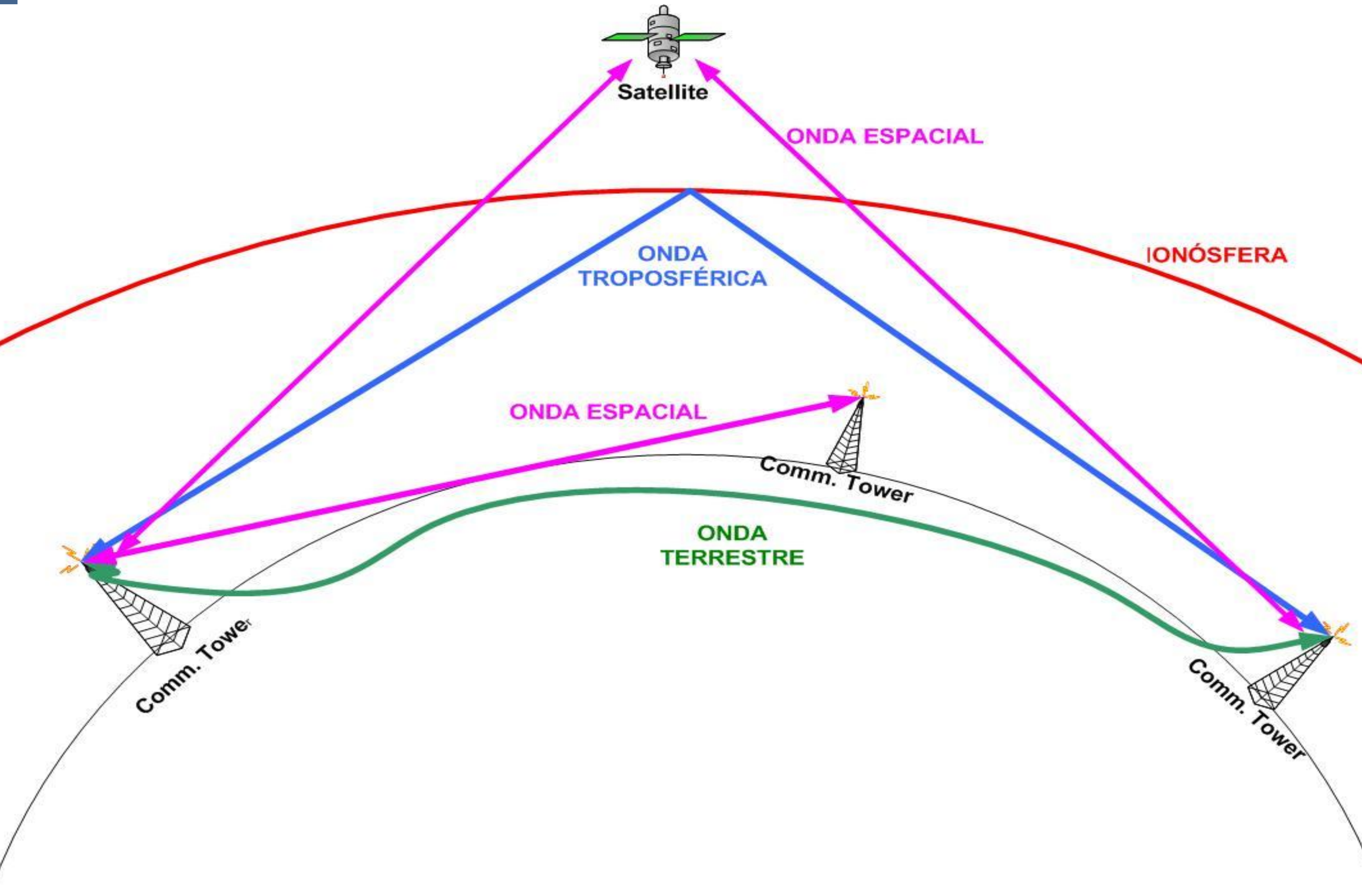
RECEPTOR SUPERHETERODINO



EAIII-INTRODUCCION- MEDIOS DE ENLACE

- **COBRE**
  - PAR TRENZADO
  - UTP / STP
  - COAXIL
  - GUIA DE ONDA
- **FIBRA OPTICA**
  - ESTRUCTURA
  - MONOMODO / MULTIMODO
  - CONECTORES Y EMPALMES
  - ATENUACION Y MEDICIONES
- **ONDAS DE RADIO**

EAIII-INTRODUCCION- MEDIOS DE ENLACE



EAIII-INTRODUCCION- MEDIOS DE ENLACE

ONDAS DE RADIO

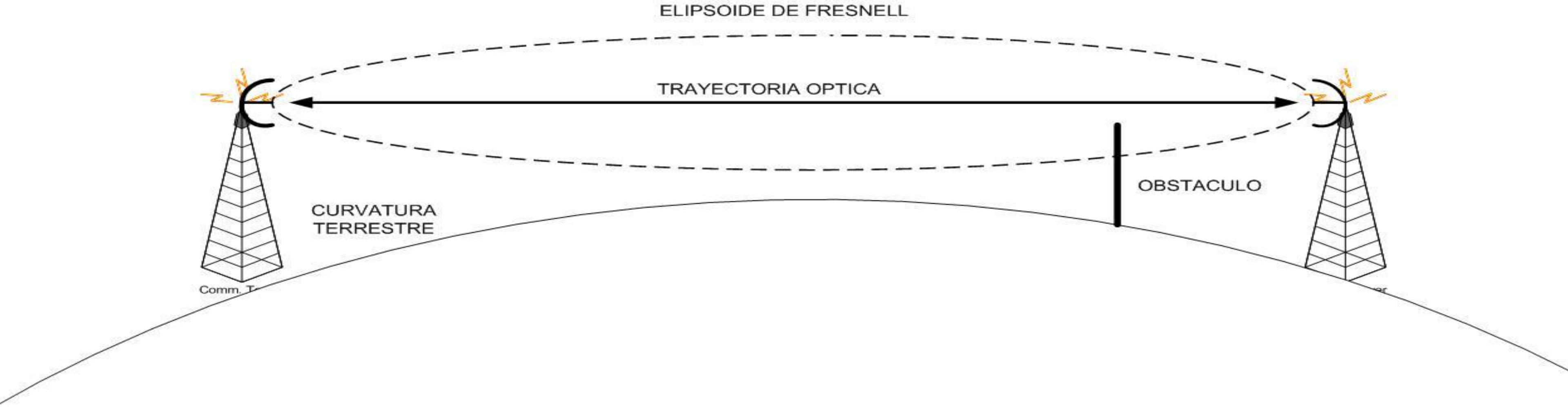
- **PROPAGACION**
  - TERRESTRE < 2 Mhz
  - TROPOSFERICA 2 Mhz < Troposf < 30 Mhz
  - ESPACIAL > 30 Mhz
  - SISTEMAS SATELITALES
    - ORBITAS GEO Ej.: Inmarsat
    - ORBITAS LEO Ej.: GPS

- **DISTRIBUCION ESPECTRAL / ANCHO DE BANDA**

- **POTENCIA**

- **TIPO DE MODULACION**
  - ANALOGICA: AM / FM / BLU
  - DIGITAL: 2PSK / 4PSK / 16 QAM / 64 QAM / 256 TCM

ONDA ESPACIAL. ATENUACION DE TRAYECTORIA



1-ALTURA DE TORRES PARA LOGRAR VISIBILIDAD ÓPTICA SOBRE TIERRA PLANA

LONGITUD DEL SALTO EN KM									
10	20	30	40	50	60	70	80	90	100
1.47	6	13	24	**37**	53	72	94	119	147
ALTURA DE AMBAS TORRES EN METROS									

2-RADIO MÁXIMO DE FRESNEL (En metros)

FREC	LONGITUD DEL SALTO EN KM									
Mhz	10	20	30	40	50	60	70	80	90	100
10	274	387	474	548	612	671	725	775	822	866
50	122	173	212	245	274	300	324	346	367	387
100	87	122	150	173	194	212	229	245	260	274
500	39	55	67	77	87	95	102	110	116	122
1000	27	39	47	55	**61**	67	72	77	82	87
5000	12	17	21	24	27	30	32	35	37	39
10000	9	12	15	17	19	21	23	24	26	27

EAIII-INTRODUCCION- MEDIOS DE ENLACE

3- ATENUACION DE ESPACIO LIBRE EN DB

FREC Mhz	LONGITUD DEL SALTO EN KM									
	10	20	30	40	50	60	70	80	90	100
10	72	78	82	84	86	88	89	91	92	92
50	86	92	96	98	100	102	103	104	106	106
100	92	98	102	104	106	108	109	111	112	112
500	106	112	116	118	120	122	123	124	126	126
1000	112	118	122	124	**126**	128	129	131	132	132
5000	126	132	136	138	140	142	143	144	146	146
10000	132	138	142	144	146	148	149	151	152	152

EAIII-INTRODUCCION- MEDIOS DE ENLACE

- **ATENUACIONES ADICIONALES. La propagación atmosférica produce:**
- **-refracción en la atmósfera (levantamiento del horizonte);**
- **-difracción por zonas de Fresnel (atenuación por obstáculo);**
- **-atenuación por reflexiones en el terreno;**
- **-desvanecimiento por múltiple trayectoria (formación de ductos);**
- **-absorción por arboledas cercanas a la antena;**
- **-absorción por gases o hidrometeoros (lluvia, nieve, etc);**
- **-dispersión de energía debido a precipitaciones;**
- **-desacoplamiento de la polarización de la onda.**

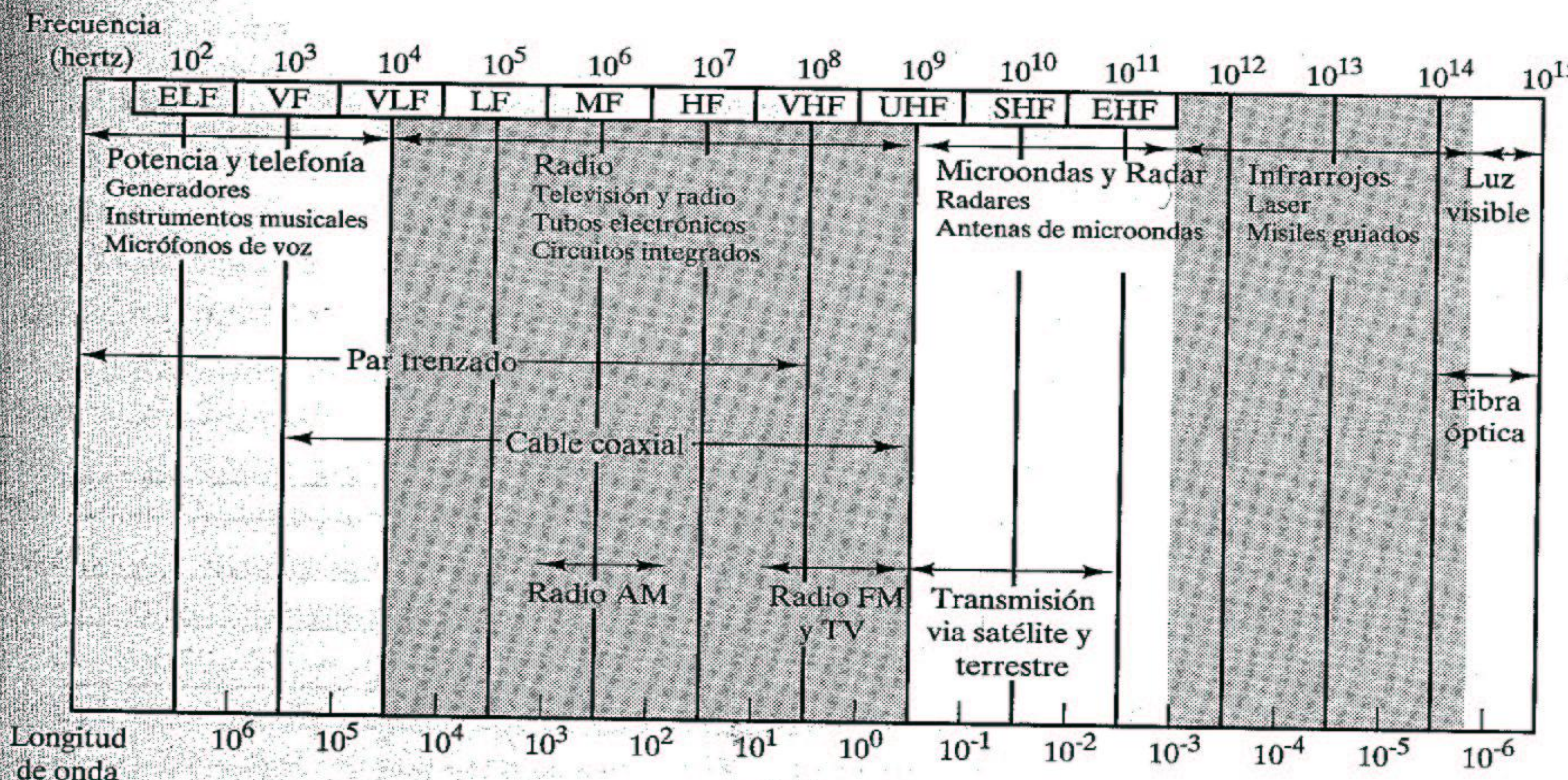


FIGURA 3.1 **Espectro electromagnético para las telecomunicaciones.**

EAIII-INTRODUCCION- MEDIOS DE ENLACE

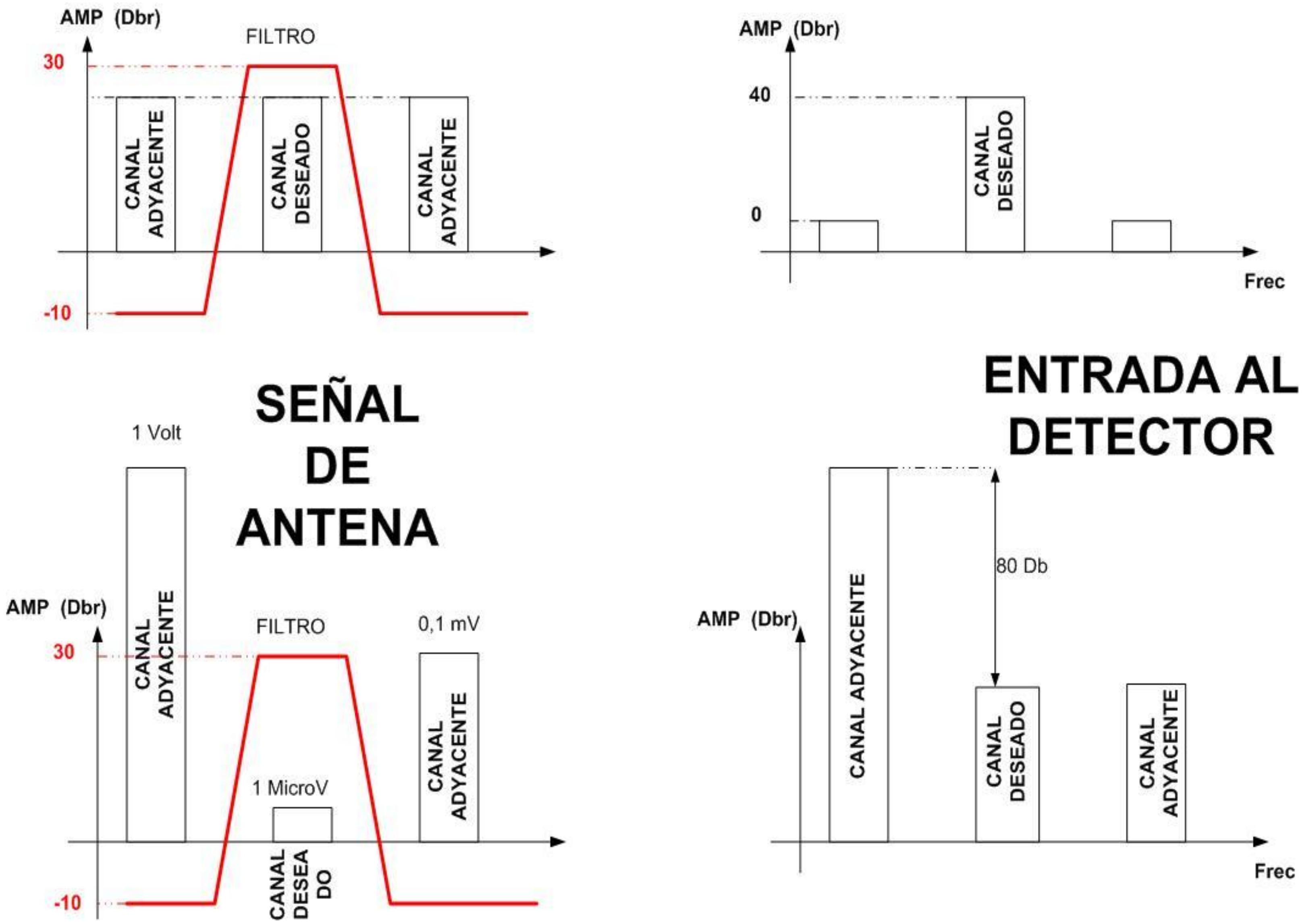
POTENCIA Y ANCHO DE BANDA	
> 1 Mwatt: Radioayudas	BW: < 1 Khz
110 Kw: BC AM	BW: 10 Khz
10 Kw: BC TV y FM	BW: 6 Mhz
1 Kw: BLU (Serv Public)	BW: 3 Khz
100 W: P to P BLU y VHF	BW: 25 Khz
1 W: RE microondas	BW: 30 Mhz (STM 1)

EAIII-INTRODUCCION- EL RECEPTOR DE RADIO

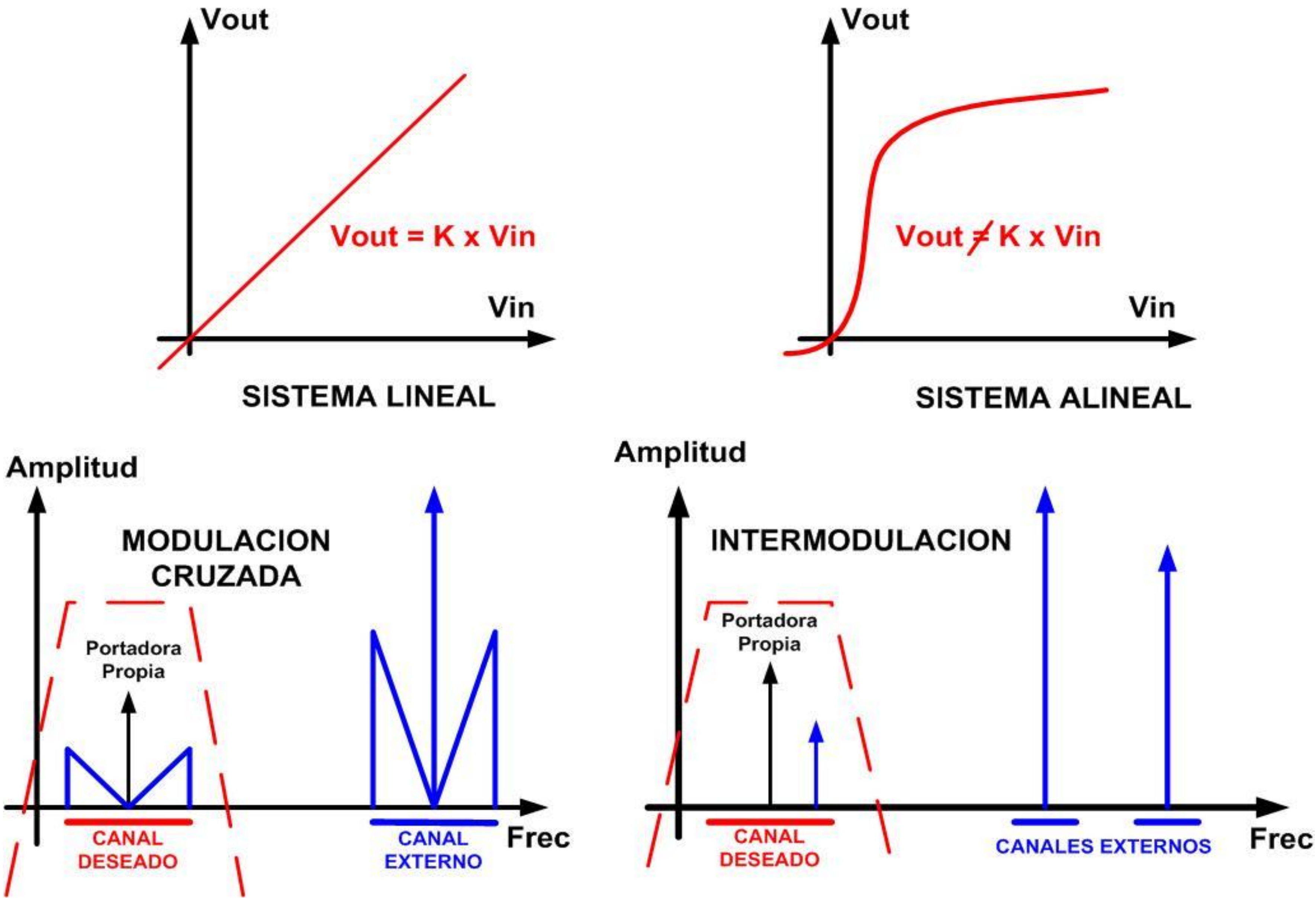
CARACTERISTICAS

- **SENSIBILIDAD**
- **SELECTIVIDAD**
  - Capacidad para recibir un canal determinado y rechazar los no deseados
- **SINTONIZABILIDAD**
  - Capacidad para cambiar de canal
  - Algunos receptores no la requieren
- **LINEALIDAD**
  - La falta de linealidad produce intermodulación y modulación cruzada
- **DEMODULACION**

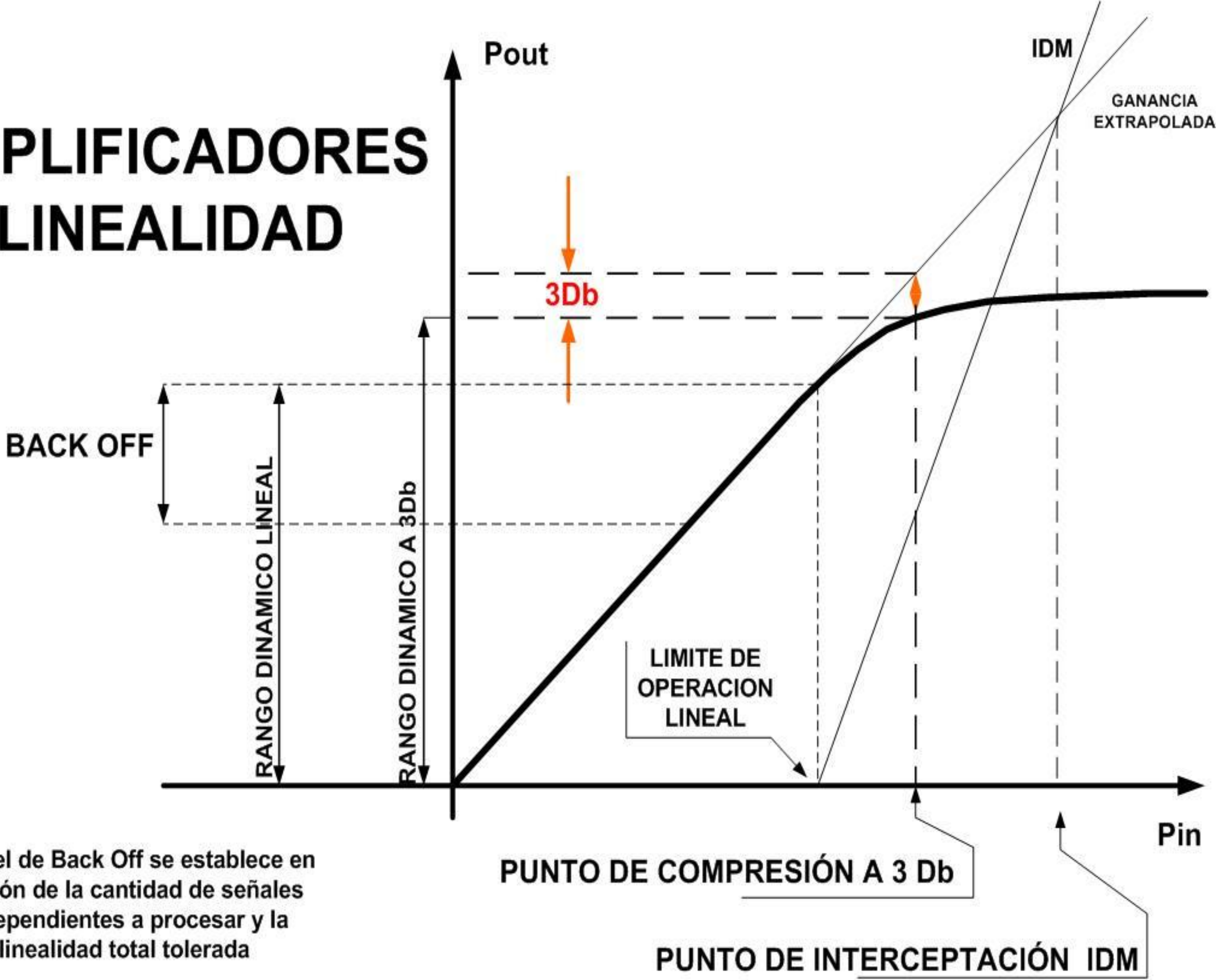
RECEPTORES: SELECTIVIDAD



RECEPTORES: LINEALIDAD

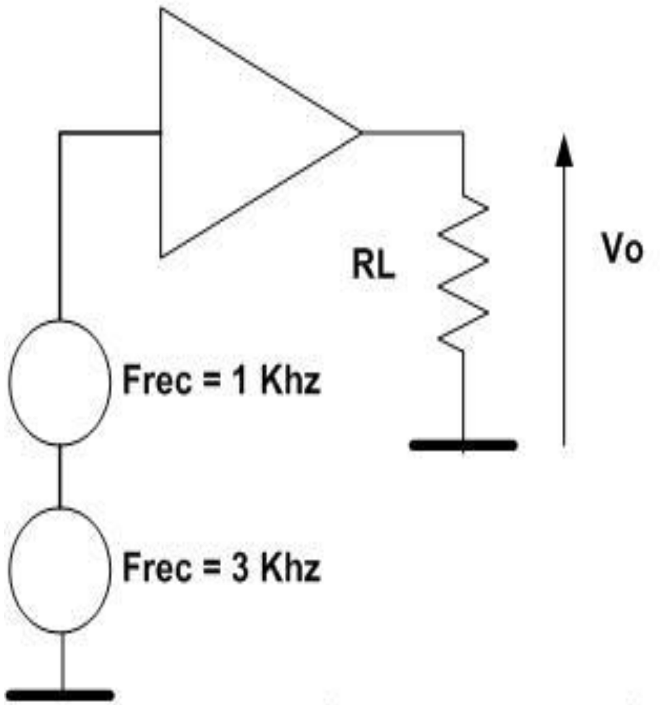


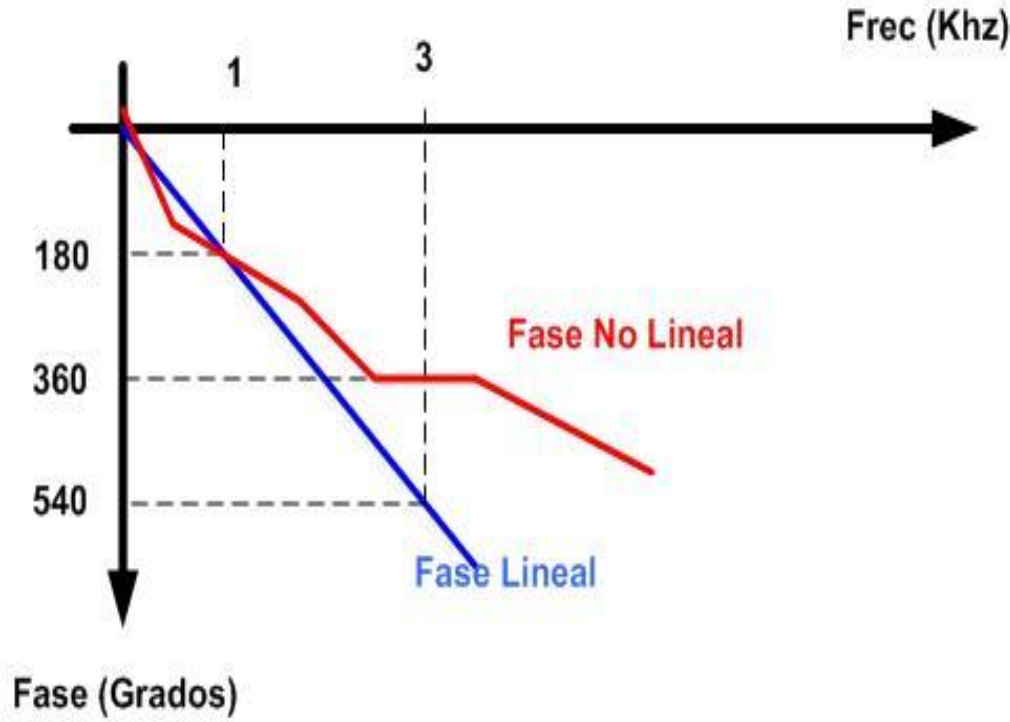
AMPLIFICADORES LINEALIDAD



El nivel de Back Off se establece en función de la cantidad de señales independientes a procesar y la linealidad total tolerada

RECEPTORES. RETARDO DE GRUPO

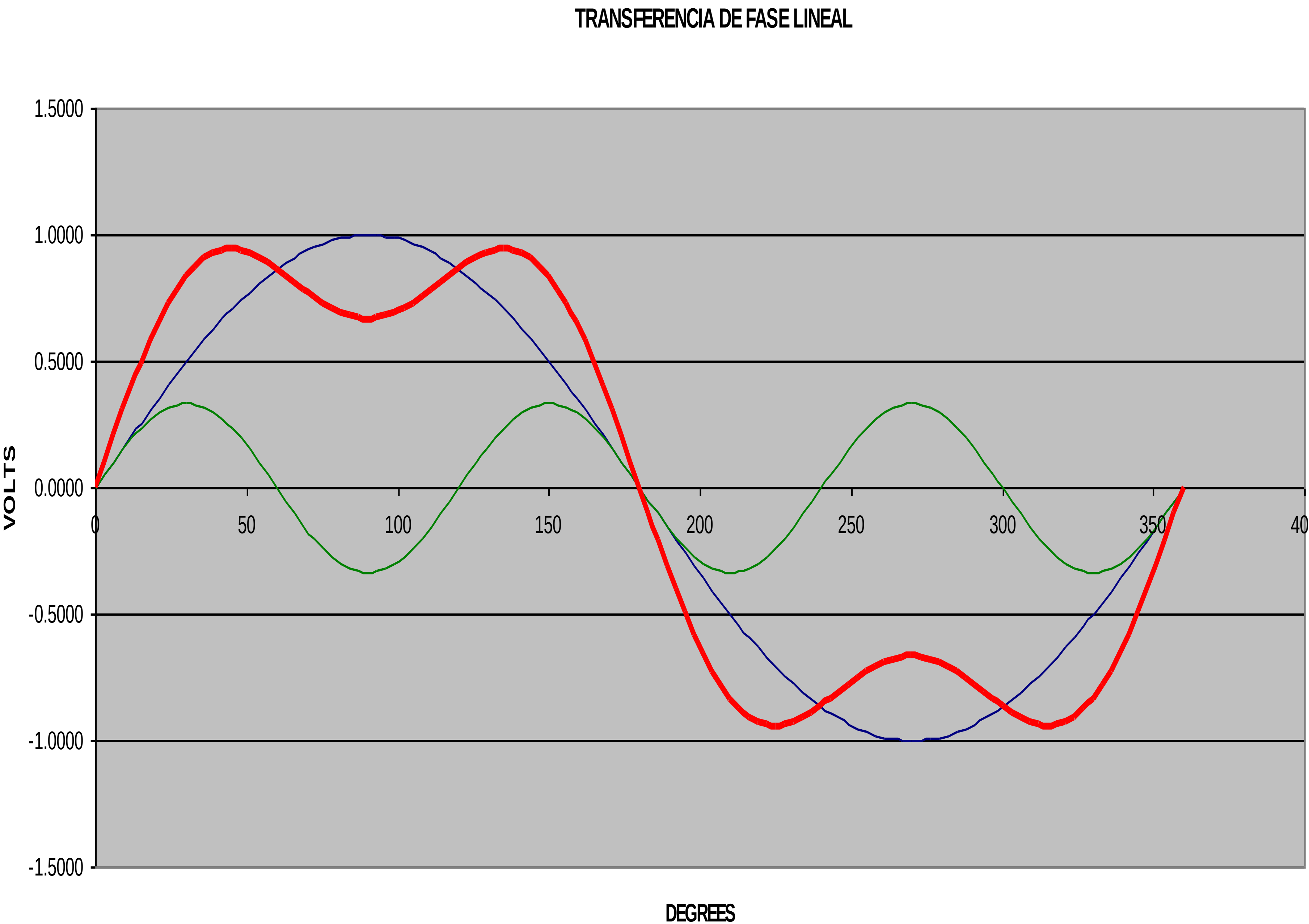




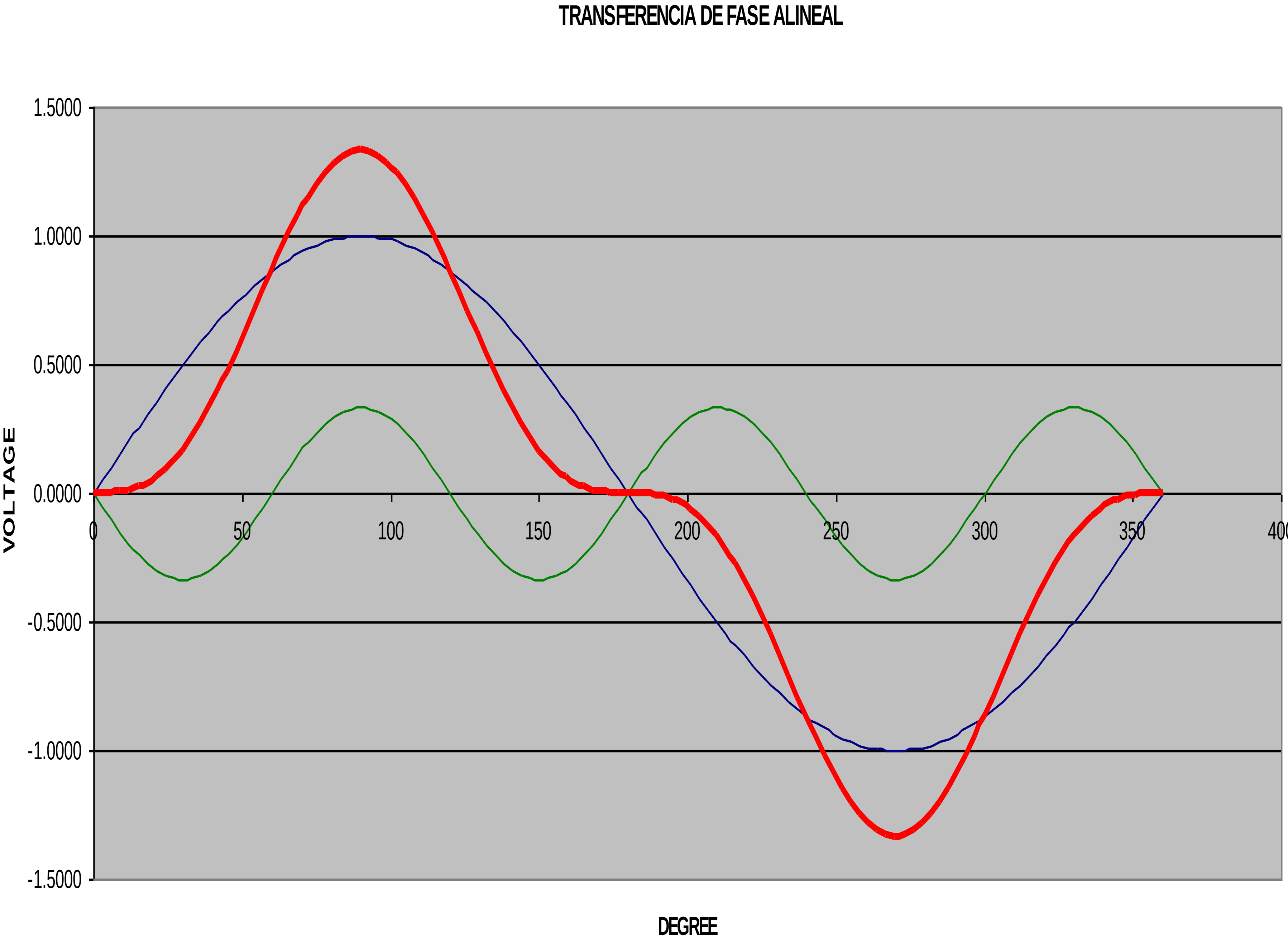
1Khz → T= 1mSeg → 180° = 0,5 mSeg

3 Khz → T= 0,333 mSeg → 540° = 0,5 mSeg

→ 360° = 0,333 mSeg



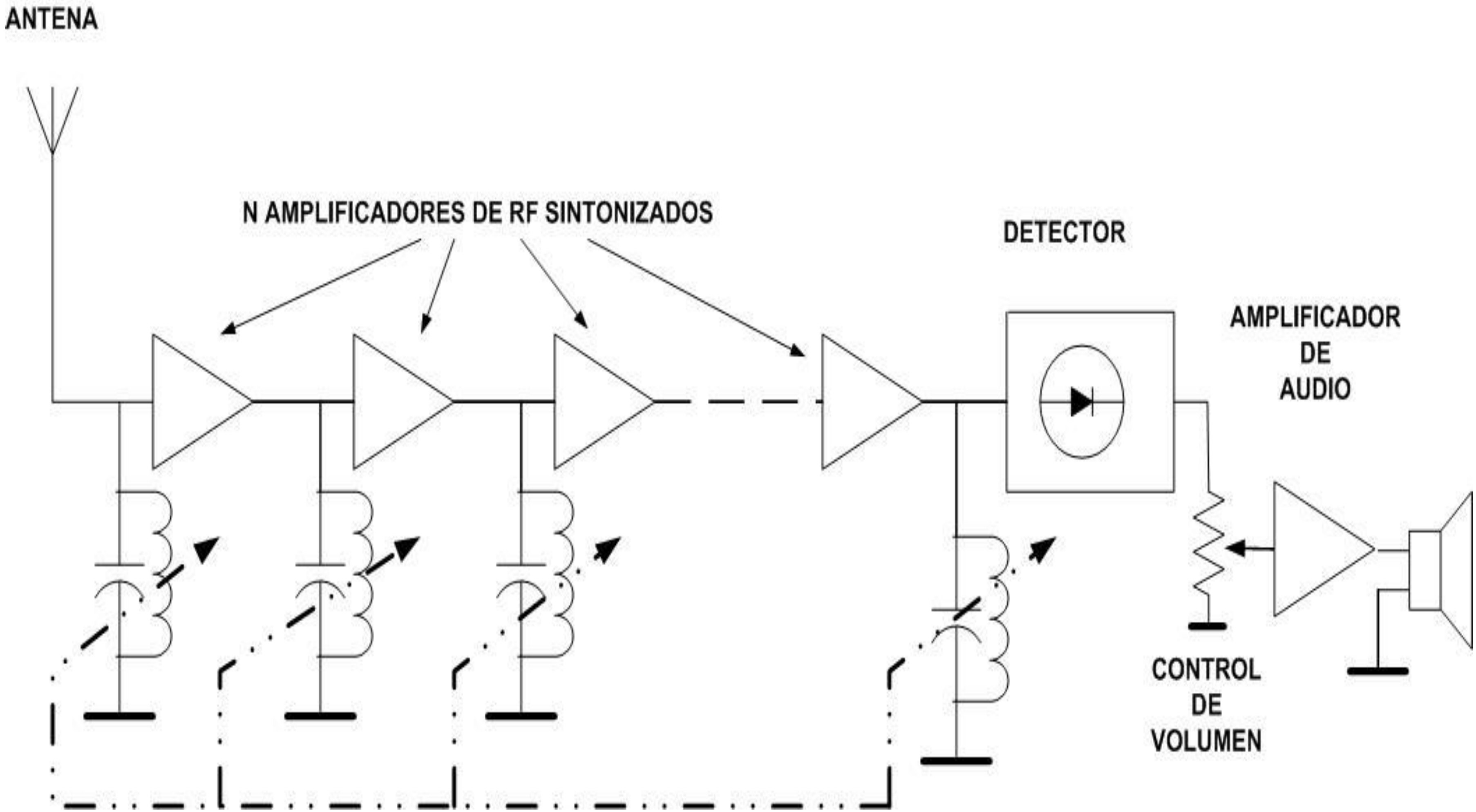
TRANSFERENCIA DE FASE LINEAL
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
VOLTS
0
50
100
150
200
250
300
350
40
DEGREES


TRANSFERENCIA DE FASE ALINEAL
VOLTAGE
1.5000
1.0000
0.5000
0.0000
-0.5000
-1.0000
-1.5000
0
50
100
150
200
250
300
350
400
DEGREE

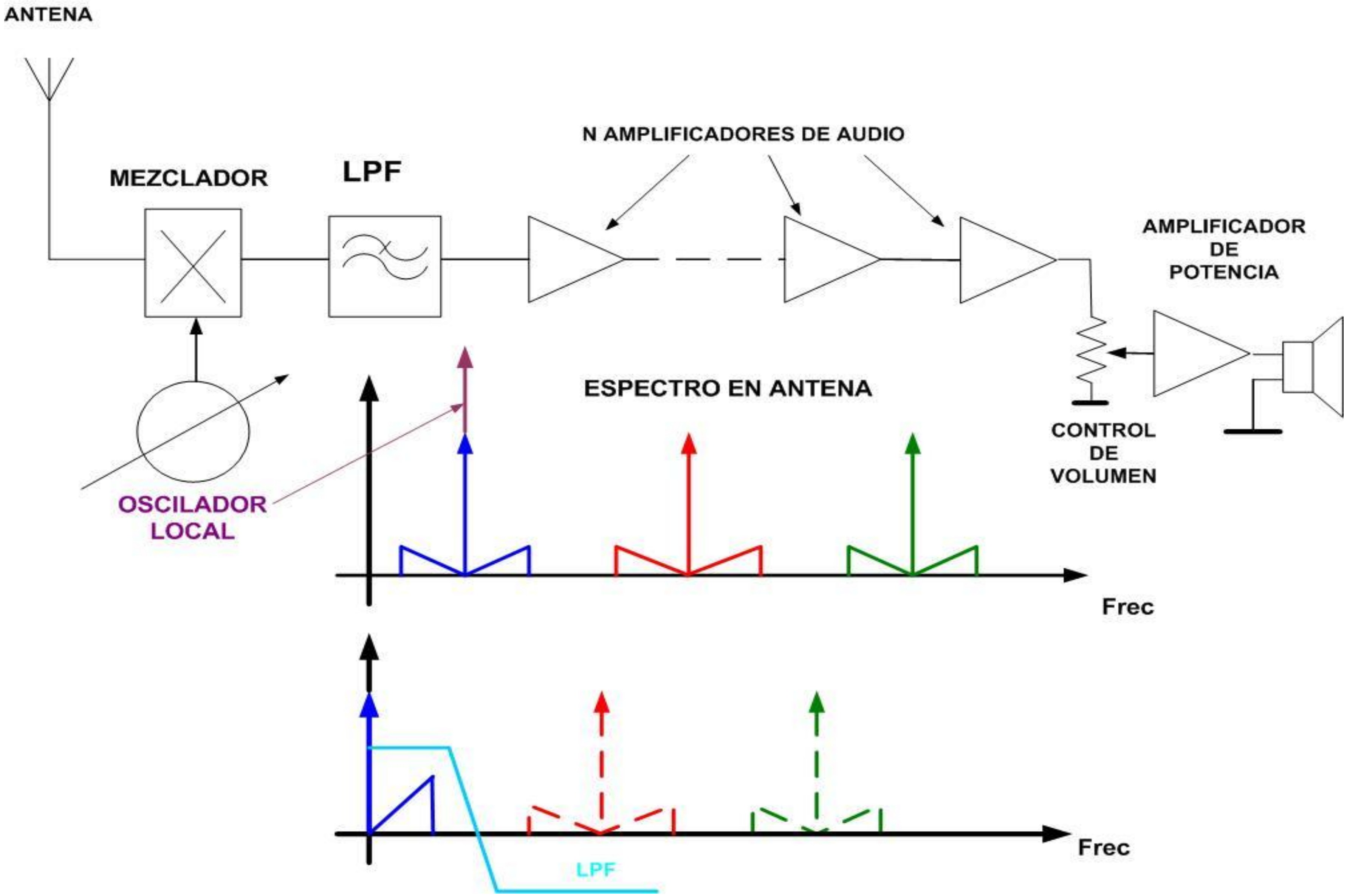
EAIII-INTRODUCCION- EL RECEPTOR DE RADIO

- **NEUTRODINO**
- **HOMODINO**
- **HETERODINO**
- **SUPERHETERODINO**
  - SIMPLE CONVERSION
  - DOBLE CONVERSION
  - BANDA ANCHA
- **EL RADIO DIGITAL**
- **FILTROS**

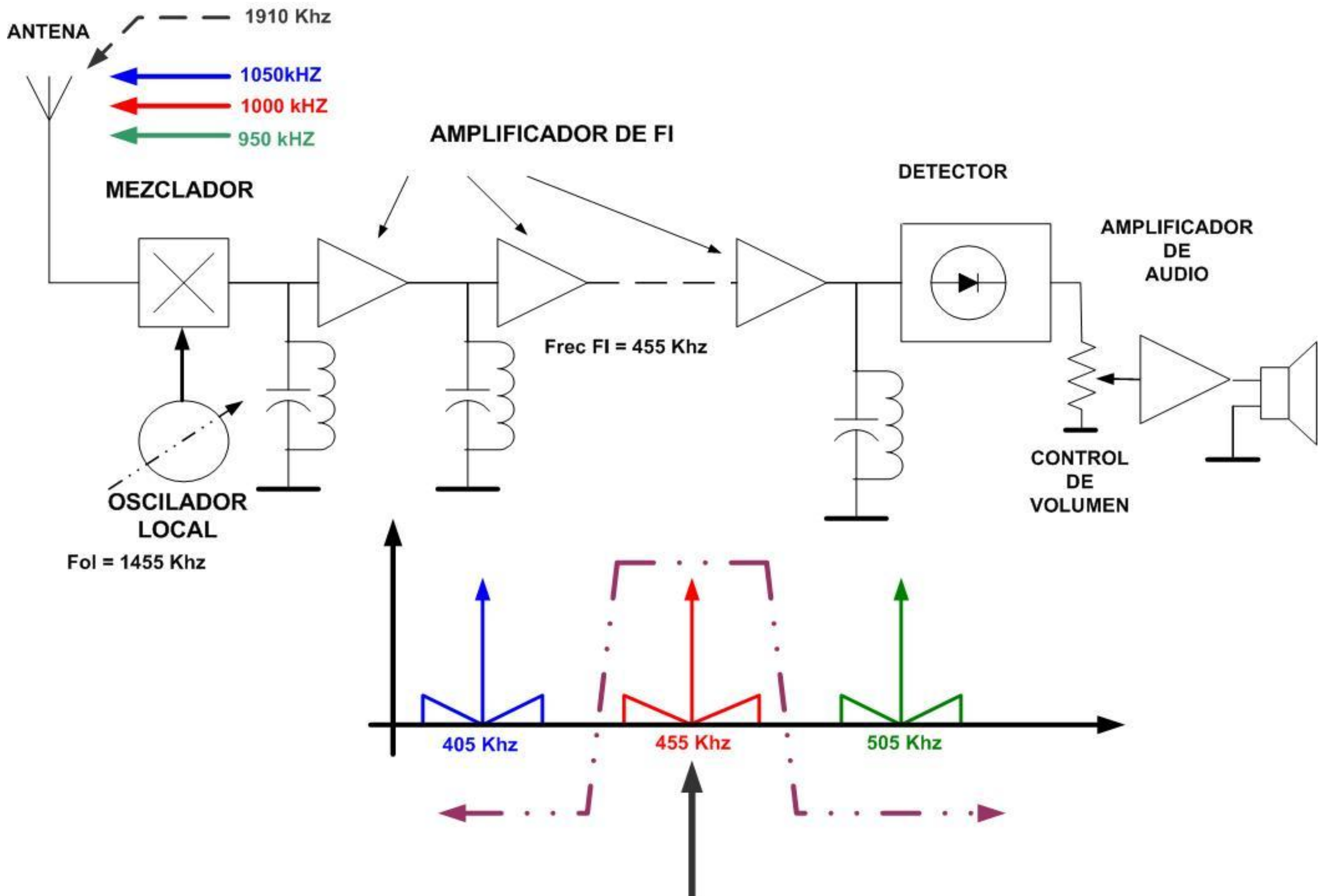
RECEPTOR NEUTRODINO ó RF SINTONIZADO



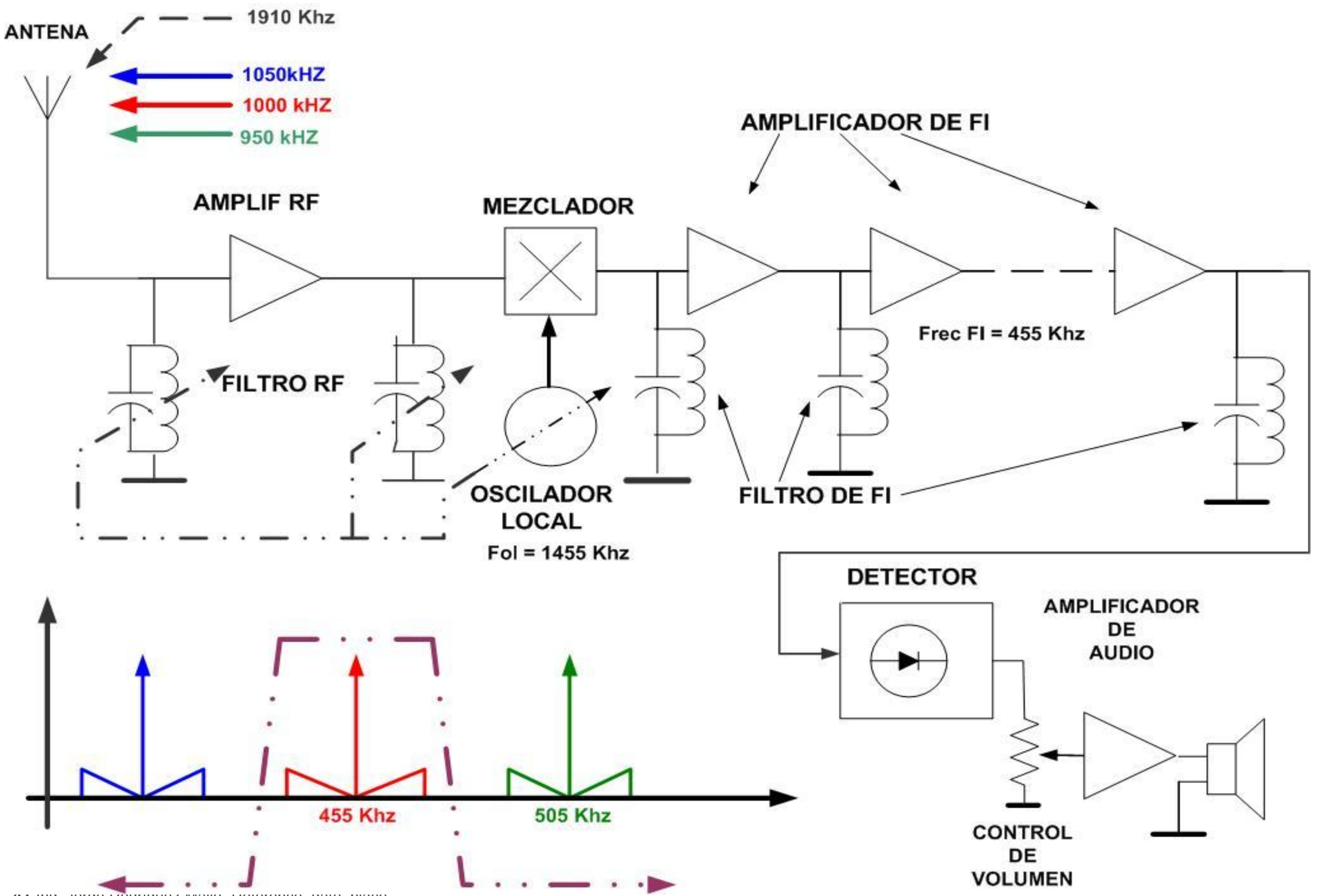
RECEPTOR HOMODINO



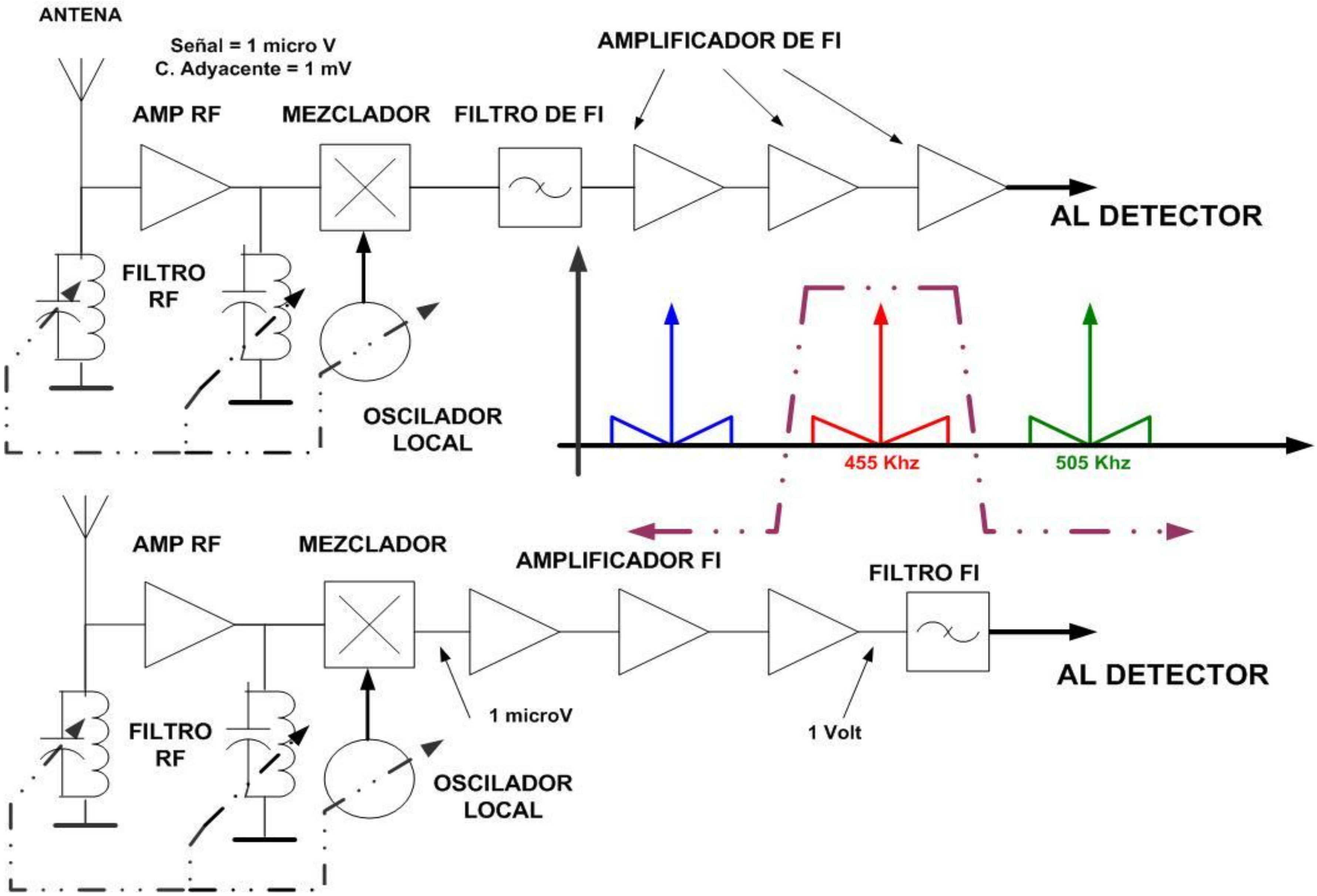
RECEPTOR HETERODINO



RECEPTOR SUPERHETERODINO



SUPERHETERODINO SIMPLE CONVERSION



RECEPTOR SUPERHETERODINO

- **FRECUENCIAS DE FI NORMALIZADAS:**

455 Khz	BC AM
10,7 Mhz	BC FM y VHF
21,4 Mhz	VHF
40 Mhz	TV
70 Mhz	RE
140 Mhz	RE

- **EJEMPLO BC-AM**
  - BANDA RX: 550 Khz / 1600 Khz — Ffi= 455 Khz
  - POSIBLES FoL — FolH= 1005 / 2055 Khz
    FolL= 95 / 1145 Khz
  - FRECUENCIA IMAGEN: — Fc + ó - 2Ffi

Fc= 550 Khz	Fimagen= 1460 Khz
Fc= 1000 Khz	Fimagen= 1910 Khz
Fc= 1600 Khz	Fimagen= 2510 Khz

RECEPCION DE SEÑALES NO DESEADAS

- ESENCIALES
  - Interferencia en banda
  - Canales adyacentes: Los debe eliminar el filtrado en FI
  - Frecuencia Imagen: La debe eliminar el filtrado de RF

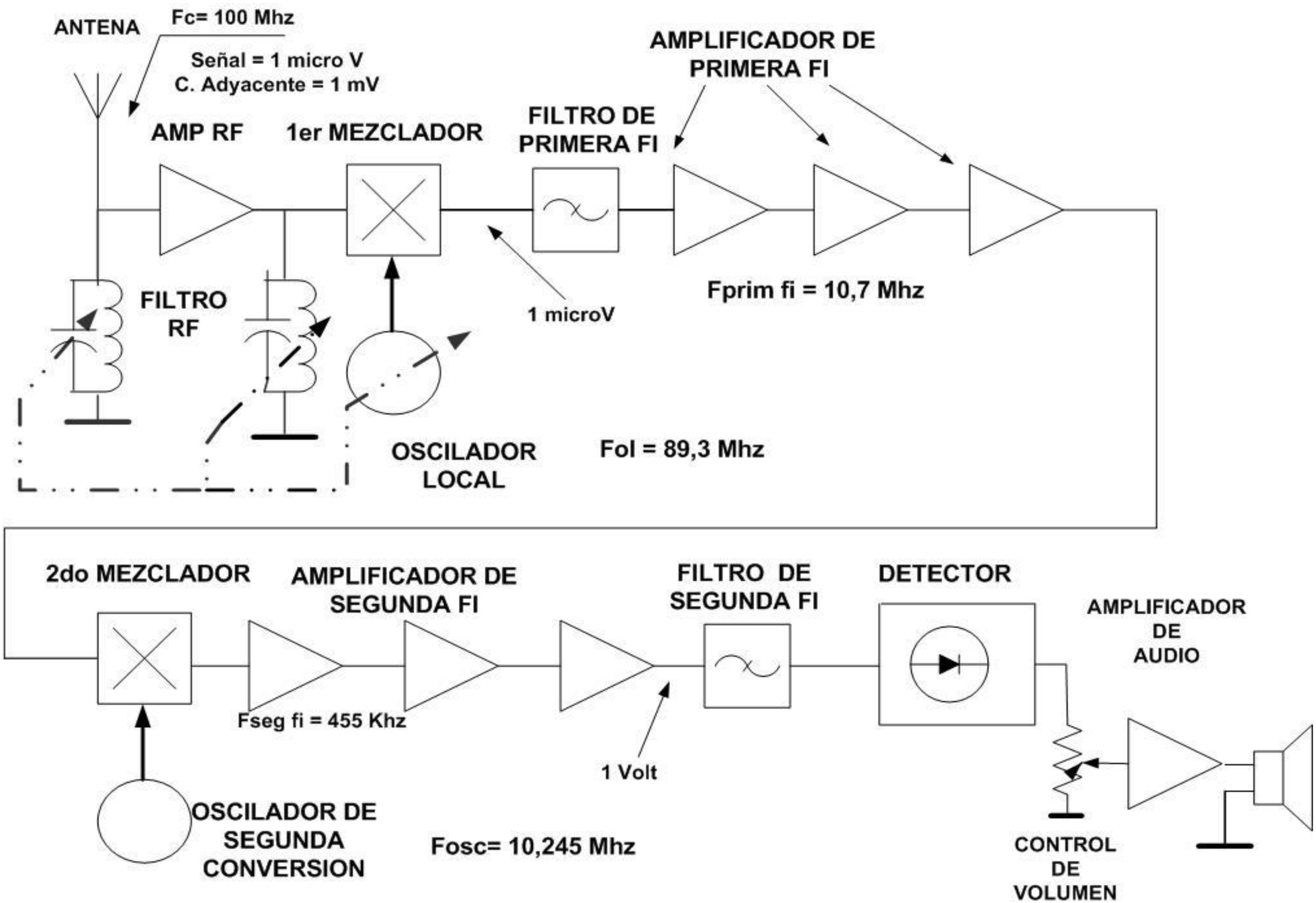
- POR ALINEALIDAD
  - IDM
  - CROSS-MODULATION
  - MEDIA FI: Ej.: BC-AM
    - Fc= 1000 Khz.   Ffi: 455 Khz   Fol= 1455 Khz   2 x Fol= 2910Khz
    - Finterferente= 1227,5   2 x Finterf= 2455 Khz
    - 2Fol – 2Fint = 2910 – 2455 = 455 Khz

- OTRAS
  - ESPUREAS DEL O.L
  - IRRADIACIÓN DE ARMÓNICAS DE FI

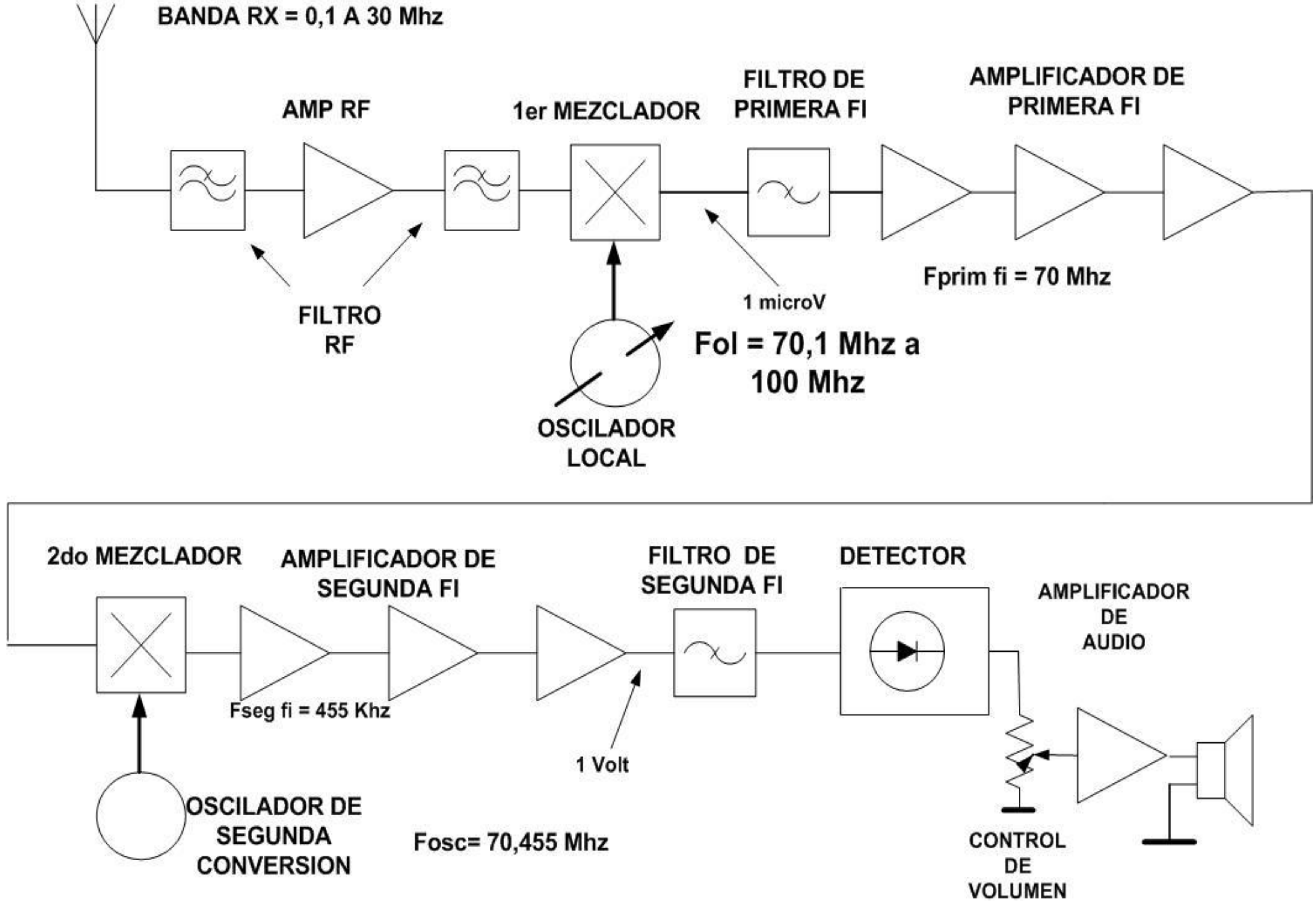
RECEPTOR SUPERHETERODINO

- EJEMPLO BC- FM
- BANDA RX 88 Mhz a 108 Mhz
- 1er CASO Ffi = 455 Khz Fimagen separada 910 Khz de Fc
  - OBLIGA A USAR UN FILTRADO DE RF MUY EXIGENTE
- 2do CASO Ffi= 10,7 Mhz Fimagen separada 21,4 Mhz de Fc
  - Fc= 88 Mhz Fol= 77,3 Mhz Fimagen= 66,6 Mhz
  - Fc= 100 Mhz Fol= 89,3 Mhz Fimagen= 78,6 Mhz
  - Fc= 108 Mhz Fol= 97,3 Mhz Fimagen= 86,6 Mhz
- CONCLUSIONES
  - Ffi = 455 Khz resulta dificil hacer el filtro de RF
  - Ffi= 10,7 Mhz resulta dificil lograr el rechazo de canal adyacente
  - La solución es usar ambos filtros: EL RECEPTOR SUPERHETERODINO DE DOBLE CONVERSION

SUPERHETERODINO DOBLE CONVERSION

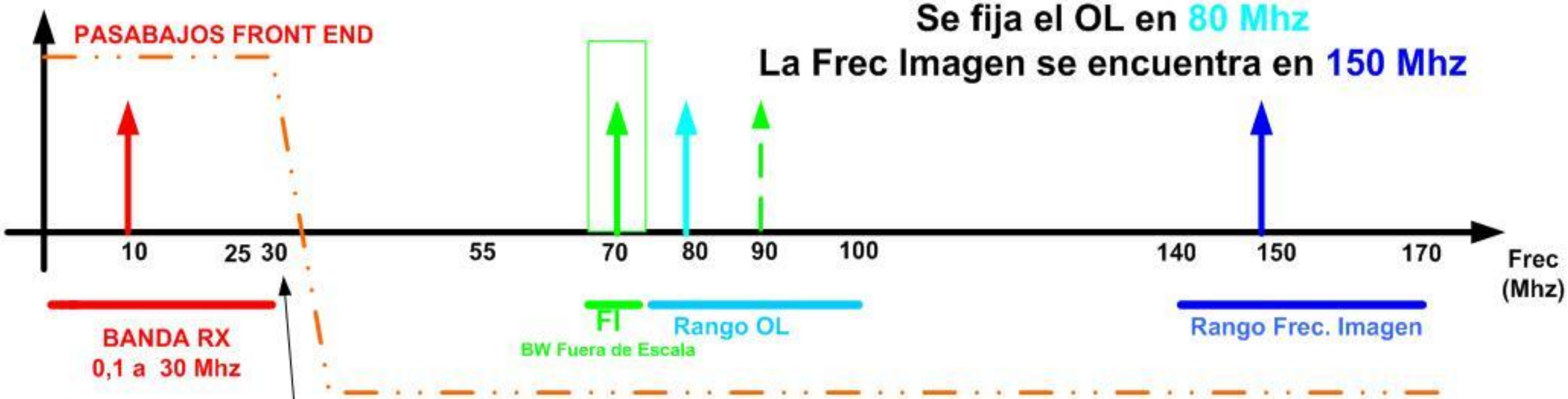


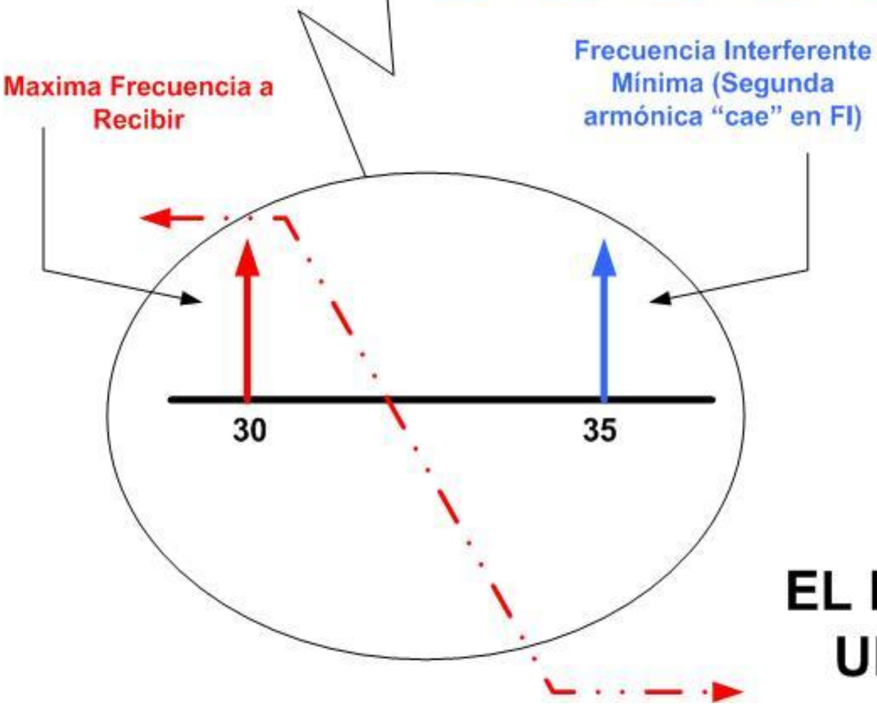
SUPERHET. DOBLE CONV. BANDA ANCHA



RECEPTOR SUPERHETERODINO BB CON OL “Por Arriba de la FI”

Para recibir 10 Mhz
Se fija el OL en 80 Mhz
La Frec Imagen se encuentra en 150 Mhz





LA MEDIA FI SIEMPRE ESTÁ “POR ARRIBA” DE 35 MhZ

EJEMPLO: Media FI para 10 Mhz Rx = 45 Mhz

OL : 80 x 2 = 160

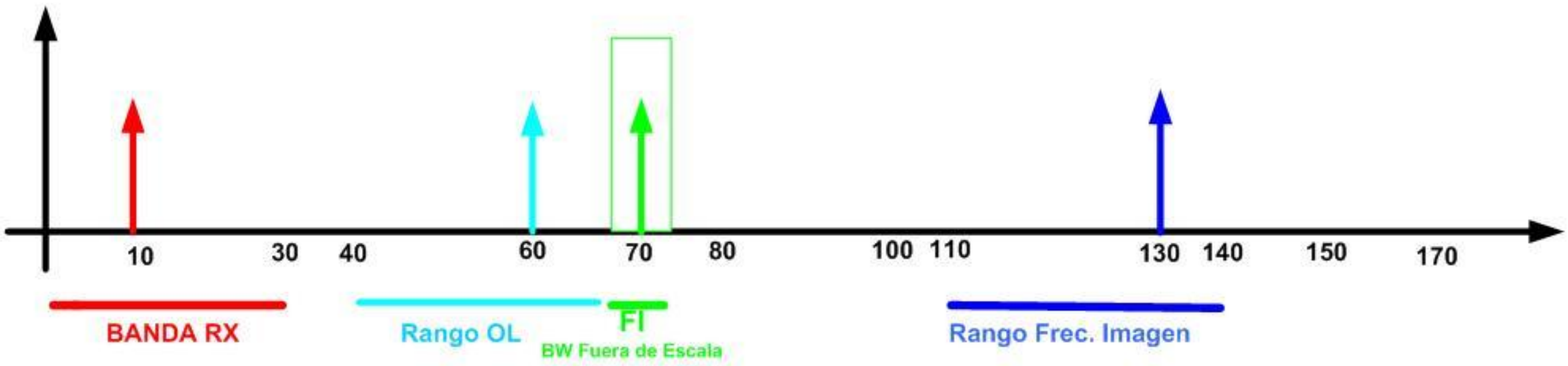
IN: 45 x 2 = 90

160 - 90 = FI

EL PASABAJOS FRONT END INCLUYE UN NOTCH REMOVIBLE EN BC AM

RECEPTOR SUPERHETERODINO BB CON OL “Por Abajo de la FI”

Para recibir 10 Mhz
Se fija el OL en 60 Mhz
La Frec Imagen se encuentra en 130 Mhz



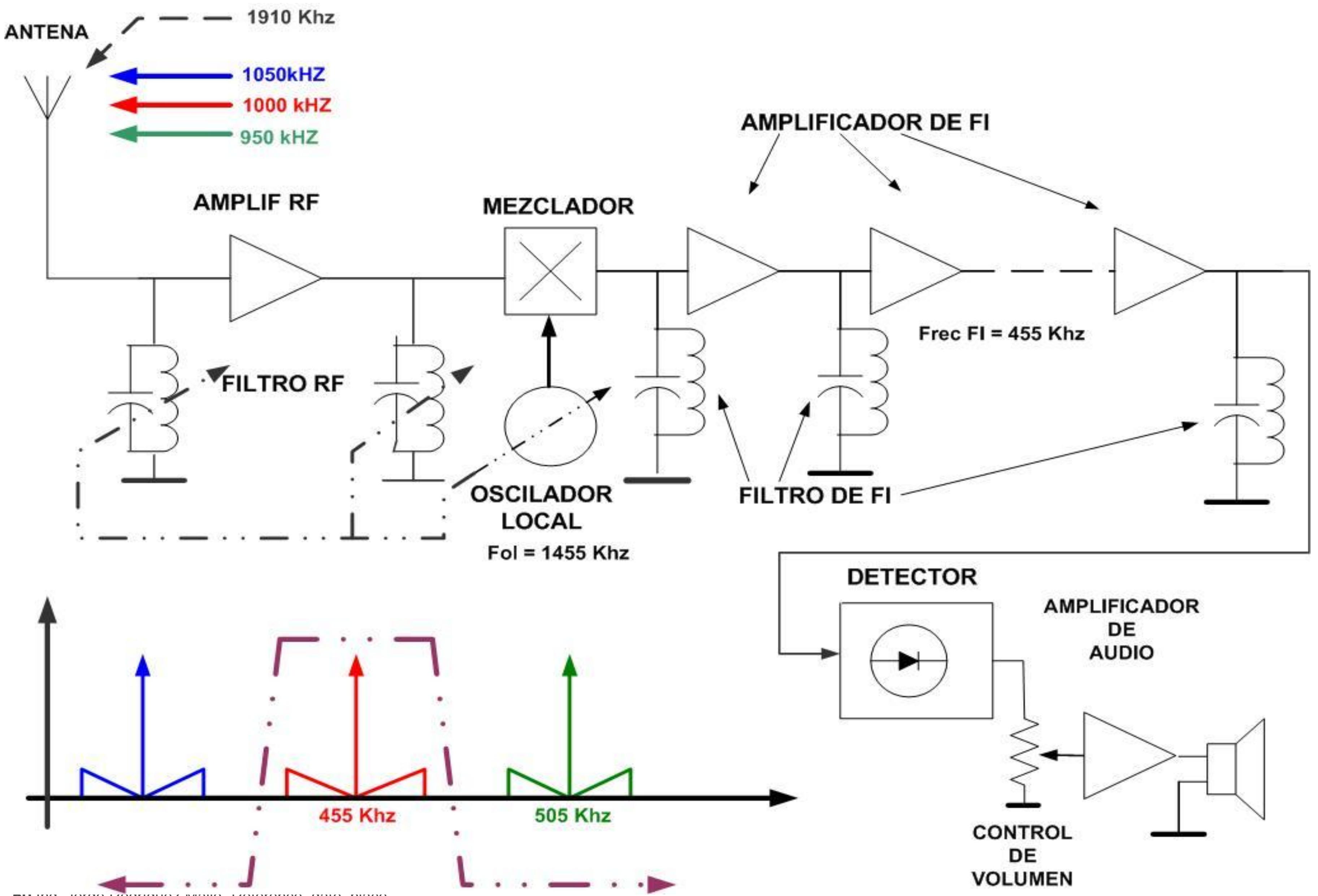
PARA CASI TODOS LOS VALORES DE Frec Rx LA MEDIA FI “CAE DENTRO DE LA BANDA Rx

EJEMPLO: MEDIA FI para 10 Mhz. Rx = 25 Mhz

OL : 60 x 2 = 120
In : 25 x 2 = 50
FI : 120 - 50 = 70

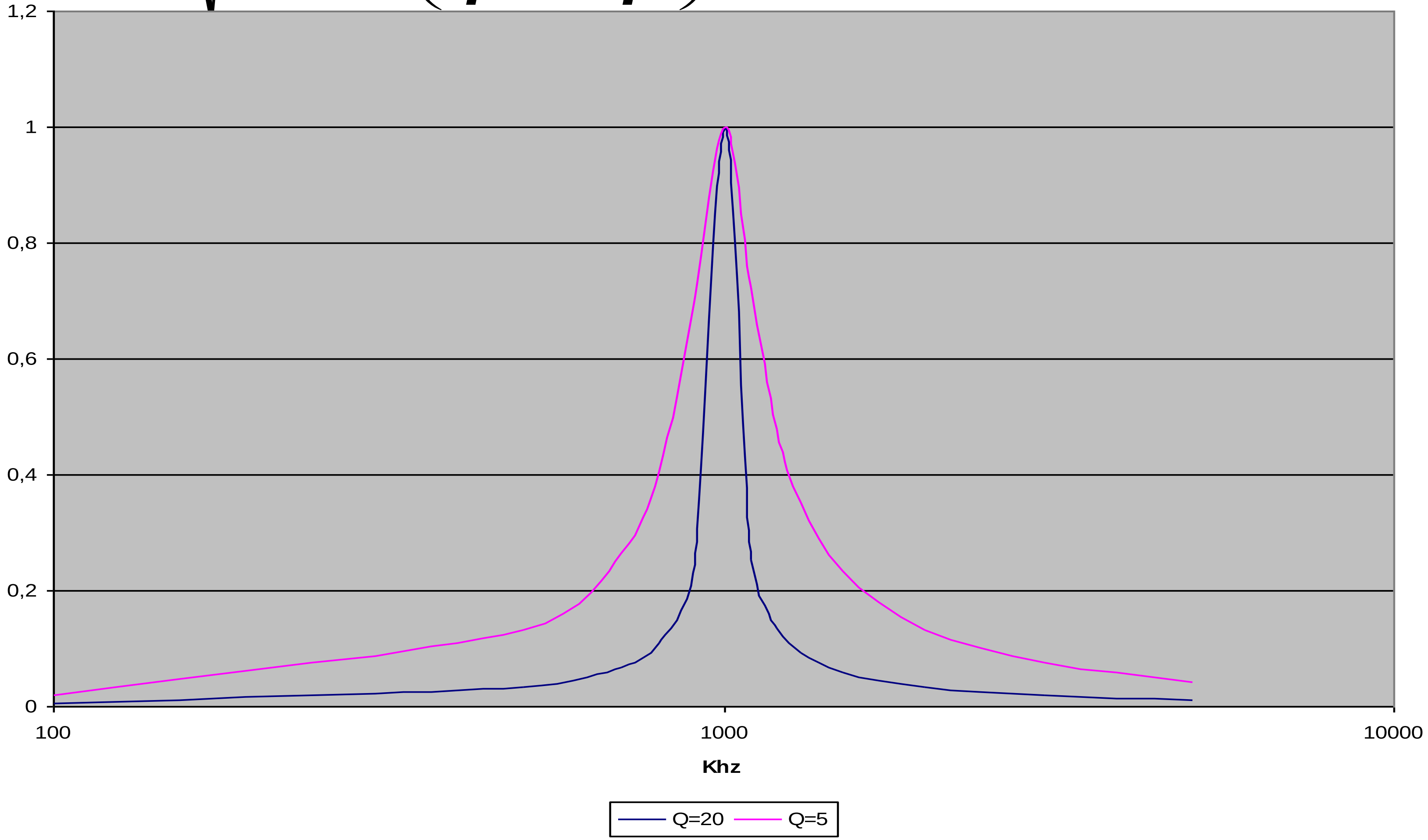
LOS RECEPTORES DE BANDA ANCHA REALIZAN LA PRIMERA CONVERSIÓN CON EL OL “POR ARRIBA” PARA MINIMIZAR EL EFECTO DE LAS ALINEALIDADES DE LA ETAPA DE RF Y CONVERSOR YA QUE EL PASABAJOS DE ENTRADA NO PUEDE ATENUAR LA MEDIA FI SALVO PARA Frec FI MÁS ELEVADAS

RECEPTOR SUPERHETERODINO

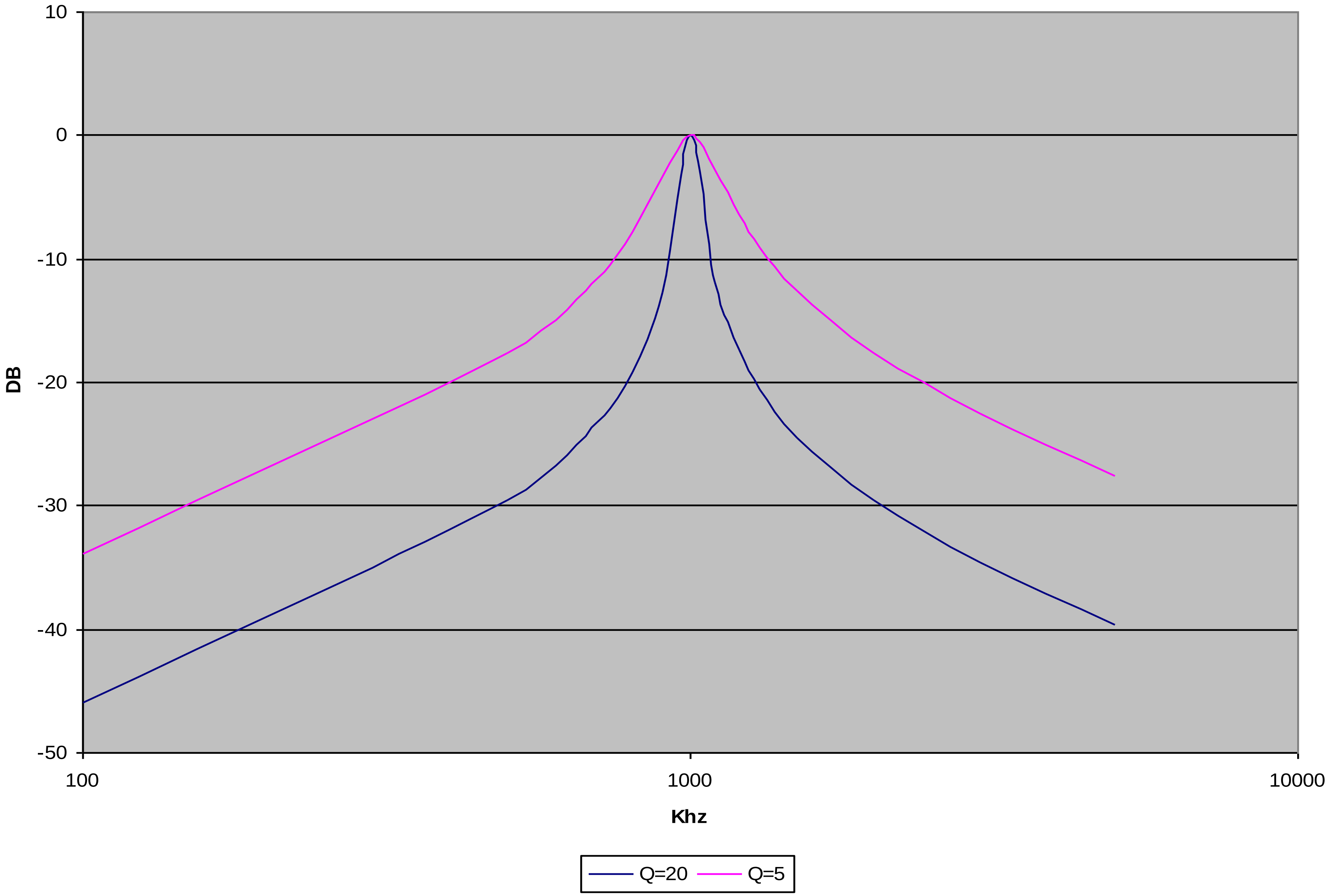


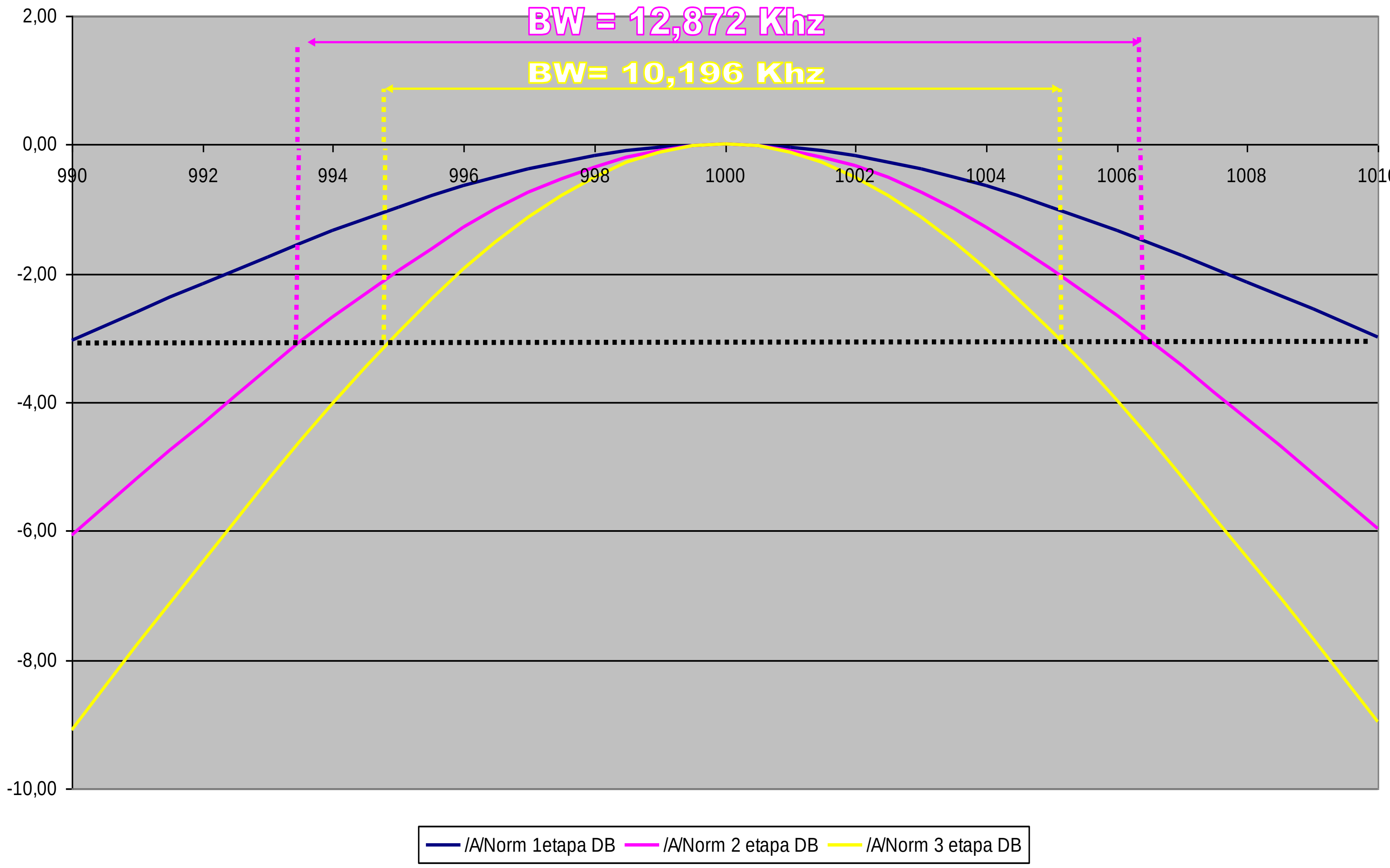
$$\left|\bar{A}\right| = \frac{1}{\sqrt{1+Q^2 \cdot \left(\frac{f}{fo} - \frac{fo}{f}\right)^2}}$$

SIMPLE SINTONIZADO

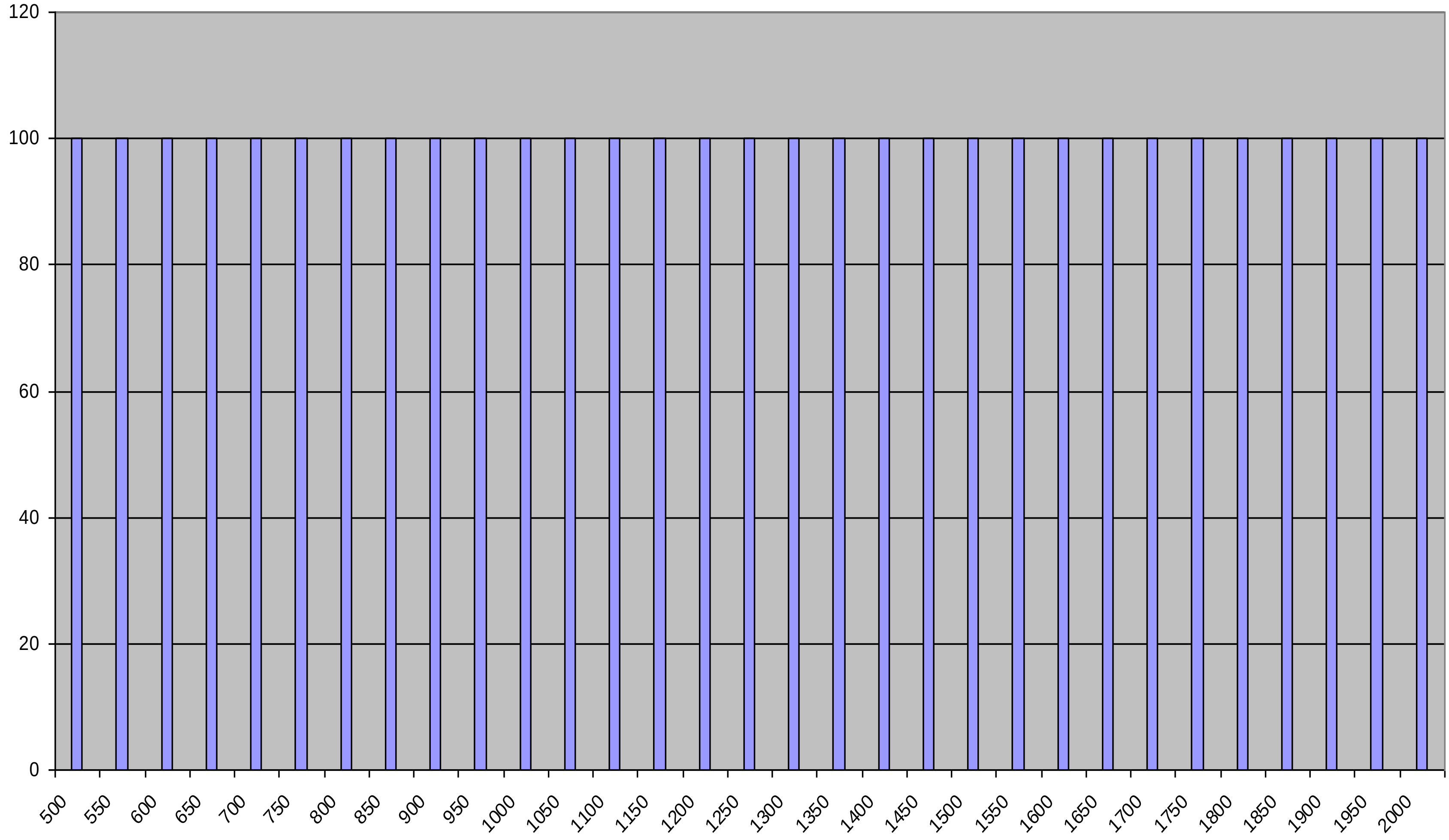


SIMPLE SINTONIZADO.ORDENADAS EN DB

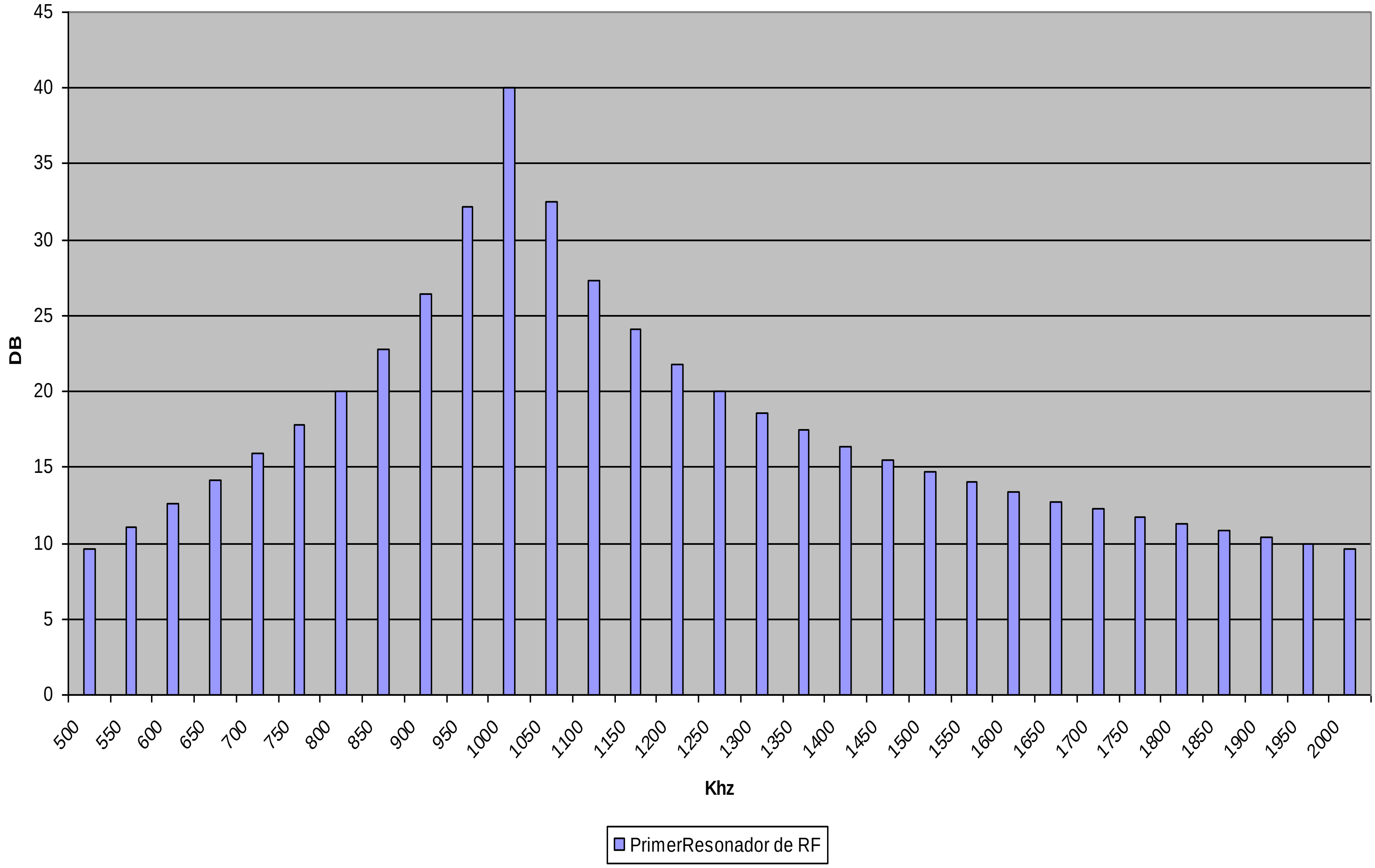



BW = 12,872 Khz
BW= 10,196 Khz
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-10,00
990
992
994
996
998
1000
1002
1004
1006
1008
1010
/A/Norm 1etapa DB
/A/Norm 2 etapa DB
/A/Norm 3 etapa DB

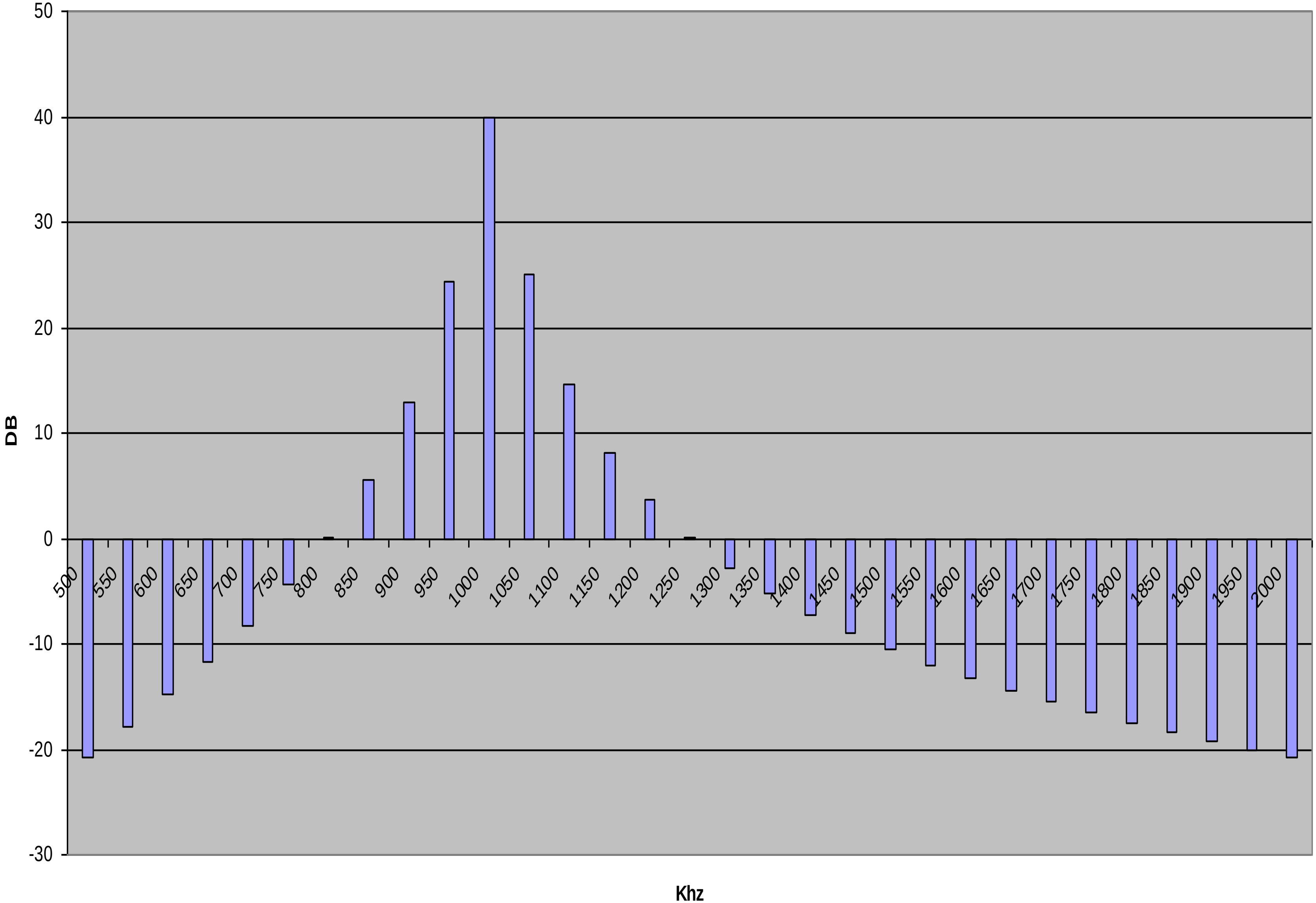
ESPECTRO DE AM EN ANTENA



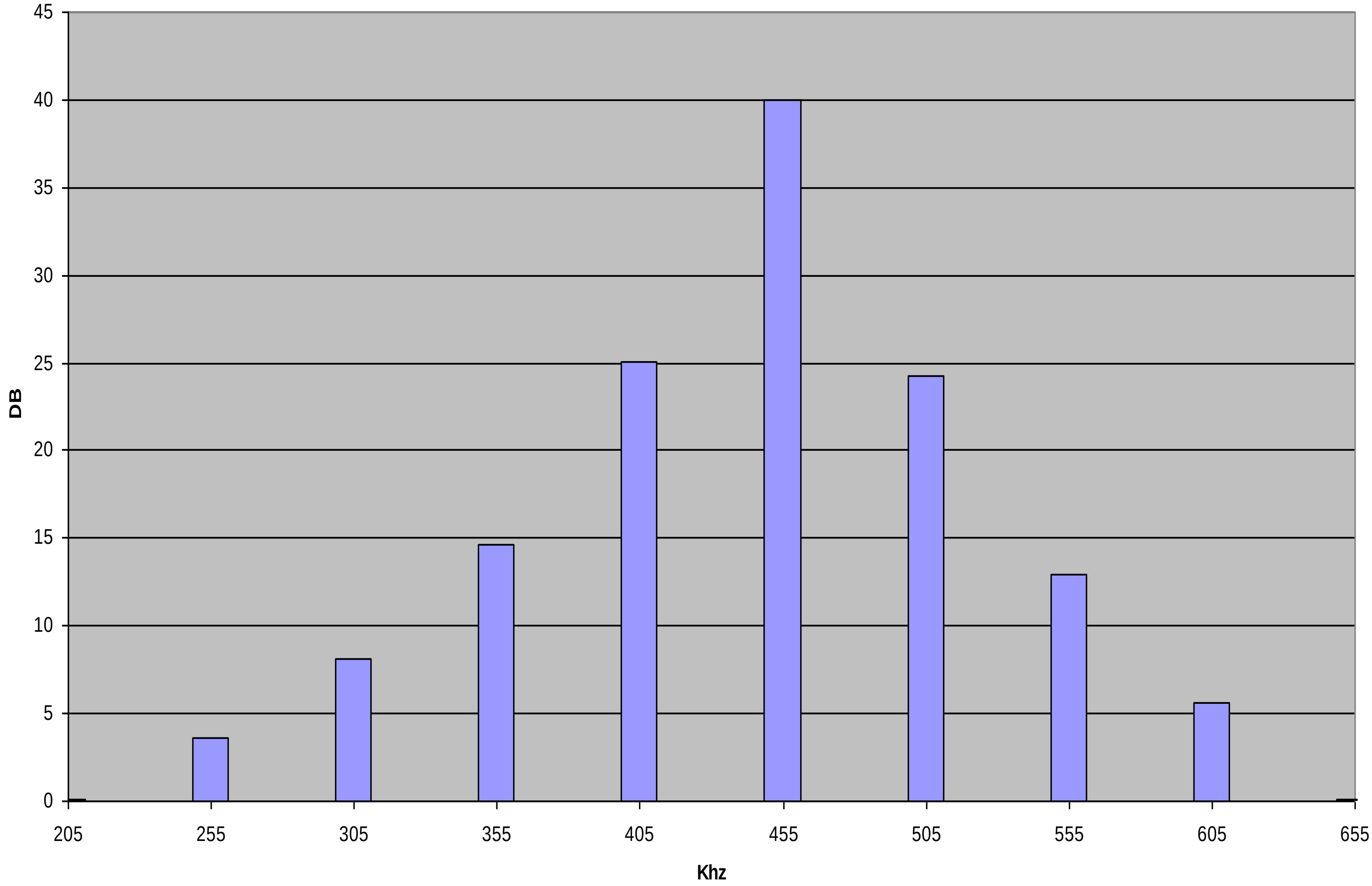
PRIMER RESONADOR DE RF. Q=22



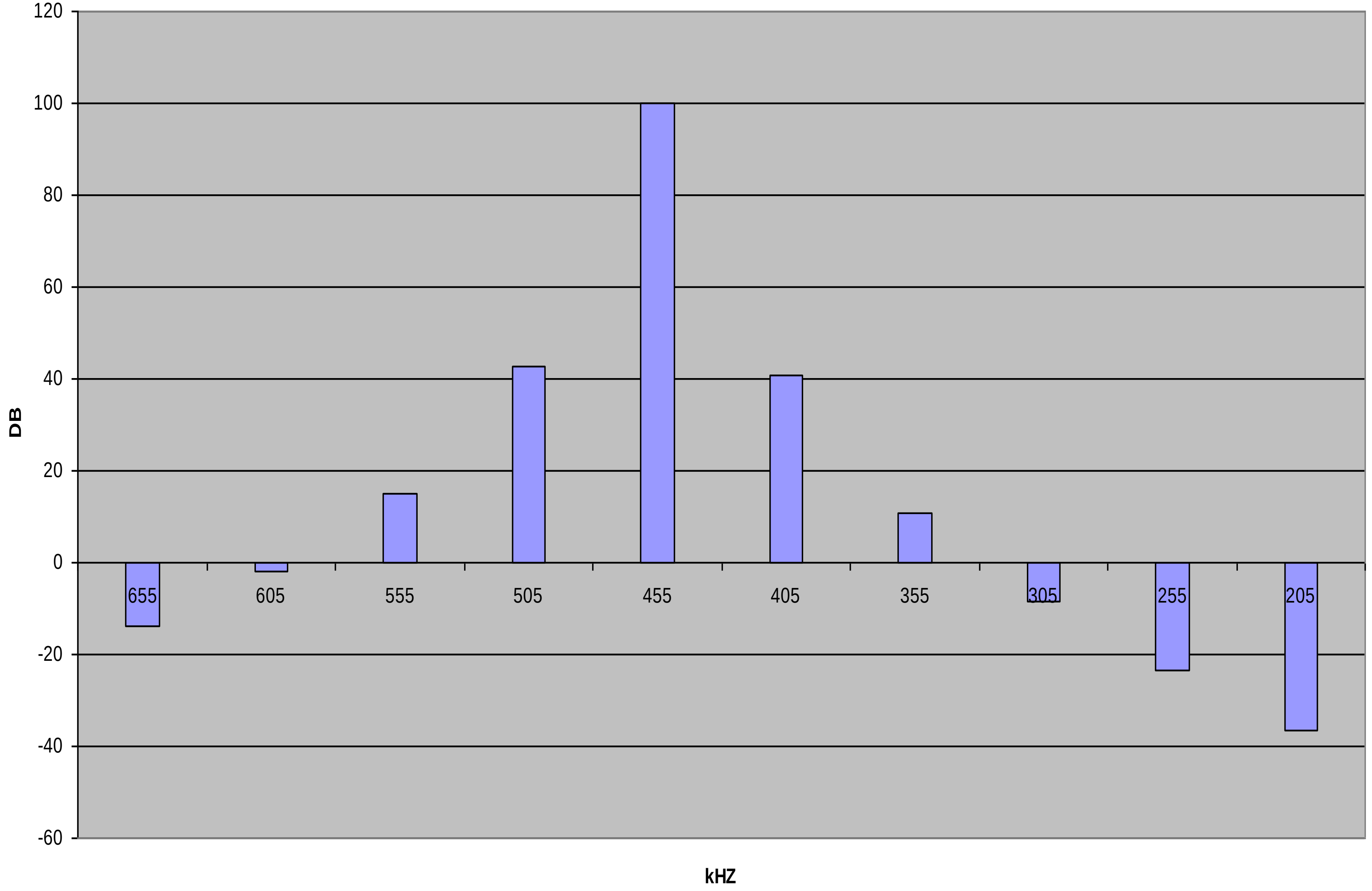
SEGUNDO RESONADOR DE RF. Q=22



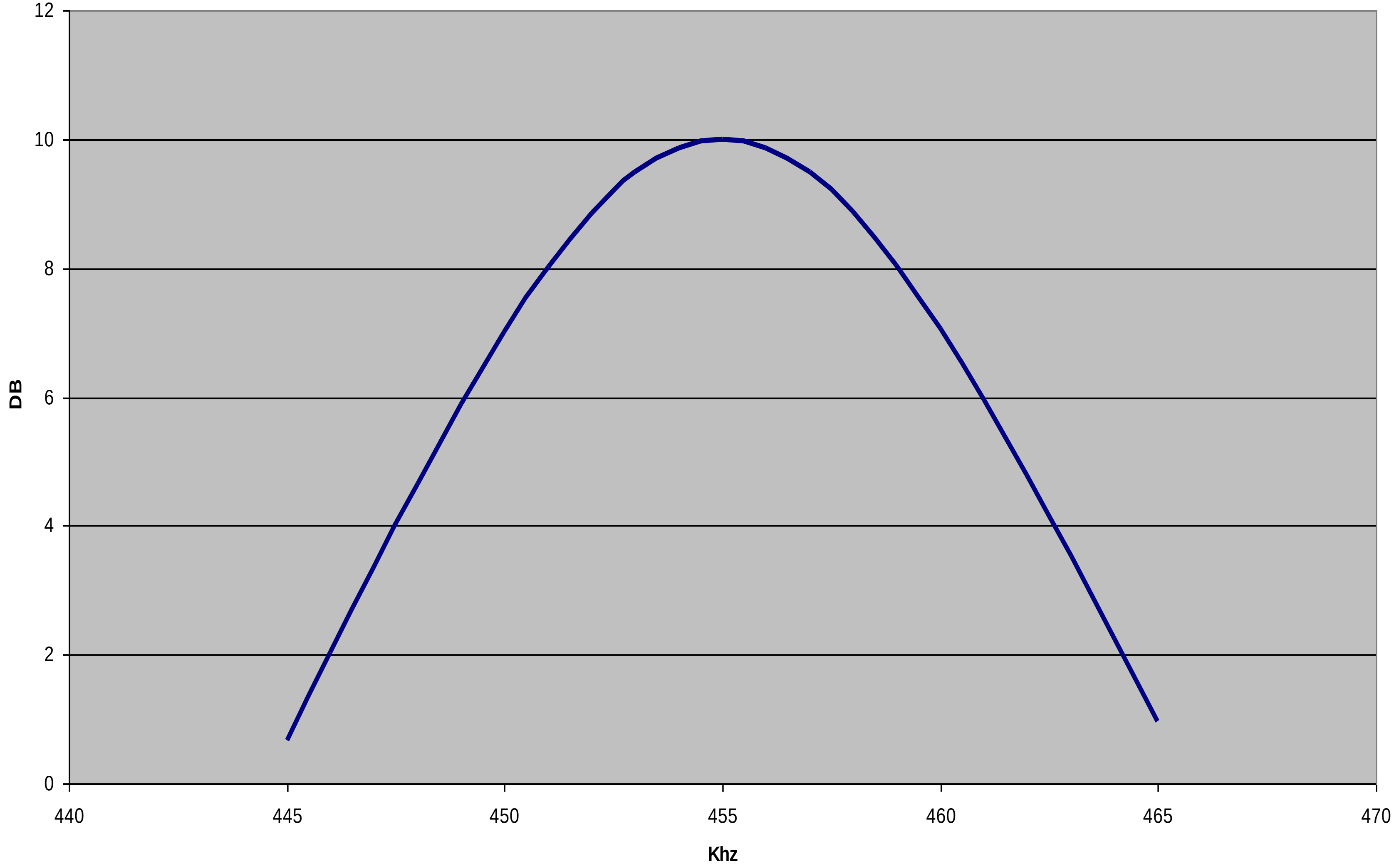
SALIDA DE MEZCLADOR=ENTRADA DE FI



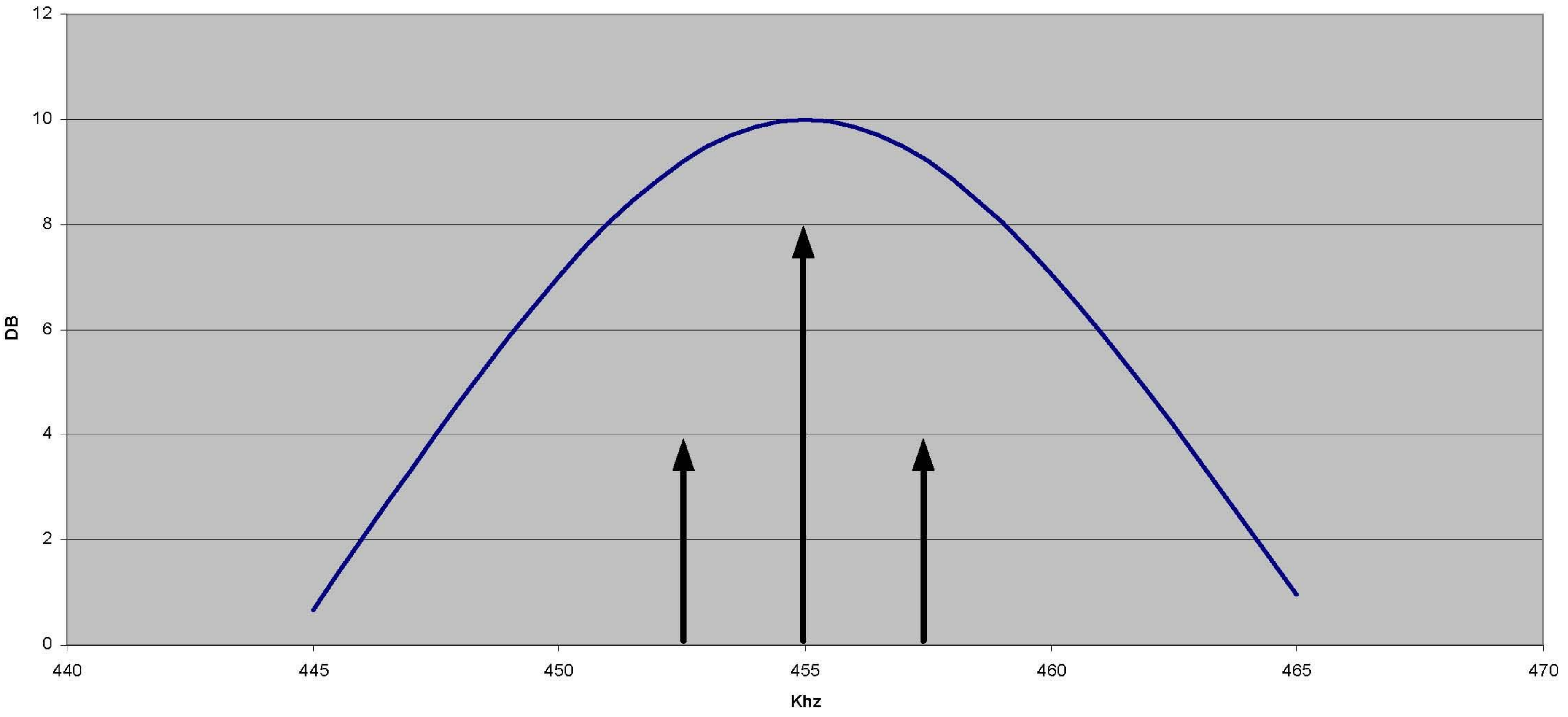
SALIDA DE FI = ENTRADA DEL DETECTOR



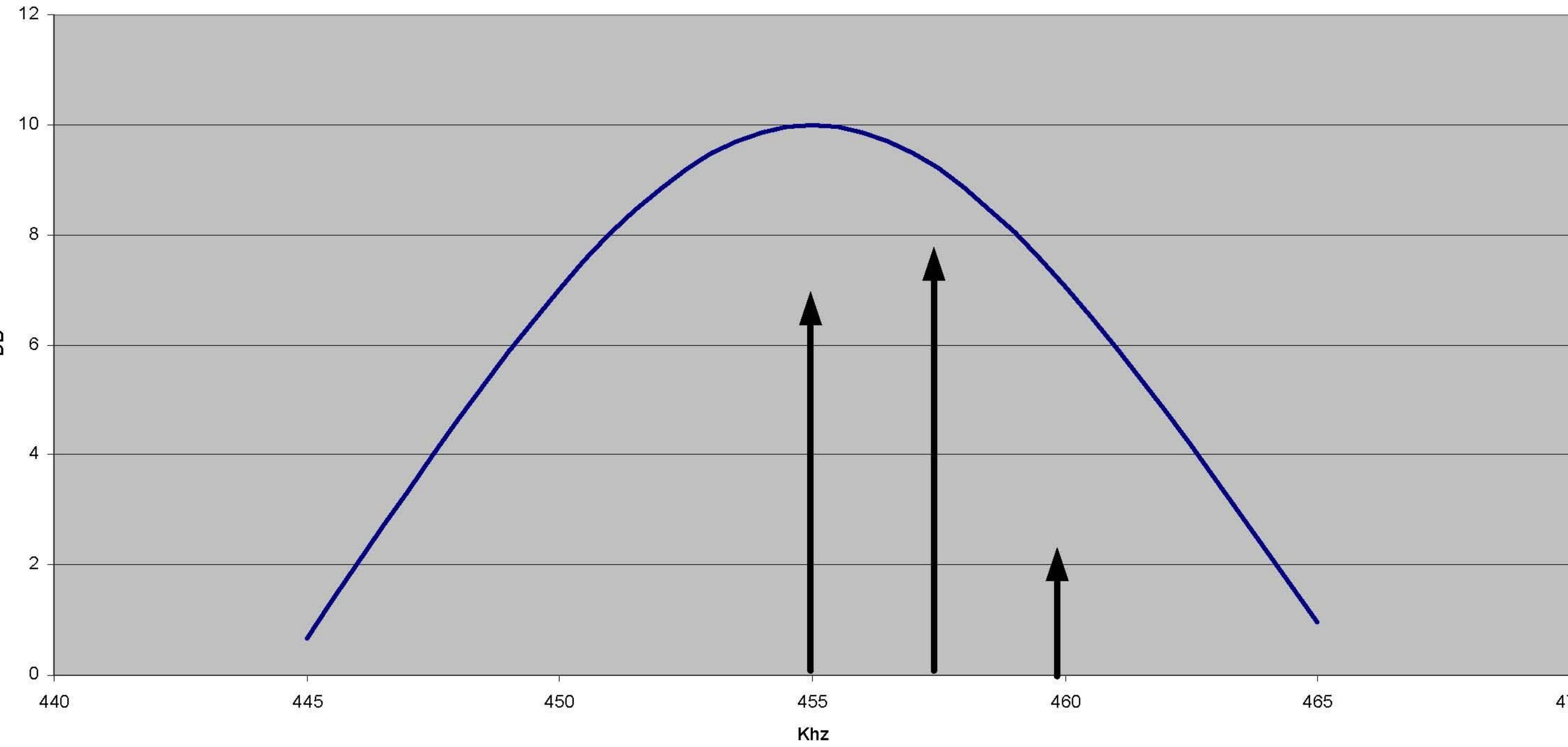
FI. PASABANDA CERCANO



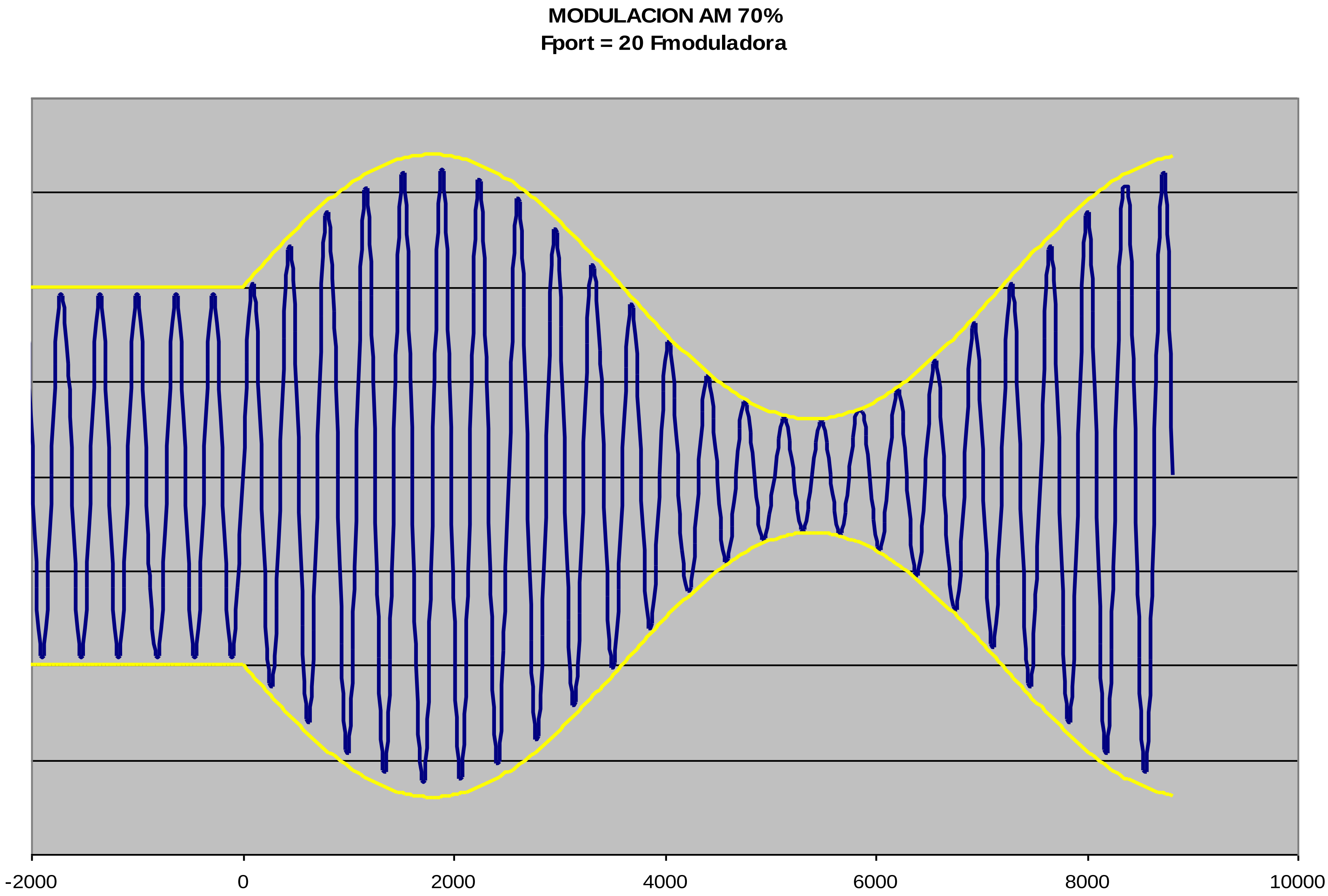
SEÑAL DE AM CENTRADA EN FI



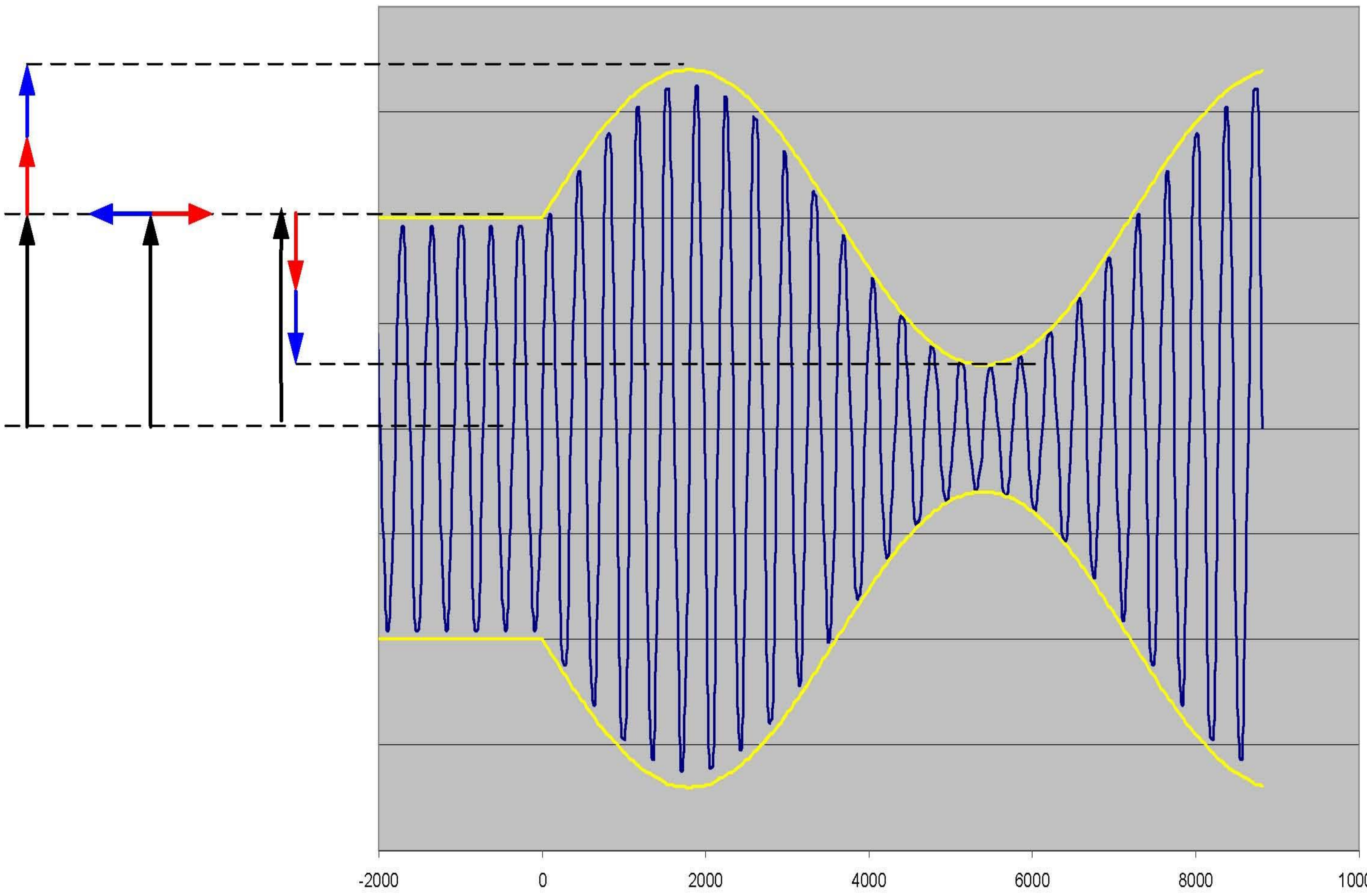
SEÑAL DE AM NO CENTRADA EN FI



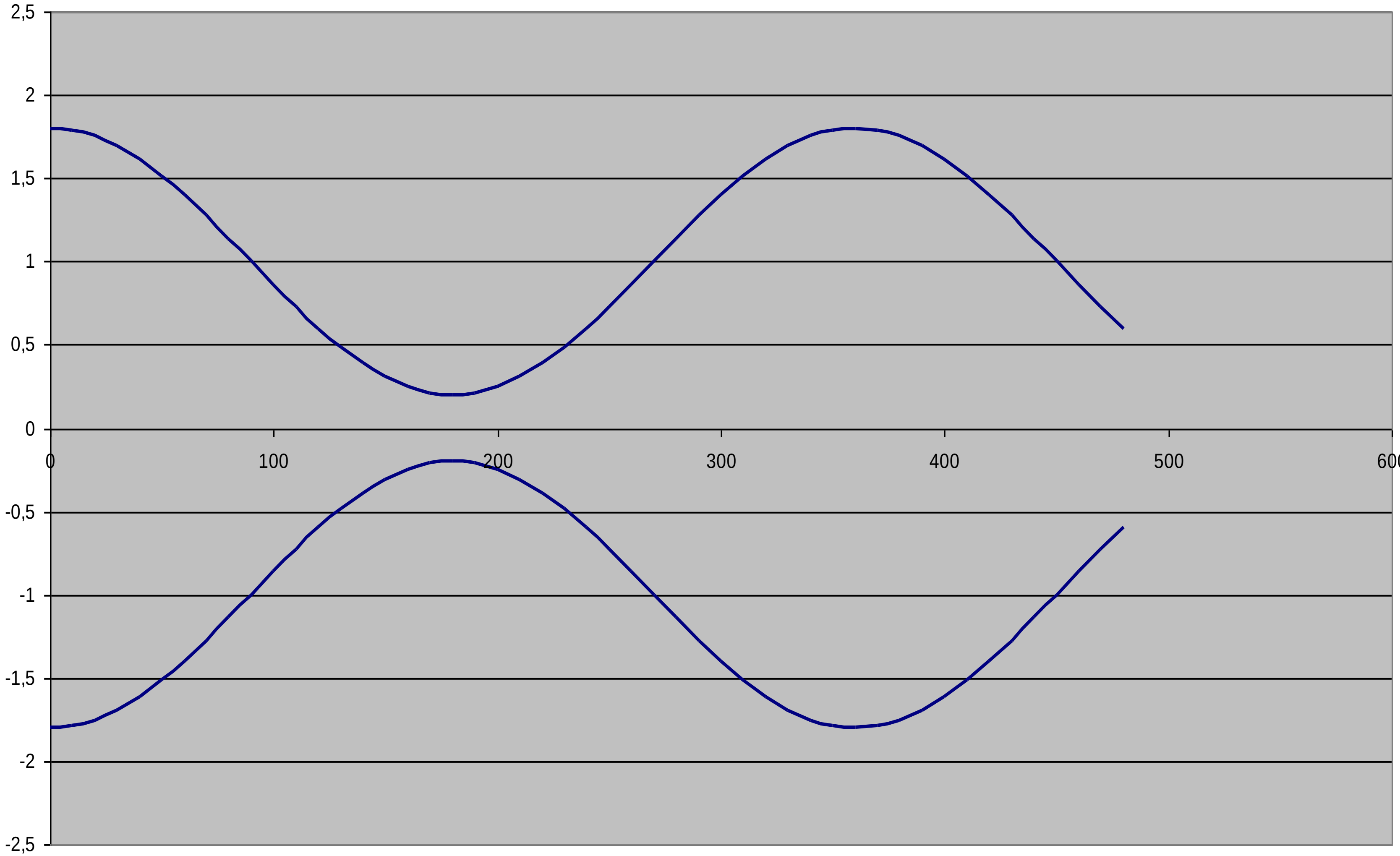
SEÑAL AM m= 70%



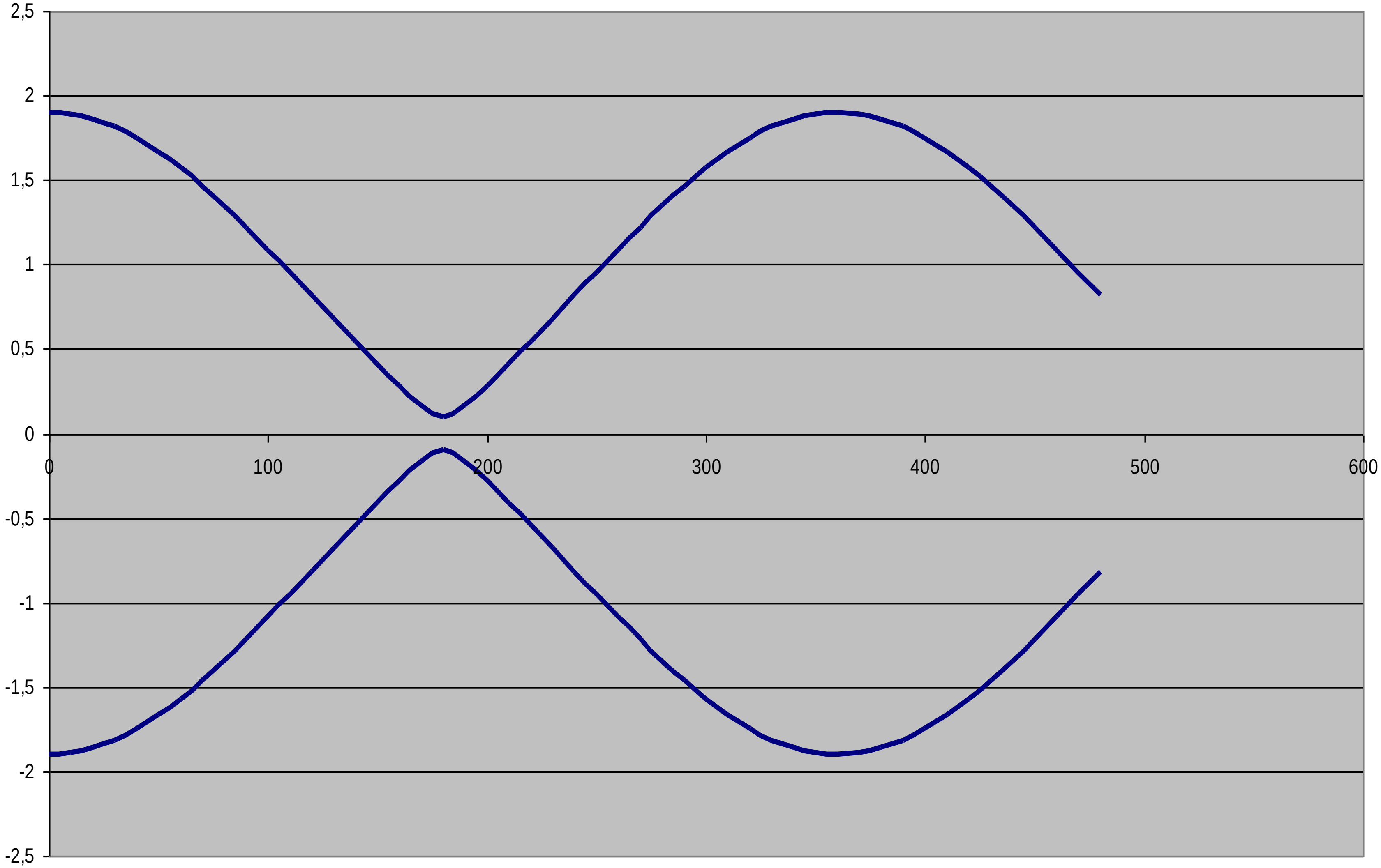
MODULACION AM 70%
Fport = 20 Fmoduladora
-2000
0
2000
4000
6000
8000
10000


-2000
0
2000
4000
6000
8000
10000

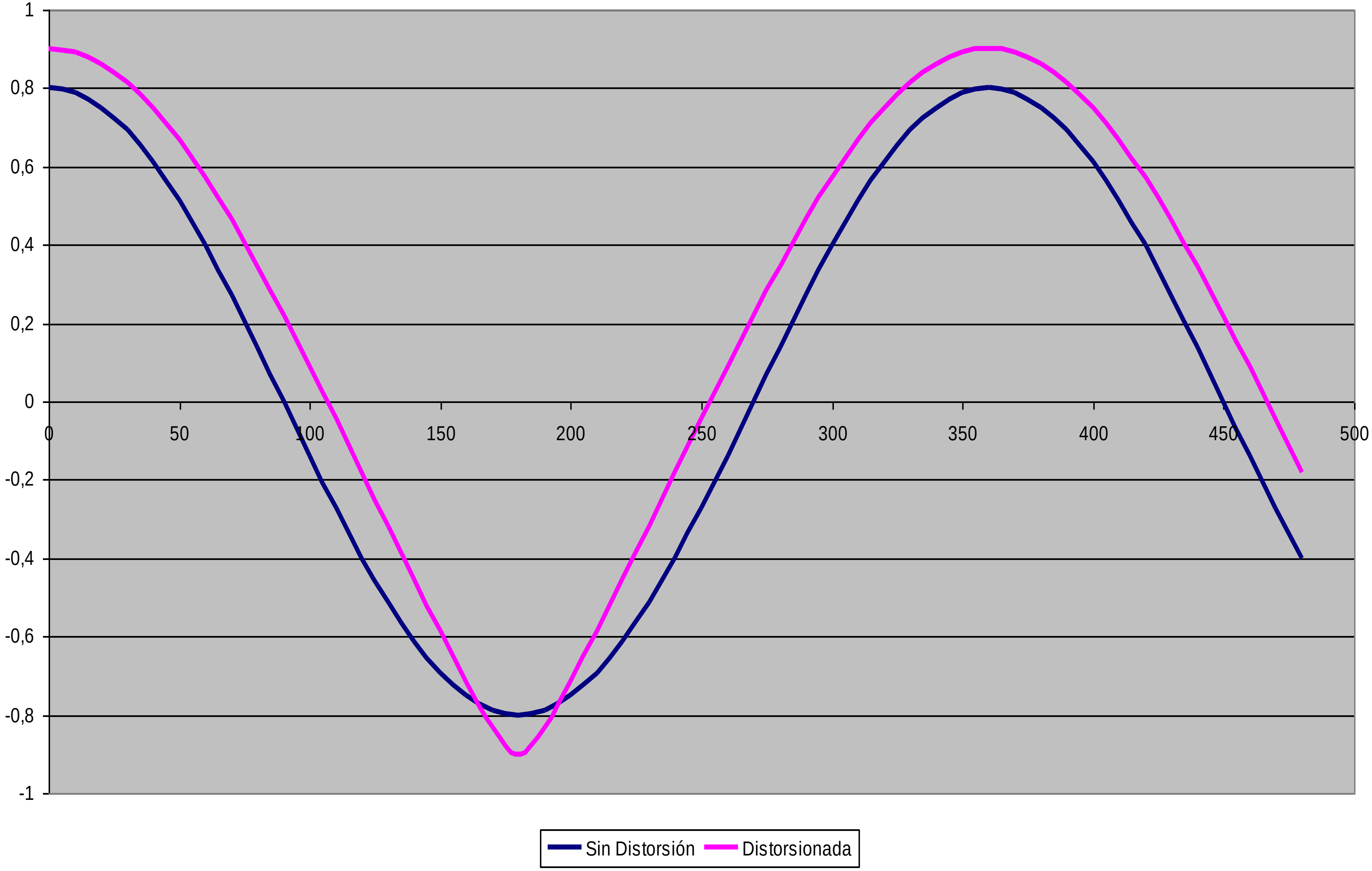
ENVOLVENTE DE AM. MODULACIÓN LINEAL



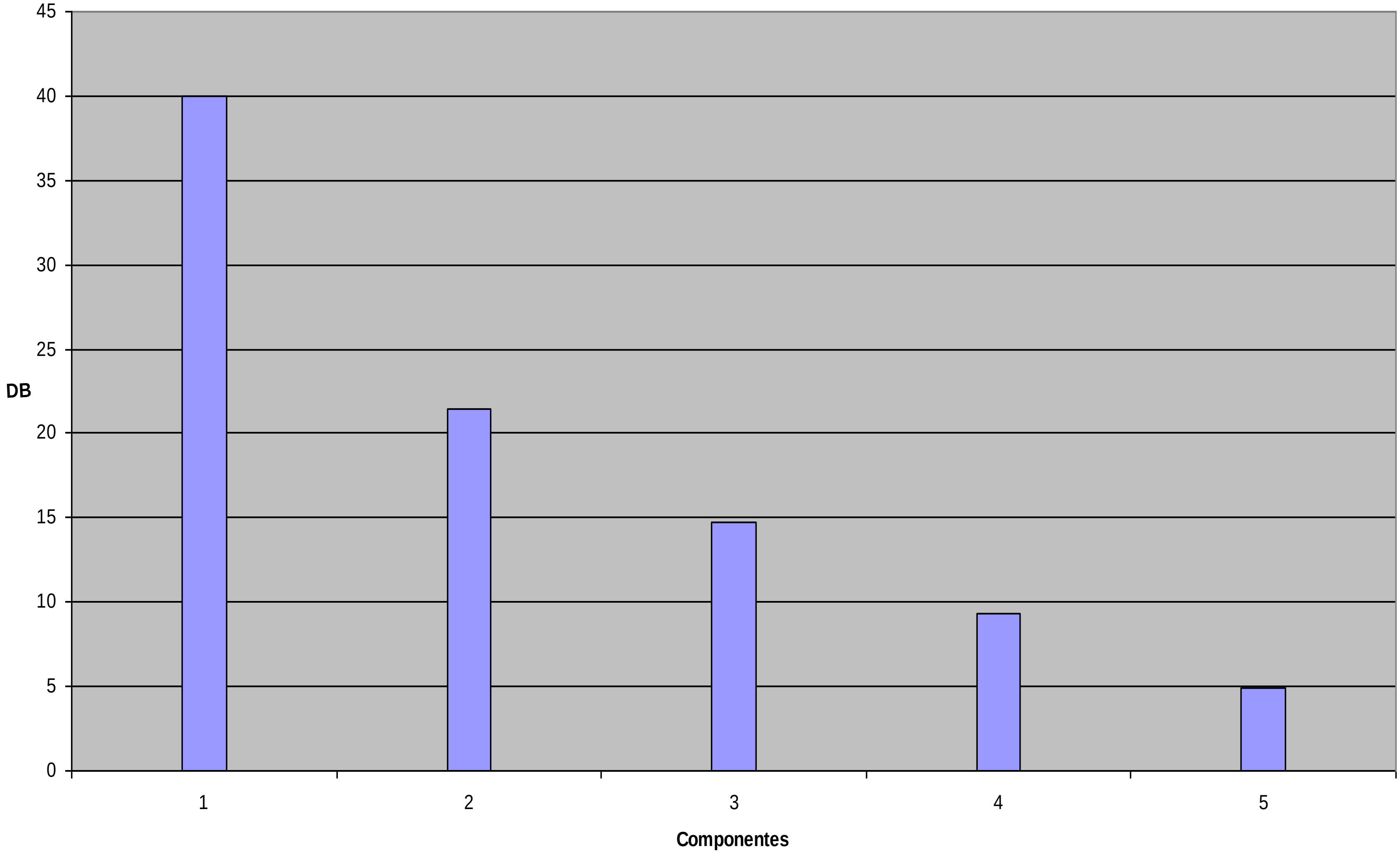
ENVOLVENTE DE AM. MODULACIÓN ALINEAL
Vport=1 Vbls= 0,8 Vbli=0,1



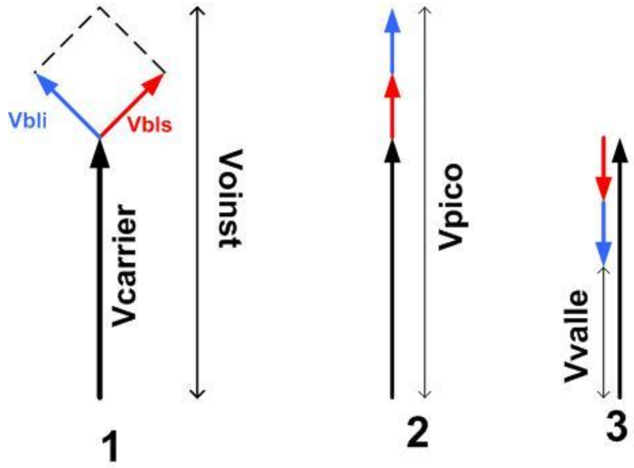
COMPARACIÓN DE SEÑALES

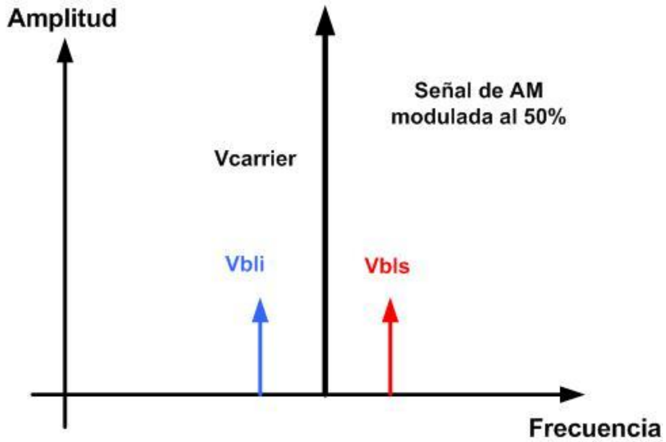


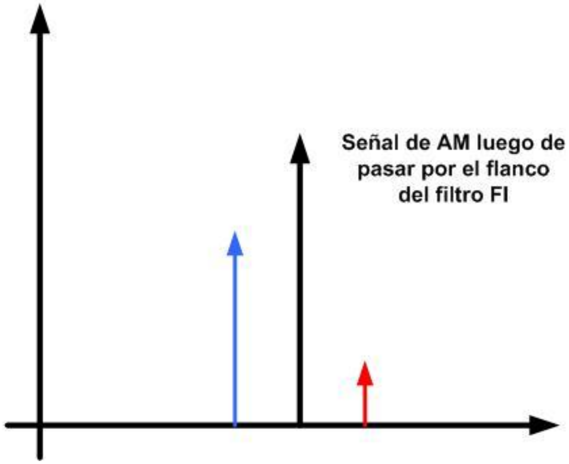
CONTENIDO ARMÓNICO DEL AUDIO DETECTADO

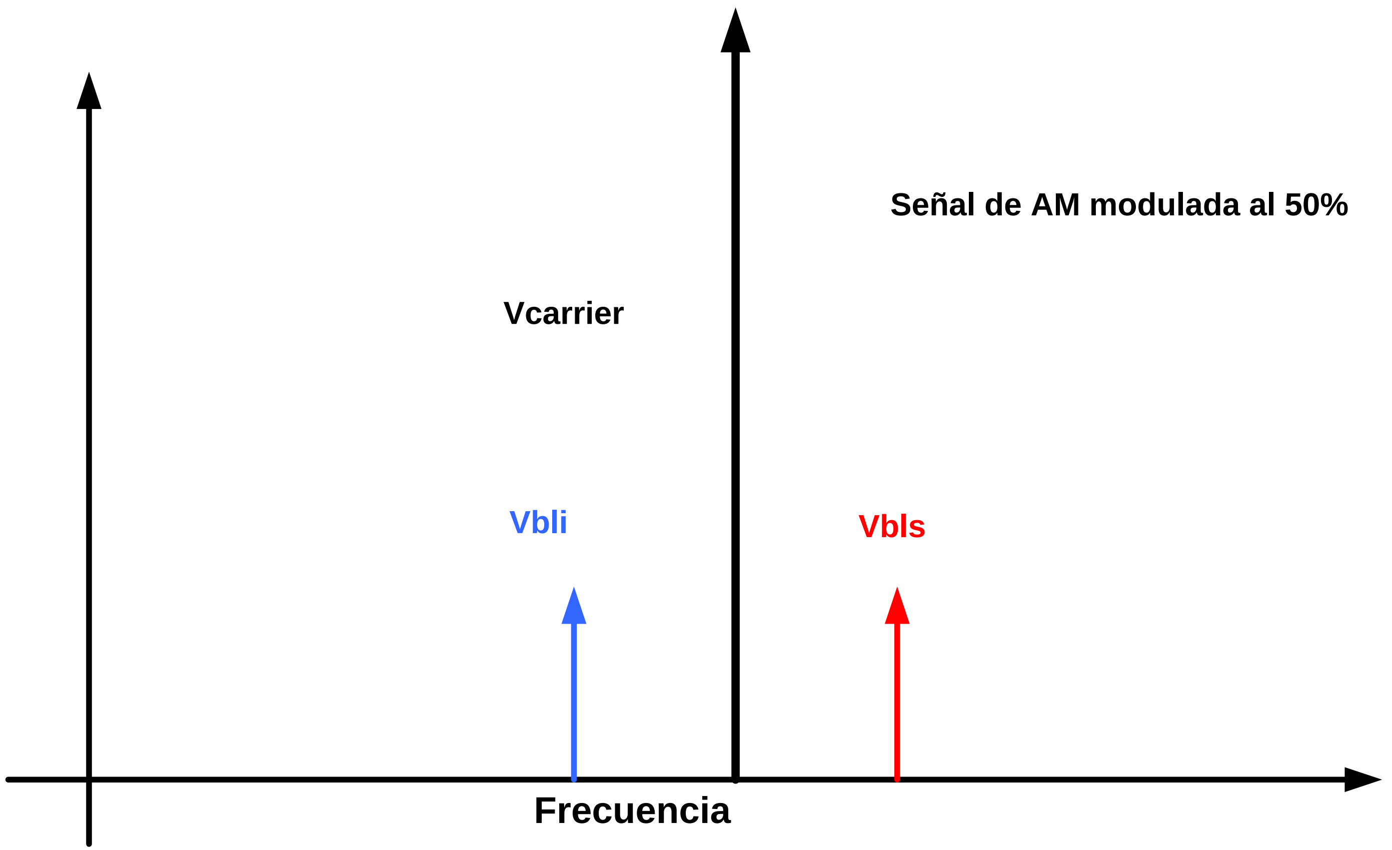


MODULACION EN AM. FASORIALES

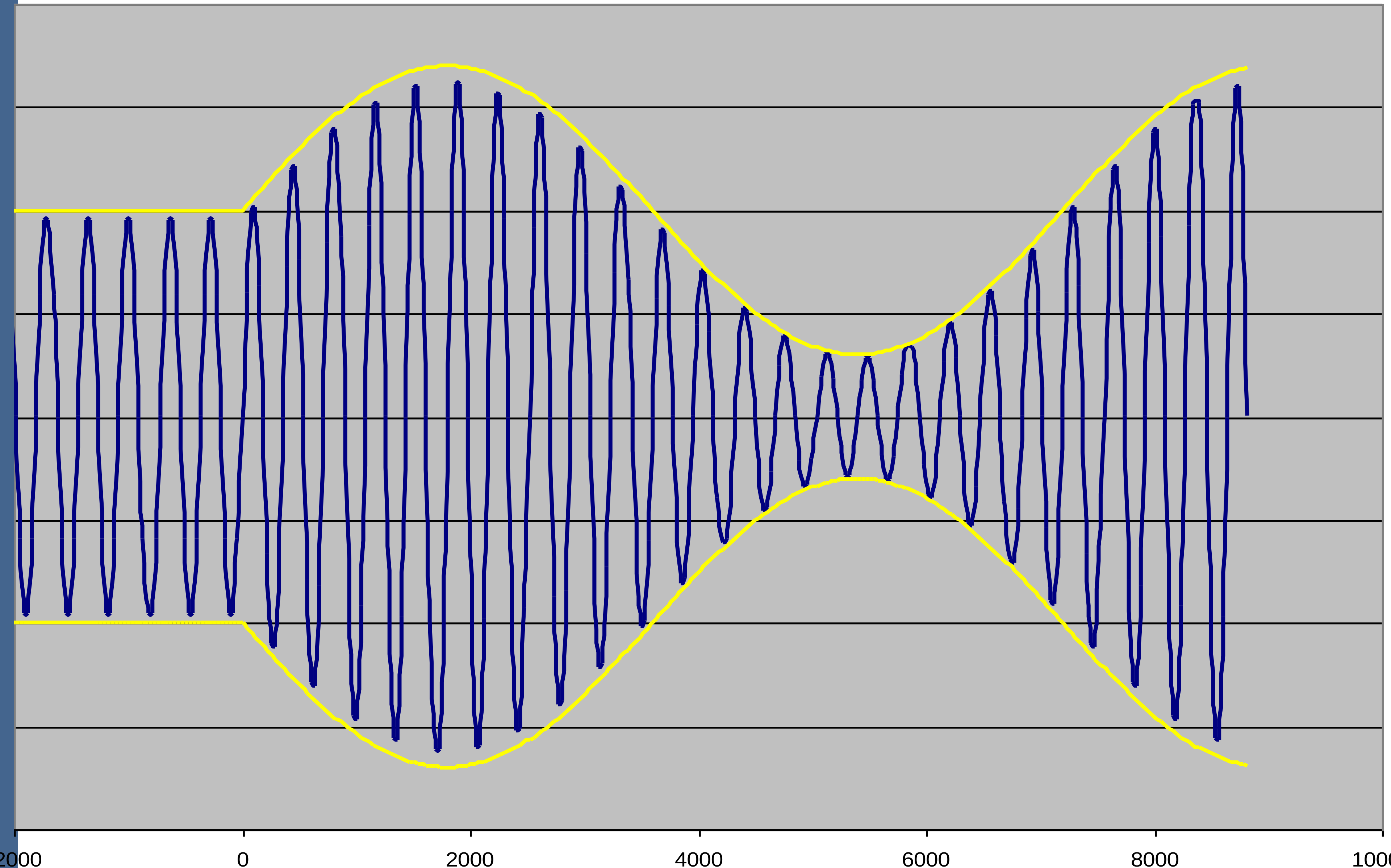


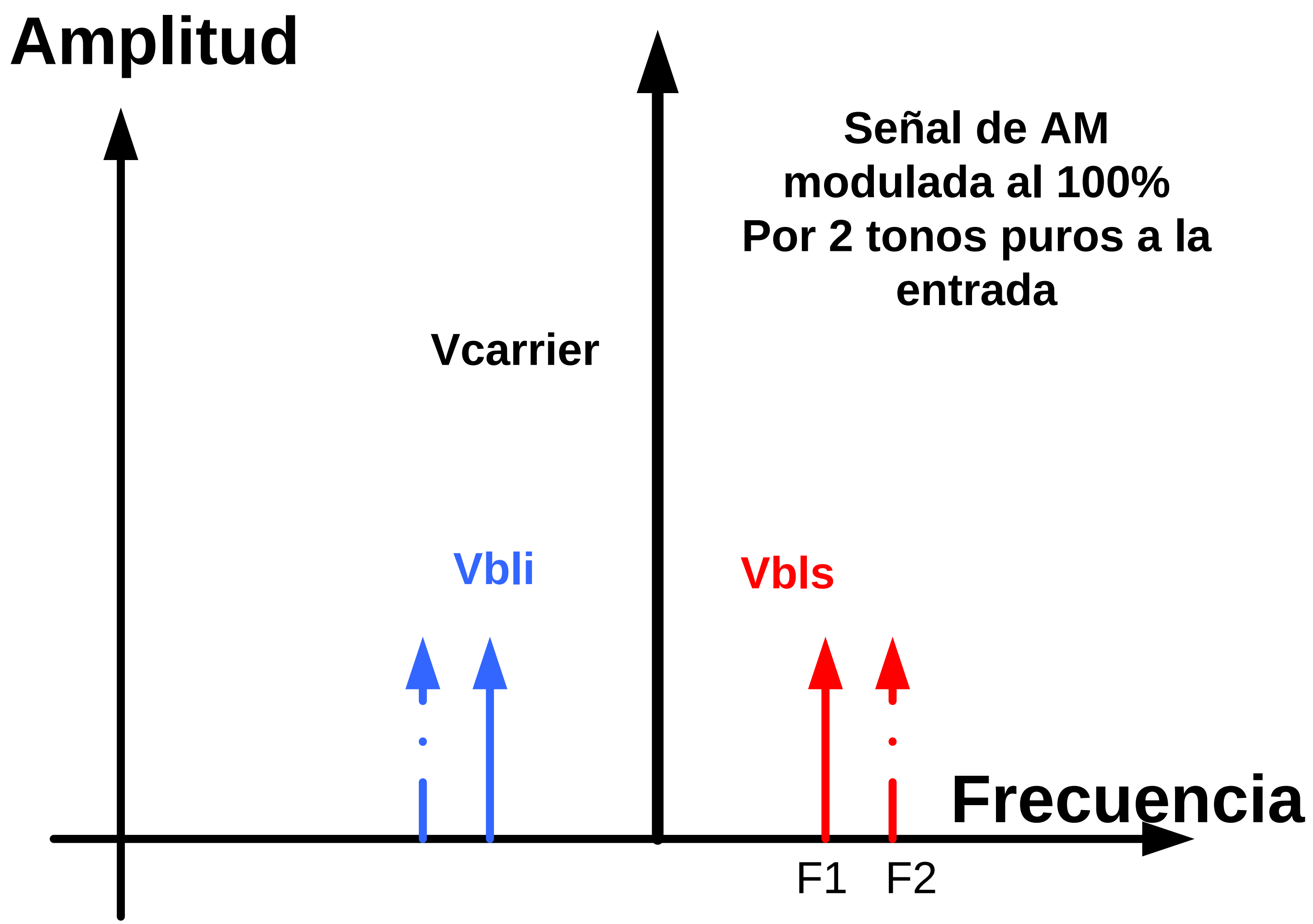


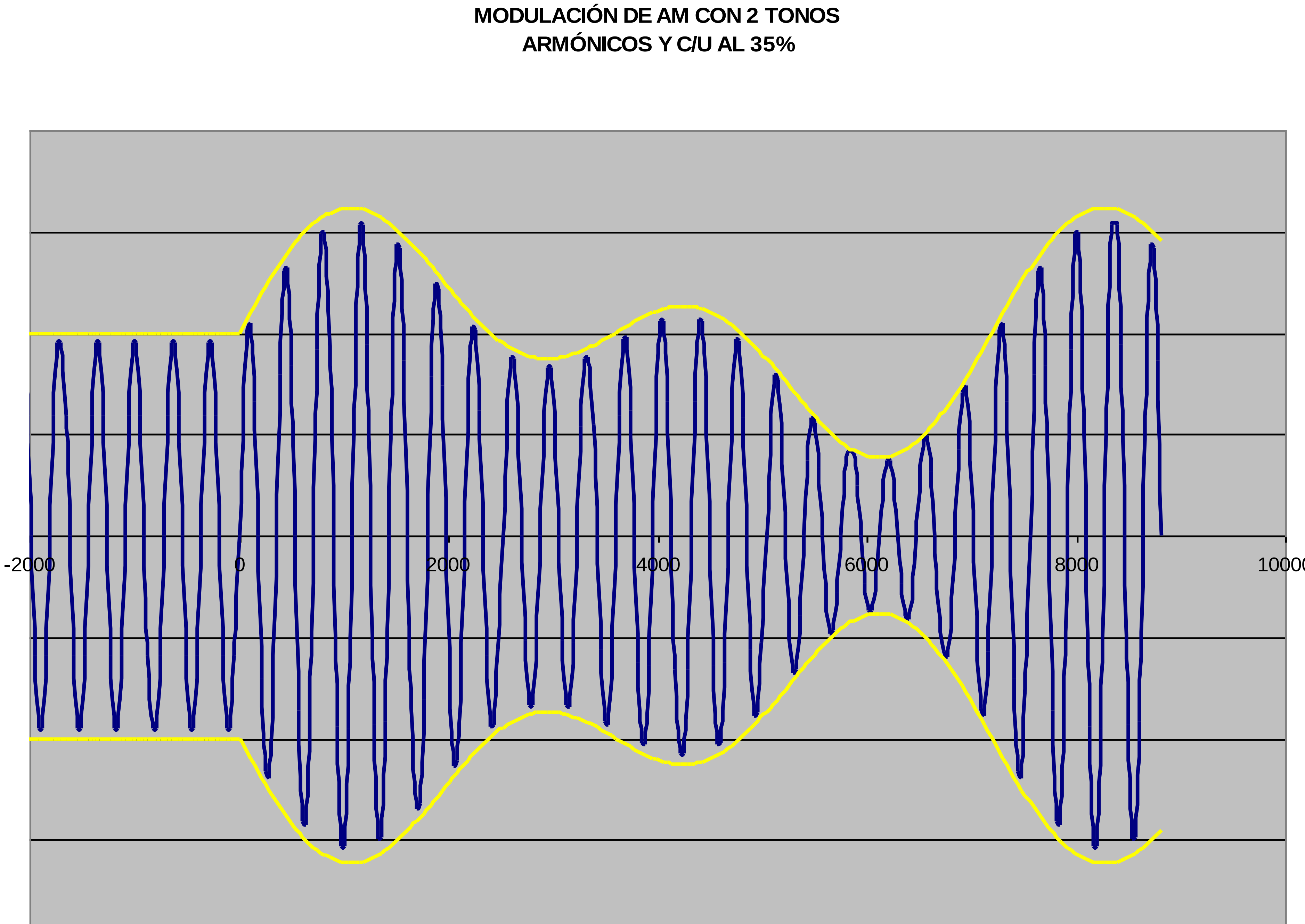



Señal de AM modulada al 50%
Vcarrier
Vbli
Vbls
Frecuencia

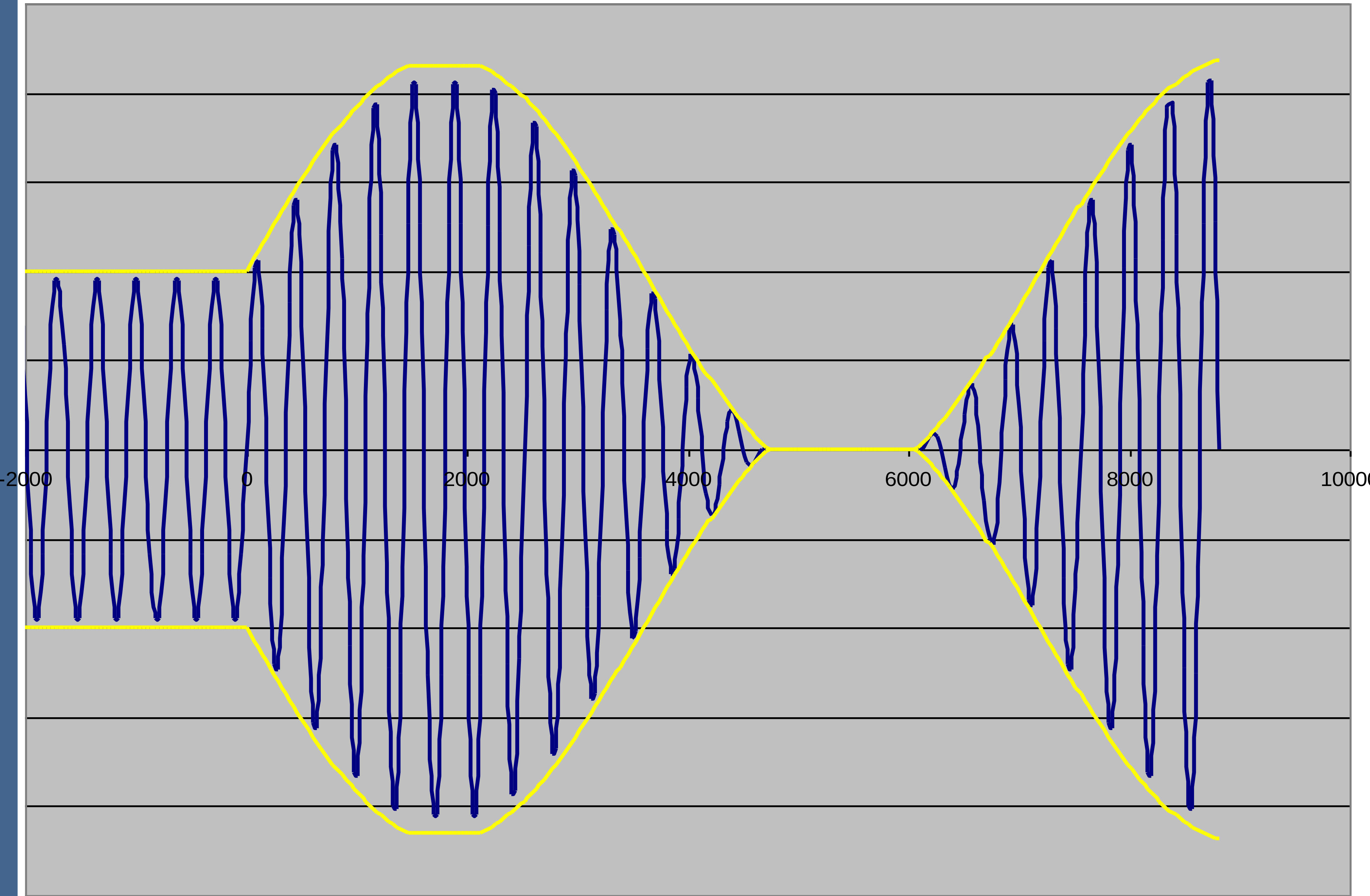
MODULACION AM 70%
Fport = 20 Fmoduladora

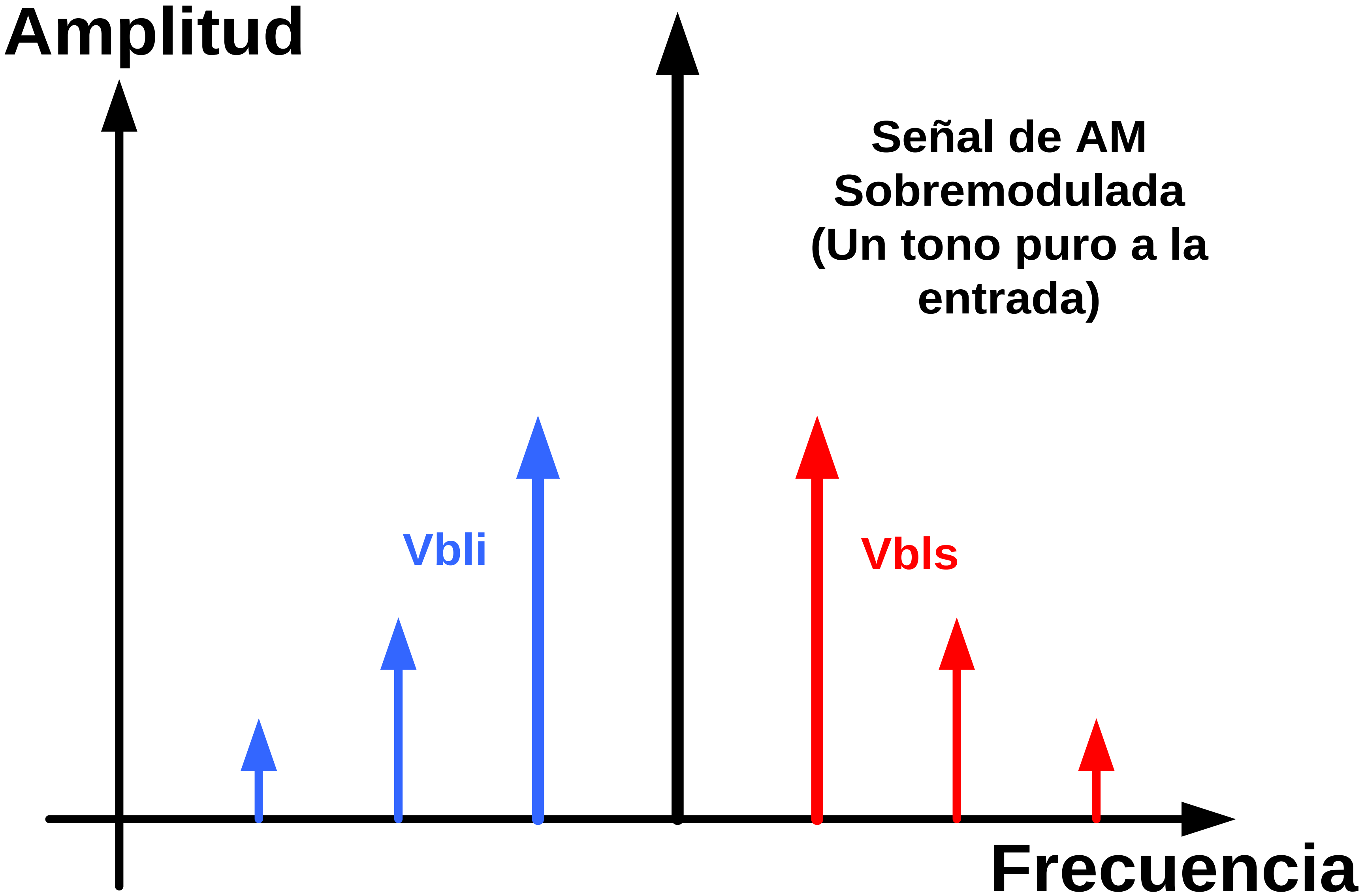


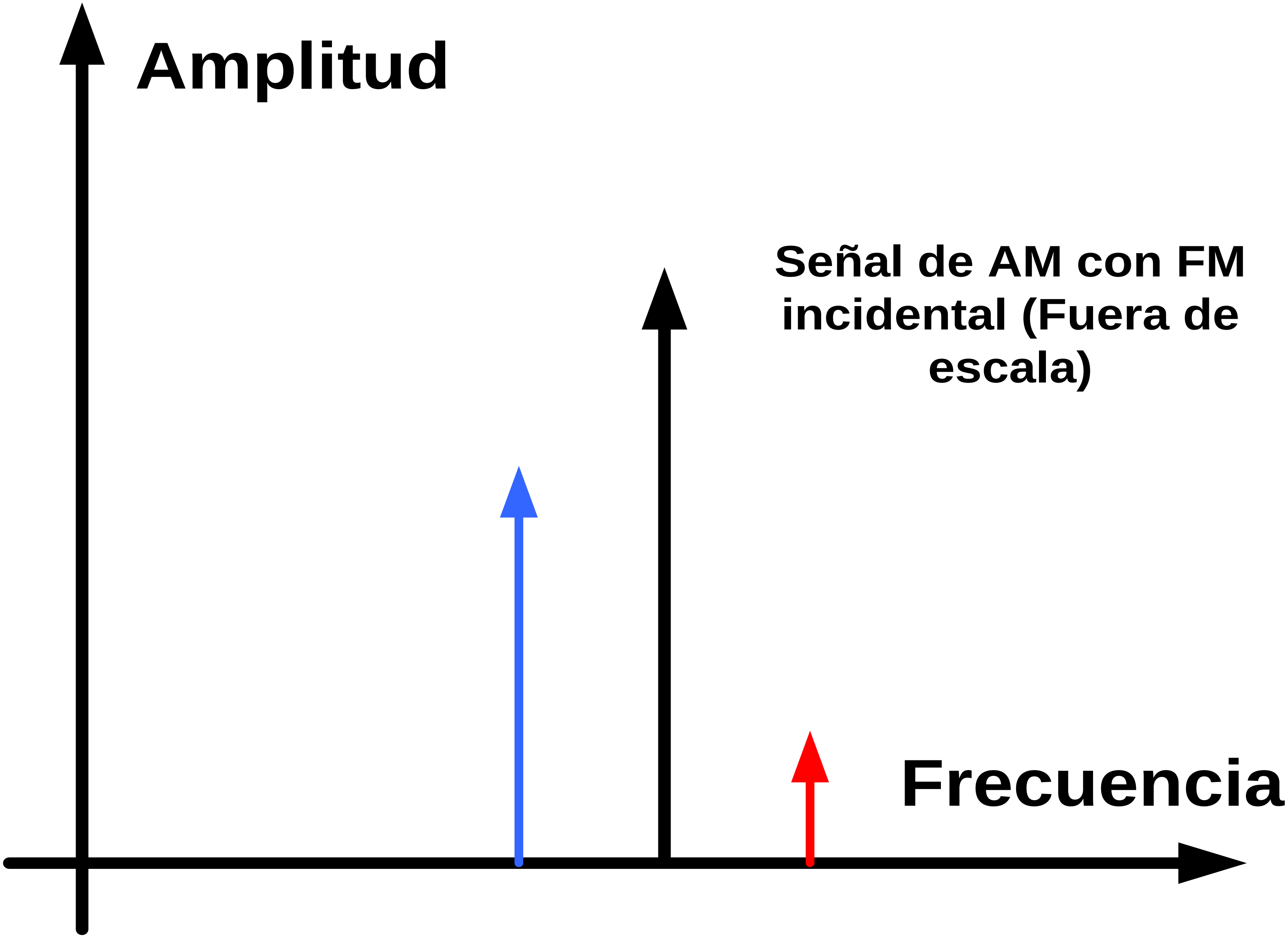

Amplitud
Señal de AM
modulada al 100%
Por 2 tonos puros a la
entrada
Vcarrier
Vbli
Vbls
Frecuencia
F1
F2


MODULACIÓN DE AM CON 2 TONOS
ARMÓNICOS Y C/U AL 35%
-2000
0
2000
4000
6000
8000
10000

AM SOBREMODULADO

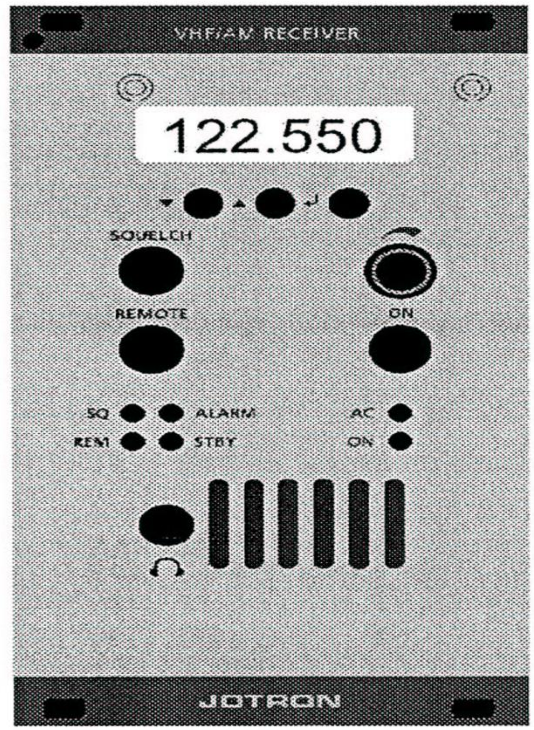



Amplitud
Señal de AM
Sobremodulada
(Un tono puro a la
entrada)
Vbli
Vbls
Frecuencia


Amplitud
Señal de AM con FM incidental (Fuera de escala)
Frecuencia

Technical Handbook

RA-7202
VHF/AM Ground to Air Receiver



JOTRON

3280 TJODALYNG, NORWAY

2 TECHNICAL SPECIFICATION

Frequency range:	118 - 137 MHz (144 MHz optional)
Channel separation:	25 kHz / 8.33 kHz. (Selectable)
Frequency stability:	25 kHz version: ± 2.5 ppm 8.33 kHz version: ±1.5 ppm, (±1 ppm 0 - 40°C).
Frequency selection:	25 / 8.33 kHz steps.
Pre-set channels	99
Type of modulation	AM (A3E)
Sensitivity:	10 dB SINAD at 1μV pd, 30 % modulation. Weighted to ITU-T.
Squelch:	Signal to noise weighting, combined with RF carrier. Adjustable from min. 1 μV pd, to 25μV pd. Squelch level adjustable from front panel and remote. Hysteresis: < 3 dB. Opening/closing: < 50 ms
THD:	< 5%, 90% mod. , 1 mV, 1 kHz
S/N ratio:	> 40 dB, 100 μV, 30%, 1 kHz.
Adjacent channel selectivity:	> 70 dB 25 kHz / > 60 dB 8.33 kHz
Cross modulation rejection:	> 85 dB, >100kHz frequency offset
Blocking / desensitisation:	> 90 dB, >1MHz frequency offset
Spurious response immunity:	> 80 dB
Intermodulation immunity:	> 80 dB rel. 1μV EMF, 2 interfering signals >100kHz offset from receiving frequency.
Image frequency rejection	>100 dB
IF rejection	>100 dB
Permissible input level:	5V EMF
RF input impedance:	50 Ω, N-connector.

AGC:	< 3 dB from - 107 to + 5 dBm input signal. Attack time: < 50 ms Recovery time: < 200 ms
Radiated spurious components:	< 2 nW (< -57 dBm) to 1GHz < 20 nW (< - 47 dBm) to 4 GHz
Audio response:	25 kHz: +1 / - 3 dB rel. to 1 kHz, 300 - 3400 Hz. -25 dB at 5000 Hz. 8.33 kHz: +1 / - 3 dB rel. to 1 kHz, 300 - 2500 Hz. -25 dB at 3200 Hz.
AAGC	<1dB 30% - 90 % modulation, (Selectable by software).
Noise cancelling system:	Noise blanker, eliminates ignition noise and radar bursts. (Selectable by software)
Audio outputs:	Loudspeaker: Max 0.5W, 8Ω. Headphone: Max 0.1W, 8Ω. Line: 600Ω symmetrical, –20 to +10 dBm. Line level adjustable from front panel and remote.
Remote control	RS-485 or RS-232. 1200b/s or 9600b/s, selectable.
Settings:	Output line level adjustable from front panel and remote.
Operating temperature:	-20 to + 55°C (Performance according to ETS 300 676)
Storage temperature:	-40 to + 70 °C.
Operating voltage	230/115 VAC ± 10% 21.6 - 31.2 VDC
Power consumption:	< 10 W

and a matching network.

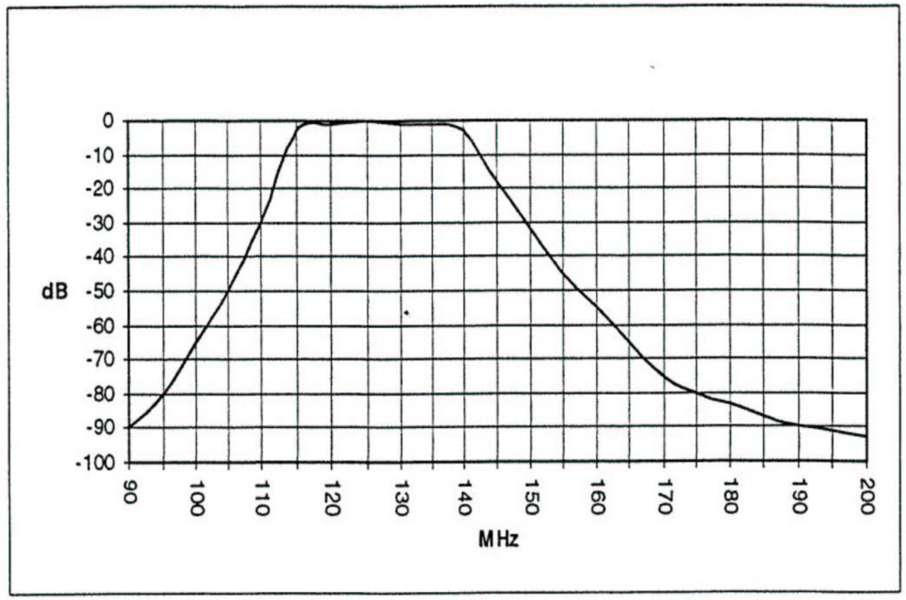


Figure C, Typical response, RF bandpass input filter.

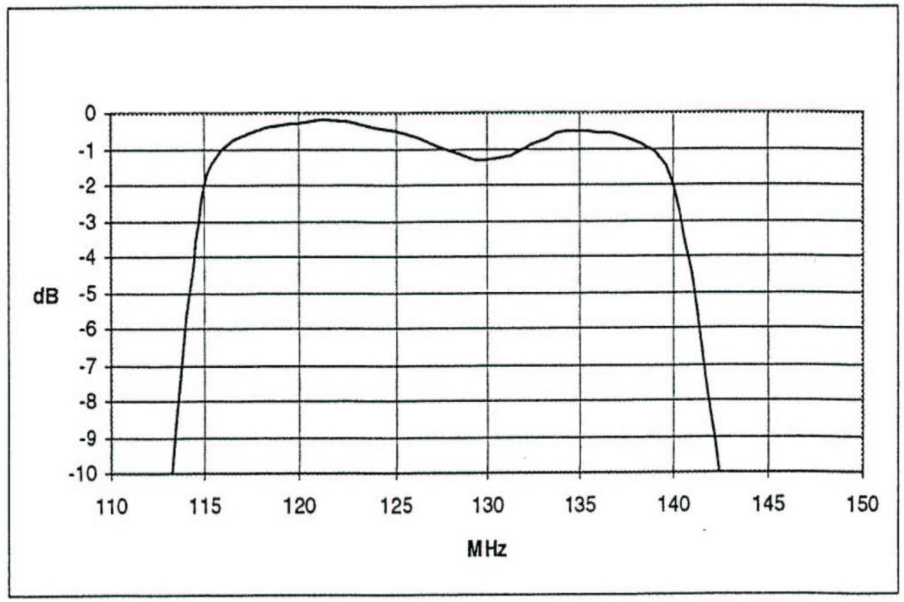


Figure D, Typical passband response, RF bandpass input filter.

signal is amplified in the IF amplifier (Q1, Q2). The gain of the IF amplifier is controlled by the AGC voltage, by controlling the feedback level with Pin diodes (D3, D4).

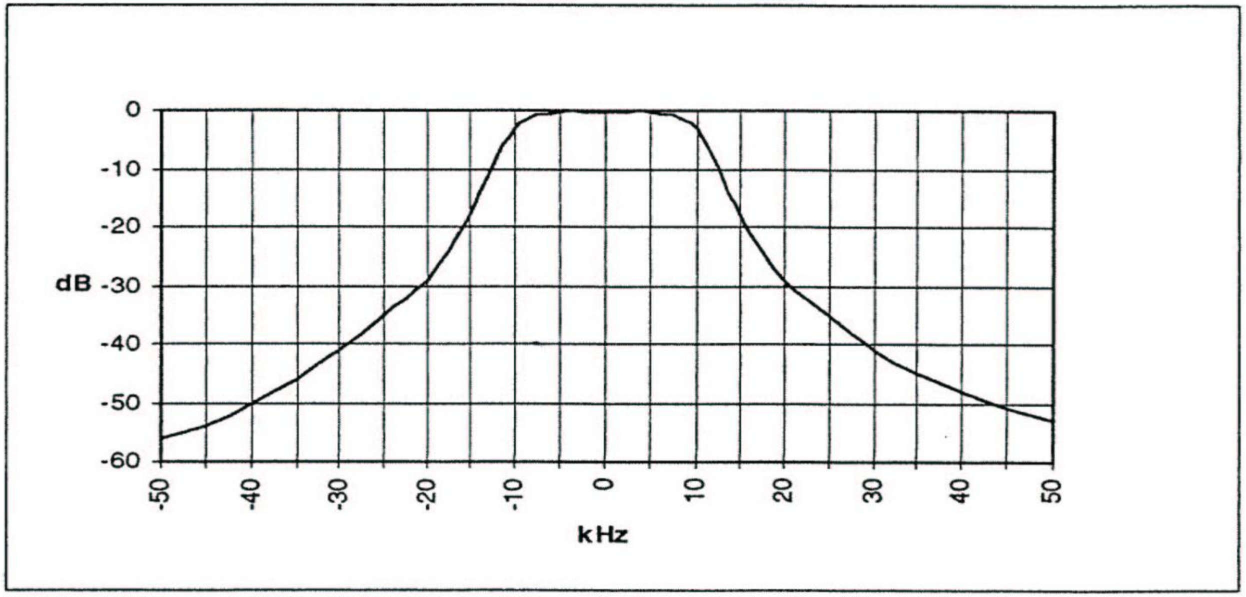


Figure E, Typical 45 MHz IF response

2nd Mixer, 455 kHz IF filter.

The 2nd mixer is part of IC2. The 45 MHz IF signal is mixed with a fixed 44.545 MHz signal. This signal is supplied from the synthesiser section, which is described separately in the next section.
The 455 kHz signal is fed to the 455 kHz ceramic filter block.
This block consists of two ceramic filters, one for 25 kHz channels, and one for 8.33 kHz channels. Selection between the filters is done with the integrated switches IC6 and IC7. The setting is controlled from the microcontroller, so that when an 8.33 kHz channel is selected, the 8.33 kHz filter is automatically selected.

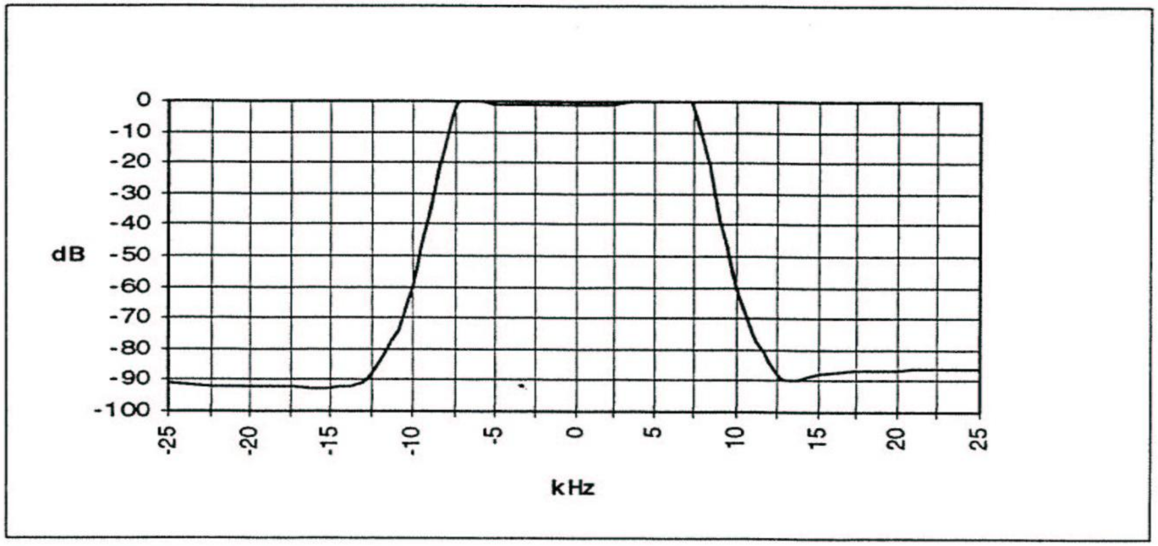


Figure F, Typical 455 kHz IF response (25 kHz channels)

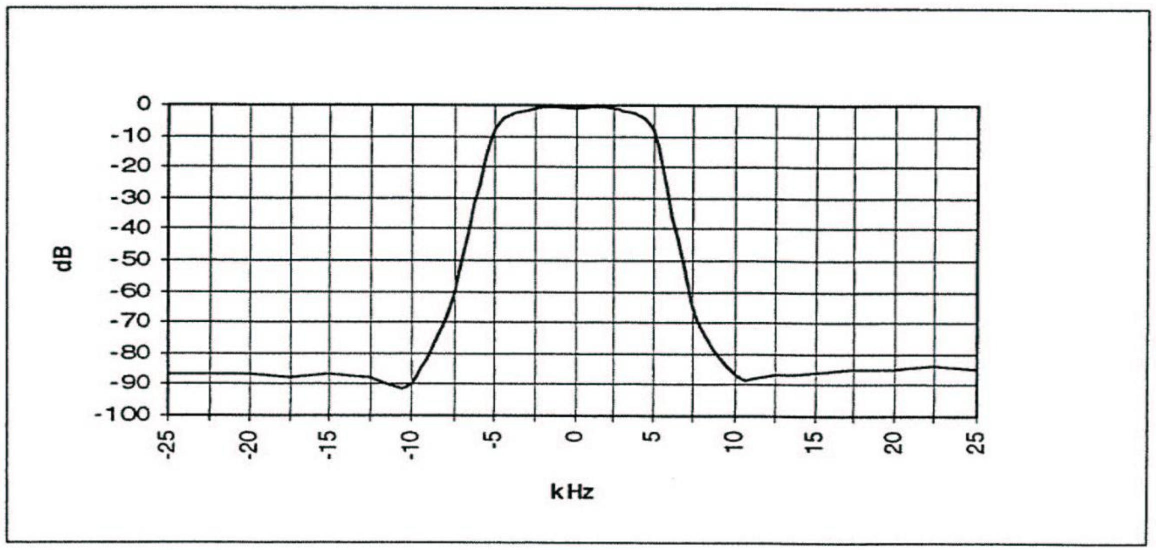
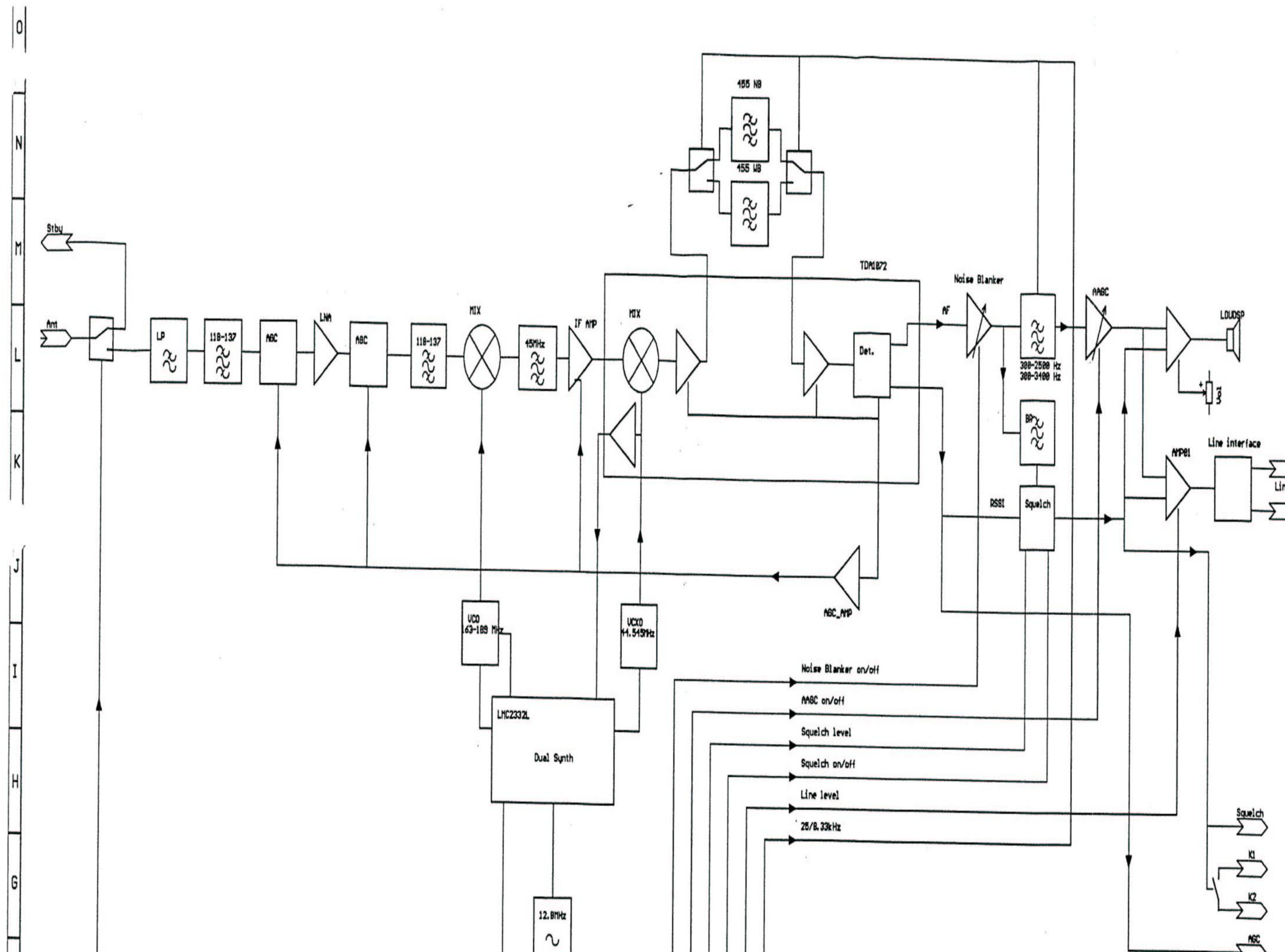


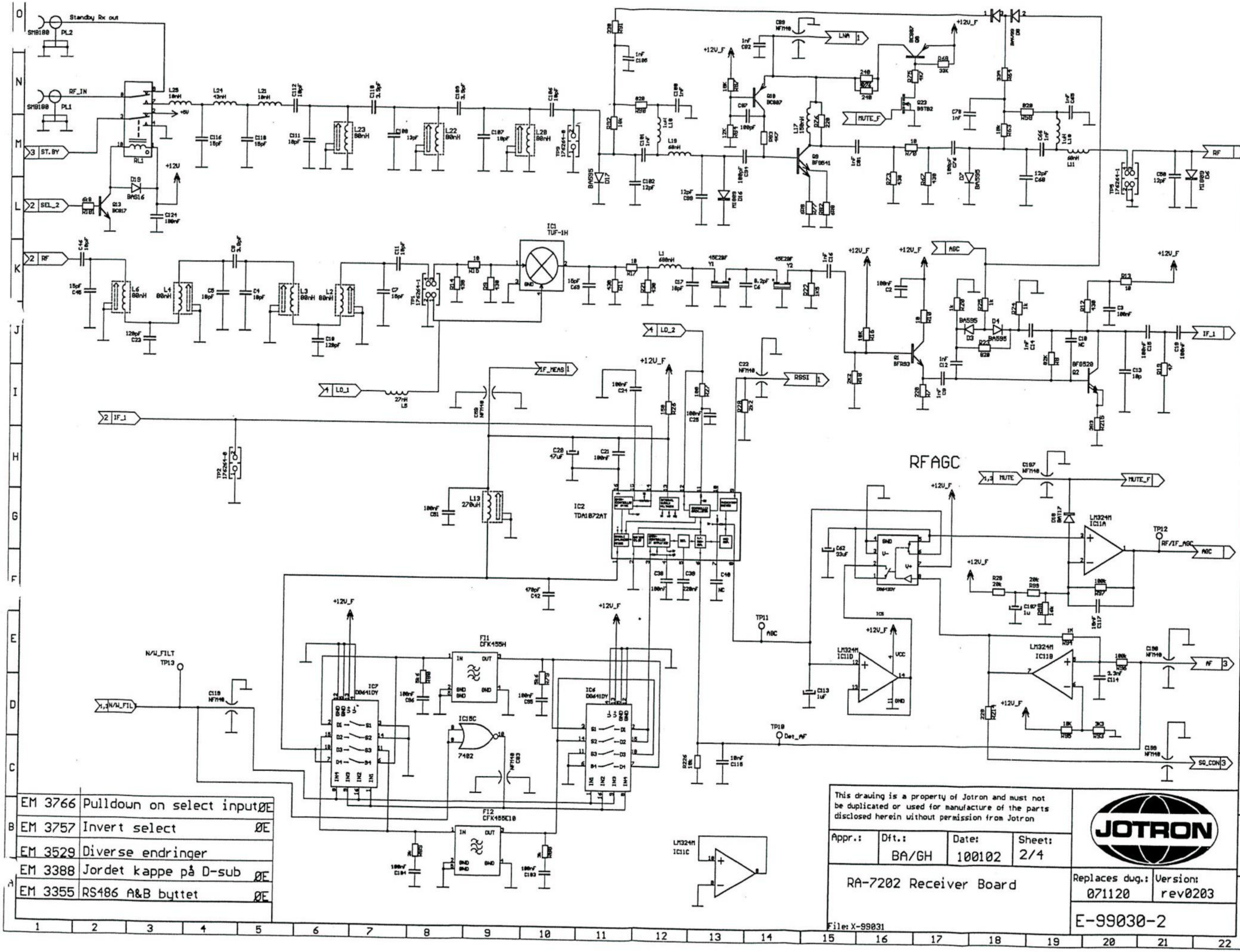
Figure G, Typical 455 kHz IF response (8.33 kHz channels)

2nd IF Amplifier, Demodulator, AGC Amplifiers.

IC2 contains also the 2nd IF amplifier, demodulator and the circuits for generating the AGC



O
N
M
L
K
J
I
H
G
455 NB
455 WB
Stby
Ant
LP
118-137
AGC
LNA
AGC
118-137
MIX
45MHz
IF AMP
MIX
TDA1072
Det.
AF
Noise Blanker
300-2500 Hz
300-3400 Hz
AAGC
LOUDSP
Vol
BP
AMP01
Line interface
RSSI
Squelch
AGC_AMP
VCO
163-189 MHz
VCXO
44.545MHz
LMC2332L
Dual Synth
12.8MHz
Noise Blanker on/off
AAGC on/off
Squelch level
Squelch on/off
Line level
25/8.33kHz
Squelch
K1
K2
AGC



EM 3766	Pulldown on select input	ØE
EM 3757	Invert select	ØE
EM 3529	Diverse endringer	
EM 3388	Jordet kappe på D-sub	ØE
EM 3355	RS486 A&B byttet	ØE

This drawing is a property of Jotron and must not be duplicated or used for manufacture of the parts disclosed herein without permission from Jotron

JOTRON

Appr.:	Dft.:	Date:	Sheet:
	BA/GH	100102	2/4

RA-7202 Receiver Board

Replaces dwg.: 071120

Version: rev0203

E-99030-2

File: X-99031

EAIII-INTRODUCCION- CLASIFICACION

SENTIDO:

- SIMPLEX Ej.: TV BC
- SEMI-DUPLEX Ej.: Handy push to talk
- DUPLEX Ej.: Teléfono

TOPOLOGIA

- PUNTO A PUNTO Ej.: Radioenlace
- PUNTO – MULTIPUNTO Ej.: TV BC
- MULTIPUNTO – MULTIPUNTO Ej.: PSTN

BANDA BASE

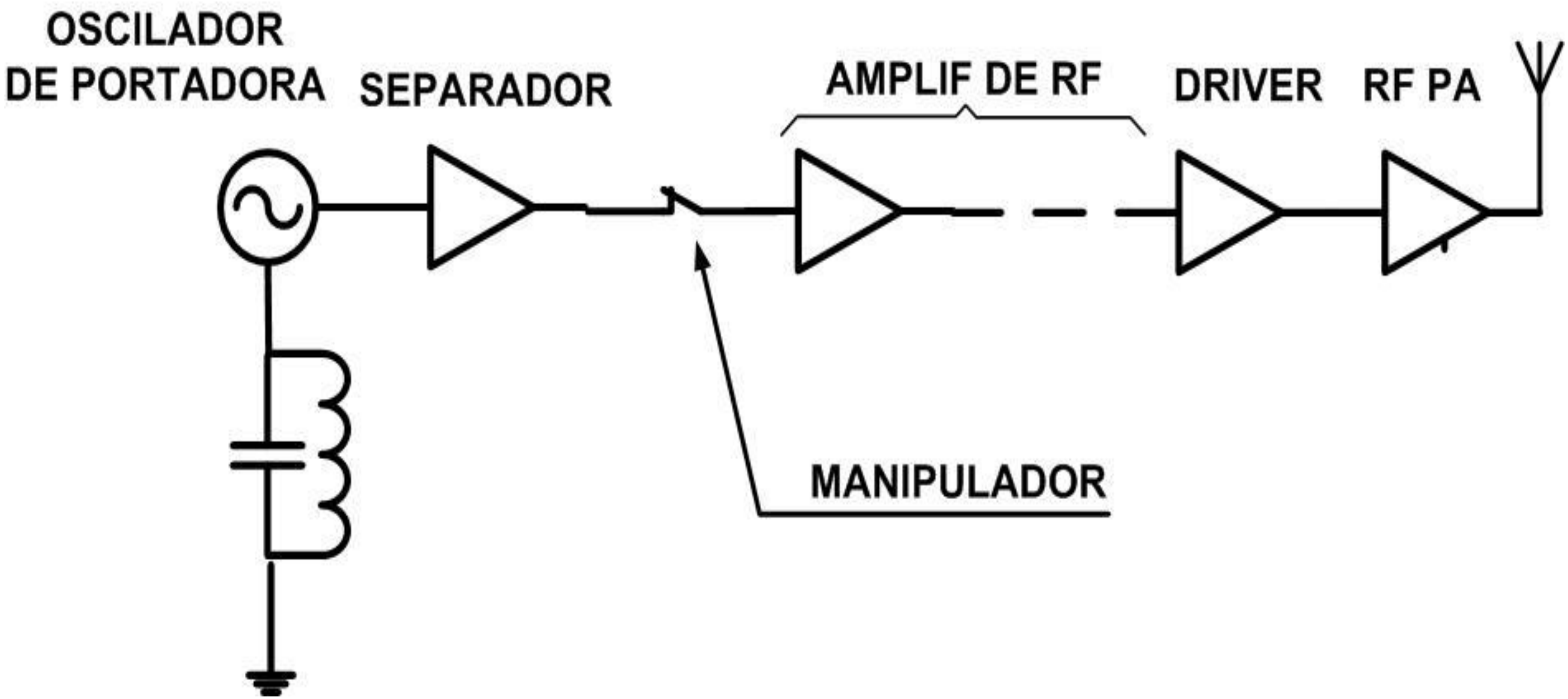
- MONOCANAL Ej.: PSTN
- MULTICANAL Ej.: ISDN

SEÑAL

- ANALOGICO Ej.: BC AM
- DIGITAL Ej.: ADSL

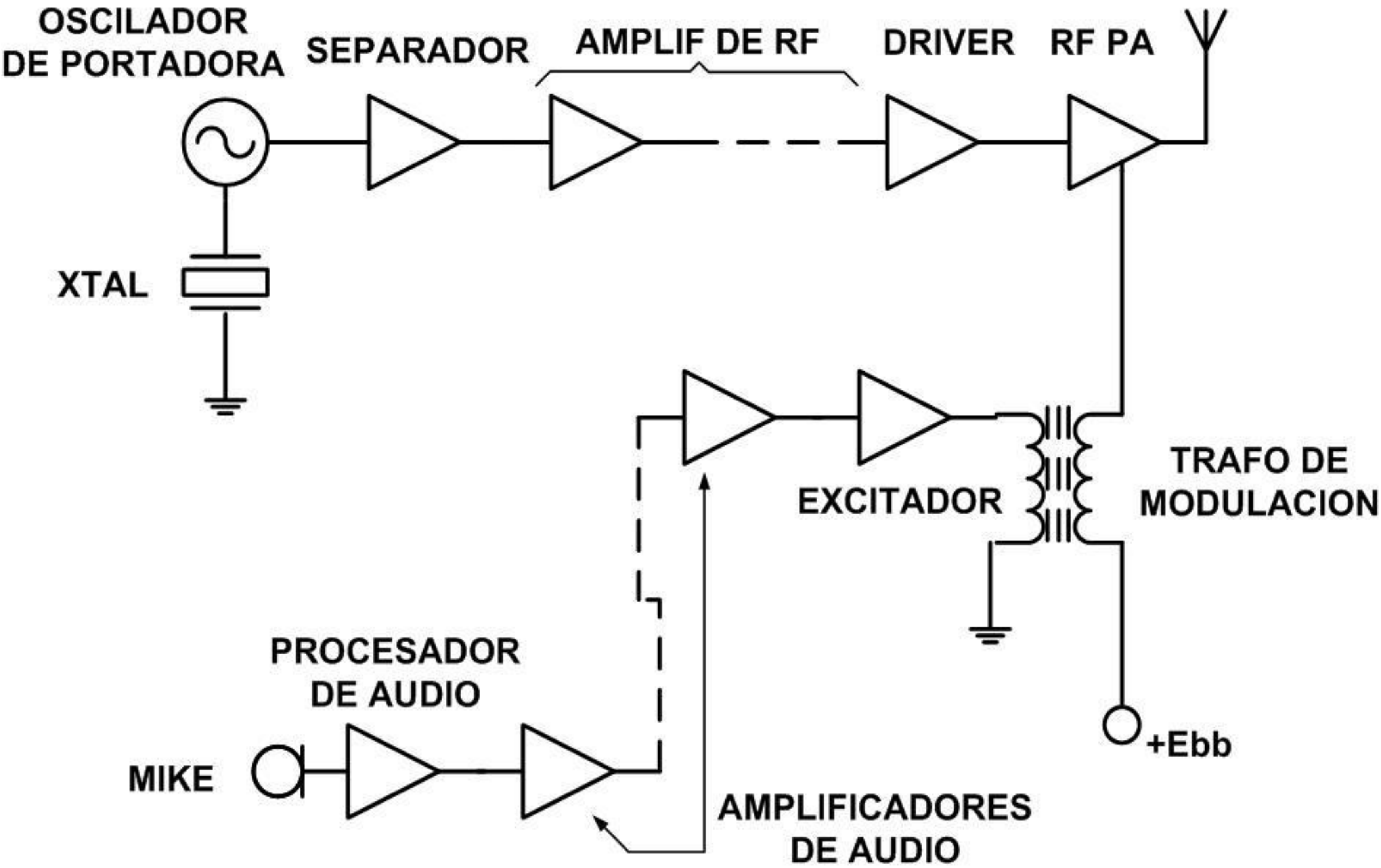
TRANSMISORES

TRANSMISOR DE TELEGRAFÍA POR INTERRUPCIÓN DE PORTADORA

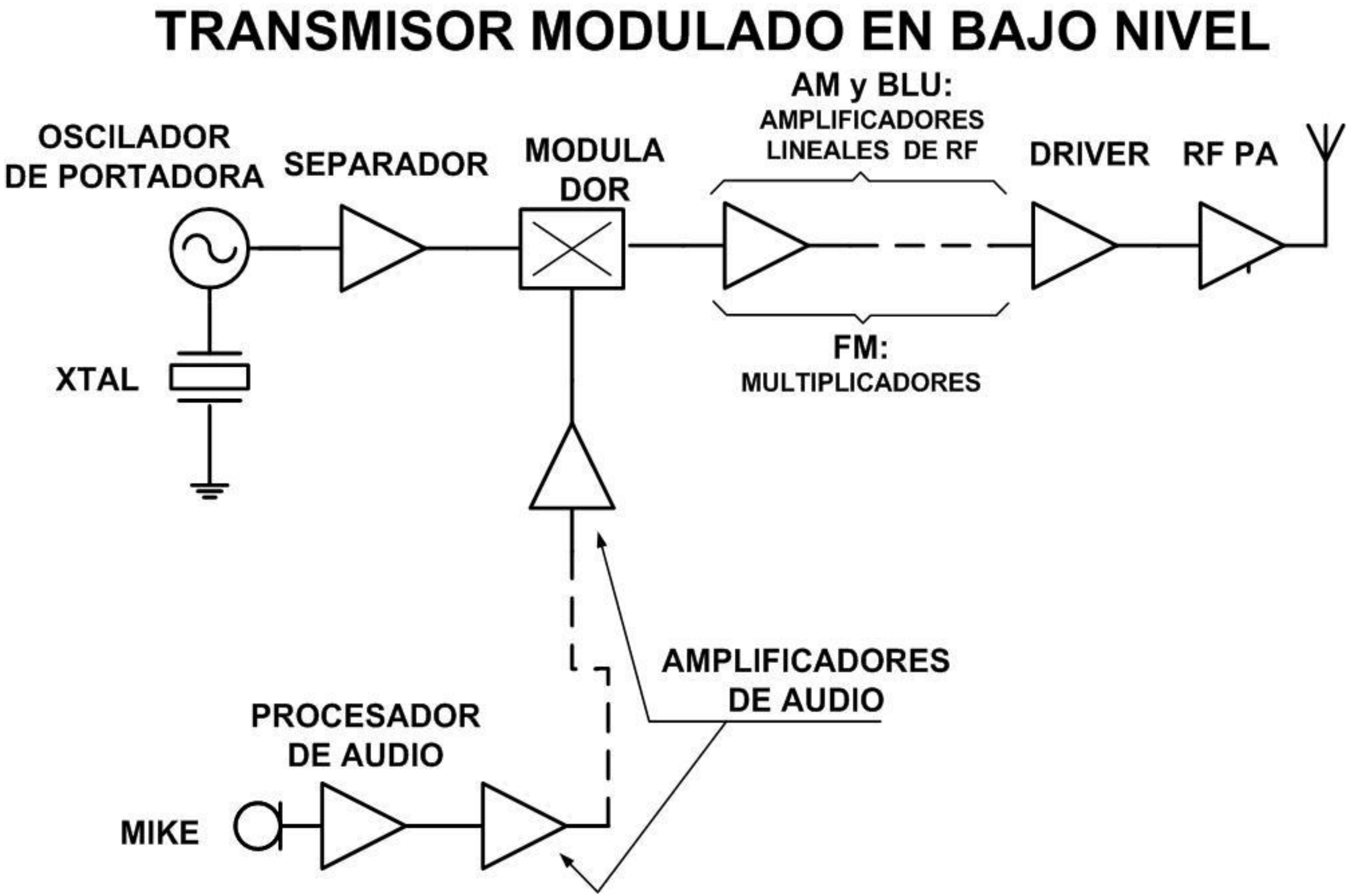


TRANSMISORES

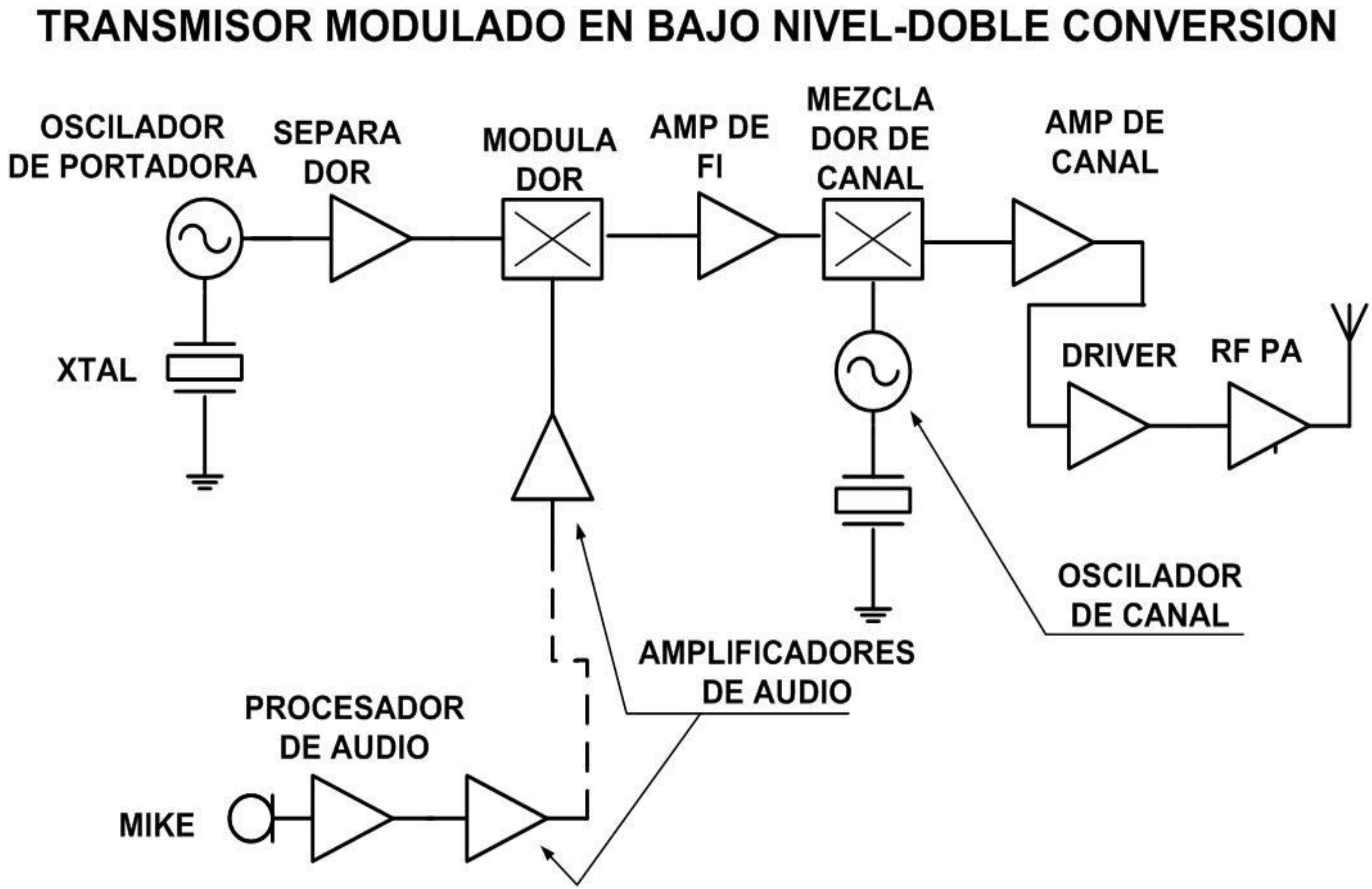
TRANSMISOR DE AM MODULADO EN ALTO NIVEL



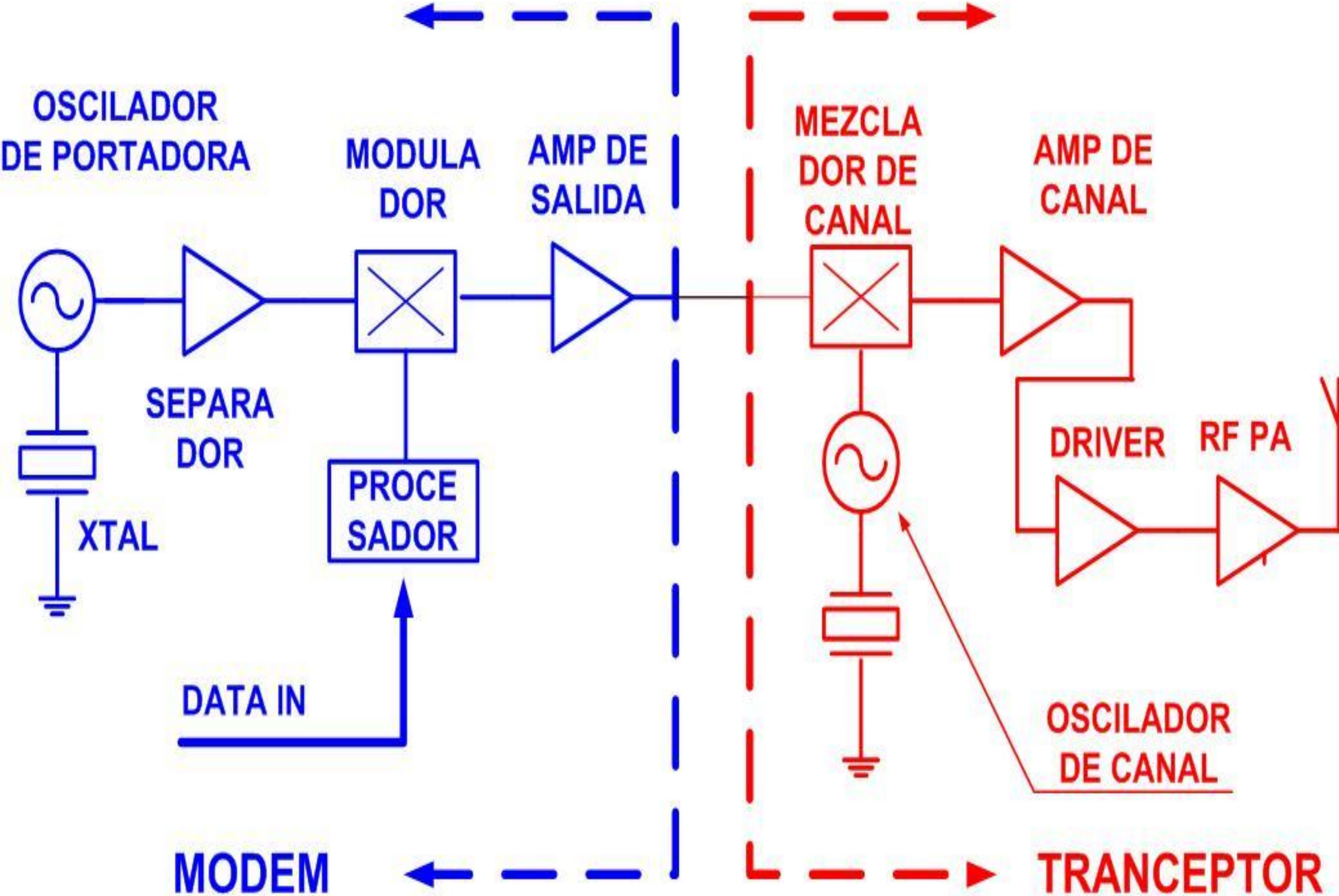
TRANSMISORES

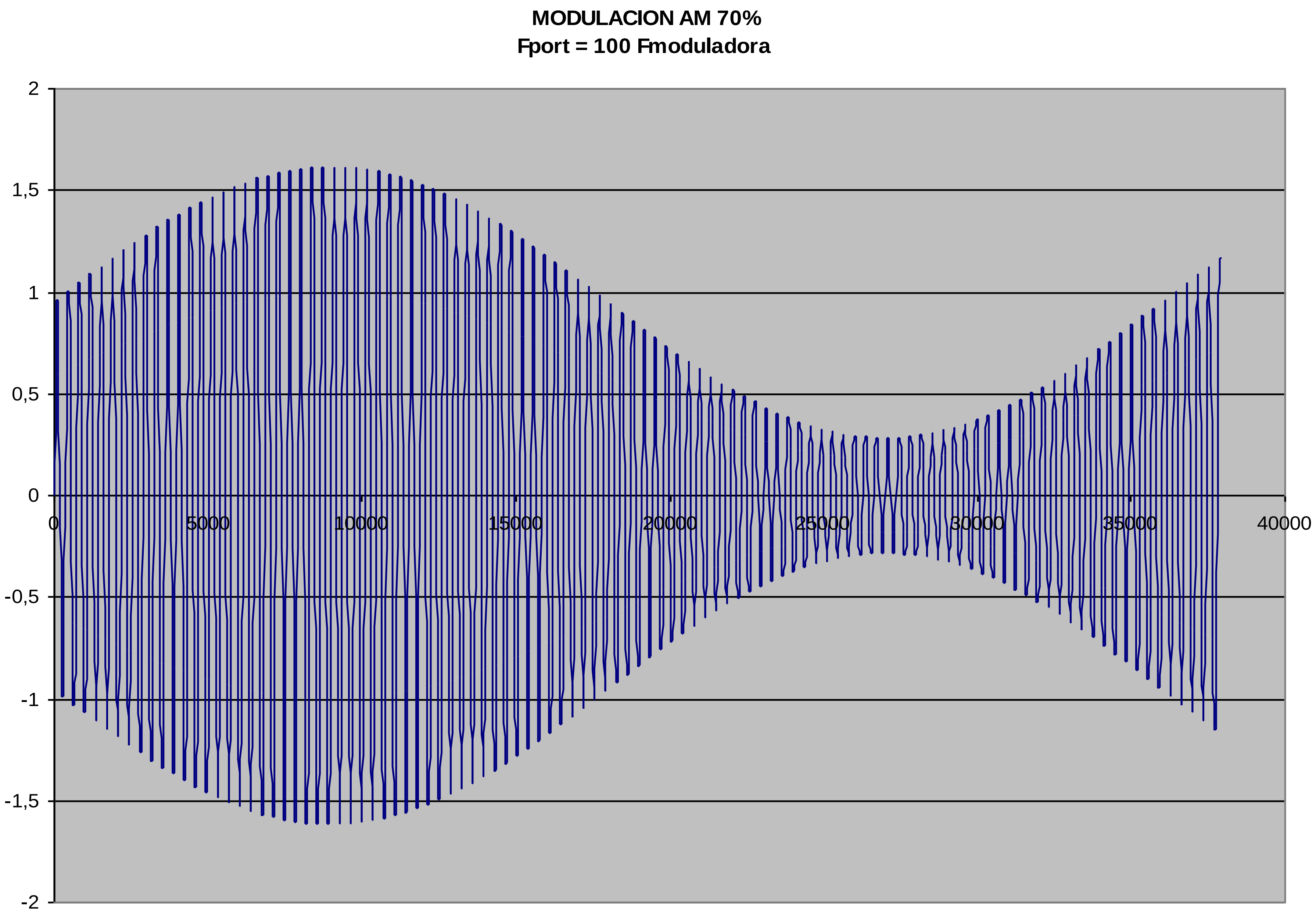


TRANSMISORES

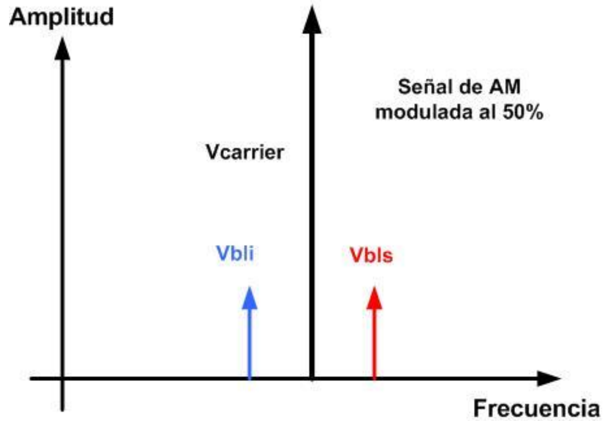


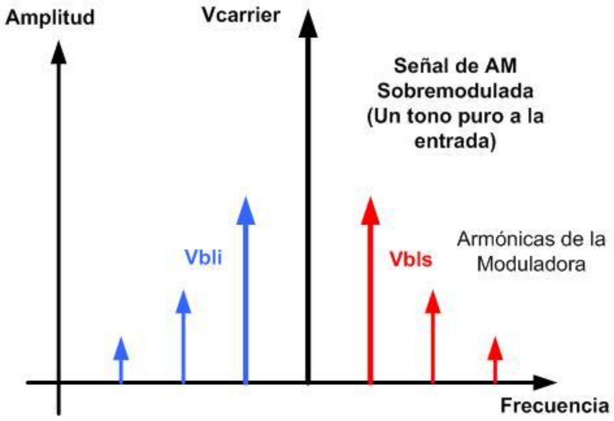
SISTEMA TRANSMISOR SATELITAL TERRESTRE

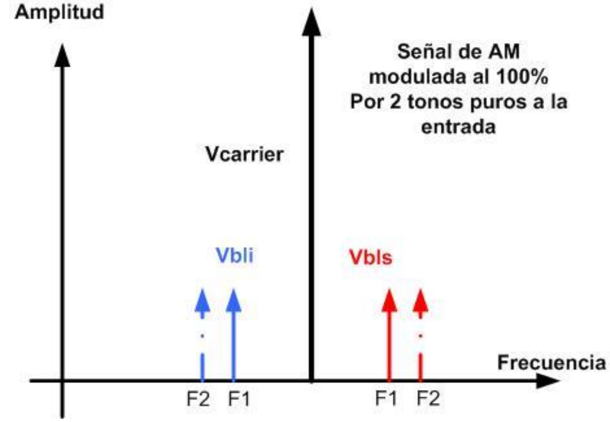


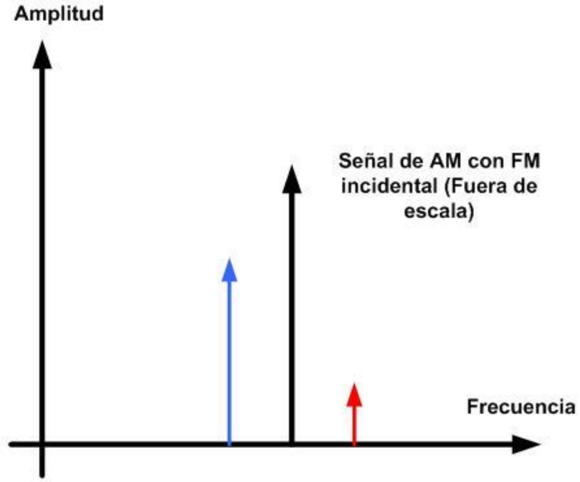

MODULACION AM 70%
Fport = 100 Fmoduladora
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
0
5000
10000
15000
20000
25000
30000
35000
40000

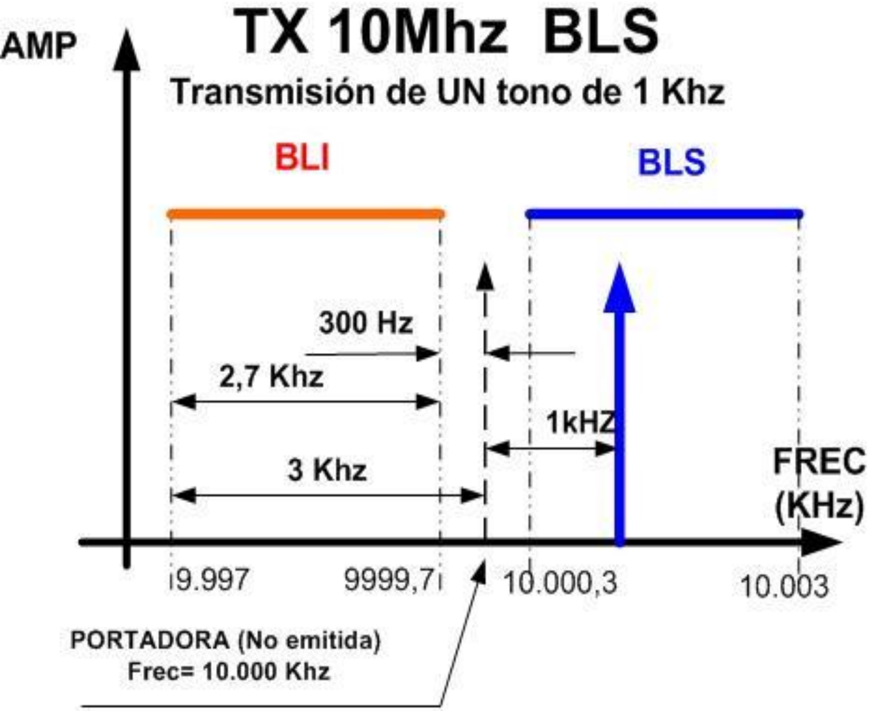
MODULACION EN AM. ESPECTRO



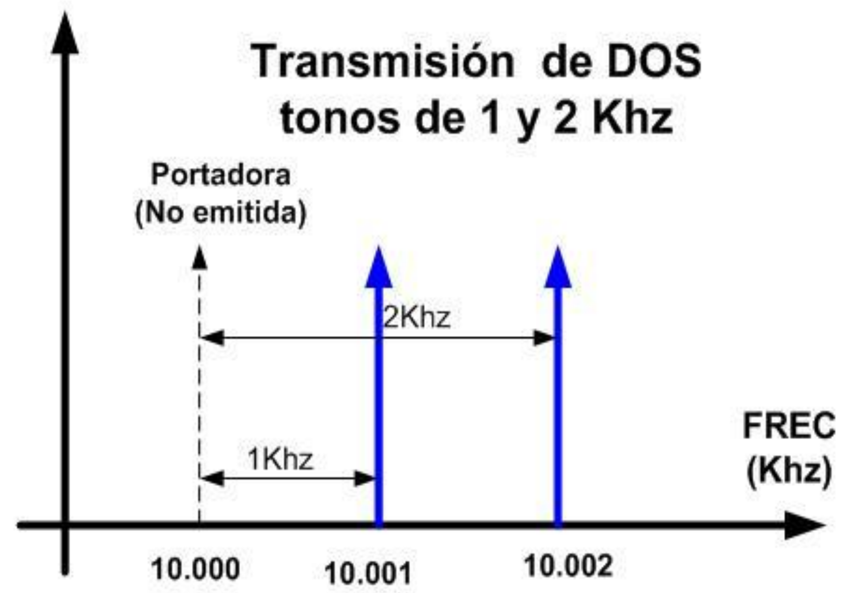




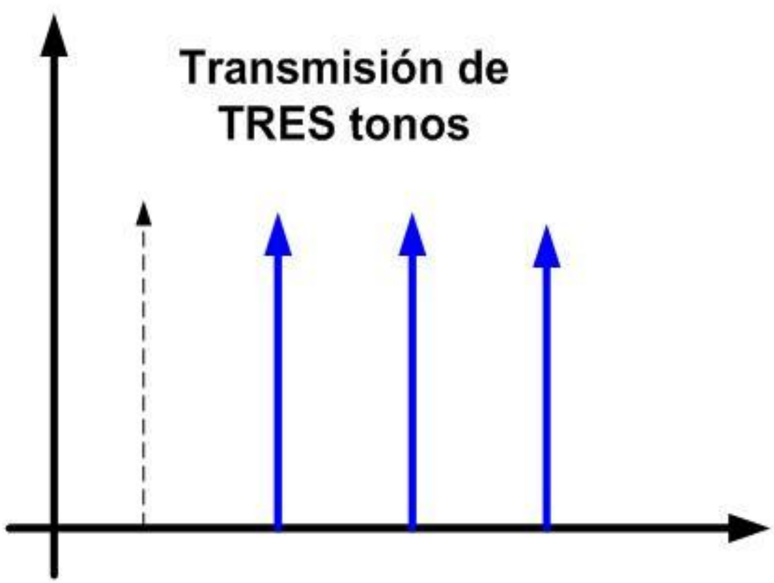




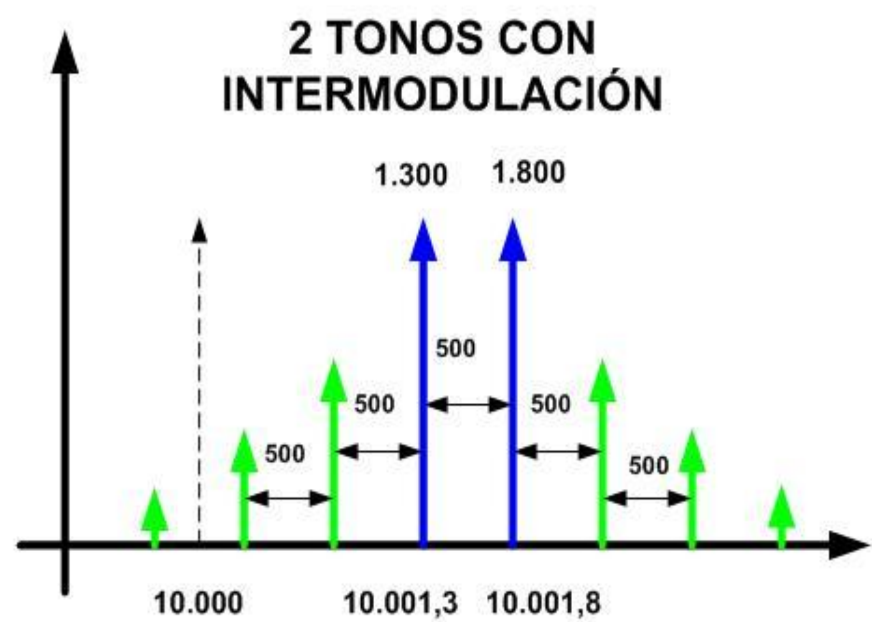
AMP
TX 10Mhz BLS
Transmisión de UN tono de 1 Khz
BLI
BLS
300 Hz
2,7 Khz
1kHZ
3 Khz
FREC
(KHz)
9.997
9999,7
10.000,3
10.003
PORTADORA (No emitida)
Frec= 10.000 Khz



Transmisión de DOS
tonos de 1 y 2 Khz
Portadora
(No emitida)
2Khz
1Khz
FREC
(Khz)
10.000
10.001
10.002

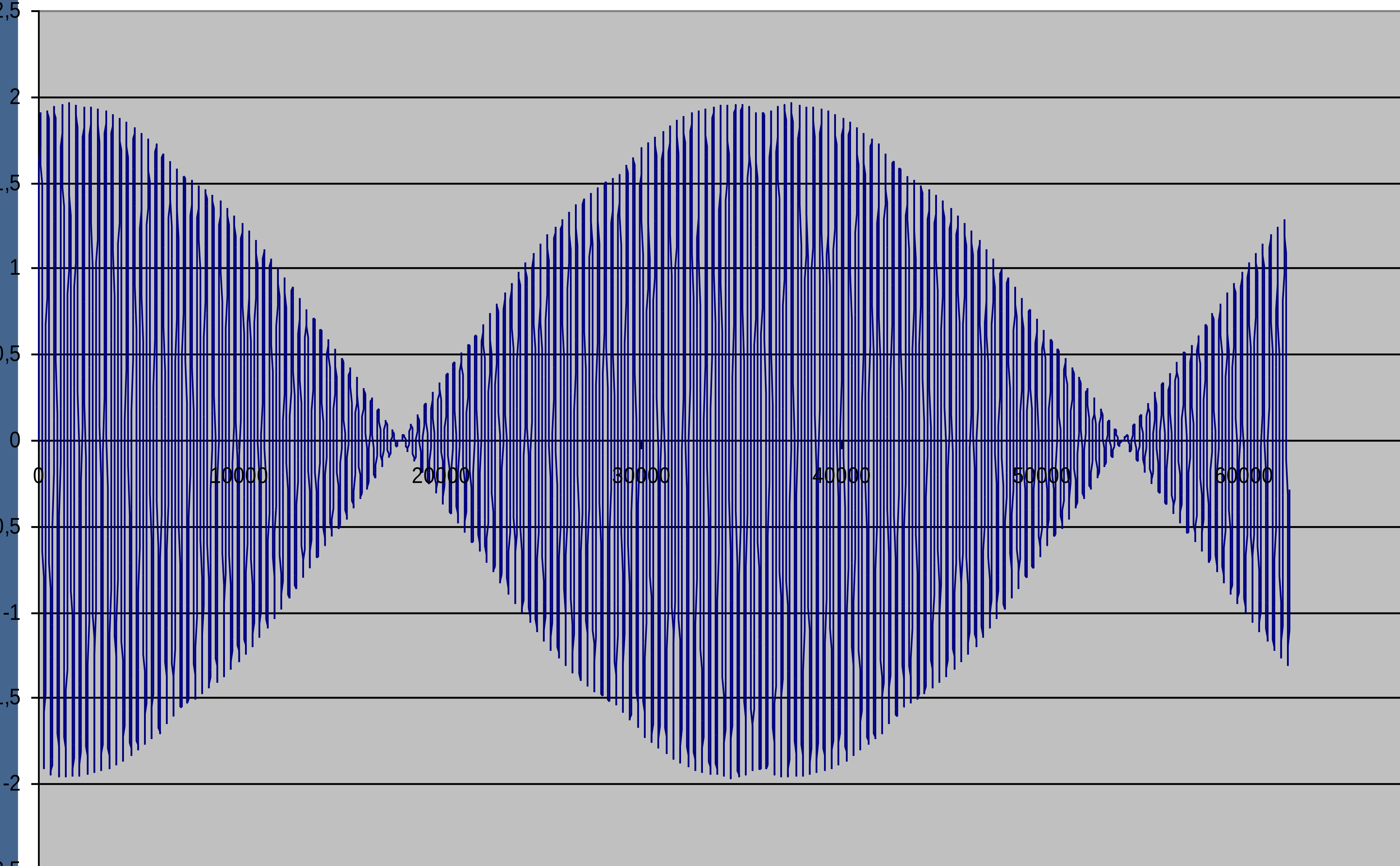


Transmisión de
TRES tonos

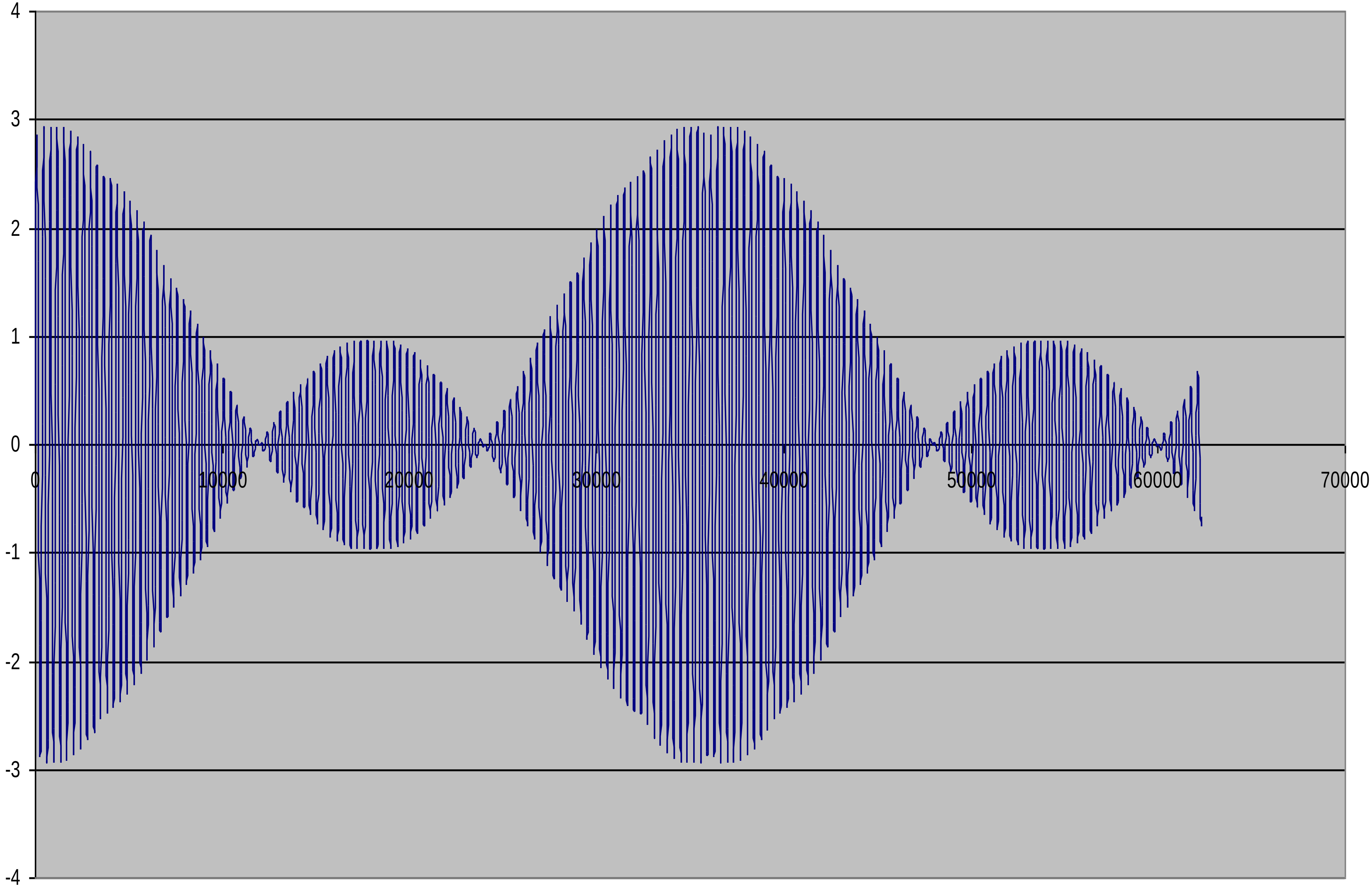


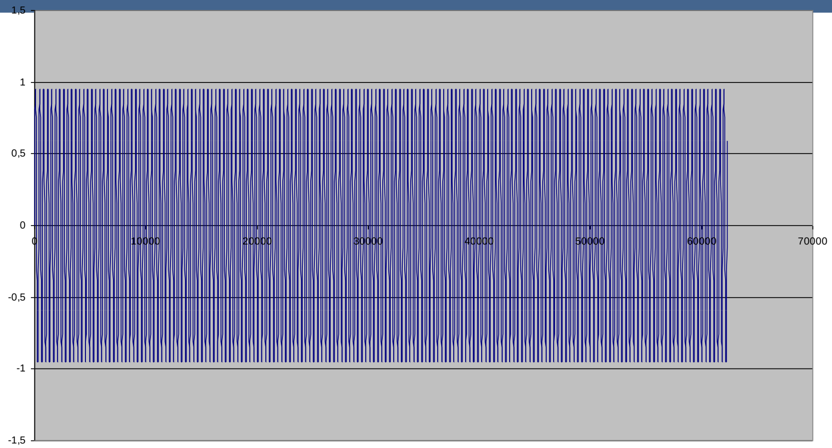
2 TONOS CON
INTERMODULACIÓN
1.300
1.800
500
500
500
500
500
10.000
10.001,3
10.001,8

BLU 2 TONOS SEPARADOS 1%



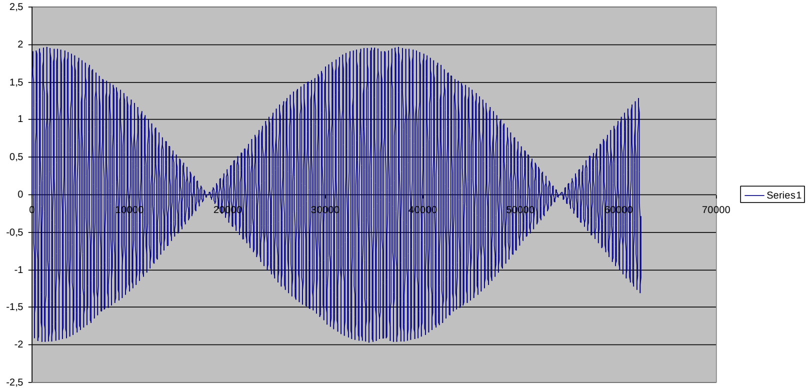
BLU 3 TONOS SIMULTANEOS





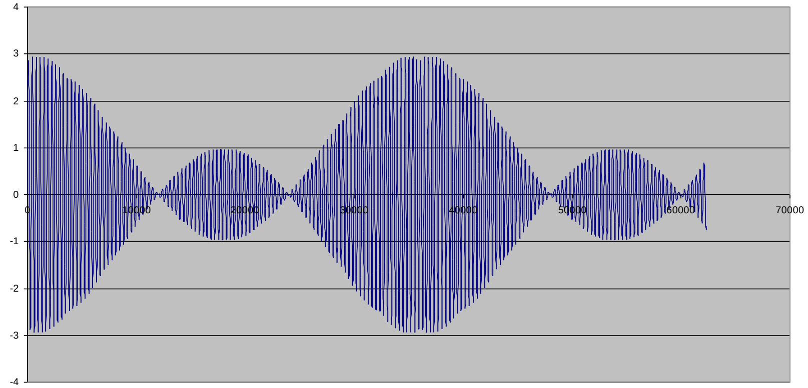
PEP = Pprom

BLU 2 TONOS SEPARADOS 1%

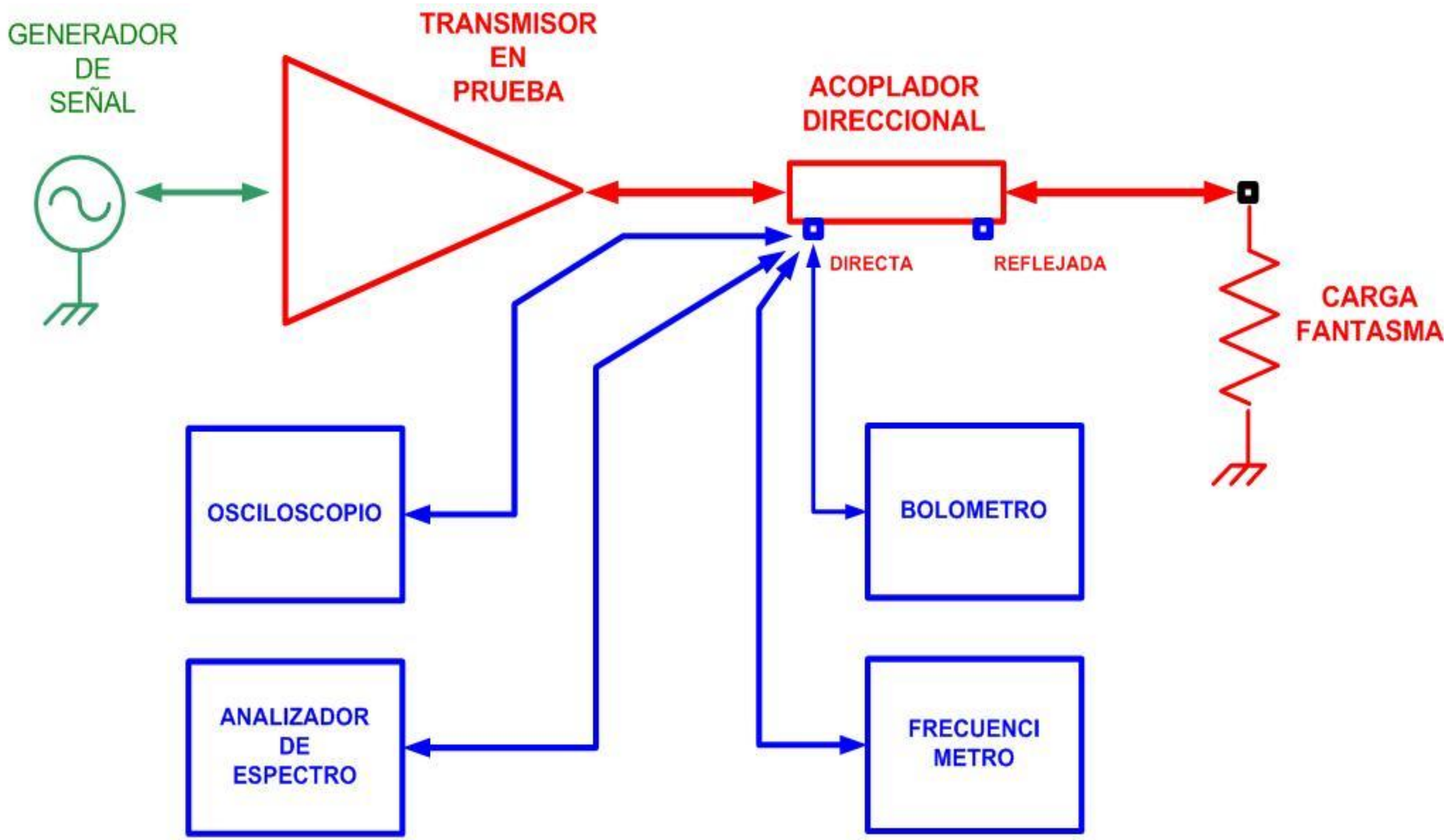


Pprom = PEP/2

BLU 3 TONOS SIMULTANEOS



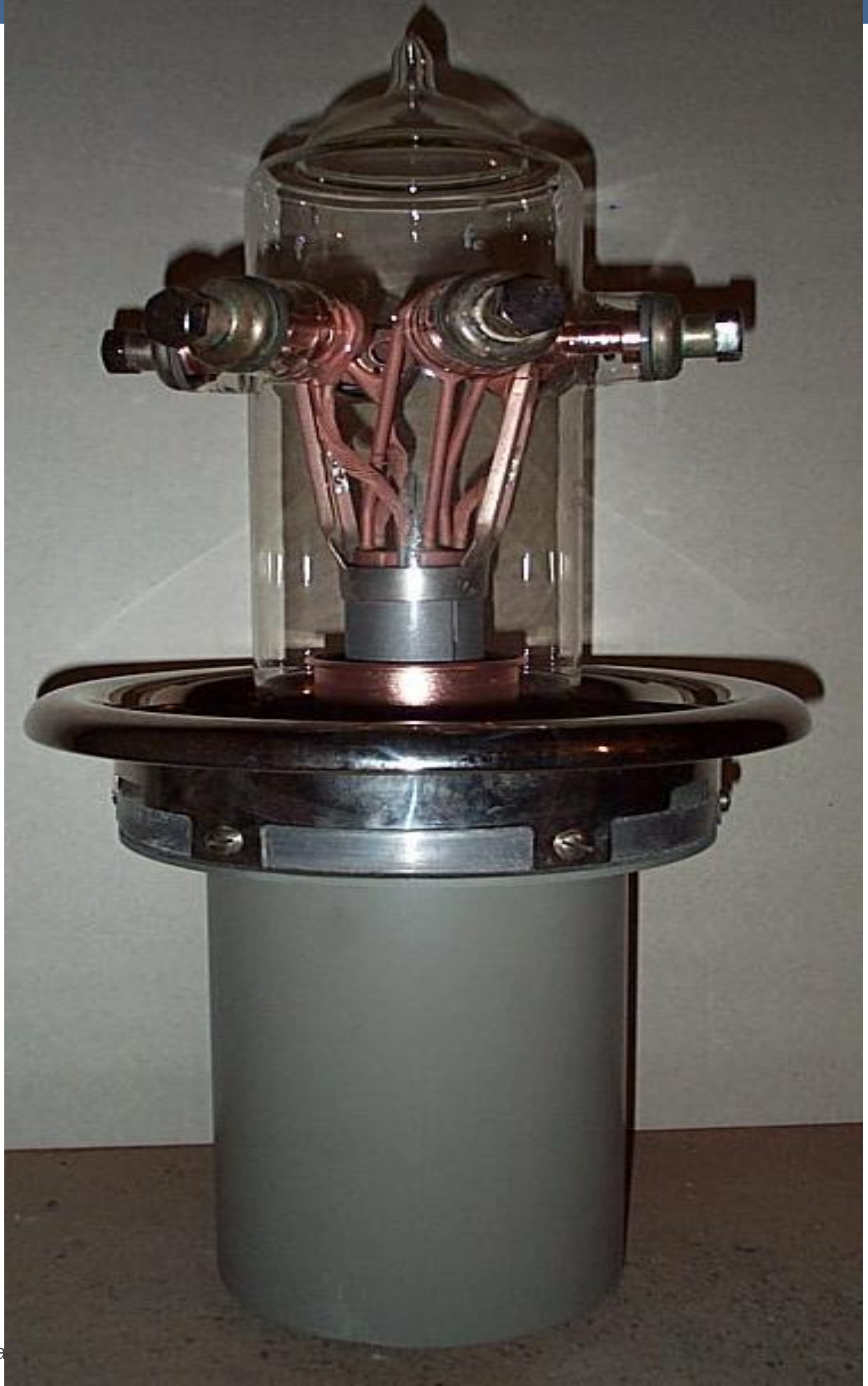
Pprom= PEP/3



ESQUEMA DE PRUEBA DE UN TRANSMISOR DE RF

LAS CONEXIONES CON DOBLE FLECHA IMPLICAN CABLE CONECTORIZADO

PUEDE UTILIZARSE INSTRUMENTAL ADICIONAL (P. Ej.: MEDIDOR DE DESVIACION)



ESPECTRO FM

g. 15—Vector representation of AM and narrow-band
M. *From P. F. Panter, "Modulation, Noise, and Spectral
nalysis," Fig. 7–5, © 1965, McGraw-Hill Book Company.*

$$-\sin\omega_c t \sum_{n=-\infty}^{\infty} J_n(\beta) \sin n\omega_m t$$

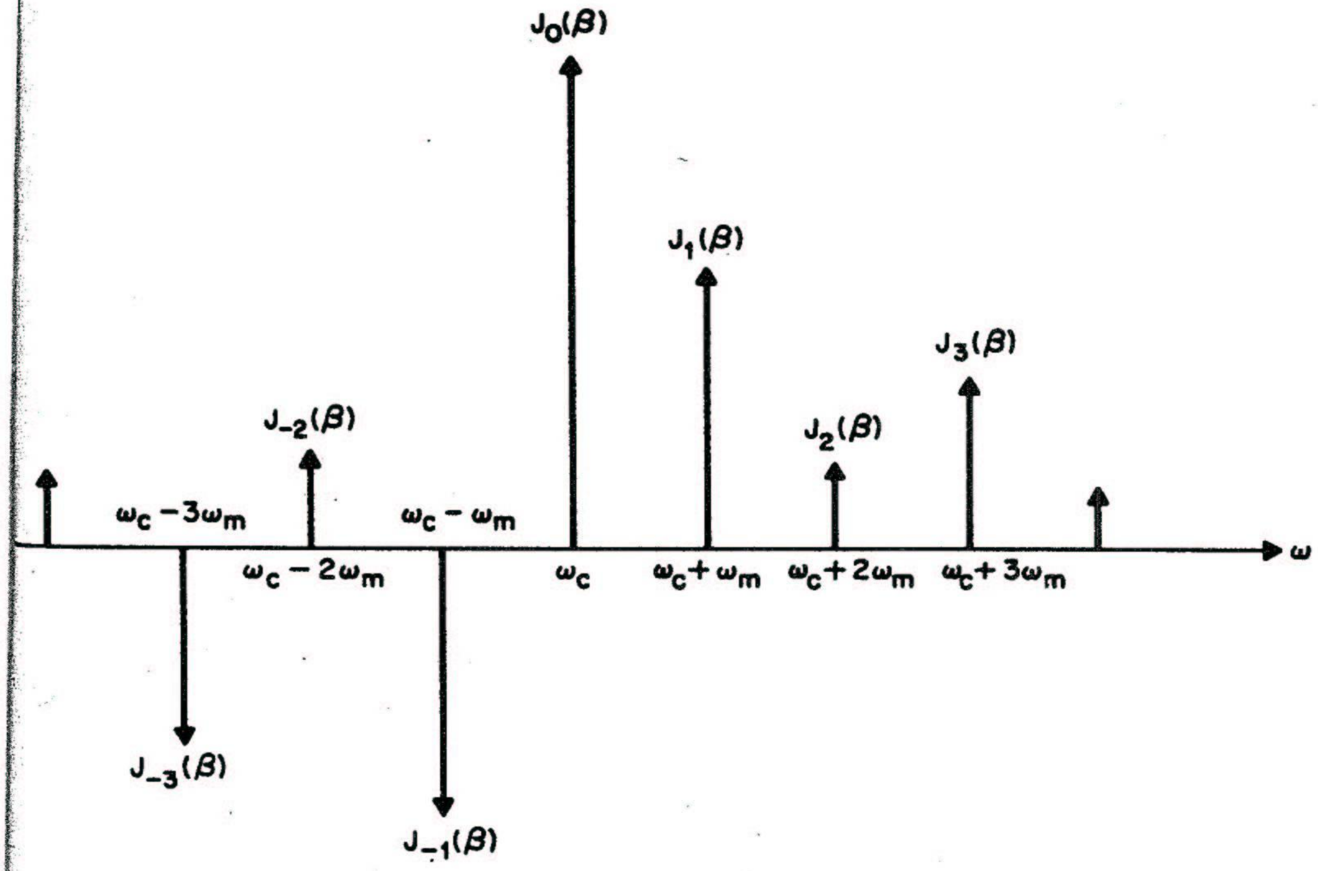


Fig. 16—Composition of FI
wave into sidebands. *From I
F. Panter, "Modulation, Nois
and Spectral Analysis," Fi
7–6, © 1965, McGraw-Hi
Book Company.*

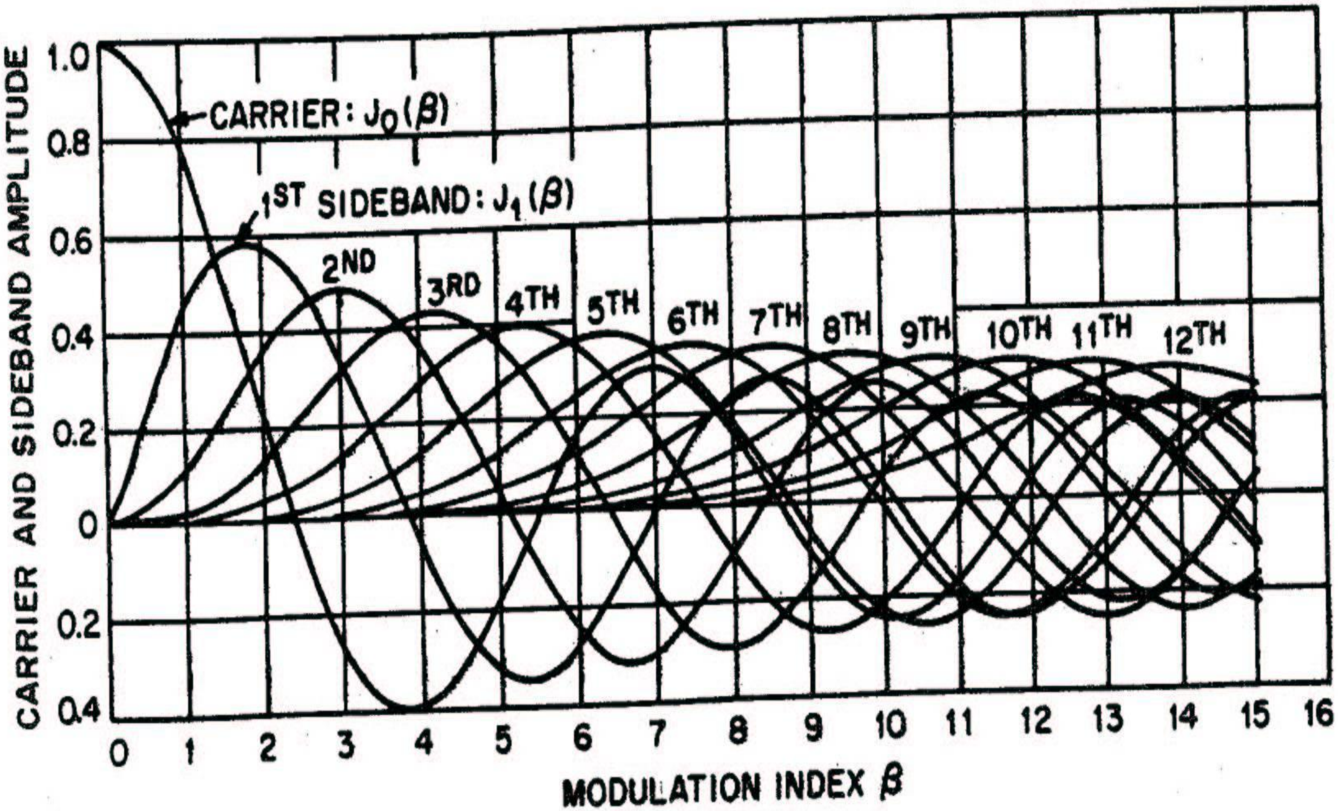
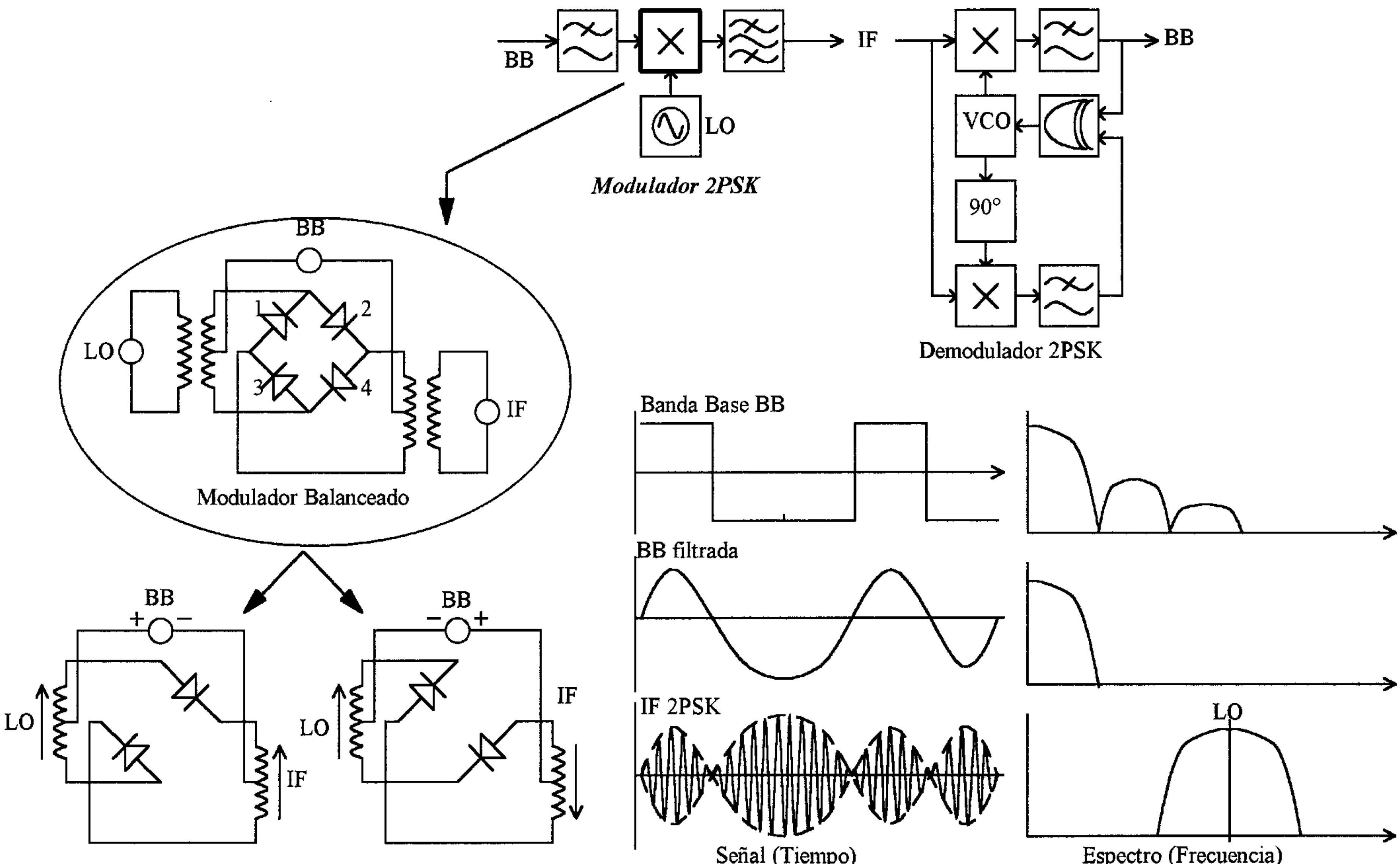


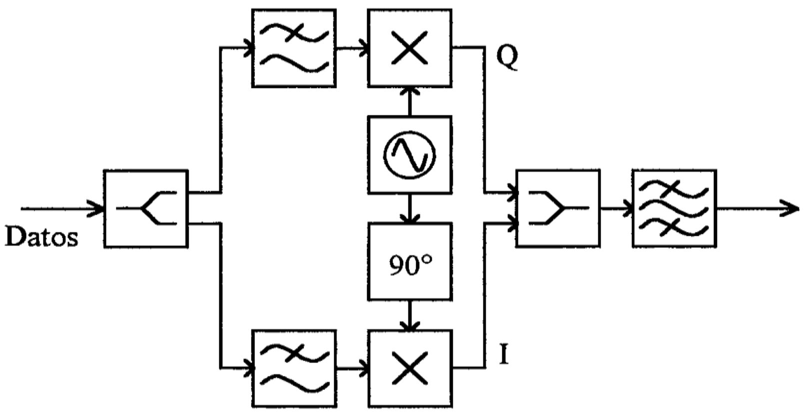
Fig. 17—Plot of Bessel functions of first kind as a function of argument β. *From P. F. Panter, "Modulation, Noise, and Spectral Analysis," Fig. 7–8, © 1965, McGraw-Hill Book Company.*

MODULACION 2PSK

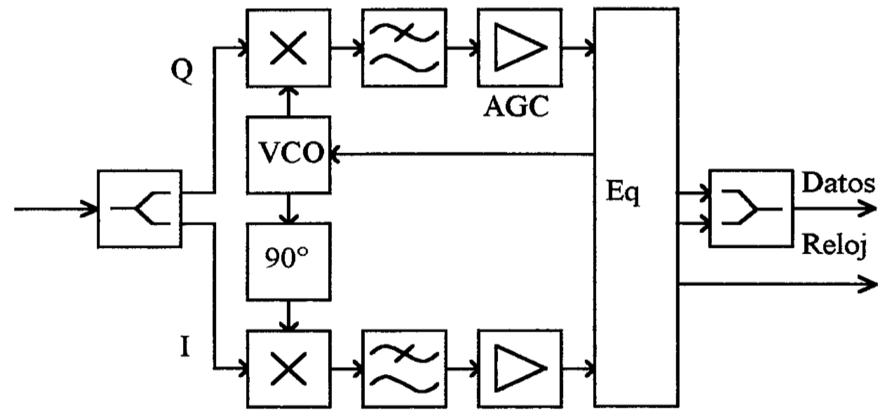


C3-01

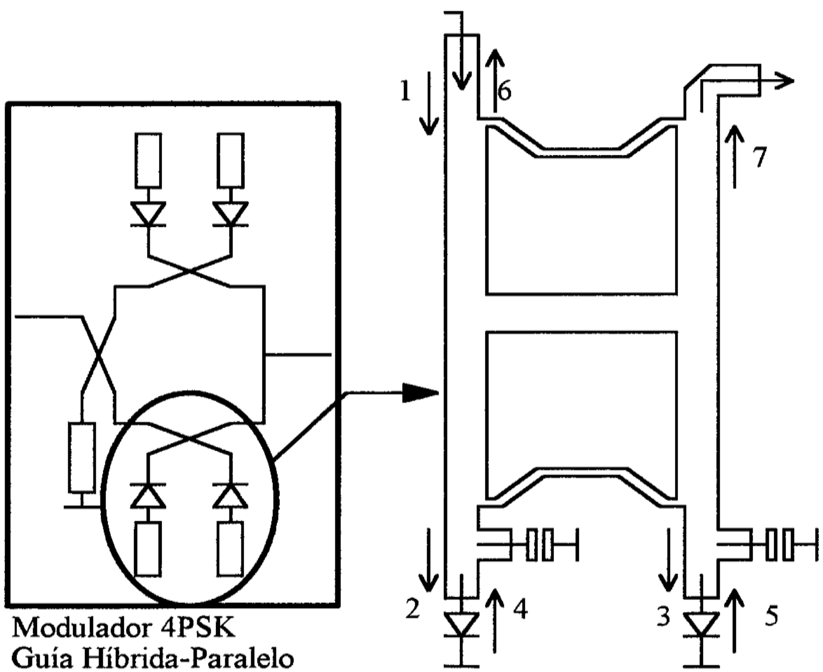
MODULACION 4PSK



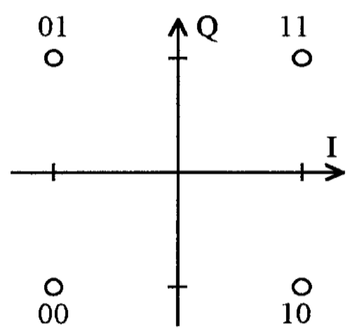
Modulador 4PSK



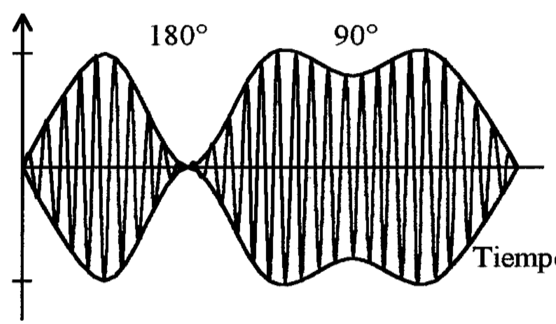
Demodulador 4PSK



Modulador 4PSK
Guía Híbrida-Paralelo

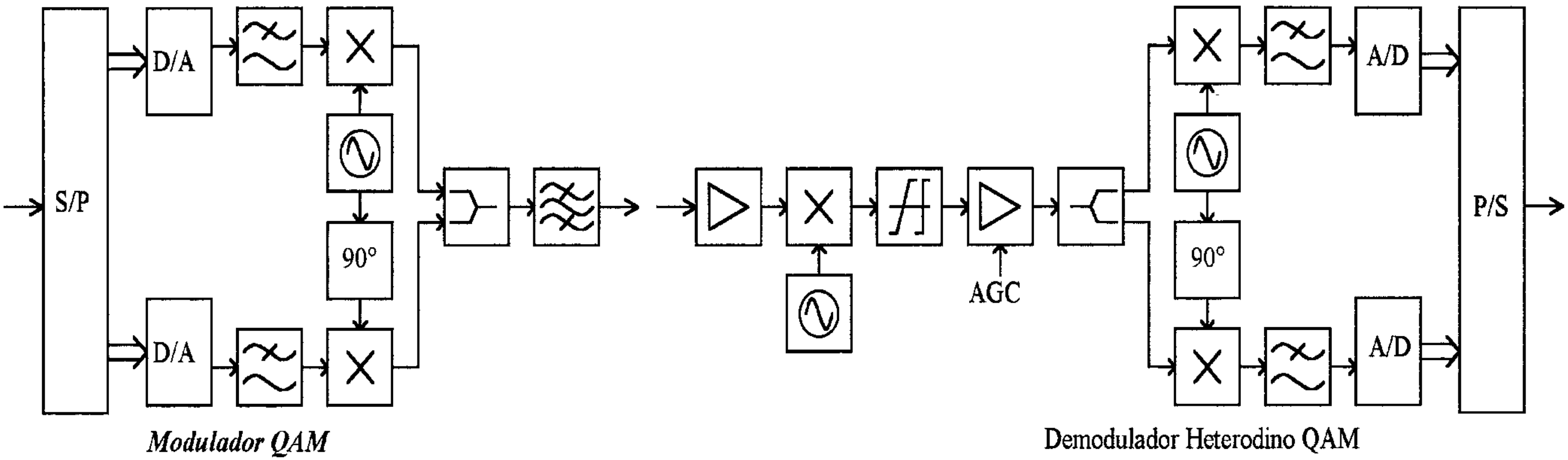


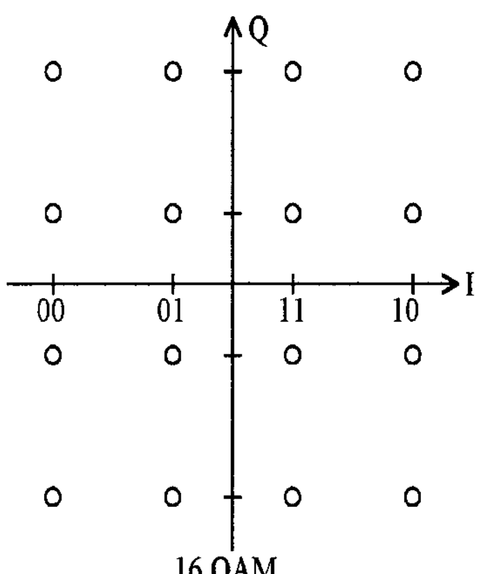
Constelación 4PSK

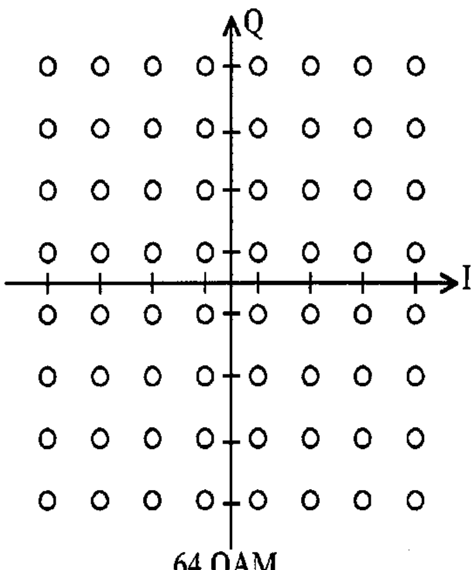


Señal Filtrada

MODULACION QAM

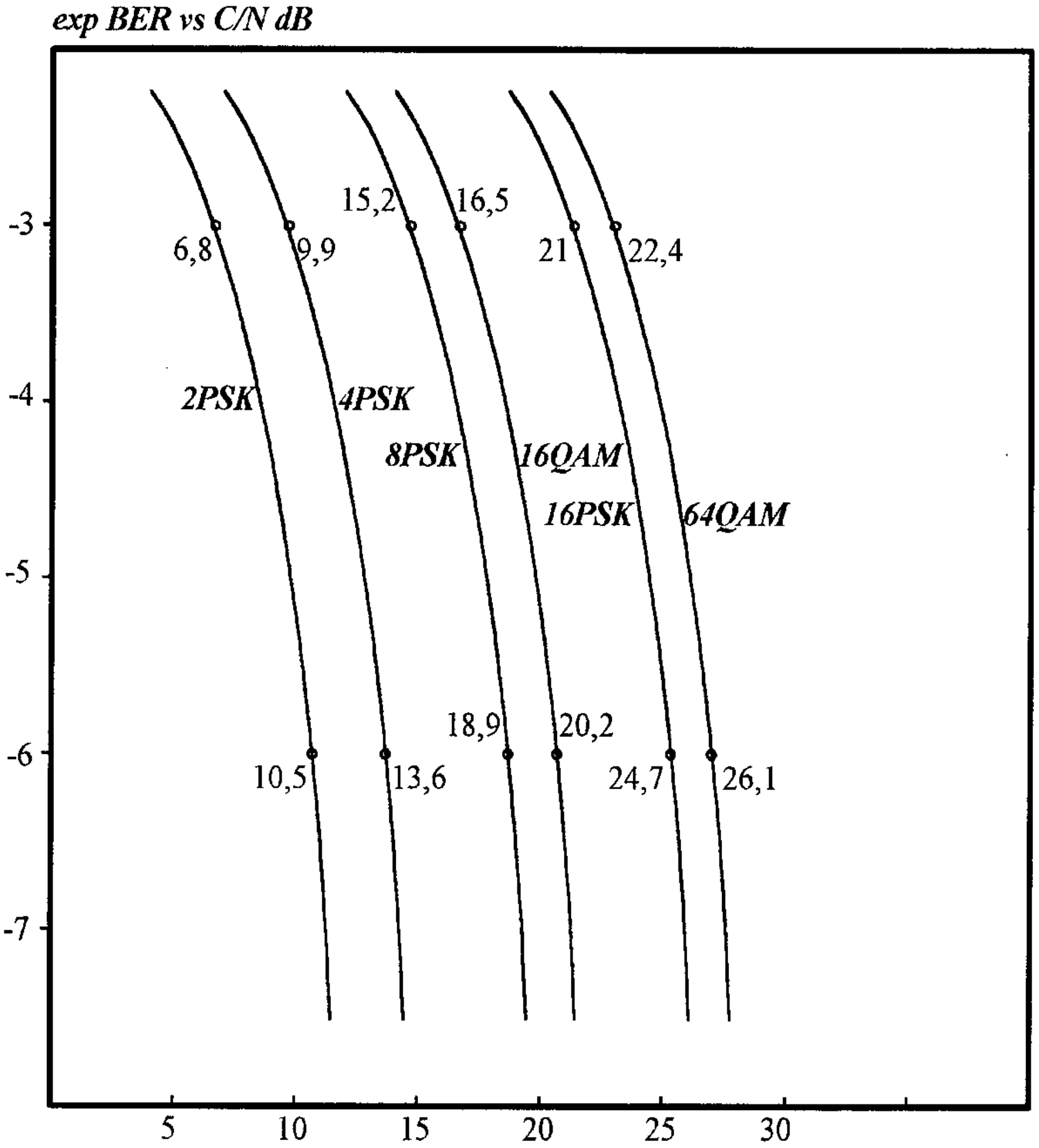


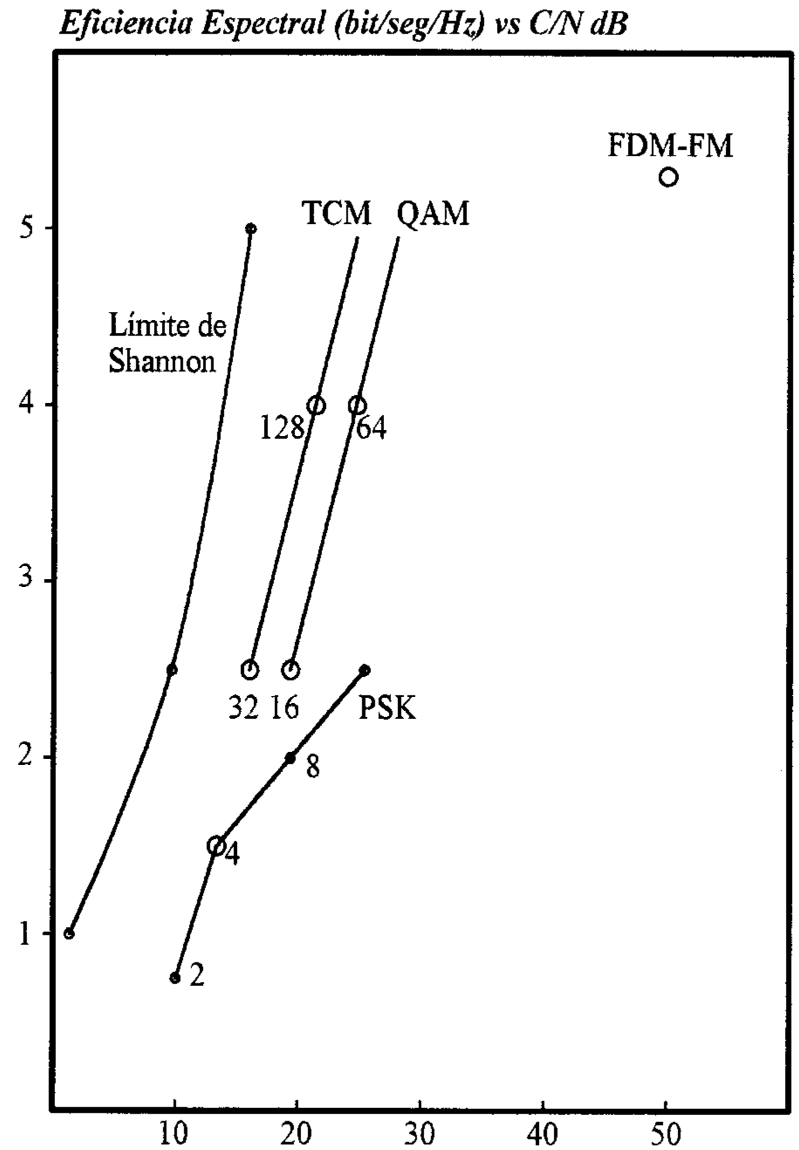




C3-03

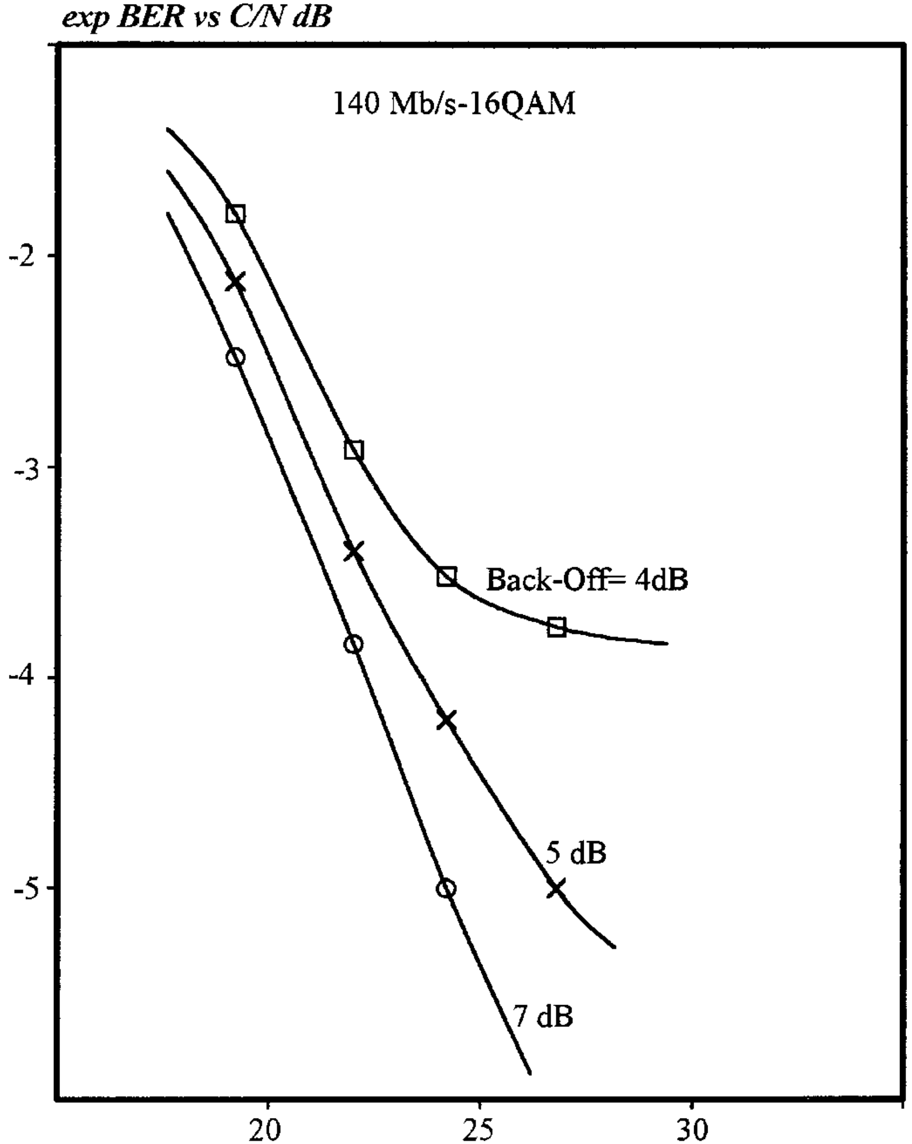
COMPARACION MODULACIONES DIGITALES



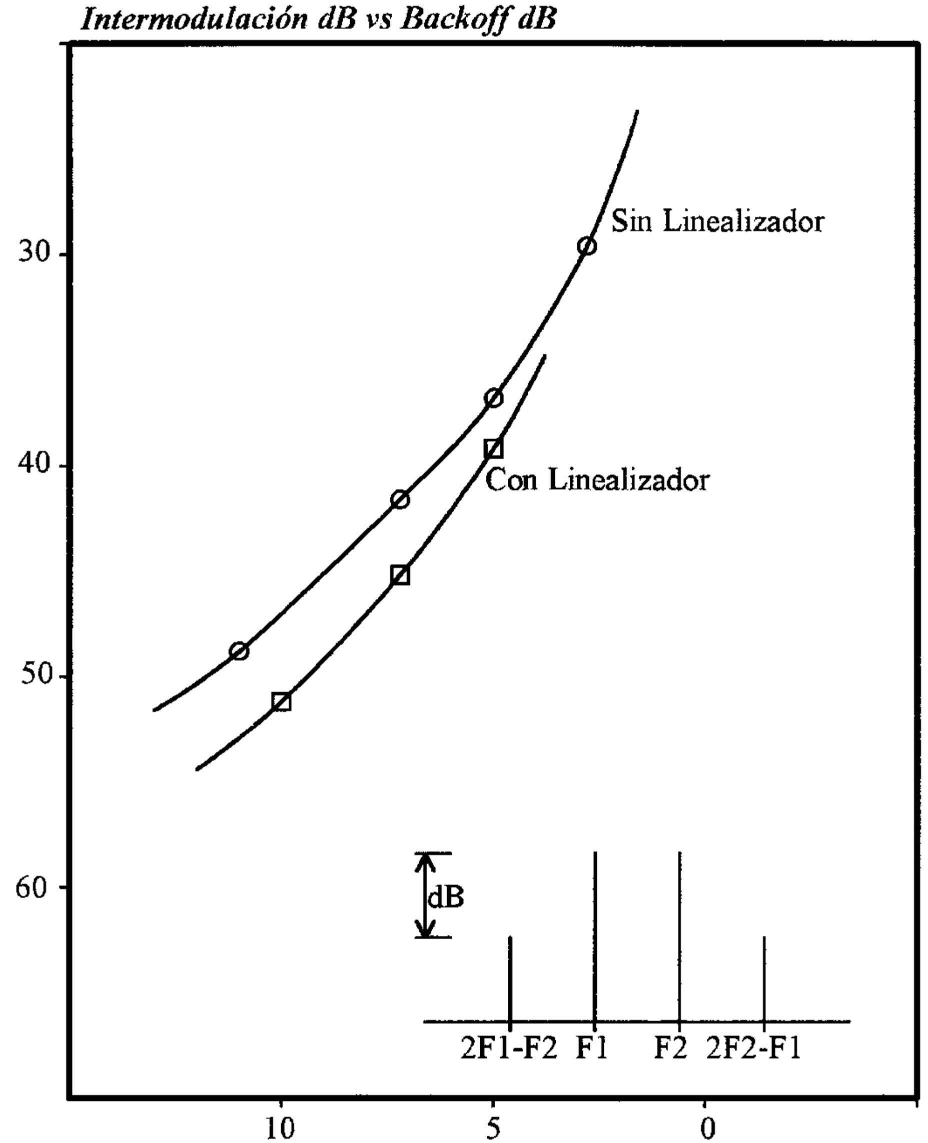


C3-09

BACK OFF



exp BER vs C/N dB
140 Mb/s-16QAM
Back-Off= 4dB
5 dB
7 dB
-2
-3
-4
-5
20
25
30



Intermodulación dB vs Backoff dB
Sin Linealizador
Con Linealizador
dB
2F1-F2
F1
F2
2F2-F1
30
40
50
60
10
5
0

EAIII-INTRODUCCION- MEDIOS DE ENLACE

REDUNDANCIA EN RADIOENLACES

- 1 + 0
- 1+1 HSB
- 1+1 DIVERSIDAD DE FRECUENCIA
- 1+1 DIVERSIDAD DE ESPACIO
- N+1

EAIII-INTRODUCCION- MEDIOS DE ENLACE

- **COBRE**
  - PAR TRENZADO
  - UTP / STP
  - COAXIL
  - GUIA DE ONDA
- **FIBRA OPTICA**
  - ESTRUCTURA
  - MONOMODO / MULTIMODO
  - CONECTORES Y EMPALMES
  - ATENUACION Y MEDICIONES
- **ONDAS DE RADIO**

1/4" Superflexible Foam Dielectric, FSJ Series – *75-ohm*

FSJ1-75

Description	Type No.
Cable Ordering Information	
Standard Cable	
1/4" Standard superflexible	**FSJ1-75**
Fire Retardant Cables	
1/4" Fire Retardant Jacket (CATVX)	**FSJ1RN-75A**
1/4" Fire Retardant Jacket (CATVR)	**FSJ1RN-75A**

Characteristics

Electrical	
Impedance, ohms	75 ± 3
Maximum Frequency, GHz	22.0
Velocity, percent	78
Peak Power Rating, kW	6.7
dc Resistance, ohms/1000 ft (1000 m)	
Inner	15 (49.2)
Outer	1.8 (5.9)
dc Breakdown, volts	2000
Jacket Spark, volts RMS	5000
Capacitance, pF/ft (m)	17.4 (57.0)
Inductance, µH/ft (m)	0.098 (0.321)
Mechanical	
Outer Conductor	Copper
Inner Conductor	Copper-Clad Steel
Diameter over Jacket, in (mm)	0.29 (7.4)
Diameter over Copper Outer Conductor, in (mm)	0.25 (6.4)
Minimum Bending Radius, in (mm)	1 (25)
Number of Bends, minimum (typical)	15 (50)
Bending Moment, lb-ft (N•m)	0.5 (0.68)
Cable Weight, lb/ft. (kg/m)	0.046 (0.068)
Tensile Strength, lb (kg)	150 (68)
Flat Plate Crush Strength, lb/in (kg/mm)	100 (1.8)

Attenuation and Average Power Ratings

Frequency MHz	Attenuation dB/100 ft	Attenuation dB/100 m	Average Power, kW
0.5	0.126	0.413	8.43
1	0.178	0.585	5.95
1.5	0.219	0.718	4.85
2	0.253	0.830	4.20
10	0.570	1.87	1.86
20	0.812	2.66	1.31
30	0.999	3.28	1.06
50	1.30	4.27	0.817
88	1.74	5.72	0.609
100	1.86	6.12	0.570
108	1.94	6.37	0.547
150	2.31	7.57	0.460
174	2.50	8.19	0.425
200	2.69	8.82	0.395
300	3.34	11.0	0.318
400	3.91	12.8	0.272
450	4.17	13.7	0.255
500	4.42	14.5	0.241
512	4.48	14.7	0.237
600	4.89	16.0	0.217
700	5.32	17.5	0.200
800	5.74	18.8	0.185
824	5.83	19.1	0.182
894	6.11	20.0	0.174
960	6.36	20.9	0.167
1000	6.51	21.4	0.163
1250	7.40	24.3	0.144
1500	8.22	27.0	0.129
1700	8.84	29.0	0.120
1800	9.14	30.0	0.116
2000	9.73	31.9	0.109
2100	10.0	32.9	0.106
2200	10.3	33.8	0.103
2300	10.6	34.7	0.101
3000	12.4	40.7	0.086
3300	13.2	43.1	0.081
3400	13.4	43.9	0.079
4000	14.8	48.6	0.072
4900	16.8	55.2	0.063
6000	19.1	62.7	0.056
8000	23.0	75.6	0.046
10000	26.7	87.6	0.040
12000	30.2	99.0	0.035
14000	33.5	110.0	0.032
16000	36.8	120.7	0.029
18000	39.9	131.0	0.027
19000	41.5	136.1	0.026
20000	43.0	141.1	0.025
22000	46.0	151.0	0.023

Standard Conditions:
For Attenuation, VSWR 1.0 ambient temperature 20°C (68°F), atmospheric pressure, dry air.
For Average Power, VSWR 1.0, inner temperature 40°C (104°F), inner conductor temperature 1000°C (212°F), no solar loading.

5" Air Dielectric, High Power
HJ( )HP Series – *50-ohm*

HJ9HP-50

Description	Type No.
Cable Ordering Information	
High Power Cable	
5" Standard High Power Cable	**HJ9HP-50**
45 – 70 MHz, 1.06 VSWR, max.	
87 – 108 MHz, 1.06 VSWR, max. over broadcast channel	
170 – 230 MHz, 1.08 VSWR, max. over broadcast channel	
470 – 860 MHz, 1.10 VSWR, max. over broadcast channel	

* For broadcast applications, specify channel and frequency.

Characteristics

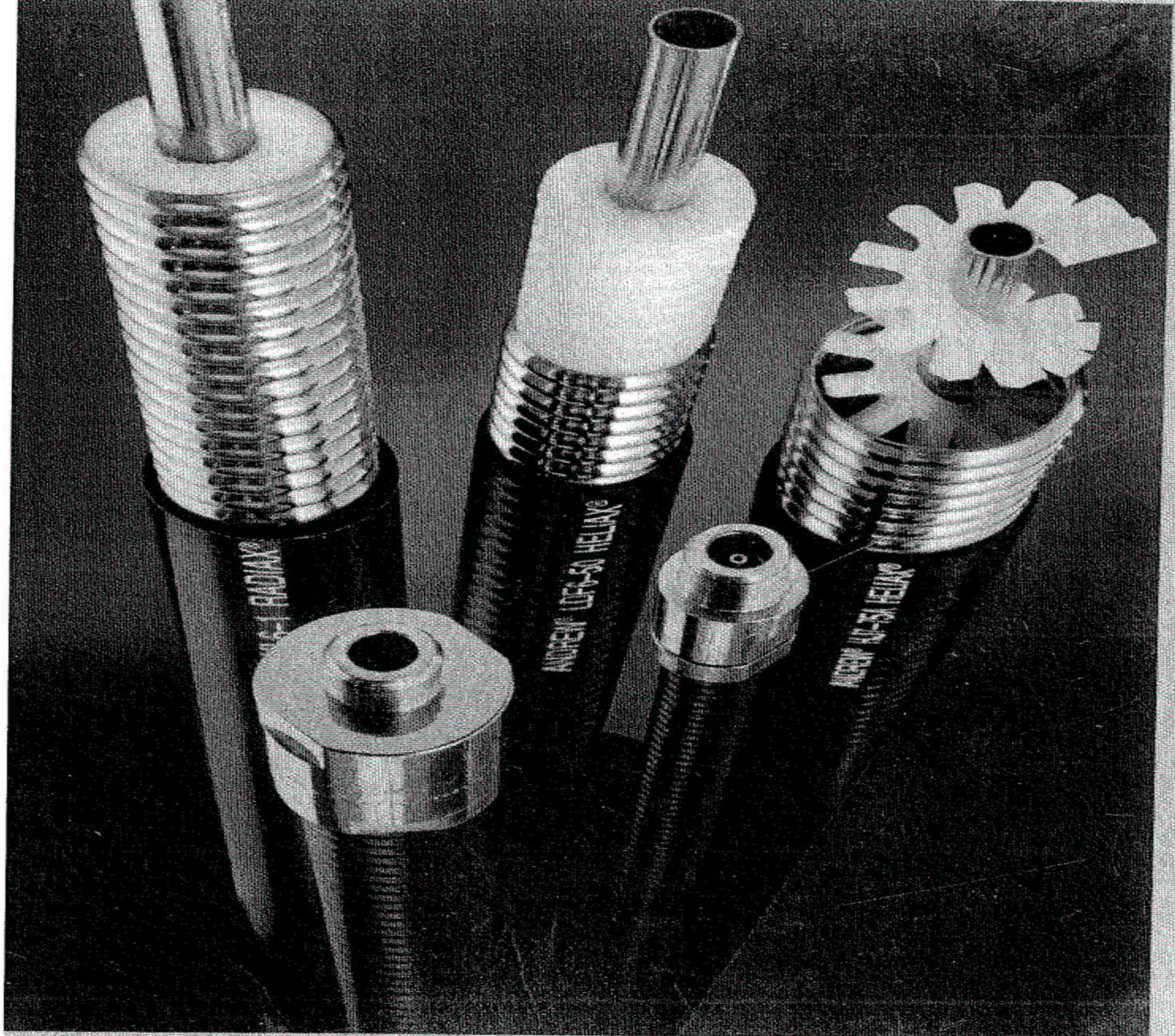
Electrical	
Impedance, ohms	50 ± 0.5
Maximum Frequency, GHz	0.96
Velocity, percent	96.4
Peak Power Rating, kW	1690
dc Resistance, ohms/1000 ft (1000 m)	
Inner	0.1 (0.33)
Outer	0.04 (0.13)
dc Breakdown, volts	26000
Jacket Spark, volts RMS	12000
Capacitance, pF/ft (m)	20.8 (68.1)
Inductance, µH/ft (m)	0.054 (0.176)
Mechanical	
Outer Conductor	Copper
Inner Conductor	Copper
Diameter over Jacket, in (mm)	5.20 (132)
Diameter over Outer Conductor, in (mm)	5.00 (127)
Diameter Inner Conductor, in (mm)	2.07 (52.7)
Nominal Inside Transverse Dimensions, (cm)	11.3
Minimum Bending Radius, in (mm)	50 (1270)
Number of Bends, minimum (typical)	15 (30)
Bending Moment, lb-ft (N•m)	200 (271)
Cable Weight, lb/ft (kg/m)	3.4 (4.9)
Tensile Strength, lb (kg)	1000 (454)
Flate Plate Crush Strength, lb/in (kg/mm)	240 (4.29)

Attenuation and Average Power Ratings

Frequency MHz	Attenuation dB/100 ft	Attenuation dB/100 m	Average Power, kW
0.5	0.0045	0.0148	1690
1	0.0064	0.0211	1690
1.6	0.0081	0.0267	1540
2	0.0092	0.0300	1375
10	0.0211	0.0693	599
20	0.0306	0.100	416
30	0.0381	0.125	335
50	0.0505	0.166	254
88	0.0695	0.228	185
100	0.0748	0.245	172
108	0.0782	0.257	165
150	0.0948	0.311	137
174	0.104	0.340	125
200	0.113	0.369	116
300	0.144	0.474	90.8
400	0.173	0.568	76.2
450	0.186	0.612	70.8
500	0.200	0.655	66.3
512	0.203	0.665	65.3
600	0.225	0.737	59.1
700	0.249	0.816	53.6
800	0.272	0.893	49.1
824	0.278	0.910	48.2
860	0.286	0.937	48.9
894	0.293	0.962	45.7
960	0.308	1.010	43.6

Standard Conditions:
For Attenuation, VSWR 1.0 ambient temperature 20°C (68°F), atmospheric pressure, dry air.
For Average Power, VSWR 1.0, inner temperature 150°C (302°F), ambient temperature 40°C (104°F), atmospheric pressure, dry air, no solar loading.

United States Patent No. 5,742,002


RADIAX®
ANDREW LDF6-50 HELIAX®


HELIAX
Corte por lo sano
Cuando Ud. necesita realmente alta performance, la opción más segura en el mercado de los cables coaxiles se llama ANDREW. Y no por casualidad. Sólo ANDREW diseña, fabrica, ensambla y pretestea los cables y conectores. Sólo ANDREW puede asegurarle la máxima confiabilidad.
• Baja atenuación
• Bajo VSWR
• Baja intermodulación
• Aptos para usos en interior e intemperie
• Alta flexibilidad
• Alta protección
• Alto rendimiento
Corte por lo sano, use productos
ANDREW

Elliptical Waveguide

Types EWP17 and EW17

Characteristics

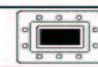
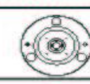
Type Numbers	
Premium Waveguide	**EWP17**
Standard Waveguide	**EW17**
Electrical	
Max. Frequency Range, GHz	1.7-2.4
$_eTE_{11}$ Mode Cutoff Frequency, GHz	1.364
Group Delay at 2.0 GHz, ns/100 ft (ns/100 m)	139 (456)
Peak Power Rating at 2.0 GHz, kW	
with 117E or 117ET Connectors	1036
with 117RT Connectors	90
Mechanical	
Minimum Bending Radii, without rebending, inches (mm)	
E Plane	20 (510)
H Plane	57 (1450)
Minimum Bending Radii, with rebending, inches (mm)	
E Plane	28 (710)
H Plane	81 (2060)
Maximum Twist, degrees/foot (m)	0.25 (0.75)
Dimensions over Jacket, in (mm)	5.65 x 2.99 (143.5 x 75.9)
Weight, pounds per foot (kg/m)	2.73 (4.06)

Attenuation, Average Power, Group Velocity

Frequency GHz	Attenuation dB/100 ft (dB/100 m)	Average Power Rating, kW	Group Velocity of Propagation,%
1.70	0.46 (1.51)	35.35	59.7
1.80	0.41 (1.35)	39.48	65.3
1.90	0.38 (1.25)	42.58	69.6
2.00	0.36 (1.19)	44.99	73.1
2.10	0.35 (1.14)	46.91	76.0
2.20	0.34 (1.10)	48.47	78.5
2.30	0.33 (1.07)	49.76	80.5
2.40	0.32 (1.05)	50.82	82.3

Attenuation values based on VSWR 1.0, ambient temperature 24°C (75°F) and are guaranteed within ±5%. Average power ratings based on VSWR 1.0 and 42°C (76°F) temperature rise over 40°C (104°F) ambient.

Connectors – Flange dimensions on pages 216-217

	L in (mm)	W in (mm)	A in (mm)	Weight lb (kg)
Type No. 117E, 117ET – Figure 1				
	15.9 (404)	6.9 (175)	12.0 (305)	7.0 (3.2)
Type No. 117RT – Figure 2				
	8.9 (225)	4.6 (116)	5.0 (127)	5.0 (2.3)

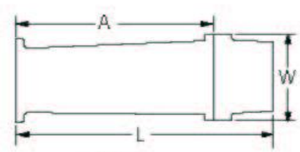


Figure 1

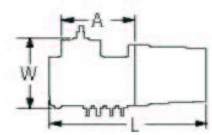
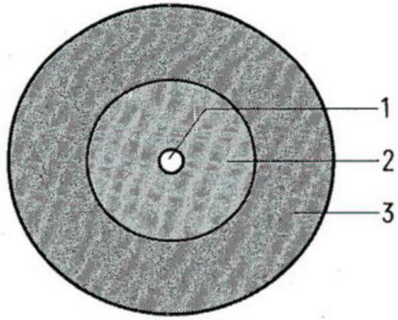


Figure 2

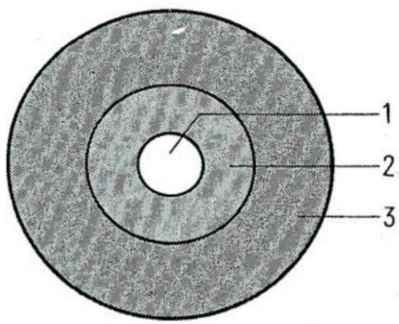
Connector Material: Nickel-Plated Aluminum

EAIII-INTRODUCCION- MEDIOS DE ENLACE-FO



1 Core Ø = 5 µm
2 Cladding Ø = 125 µm
3 Coating Ø = 250 µm

Figure 6.2
Single-mode fiber



1 Core Ø = 50 µm
2 Cladding Ø = 125 µm
3 Coating Ø = 250 µm

Figure 6.1
Multimode fiber

88

video conferences and videophone.

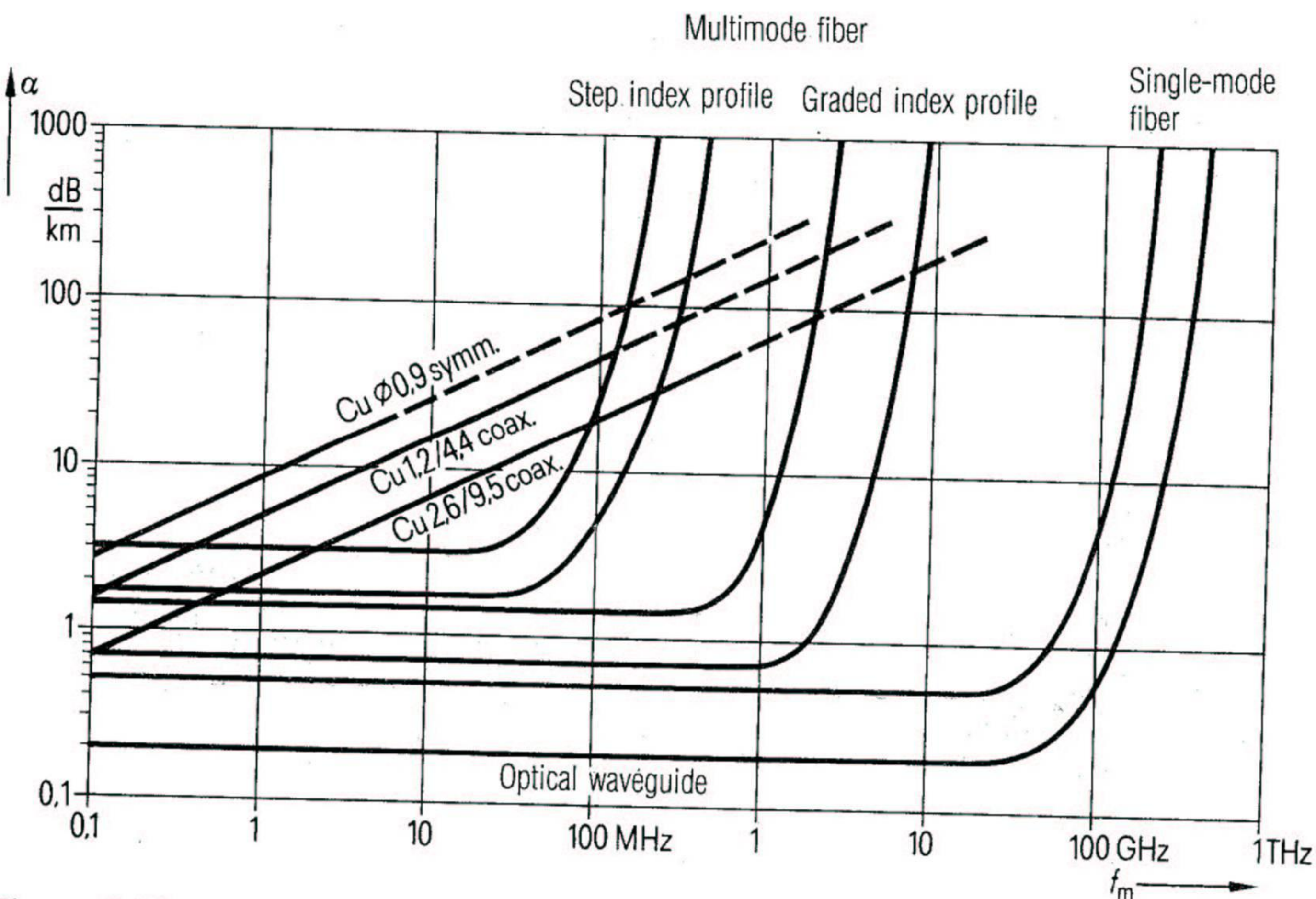
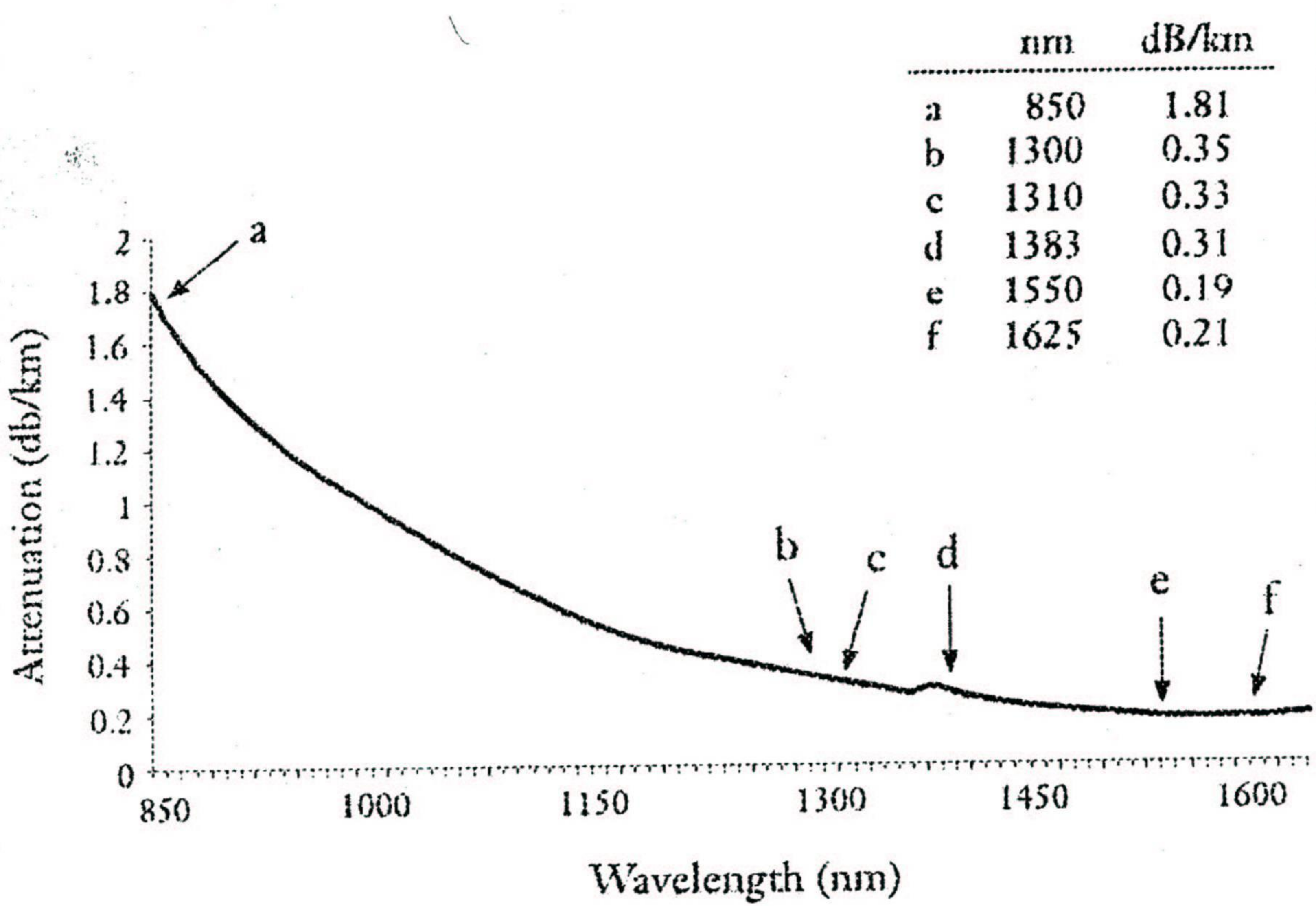
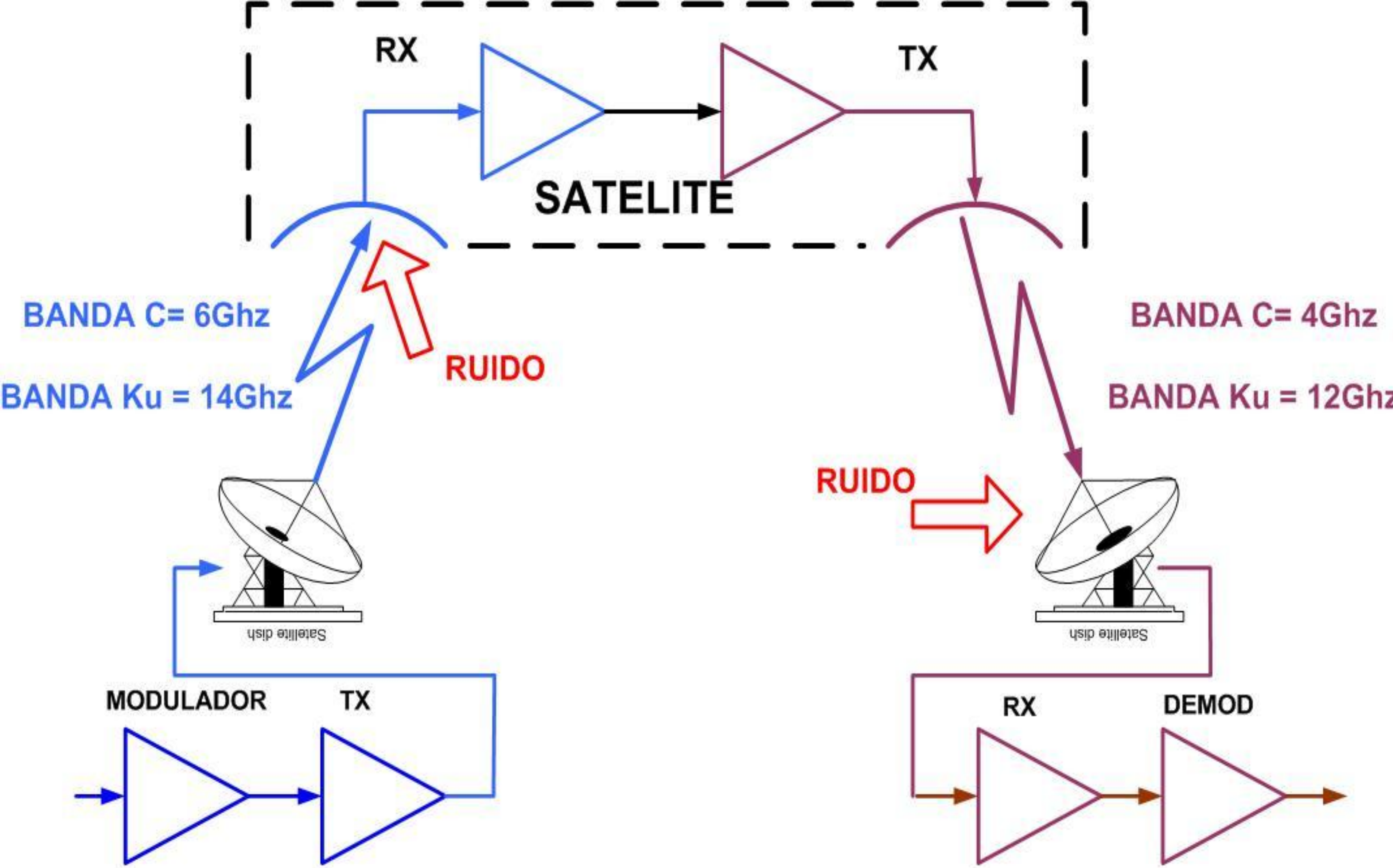


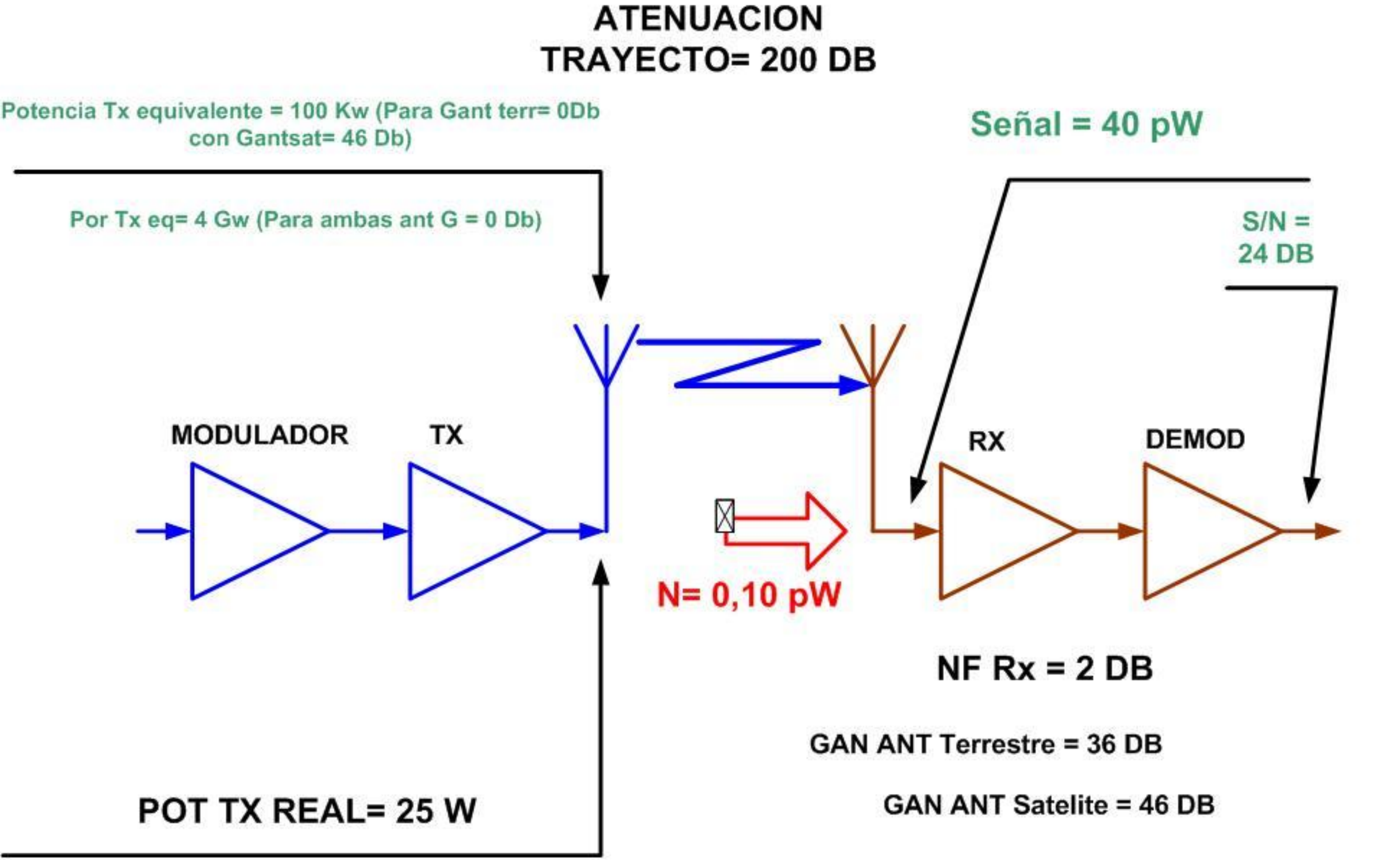
Figure 9.12
Attenuation coefficient as a function of the frequency of modulation for balanced and coaxial copper cables and for various optical cables

Spectral Attenuation (typical fiber)

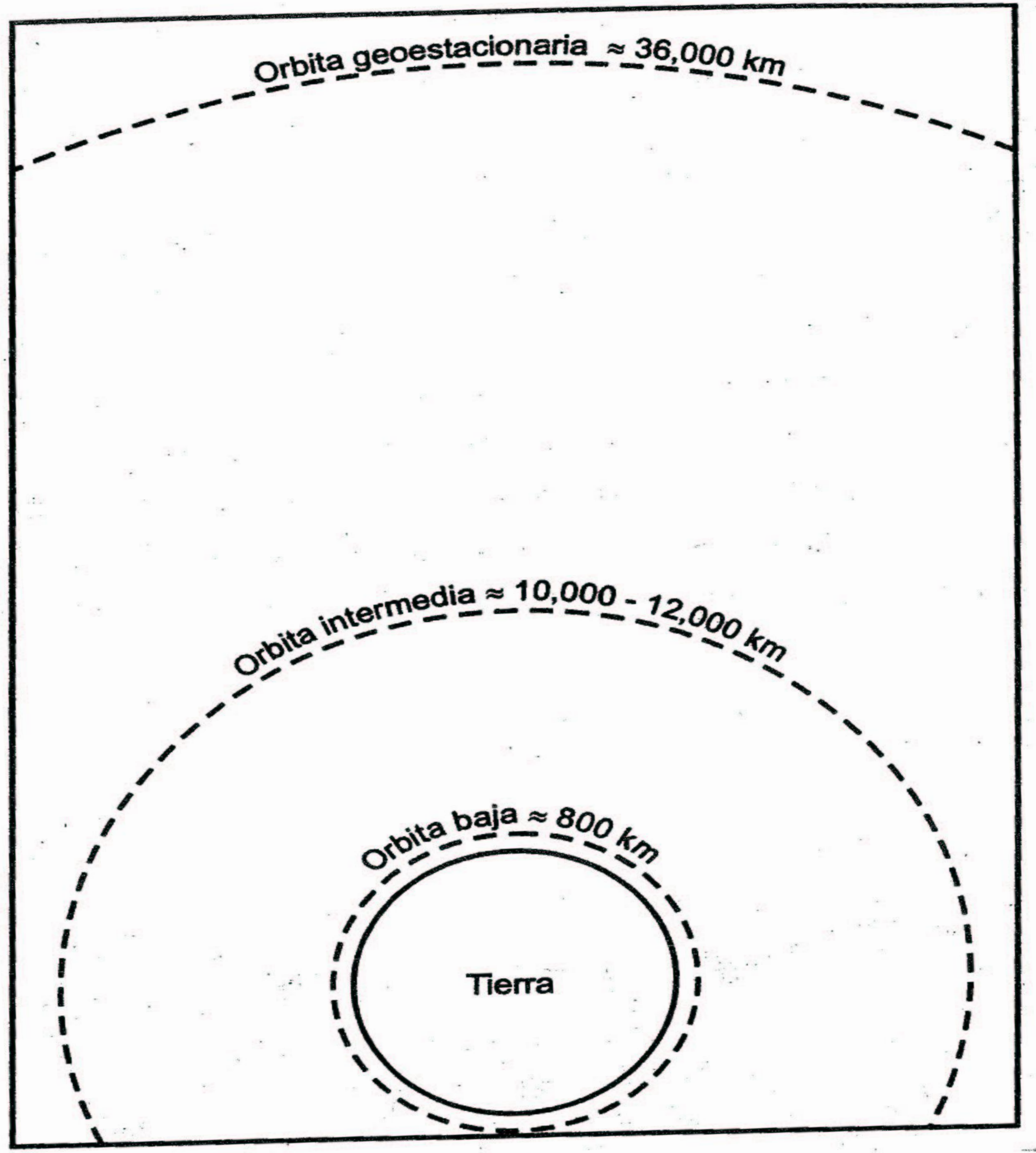




LOS VALORES EXPUESTOS EN EL PRESENTE GRAFICO SON REFERENCIALES, NO CORRESPONDEN A NINGUN ENLACE PARTICULAR Y SE INCLUYEN SOLO CON FINES DIDACTICOS



LOS VALORES EXPUESTOS EN EL PRESENTE GRAFICO SON REFERENCIALES, NO CORRESPONDEN A NINGUN ENLACE PARTICULAR Y SE INCLUYEN SOLO CON FINES DIDACTICOS


Orbita geoestacionaria ≈ 36,000 km
Orbita intermedia ≈ 10,000 - 12,000 km
Orbita baja ≈ 800 km
Tierra

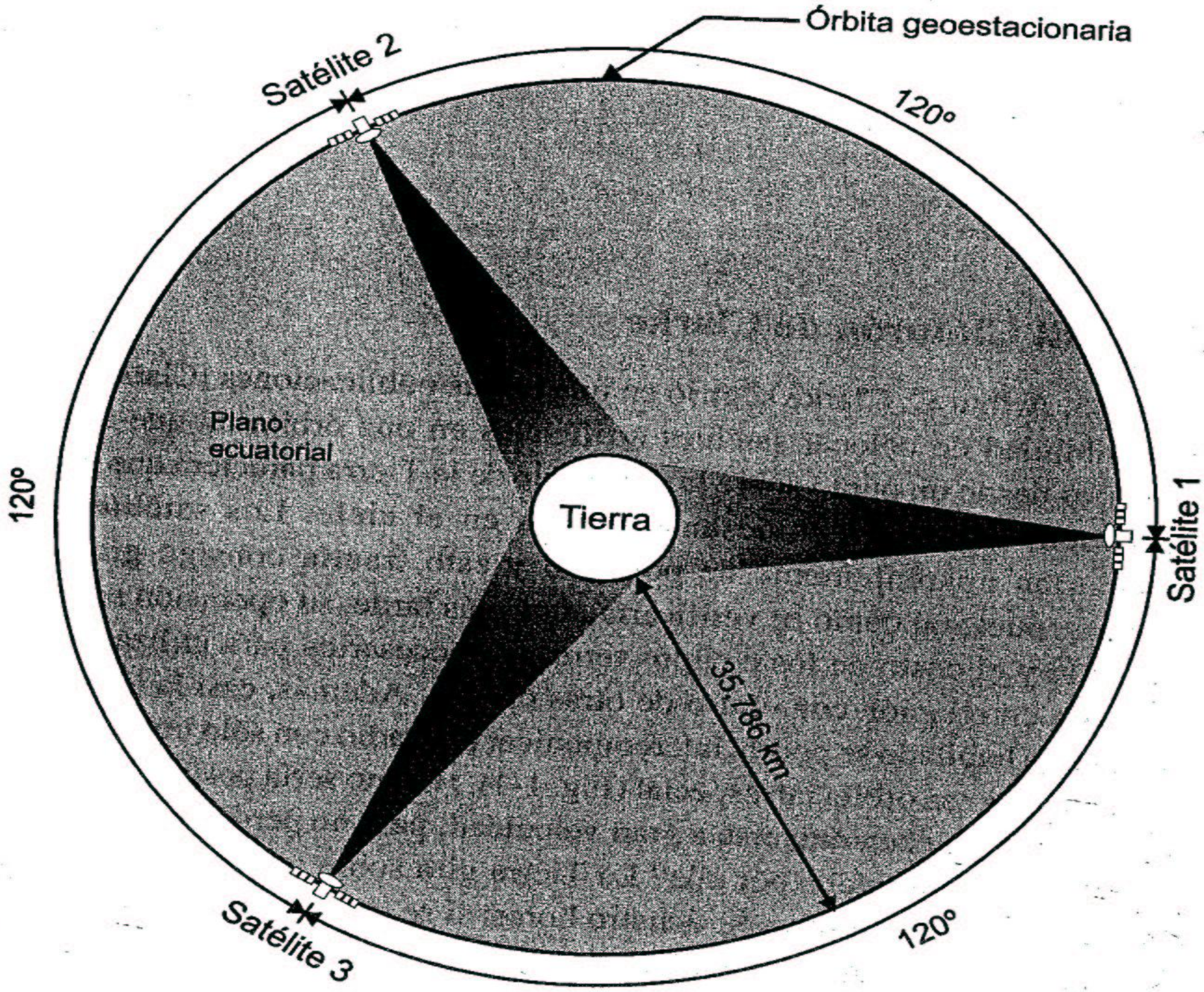
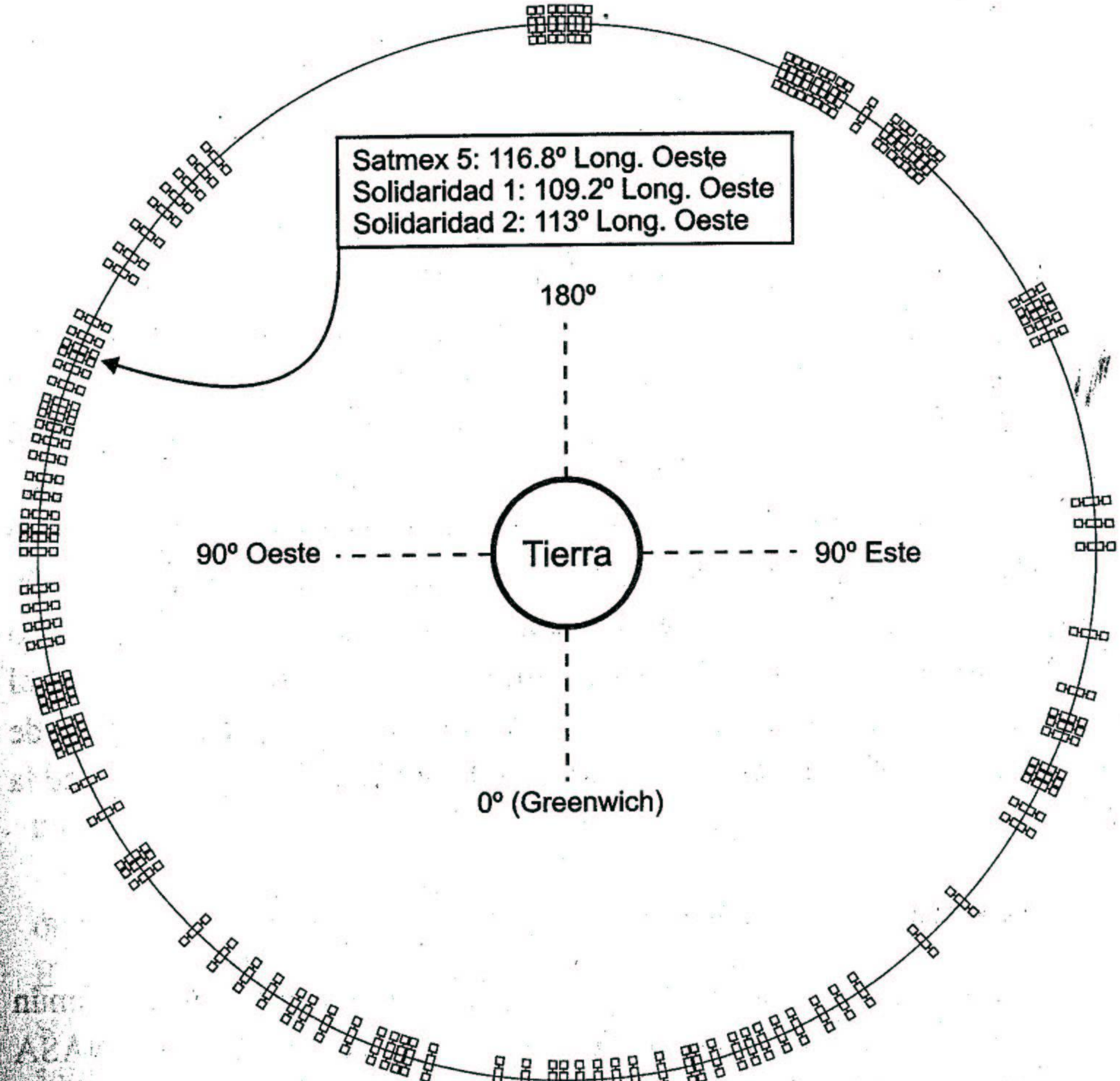

Órbita geoestacionaria
Satélite 2
120°
Plano
ecuatorial
120°
Tierra
Satélite 1
35.786 km
Satélite 3
120°

Fig. 1.1

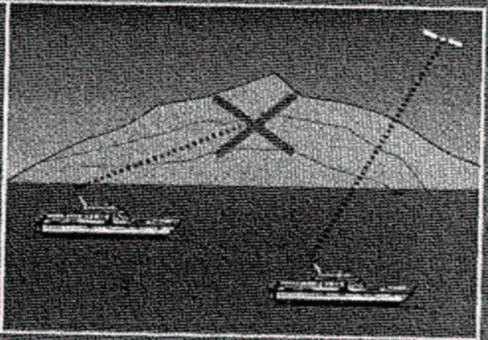

Satmex 5: 116.8º Long. Oeste
Solidaridad 1: 109.2º Long. Oeste
Solidaridad 2: 113º Long. Oeste
180º
90º Oeste
Tierra
90º Este
0º (Greenwich)

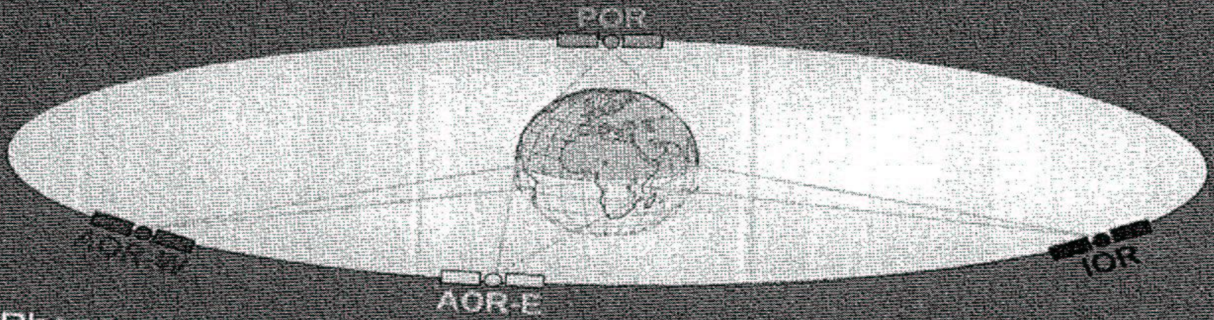

41
42
43
43
42
43
42
41
42
41
43
42
43
41
42
42
41

The WorldPhone provides communication with the public telephone network via **satellite**, which requires **free line of sight**.

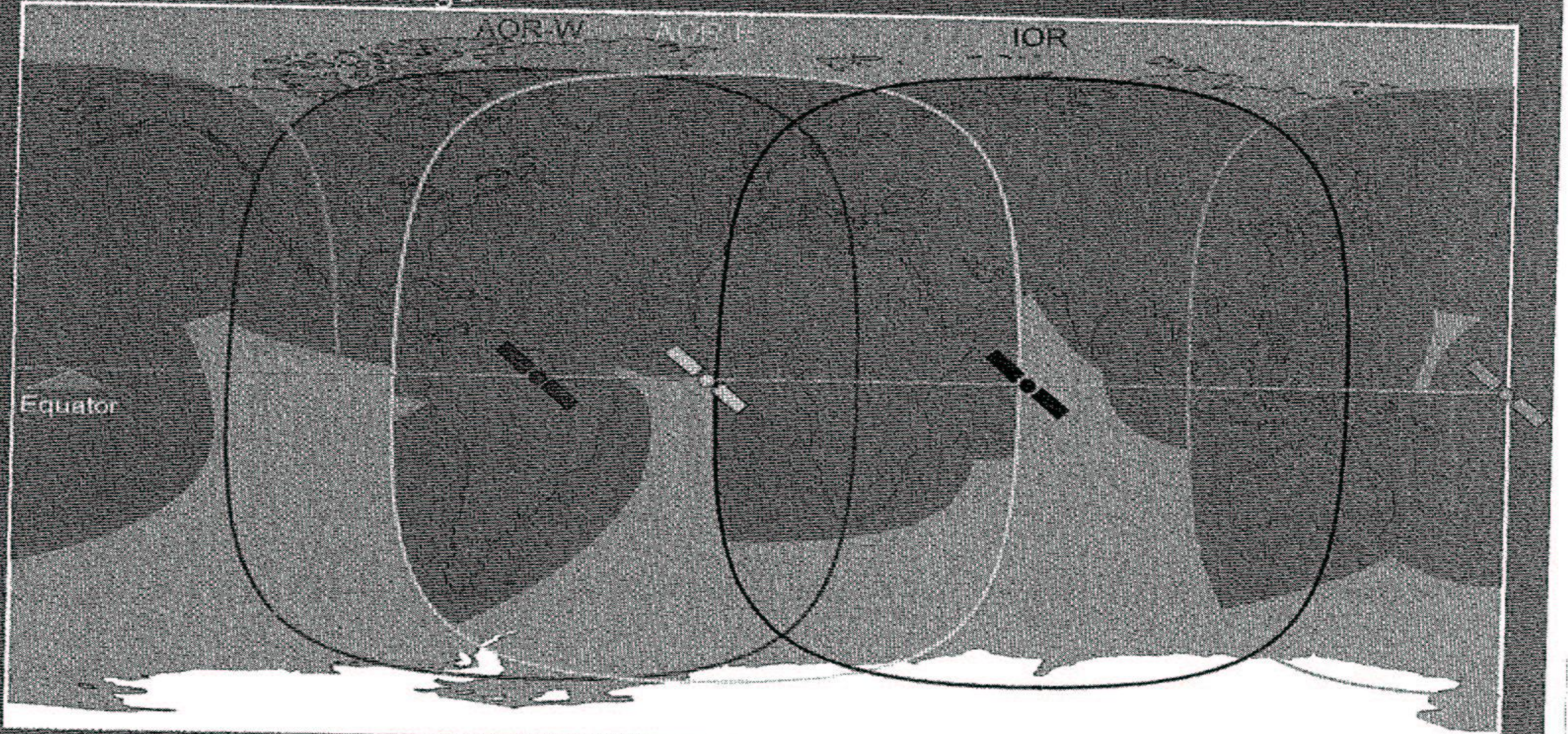
Four satellites are positioned stationary above **equator**. The satellites provide the coverage shown on the map below.

The WorldPhone searches **any satellite** as default.





WorldPhone coverage



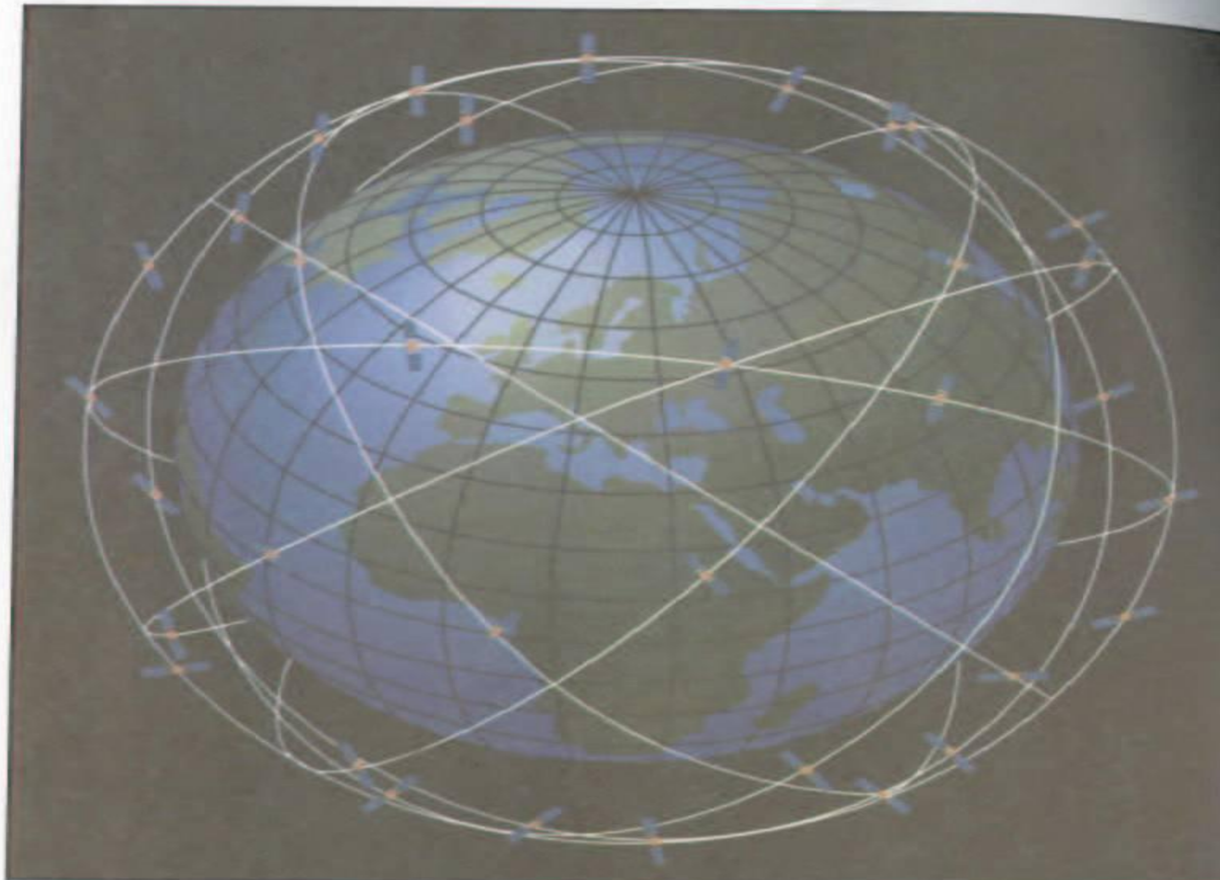
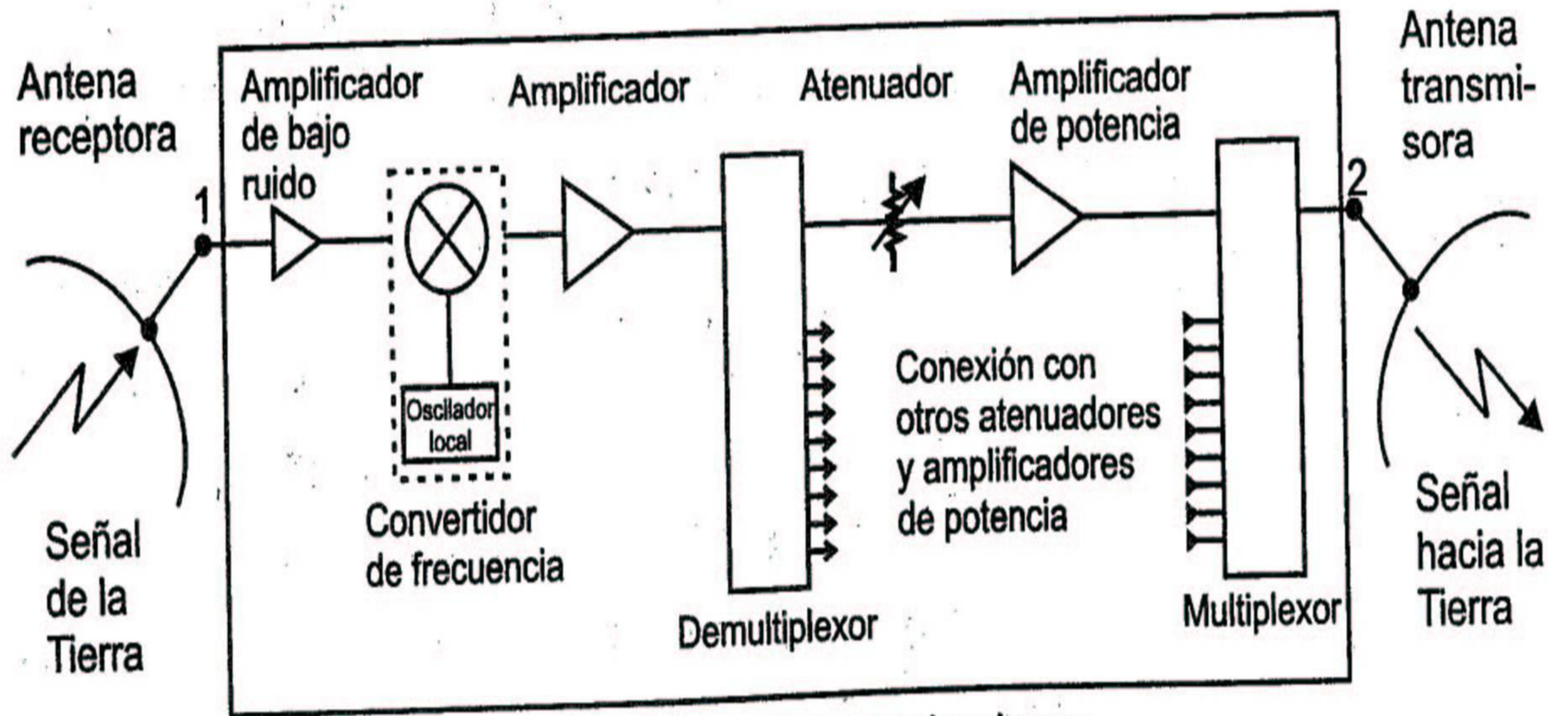
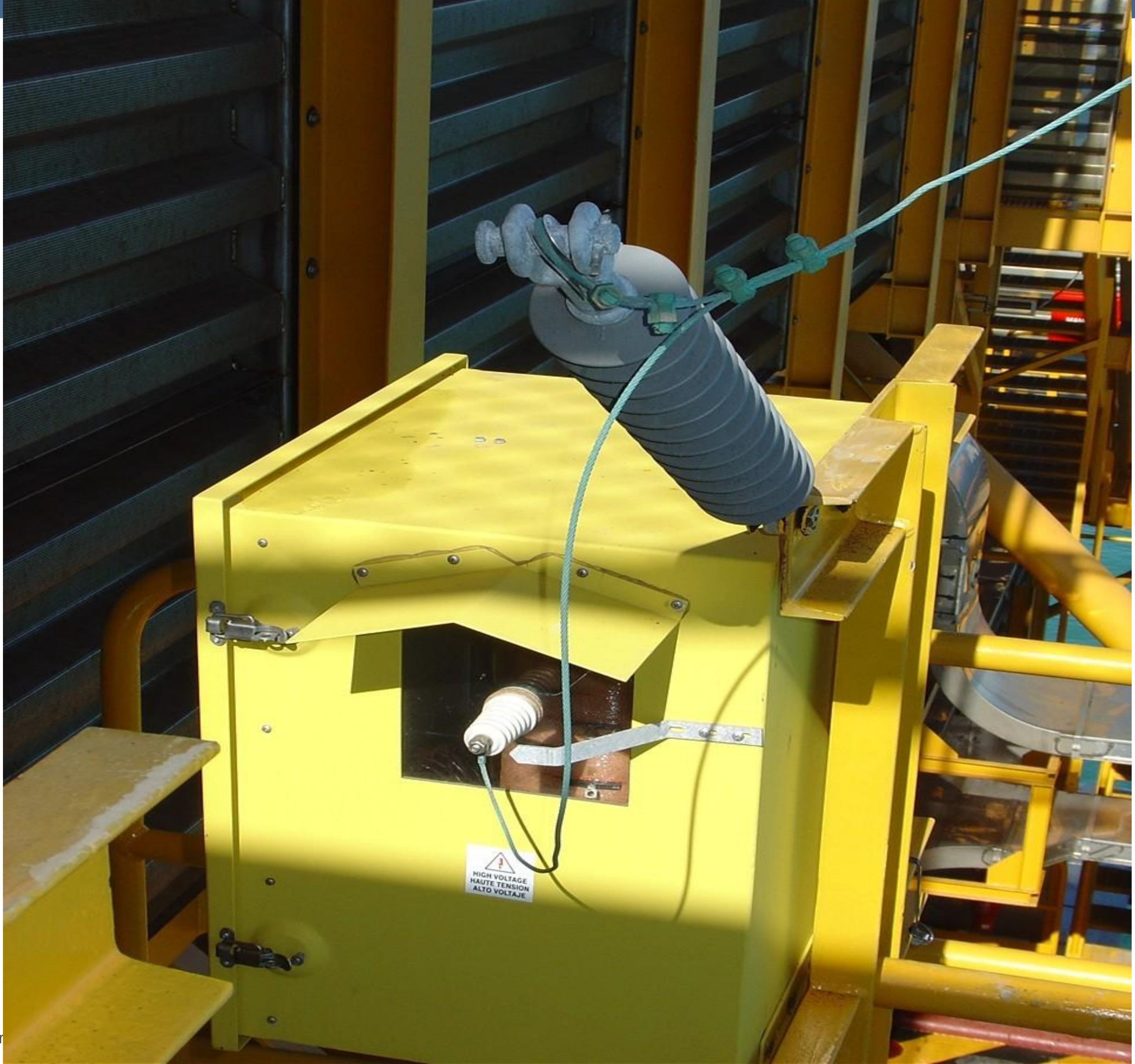


Lámina 32 La constelación Globalstar consiste de 48 satélites en órbita baja. (Cortesía de Globalstar). Véase también la Fig. 8-20, pp 453.

Subsistema	Función
1 Antenas	Recibir y transmitir las señales de radiofrecuencia desde o hacia las direcciones y zonas de cobertura deseadas.
2 Comunicaciones	Amplificar las señales recibidas, cambiar su frecuencia y entregárselas a las antenas para que sean retransmitidas hacia la Tierra. Posibilidades de conmutación y procesamiento.
3 Energía eléctrica	Suministrar electricidad a todos los equipos, con los niveles adecuados de voltaje y corriente, bajo condiciones normales y también en los casos de eclipses.
4 Control térmico	Regular la temperatura del conjunto, durante el día y la noche.
5 Posición y orientación	Determinar y mantener la posición y orientación del satélite. Estabilización y orientación correcta de las antenas y paneles de células solares.
6 Propulsión	Proporcionar incrementos de velocidad y pares para corregir las desviaciones en posición y orientación. Ultima etapa empleada para la colocación del satélite en la órbita geoestacionaria al inicio de su vida útil.
7 Rastreo, telemetría y comando	Intercambiar información con el centro de control en Tierra para conservar el funcionamiento del satélite. Monitoreo de su "estado de salud".
8 Estructural	Alojar todos los equipos y darle rigidez al conjunto, tanto durante el lanzamiento como en su medio de trabajo.



Subsistema de comunicaciones


HIGH VOLTAGE
HAUTE TENSION
ALTO VOLTAJE

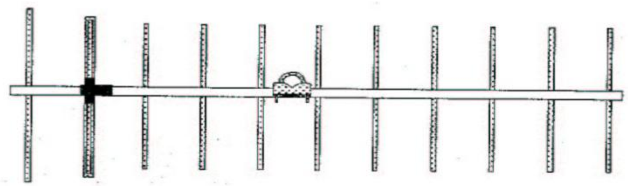

210
190
170
150
130
110
90

ANTENAS PROFESIONALES S.A.	YAGI SOLDADA **12 DB** D11E-150BAS **120 A 200 MHz**

DESCRIPCION DEL PRODUCTO

La yagi soldada **D11E-150BAS**, es una antena direccional de 11 elementos, de banda ancha, en la banda de 120 a 200 MHz.. La misma se entrega medida en ***forma individual***, en lo que se refiere a R.O.E., desde antes de la frecuencia minima y hasta más allá de la máxima especificada.

No necesita de ningún ajuste en el lugar de instalación y se provee con todas sus grampas de sujeción.



DESCRIPCION ELECTRICA

La yagi soldada **D11E-150BAS** es una antena direccional basada en la técnica desarrollada por Yagi y Uda. Nuestro Departamento de Investigación y Desarrollo ha optimizado la misma a fin de obtener un gran ancho de banda, asi como muy baja R.O.E. y ganancia constante a través de toda la banda de operación.

El elemento irradiante, es un dipolo plegado de banda ancha, alimentado con un balun. El conector coaxial de entrada es hembra "N" con pinza de contacto de Cobre-Berilio.

CONSTRUCCION

La conexión del balun y la linea de transmisión al elemento radiador está realizada con una **"UNION MOLECULAR INTERMETALICA LAMINADA" UMIL**. Esta unión garantiza la ausencia total de corrosión en los lugares donde deben unirse la linea de transmisión y el balun (cobre) con la aleación de aluminio del elemento excitado. El resultado de esta técnica evita totalmente la reducción de la performance del enlace en el tiempo, así como los problemas de intermodulación que se generan por la corrosión de contactos (juntas semiconductoras), ruidos de recepción y variaciones del nivel de señal transmitida.

La estanqueidad del dipolo se asegura mediante el encapsulado en resinas sintéticas sumamente resistentes y con protección contra la acción de los rayos UV. Estas resinas han sido probadas ampliamente por más de 20 años en otros productos de nuestra fabricación que funcionan expuestos a la intemperie, sin que se experimente degradación alguna. Entre las pruebas que se le realizan al dipolo, figura la de someterlo **a inmersión en agua a 0,50 mt. durante 10'** a fin de comprobar su total estanqueidad.

El material utilizado en la construcción es aleación de aluminio, soldado en atmósfera inerte (Argón). Los elementos de sujeción, son de acero galvanizado por inmersión en caliente y de acero inoxidable.

SUMA DE YAGIS

Las yagis **D11E-150BAS** pueden ser sumadas, a fin de lograr diagramas de radiación especiales, como por ejemplo radiación bi-direccional, en este caso la ganancia se ve reducida en aproximadamente 3 dB en cada uno de los sentidos.

Se pueden obtener con las **D11E-150BAS** ganancias en azimut y elevación para diferentes usos, obteniendo control total sobre el lóbulo, mediante el apilamiento lado a lado y/o una encima de la otra y/o ambas, sumando en los distintos campos (horizontal y/ o vertical) suficiente cantidad de yagis, para obtener tanto la ganancia como el cubrimiento necesario. Podemos proveer los arneses de enfasado correspondientes en cada caso.

Nuestro Departamento de Ingenieria puede asesorarlo al respecto.

CARACTERISTICAS ELECTRICAS

Rango de frecuencia	**120 a 200 MHz(*)**
Impedancia nominal	**50 ohm**
Relación de ondas estacionarias	**ver gráfico**
Ancho del lóbulo horizontal (-3DB)	**35°**
Ancho del lóbulo vertical (-3 DB)	**40°**
Ganancia (Sobre media onda)	**12dB**
Relación antero posterior	**13dB**
Máxima potencia de entrada	**250 Watt**
Protección contra descarga	**a tierra**
Terminación estandar	conector **"N"** hembra

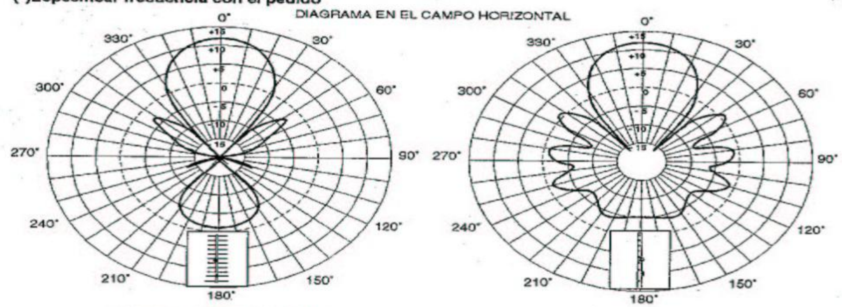
(*)Especificar frecuencia con el pedido

CARACTERISTICAS MECANICAS

Botalón	**31.75 x 2.0 mm.**
Diámetro de elementos parásitos(1)	**12.7 x 1.5 mm.**
Elemento irradiante	**19.05 x 1.5 mm. y 12.7 x 1.5 mm.**
Grampa de montaje	**toma hasta 50.8 mm.**
Máxima área expuesta	**0.22 m²**
Máxima velocidad de viento	**150 Km. x hora**
Dimensiones con embalaje	**3625 x 900 x 130 mm.**
Peso sin embalaje	**4.6 Kg.**
Peso con embalaje (en cartón)	**11.0 Kg.**

(1) con refuerzo interior de 9.52 x 1.5 mm.

DIAGRAMA EN EL CAMPO HORIZONTAL



POLARIZACION HORIZONTAL

POLARIZACION VERTICAL

Cap. M. Cajaraville 3629 - Carapachay - Argentina · 766-4510/3916 - 763-1245 - 763-1345 · INTL. 54-1-11-2593

ANTENAS PROFESIONALES S.A.

PARA-DIEDRO **10 DB**
DER-2130S **210 a 300 MHz**

DESCRIPCION DEL PRODUCTO

El para-diedro reflector **DER-2130S**, es una antena direccional de banda ancha que opera entre 210 y 300 MHz.. La misma se entrega medida en ***forma individual***, en lo que se refiere a R.O.E., desde antes de la frecuencia mínima y hasta más allá de la máxima especificada.

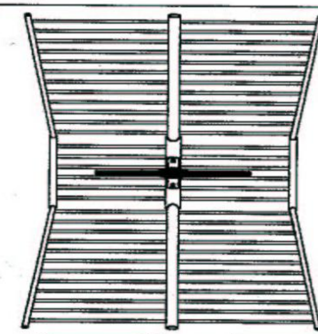
No necesita de ningún ajuste en el lugar de instalación y se entrega con todas sus grampas de sujeción.

SUMA DE DIEDROS

Los **DER-2130 S** pueden ser sumados, a fin de lograr diagramas de radiación especiales, como por ejemplo radiación bi-direccional; en este caso la ganancia se ve reducida en aproximadamente 3 dB en cada uno de los sentidos.

Se pueden obtener diagramas especiales a fin de lograr ganancias en azimut y elevación para diferentes usos, por ejemplo, en TV codificada, sumando en los distintos campos (horizontal y/o vertical) suficiente cantidad de para-diedros obteniéndose tanto la ganancia como el cubrimiento necesario.

Nuestro Departamento de Ingeniería puede asesorarlo al respecto.



DESCRIPCION ELECTRICA

El DER-2130S es un para-diedro reflector de 90°, que incluye el uso de tres superficies electricamente planas, como reflector, que se asemejan en performance a un plano parabólico.

El elemento irradiante, es un dipolo plegado de banda ancha, alimentado con un balun. Esta combinación de tipo de reflector y dipolo permite lograr una ganancia >12 dBi, así como una relación antero-posterior >25 dB. y un gran ancho de banda para R.O.E. de 1.2:1. El conector coaxial de entrada es hembra "N" con pinza de contacto de Cobre-Berilio.

CARACTERISTICAS ELECTRICAS

Rango de frecuencia	210 a 300 MHz(*)
Impedancia nominal	50 ohm
Relación de ondas estacionarias	ver gráfico
Ancho del lóbulo horizontal (-3DB)	56°
Ancho del lóbulo vertical (-3 DB)	38°
Ganancia (Sobre media onda)	10 dB
Relación antero posterior	>25 dB
Máxima potencia de entrada	250 Watt
Protección contra descarga	a tierra
Terminación estandar	conector "N" hembra

(*)Especificar frecuencia con el pedido

CARACTERISTICAS MECANICAS

Brazos reflector	25.4 x 1.5 mm. - 15.87 x 1.5 mm.
Elementos reflector	9.52 x 1 mm.
Brazo irradiante	25.4 x 1.5 mm.
Elemento irradiante	12.7 x 1.5 mm.
Grampa de montaje	toma hasta 50.8 mm.
Máxima área expuesta	0.20 m²
Máxima velocidad de viento	150 Km. x hora
Dimensiones con embalaje	1100 x 850 x 133 mm.
Peso sin embalaje	8 Kg.
Peso con embalaje (en madera)	13 Kg.

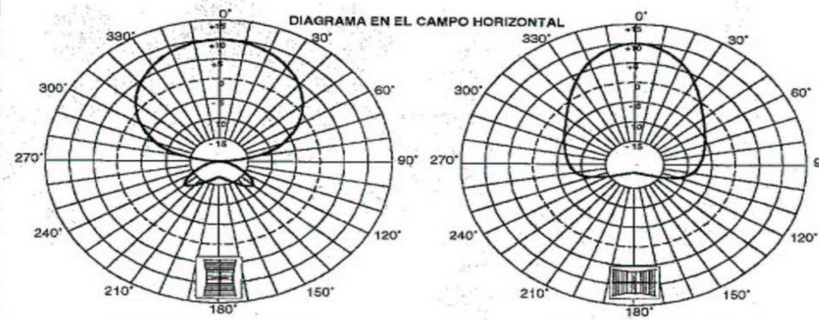
CONSTRUCCION

La conexión del balun y la línea de transmi-sión al elemento radiador está realizada con una **"U-NION MOLECULAR INTERMETALICA LAMINADA" UMIL**. Esta unión garantiza la ausencia total de corrosión en los lugares donde deben unirse la línea de transmisión y el balun (cobre) con la aleación de aluminio del elemento excitado. El resultado de esta técnica evita totalmente la reducción de la perfomance del enlace en el tiempo, así como los problemas de intermodulación que se generan por la corrosión de contactos (juntas semiconductoras), ruidos de recepción y variaciones del nivel de señal transmitida.

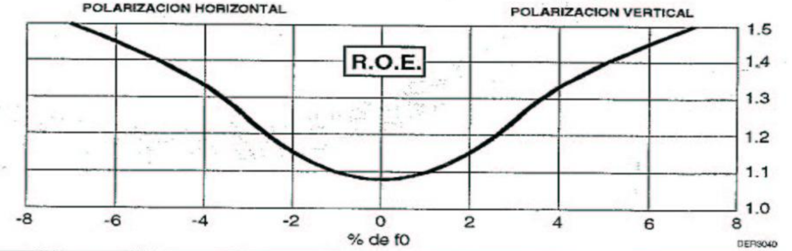
La estanqueidad del dipolo se asegura mediante el encapsulado en resinas sintéticas sumamente resistentes y con protección contra la acción de los rayos UV. Estas resinas han sido probadas ampliamente por más de 20 años en otros productos de nuestra fabricación que funcionan expuestos a la intemperie, sin que se experimente degradación alguna. Entre las pruebas que se le realizan al dipolo, figura la de someterlo **a inmersión en agua a 0,50 mt. durante 10'** a fin de comprobar su total estanqueidad.

El material utilizado en la construcción es aleación de aluminio, soldado en atmósfera inerte (Argón). Los elementos de sujeción, son de acero galvanizado por inmersión en caliente y de acero inoxidable.

DIAGRAMA EN EL CAMPO HORIZONTAL



POLARIZACION HORIZONTAL — POLARIZACION VERTICAL



Cap. M. Cajaraville 3629 - Carapachay - Argentina ☎ & 766-4510/3916 - 763-1245 - 763-1345 INTL. 54-1-11-2593

ANTENAS PROFESIONALES S.A.

SUMA DE 8 DIPOLOS COLINEALES MODELO **FVHF-8A DE 136 A 174 MHZ**

DESCRIPCION DEL PRODUCTO

La suma de ocho dipolos soldada **FVHF-8A** es una antena onmidireccional o unidireccional de banda ancha, en la banda de 136 a 174 MHz.. La misma se entrega medida en ***forma individual***, en lo que se refiere a R.O.E., desde antes de la frecuencia mínima y hasta más allá de la máxima especificada.

No necesita de ningún ajuste en el lugar de instalación y se provee con todas sus grampas de sujeción.

DESCRIPCION ELECTRICA

La suma de ocho dipolos es una antena omnidireccional o unidireccional basada en la técnica de suma espacial de los campos de ocho dipolos. Nuestro Departamento de Investigación y Desarrollo ha optimizado la misma a fin de obtener un gran ancho de banda, asi como muy baja R.O.E. y ganancia constante a través de toda la banda de operación.

Los elementos irradiantes, son dipolos plegados de banda ancha, alimentados con un balun y lineas de puesta en fase cuidadosamente medidas (***en forma individual)***. El conector coaxial de entrada es hembra "N" con pinza de contacto de Cobre-Berilio.

CONSTRUCCION

La conexión del balun y la linea de transmisión a los elementos radiadores está realizada con una **"UNION MOLECULAR INTERMETALICA LAMINADA" UMIL**. Esta unión garantiza la ausencia total de corrosión en los lugares donde deben unirse la linea de transmisión y el balun (cobre) con la aleación de aluminio de los elementos. El resultado de esta técnica evita totalmente la reducción de la perfomance del enlace en el tiempo, asi como los problemas de intermodulación que se generan por la corrosión de contactos (juntas semiconductoras), ruidos de recepción y variaciones del nivel de señal transmitida.

La estanqueidad de los dipolos se asegura mediante el encapsulado en resinas sintéticas sumamente resistentes y con protección contra la acción de los rayos UV. Estas resinas han sido probadas ampliamente por más de 20 años en otros productos de nuestra fabricación que funcionan expuestos a la intemperie, sin que se experimente degradación alguna. Entre las pruebas que se le realizan a los dipolos, figura la de someterlos **a inmersión en agua a 0,50 mt. durante 10'** a fin de comprobar su total estanqueidad.

El material utilizado en la construcción es aleación de aluminio, soldado en atmósfera inerte (Argón). Los elementos de sujeción, son de acero galvanizado por inmersión en caliente y de acero inoxidable.

DIAGRAMA DE RADIACION

Se pueden obtener diferentes diagramas de radiación, como se muestra más abajo, de acuerdo a la posición de los dipolos con referencia a la estructura de soporte, en el momento del armado de la formación siendo los mismos válidos cuando las riendas sean debidamente cortadas con aisladores o Phillistran (producto de nuestra venta). En caso de montarse al costado de la torre el diagrama es afectado por el tamaño de la estructura.

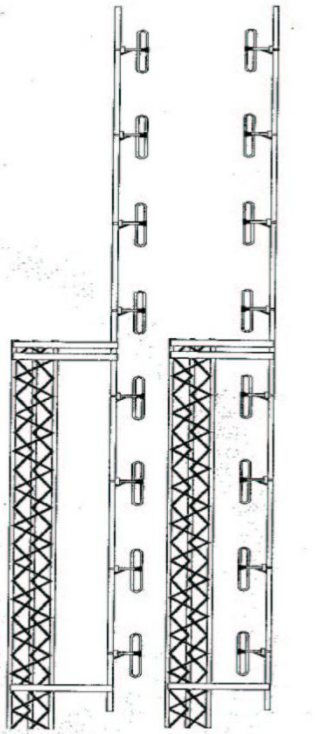
CARACTERISTICAS ELECTRICAS

Rango de frecuencia	136 a 174 MHz(*)
Impedancia de entrada	50 ohm
Ganancia (Sobre media onda)	
Unidireccional	12 dB
Omnidireccional	9 dB
Ancho del lóbulo vertical (-3 DB)	8°
Máxima R.O.E	1,5 : 1
Ancho de Banda	10 %
Polarización	vertical
Alimentación	directa
Máxima potencia de entrada	300 Watt
Protección contra descarga	a tierra
Terminación estandar	conector "N" hembra

(*)Especificar frecuencia con el pedido

CARACTERISTICAS MECANICAS

Botalón	38.10 x 3.0 mm.
	44.44 x 2.85 mm.
	54 x 4.5 mm.
Elementos irradiantes	12.7 x 1.5 mm.
Longitud máx. de la suma	16.00 mts.
Máxima área expuesta	0.82 m²
Máxima velocidad de viento	160 Km. x hora
Dimensiones con embalaje	2 Cajas de 1100 x 600 x 200 mm. y 2 de 3000 x 125 x 125 mm.
Peso sin embalaje	36.50 Kg.
Peso con embalaje (en cartón)	41.30 Kg.



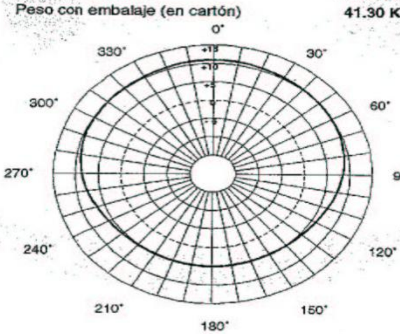


Diagrama unidireccional

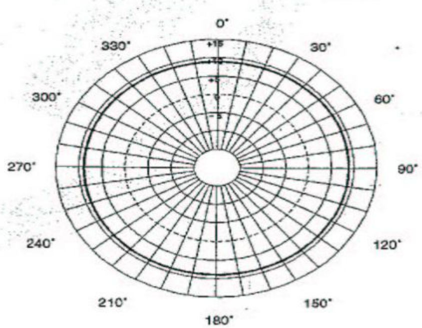


Diagrama omnidireccional

VHF8DIP

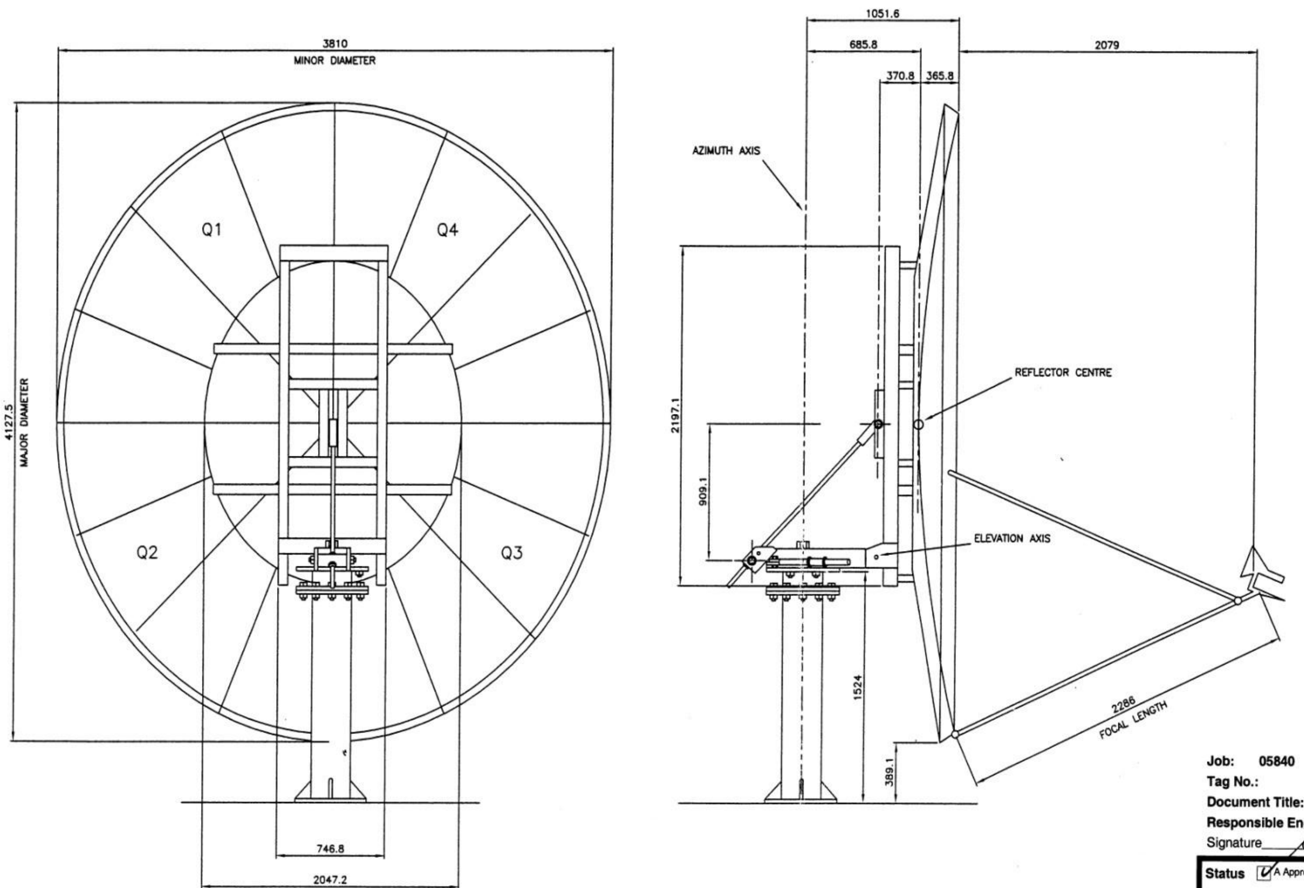
Cap. M. Cajaraville 3629 - Carapachay - Argentina ☎ & 766-4510/3916 - 763-1245 - 763-1345 INTL. 54-1-11-2593

3rd ANGLE PROJECTION

USED ON: P1073

NOTES

1. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.
2. OEM : PRODELIN CORPORATION
   MODEL : 3.8m SERIES 1383
   TAG No. : TBA
   LOCATION : RIO CULLEN
   WEIGHT : 700kg



REAR VIEW

SIDE VIEW

Job: 05840 003 01 00 **P.O.#:** 1902-05842-HH001500
Tag No.: **Dwg. No.:** P1073-GA-001
Document Title: 3.8M C-Band Antenna (Shts 1 of 3)
Responsible Engineer: SOFIAN CHANDRA
Signature Sofyan Chanda Date 16 March 200?

Status
- [x] A Approved without exception. Manufacturer may proceed with fabrication.
- [ ] B Approved except as noted. Manufacturer may proceed with fabrication. Resubmit corrected print within seven (7) days in accordance with comments.
- [ ] C Not approved. Manufacturer may not proceed w/fabrication. Resubmit corrected print.
- [ ] FI For Information

PO No.	1902-05842-HH001500
TITLE	CARINA & ARIES FIELD DEVELOPMENT PROJECT TELECOMMUNICATIONS SYSTEM

TOTAL
TOTAL AUSTRAL SA

REV	DESCRIPTION OF REVISON	DATE	BY	NESSCO CHKD	NESSCO APPVD	CLIENT CHKD	CLIENT APPVD
A	ISSUED FOR COMMENT	15/1/02	J.S.	SD			

REFERENCE DRAWINGS

DRAWING No.	SUBJECT

NESSCO LIMITED
NESSCO HOUSE
KIRKHILL DRIVE, DYCE
ABERDEEN, AB21 OEU
TEL (01224)771444 FAX (01224)722707 TELEX (01224)739647

JOB No.	P1073
CLIENT JOB No.	
ENGINEER	S. DAVIDSON
DRAWN	J. SUTHERLAND
DATE	15/1/02
SCALE	NTS
FILENAME	P1073GA00101

CLIENT: J. RAY McDERMOTT ENGINEERING, LLC

TITLE: 3.8M C-BAND ANTENNA GENERAL ARRANGEMENT

A1 DRAWING No. P1073/GA/001 SHEET No. 1of3 REV A

05840 – 003 - 001 - 00

Filename :- P1073GA00101.DWG Plotted By :- J. SUTHERLAND on date 15/1/02

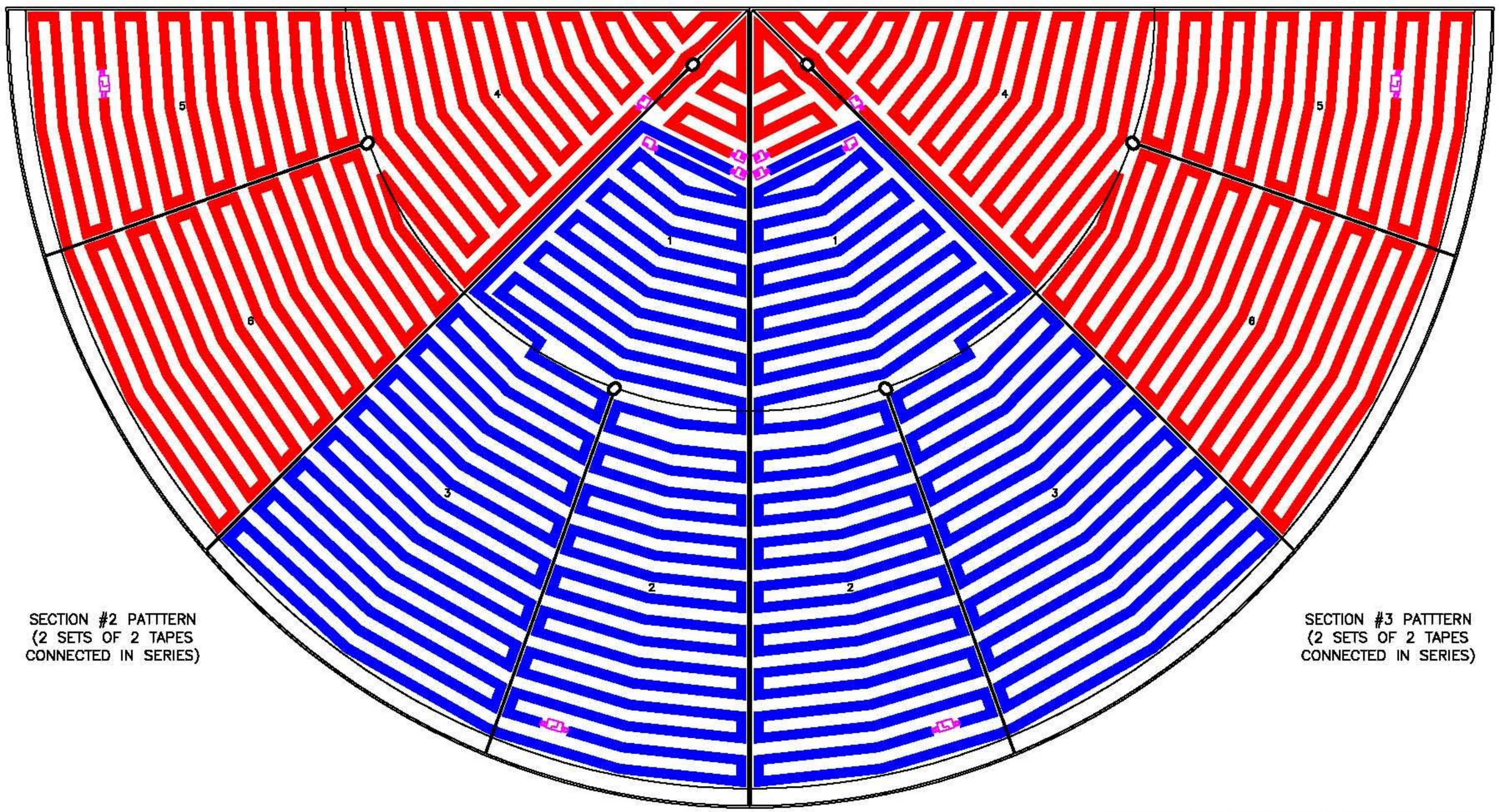
DRAWING No. P1073/GA/001 SHEET No. 1of3 REV A

F:\JOBS\P1073\DRAWINGS\P1073GA00101.DWG


15 3 '04

APS™-4
Snow/Ice Melting Controller
SUPPLY : 208Vac, 3 Phase, 50/60 Hz, 35 VA
HEATER : 208Vac, 3 Phase, 50 Amp. MAX. RESISTIVE
USE ONLY COPPER CONDUCTORS HAVING SUFFICIENT AMPACITY . SEE INSTALLATION INSTRUCTIONS.
30 mA Ground Fault Circuit Interrupter (GFCI).
OPERATION
To verify the operation of ground fault detection/ interruption, momentarily place toggle in test (down) position and release to obtain flashing indication. Reset by momentarily placing toggle in reset (up) position and release. A ground fault exists if flashing indicator cannot be reset -- trouble shooting/ servicing is required.
Hold-on Time adjustment maintains heating for the set time interval (0-10 hrs.) after snowfall stops. Heater(s) may be manually energized for the set time interval by momentarily depressing the HEATER CYCLE push button.
SUPPLY
SNOW
HEATER
GROUND FAULT
HEATER CYCLE
RESET
TEST
GROUND FAULT
HOLD-ON TIME (HRS)
WARNING
DANGER OF ELECTRICAL SHOCK OR ELECTROCUTION
Lethal voltages are present beneath this cover. Service by qualified personnel only. More than one disconnect may be required to de-energize this control for servicing.
We Manage Heat™
Environmental Technology, Inc
South Bend, Indiana USA
LISTED
109R

SYM	REVISIONS DESCRIPTION	DATE

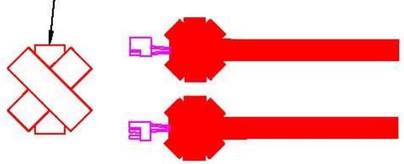


SECTION #2 PATTERN
(2 SETS OF 2 TAPES
CONNECTED IN SERIES)

SECTION #3 PATTERN
(2 SETS OF 2 TAPES
CONNECTED IN SERIES)

NUMBERS ARE FOR TEMPLATE LOCATION. MARK SECTION #3 FIRST WITH TEMPLATES FACE UP. FOR SECTION #2 TURN TEMPLATES FACE DOWN AND MARK.

3 PCS. OF FOIL TAPE 3" LONG
ON EACH TAPE END



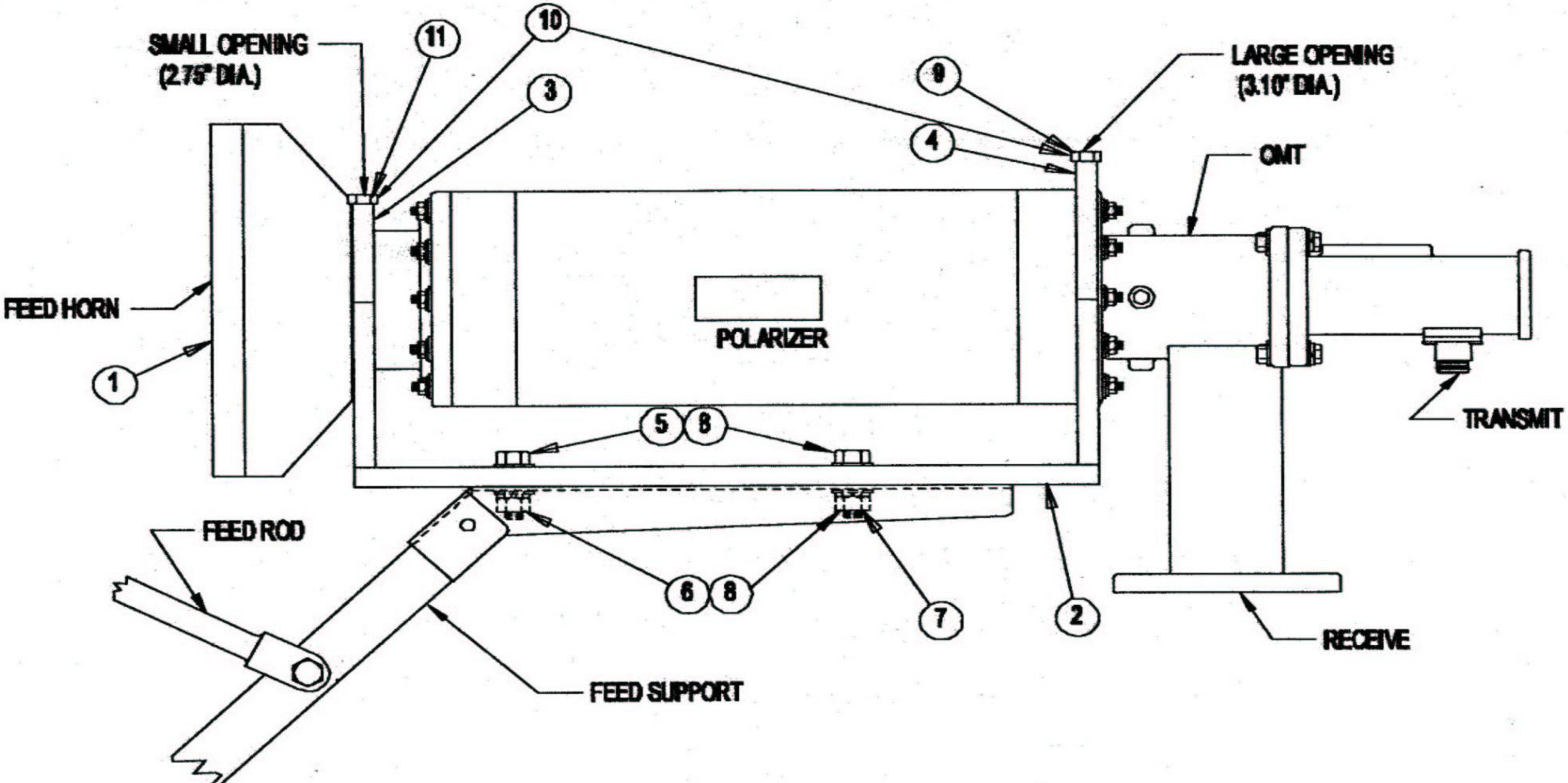
ANTENNA COVERAGE
(REAR VIEW)

FIGURE 1

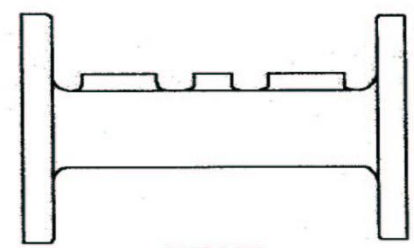
UNLESS OTHERWISE SPECIFIED		
THIRD ANGLE PROJECTION DIMENSIONS IN INCHES 3 PLACE DIM. +/- 2 PLACE DIM. +/- ANGULAR DIM. +/- SCALE: NONE	DATE 04-15-02 DRN J. MILLER CHK APPD. PROVE DES / PROD.	ENVIRONMENTAL TECHNOLOGY, INC. SOUTH BEND, INDIANA U.S.A. TITLE 3.8M PRODELIN TAPE LAYOUT DWG NO. 20498


2 3'04


2 3 '04

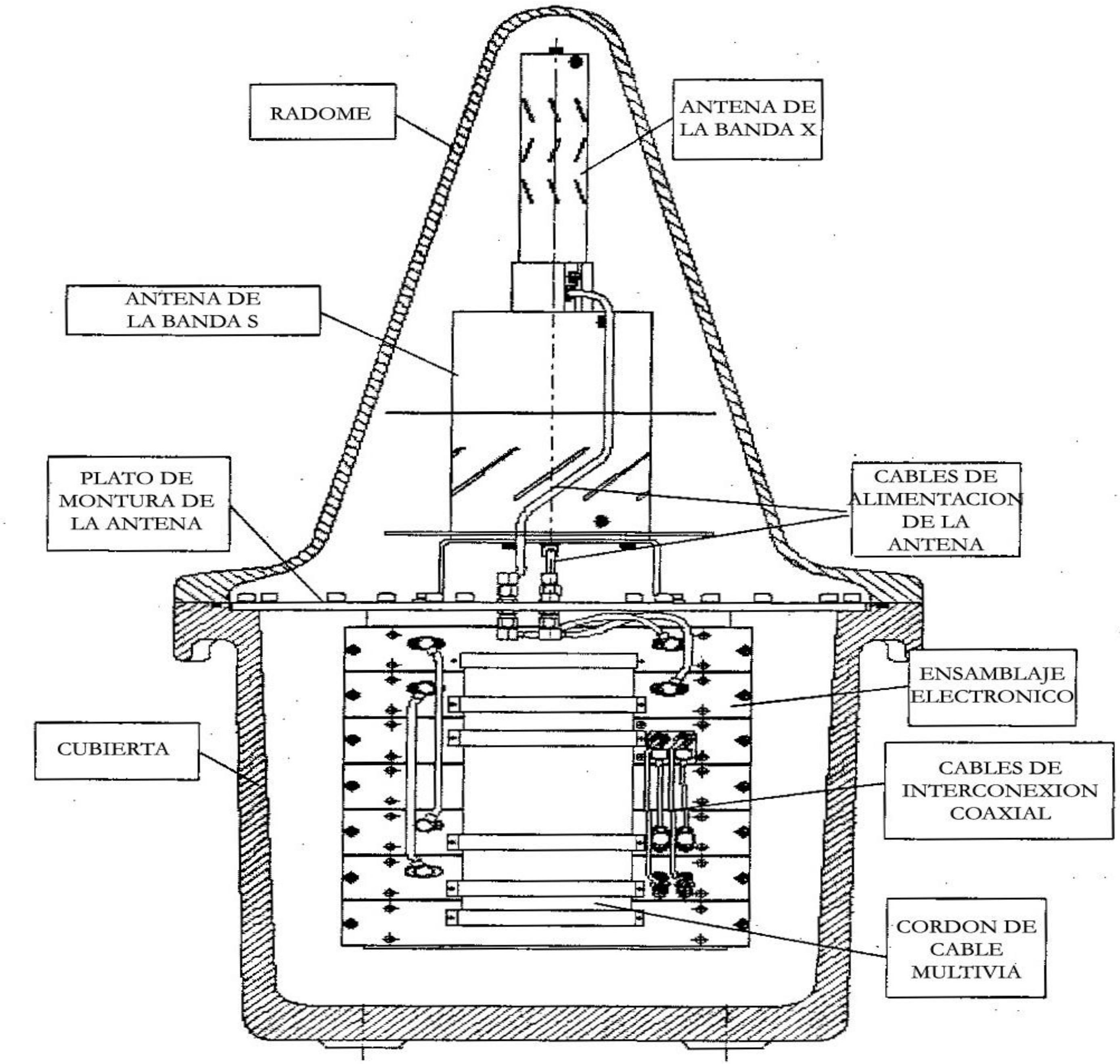


SMALL OPENING
(2.75" DIA.)
11
10
3
9
LARGE OPENING
(3.10" DIA.)
4
OMT
FEED HORN
1
POLARIZER
TRANSMIT
5
8
FEED ROD
6
8
7
2
RECEIVE
FEED SUPPORT

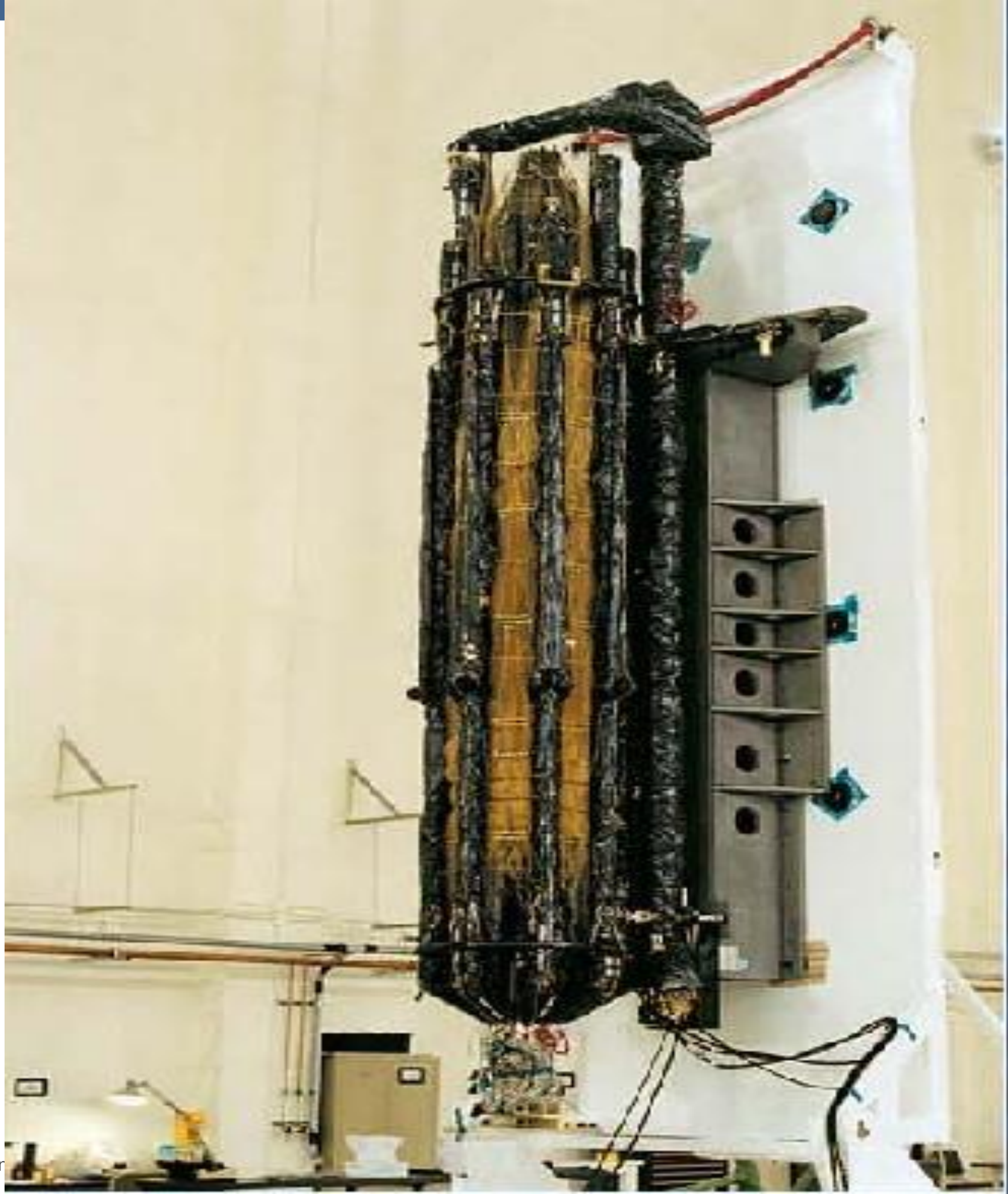


WR137


NERA
18.08.2006 10:

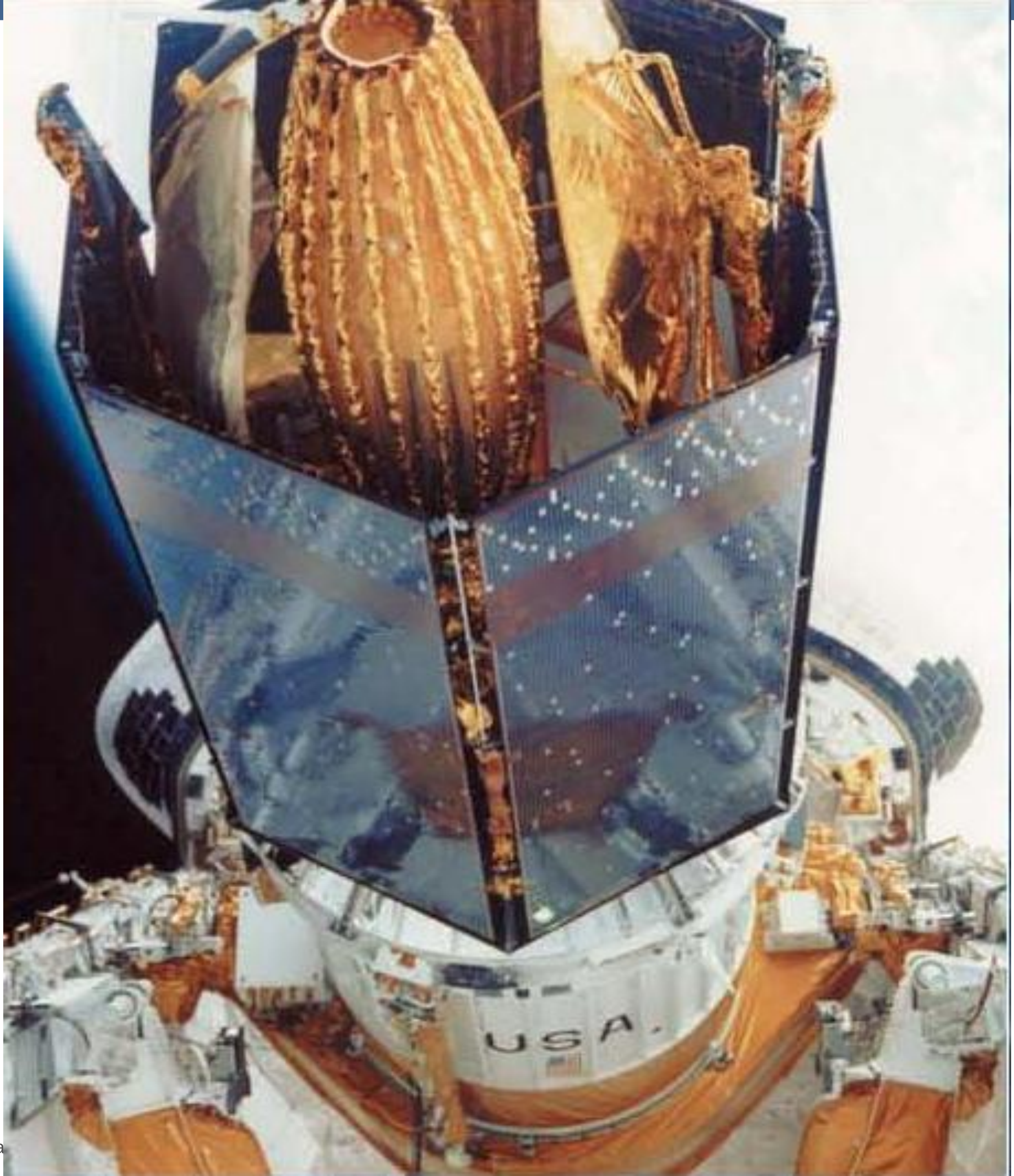

RADOME
ANTENA DE LA BANDA X
ANTENA DE LA BANDA S
PLATO DE MONTURA DE LA ANTENA
CABLES DE ALIMENTACION DE LA ANTENA
ENSAMBLAJE ELECTRONICO
CUBIERTA
CABLES DE INTERCONEXION COAXIAL
CORDON DE CABLE MULTIVIA

ANTENA CASSEGRAIN. GENERAL DYNAMICS 21 MTS GAN=60Db BANDA C



REFLECTOR DE 12 MTS

PLEGADO Y ASEGURADO PARA LANZAMIENTO


USA.

QUARTER WAVE STUB (QWS) PROTECTION

Some **RADIA**LL lightning protectors utilize a quarter wave stub design. This technology is based on a 3 port coaxial device. One of these ports is a metallic short-circuit between the inner and the outer conductors, whose length is one quarter of wavelength at the centered frequency. Quarter wave protectors work like band pass filters. They operate within a specified frequency band.

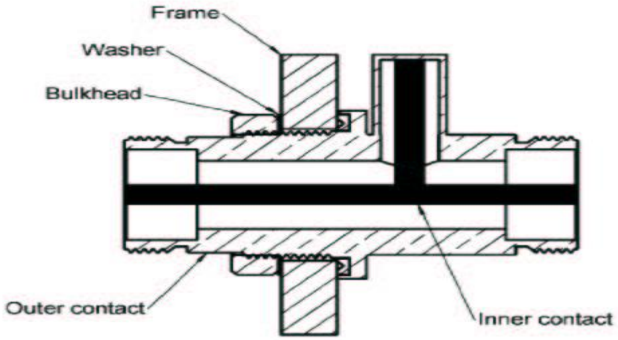
In normal use (i.e within the working frequency band), the RF signal flows through the quarter wave lightning protector to the protected equipment.
Whenever lightning hits the infrastructure (ex : Antenna mast), current will flow through the cable (feeder cable) to the lightning protector installed at the entrance to the critical equipment to be protected (Base Transceiver Station).
As lightning strikes operate at low frequencies i.e outside of the protector working frequency band, current will be instantaneously diverted through the short-circuit to the ground.

Since it is a mechanical system, it can handle repeated surges. Any impulse at any time will always be shunted to the ground. Only a low residual voltage, less than 15V, can pass through the equipment.

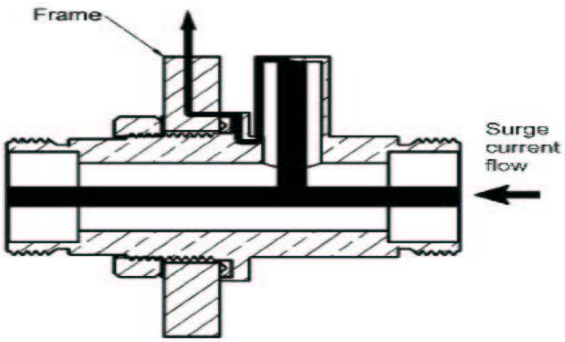
Single band devices for common wireless bands like CDMA, GSM, PCS, DCS are available as standard products. Quarter wave protectors working at other frequency bands or using other coaxial interfaces can be developed upon request.
Cable assemblies made with single band quarter wave protectors on SHF type cables are available as well.

RADIALL has already designed the next generation of quarter wave protectors : Multiband protectors. The same protector can work within several frequency bands. Our standard multiband protectors can provide the same excellent protection, whether to CDMA, GSM, PCS, DCS or UMTS communication networks.

Main features :
Quarter wave protectors do not require any maintenance, they achieve high passive intermodulation performance (-110dBm/-153dBc) and they only pass the lowest residual voltage.
But, disadvantages are that they can not pass DC signals and must incorporate a fairly long stub element.



Under normal conditions



When lightning strikes

GAS DISCHARGE TUBE (GDT) PROTECTION

RADIALL GDT surge protectors look like in-line coaxial adapters using interfaces like N or 7/16, and that contain a field replaceable gas capsule placed between their inner and outer conductors. Unlike single band quarter wave protectors, gas tube surge arresters can be used for broadband applications. Their operating frequency band is DC to 2.5GHz.

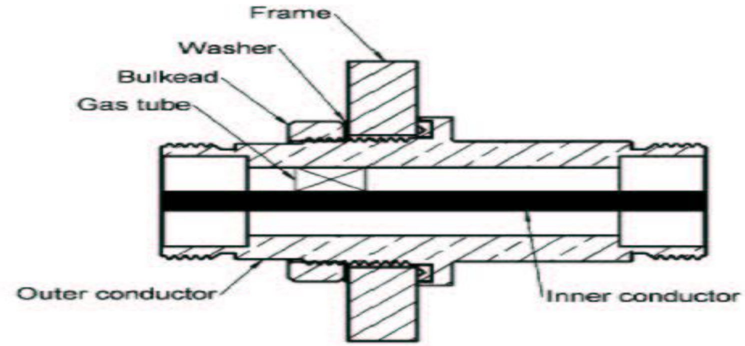
Gas discharge protectors work as voltage filters.

During normal operation, the gas inside the tube is and remains inert. Signal can pass through the surge arrester to the equipment.

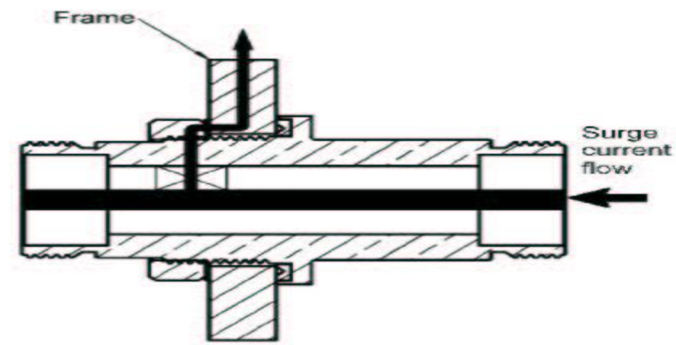
When a lightning strikes the infrastructure, current will flow through the cable to the surge protector. The voltage, appearing across the gas capsule, increases. When it reaches the DC sparkover voltage, the gas ionizes and becomes conductive. Current is then diverted through the gas capsule to the ground, outside of the equipment. A residual voltage will nevertheless reach the equipment. Once the pulse has been discharged to the ground i.e when the voltage is less than the holdover voltage, the gas capsule comes back to its initial state.

Life of the gas capsule depends on the number of strikes and of their intensity. The same capsule can divert to the ground either few impulses of 20KA or only one of 40KA. Regular control and maintenance are therefore highly recommended. However it is preferable to replace any suspicious gas tube.

Gas discharge protectors are delivered without gas capsule. A choice of gas capsules is available offering different static sparkover voltages. Selection should be made according to the maximum transmission power.



Under normal conditions



When lightning strikes

Main features :

Gas discharge capsule protectors are the only solution when DC injection is required, for example when a Tower Mount Amplifier is utilized. Moreover, they offer a wide band performance and benefit from their reduced dimensions. But disadvantages are the need of maintenance and non negligible residual voltage.

CONCLUSION

In order to be able to choose the best suited lightning protector to their application between a quarter wave lightning protector and a gas discharge protector, users should answer the following questions :

- ☞ Should DC signal pass ? Are there some tower mount electronics ?
- ☞ Is maintenance possible ?
- ☞ What is the desired operating frequency range ?
- ☞ What is the maximum voltage that can withstand the equipment to be protected?
- ☞ Is Intermodulation level critical?

	ADVANTAGES	DISADVANTAGES
 QWS = Frequency filter	Maintenance free Lower residual voltage Low intermodulation level	No DC capability Narrowband (except multiband ones)
 GDT = Voltage filter	DC capability Wide band DC-2.5GHz Reduce dimensions	Maintenance required Non negligible residual voltage

CHARACTERISTICS

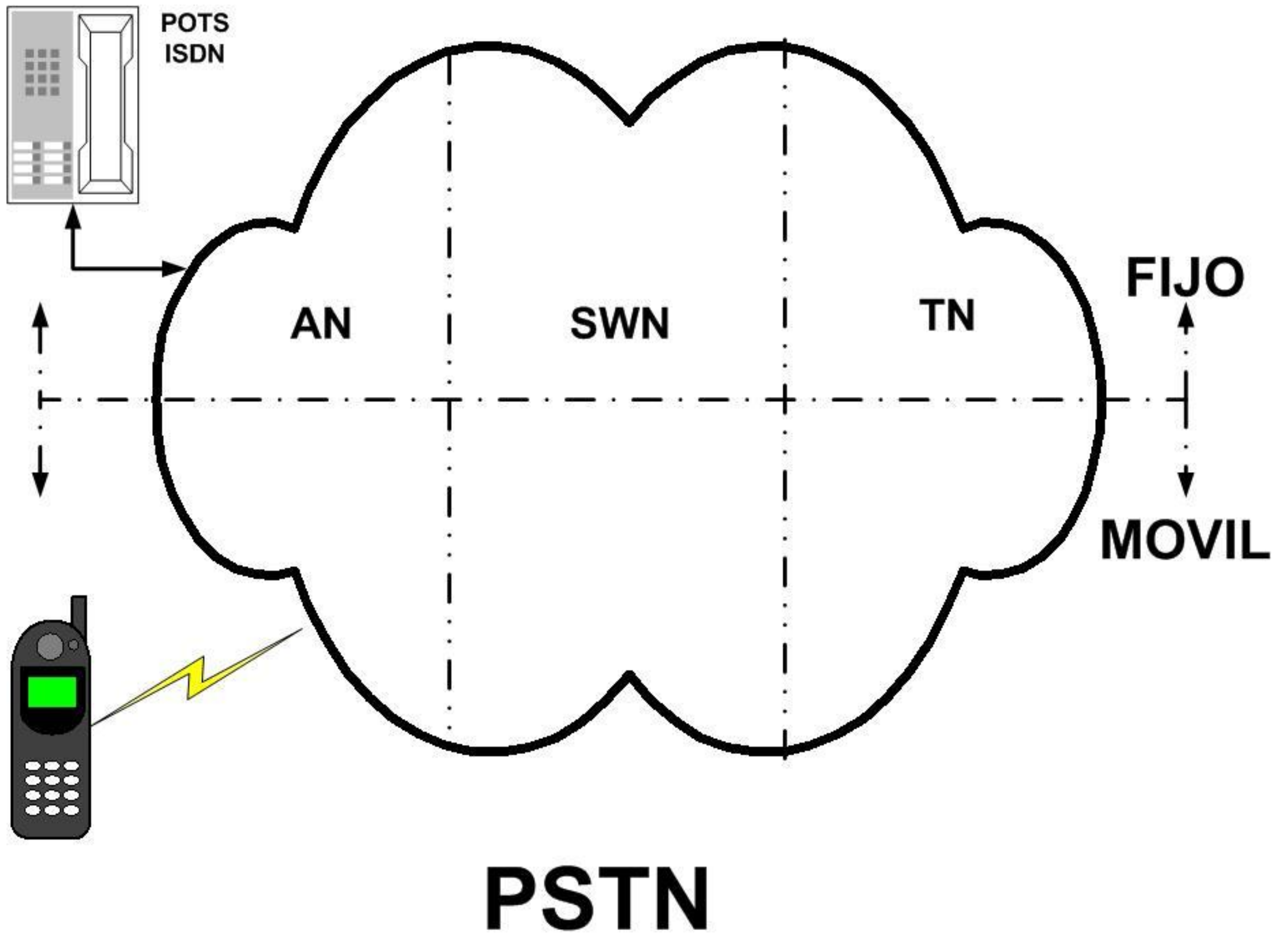
	N	7/16
ELECTRICAL		
Impedance	50	
Frequency range	According to product specification	
VSWR	1.20 max	
Insertion loss (dB)	0.2dB	
RF leakage (dB)	100	
Surge current capability (kA) (8/20 s test pulse)	2.5	
Residual voltage : QWS and MBQWS GDT	15V max at 2.50 kA, 8/20 s 350V max at 2.50 kA, 8/20 s	
Intermodulation products (2x20W) 3rd order QWS and MBQWS	-110dBm (-153dBc)	
RF power (kW) for VSWR=1, sea level and 20°C QWS and MBQWS	1.2 at 0.9 GHz, 0.8 at 1.9 GHz	2.2 at 0.9 GHz, 1.7 at 1.9 GHz
GDT	according to selected gas capsule	
DC current (A) GDT only	11.8	15.5
MECHANICAL		
Durability (matings)	500	
Recommended coupling nut torque (N.cm)	170	3500
Bulkhead mounting torque (N.cm)	500	3500
ENVIRONMENTAL		
Temperature range	- 40/+85 C	
Moisture resistance	IP67 (IP 65 for crimp type)	
Thermal shocks	CECC -40°C/+155°C/5 cycles	IEC -55°C/+155°C/5 cycles
High temperature test	CECC 1000h/120°C	CECC 1000h/155°C
Salt spray corrosion	CECC 48h	IEC 48h/Na Cl 5%/35°C
Vibration	CECC 98m/s^2 - 10 Hz at 500 Hz	
MATERIALS		
Body	Brass	
Nut	Brass	
Center contact male female	Brass CuBe2	
Insulator	PTFE	
Gasket	Silicon rubber	Silicon rubber or copper
FINISH		
Body	Silver (+ flash BBR*)	
Nut	BBR*	
Center contact male female	Silver (+ flash BBR*) Silver (+ flash BBR*)	

** BBR : Bright Bronze RADIALL* ***D1 030 DE***

EAIII-INTRODUCCION-REDES DE COMUNICACIONES

- PSTN: FIJOS – CELULARES - TRUNKING
- WWW
- REDES LAN - WAN
- BROADCASTING: RADIO – CATV- TV SATELITAL
- PUNTO A PUNTO
- CONVERGENCIA – NGN – TRIPLE PLAY

EAIII-INTRODUCCION-REDES DE COMUNICACIONES



EAIII-INTRODUCCION-REDES DE COMUNICACIONES

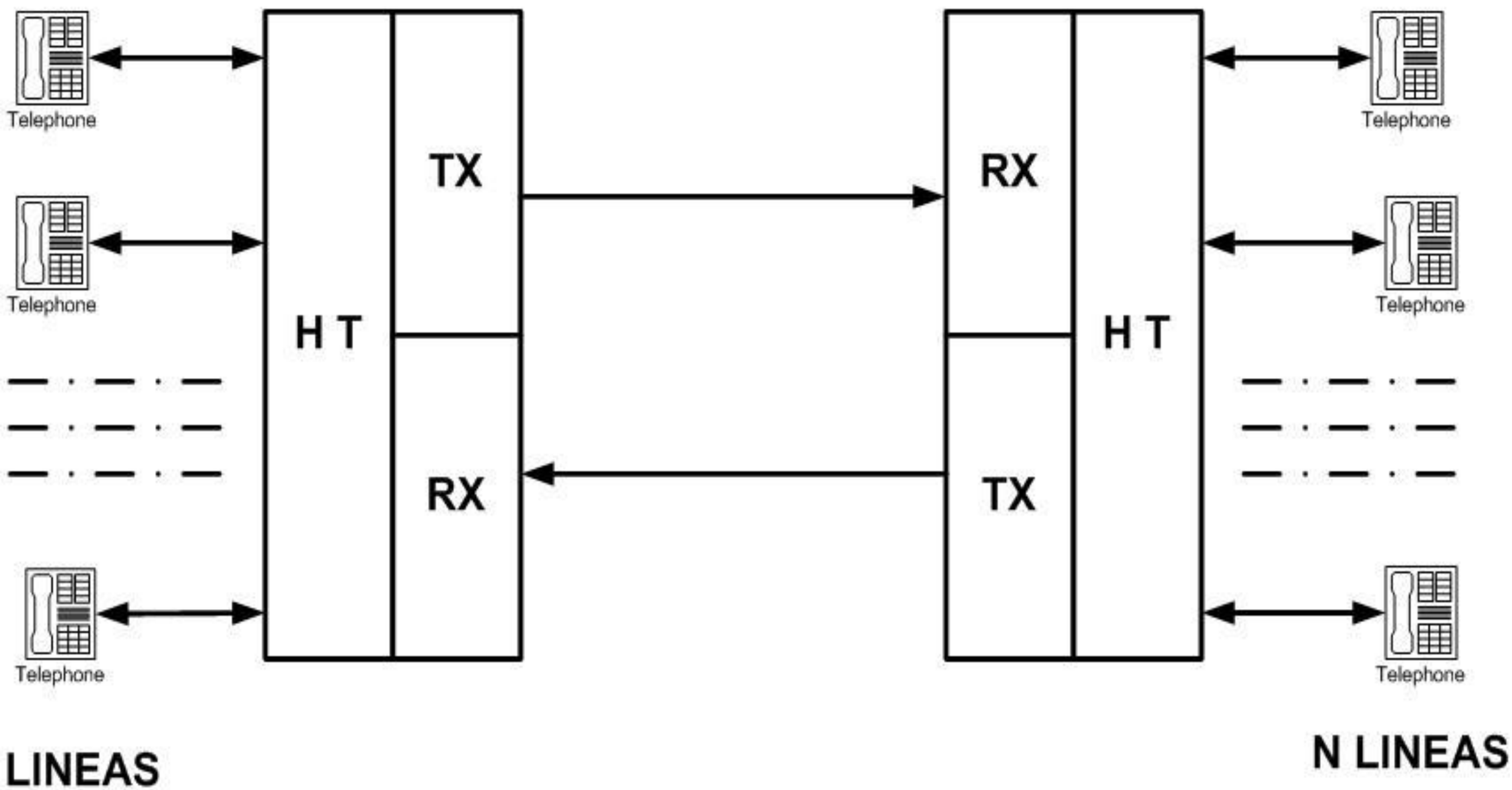
PSTN CAPA DE TX

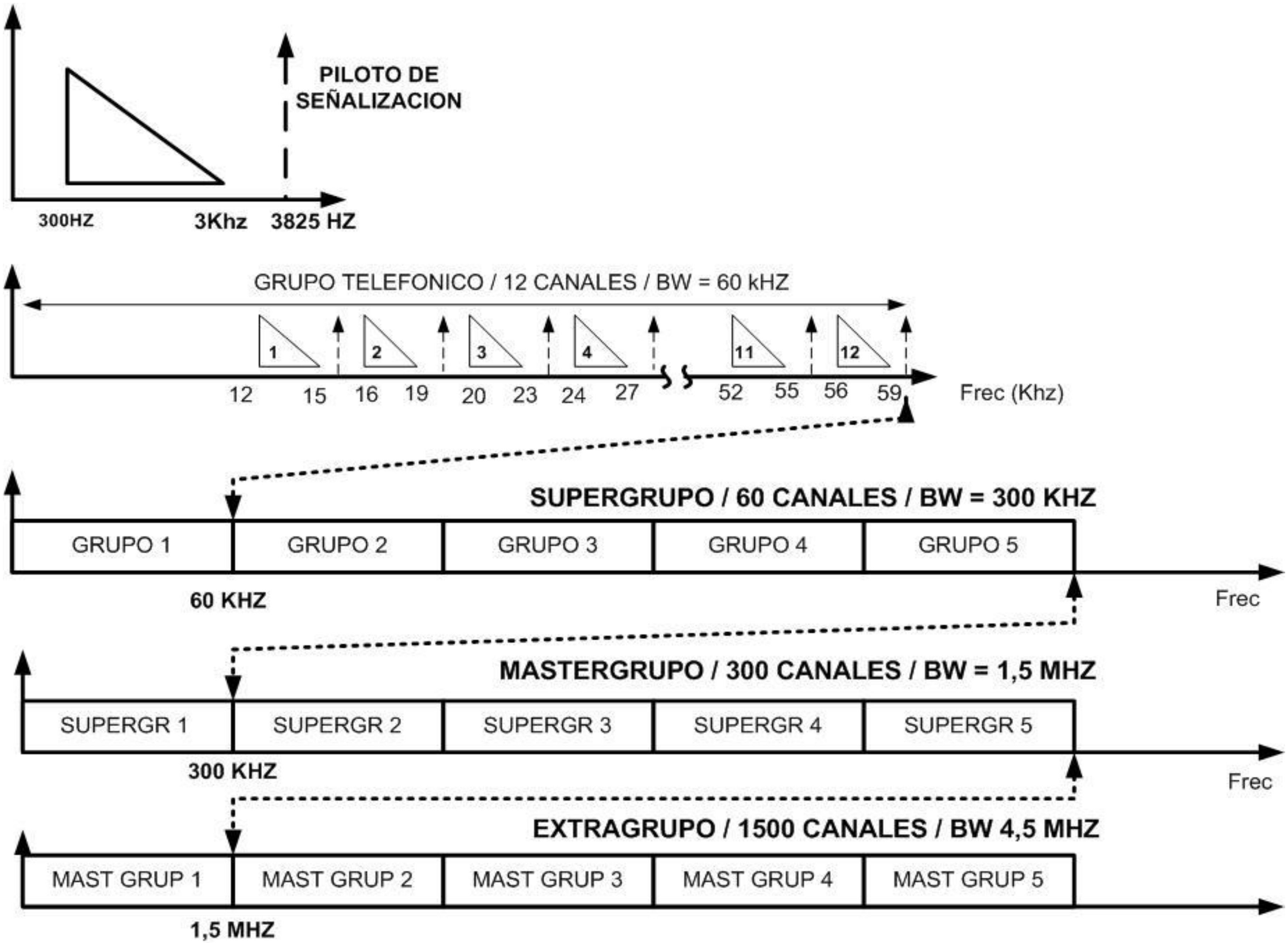
- **EL MUX**
  - ANALOGICO
  - DIGITAL

- **JERARQUIAS PDH:**
  - E1 – 2 Mb/s
  - E2 – 8 Mb/s
  - E3 – 34 Mb/s
  - E4 – 140 Mb/s

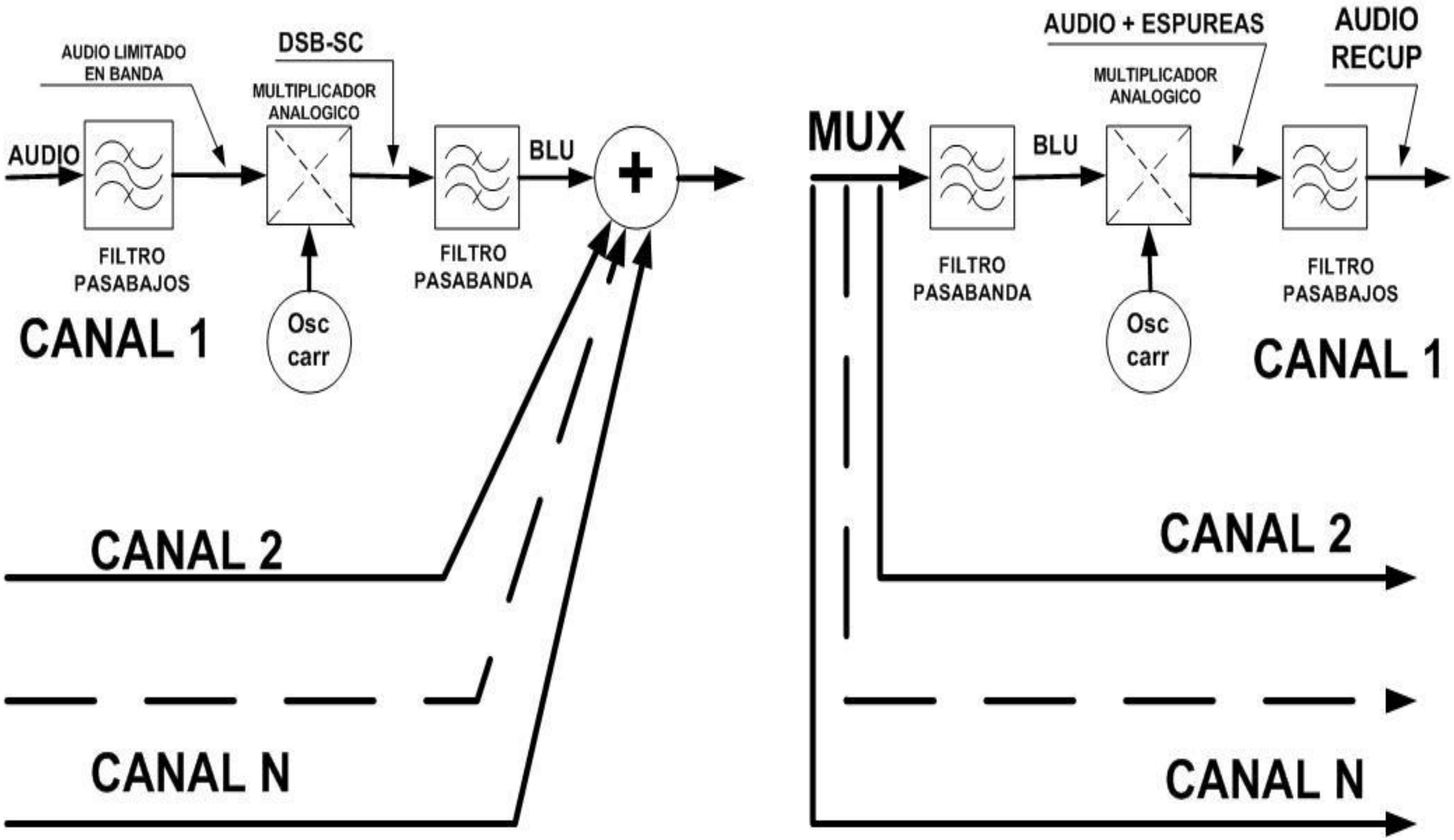
- **JERARQUIAS SDH:**
  - STM1 - 155 Mb/s
  - STM4 – 620 Mb/s
  - STM 16 – 2,5 Gb/s
  - STM 64 – 10 Gb/s


2 HILOS
HIBRIDA
TELEFONICA
2 HILOS TX
2 HILOS RX
4 HILOS
SEÑALIZACION
E & M
Telephone


Telephone
Telephone
Telephone
H T
TX
RX
RX
TX
H T
Telephone
Telephone
Telephone
N LINEAS
N LINEAS


PILOTO DE
SEÑALIZACION
300HZ
3Khz
3825 HZ
GRUPO TELEFONICO / 12 CANALES / BW = 60 kHZ
1
2
3
4
11
12
12
15
16
19
20
23
24
27
52
55
56
59
Frec (Khz)
SUPERGRUPO / 60 CANALES / BW = 300 KHZ
GRUPO 1
GRUPO 2
GRUPO 3
GRUPO 4
GRUPO 5
60 KHZ
Frec
MASTERGRUPO / 300 CANALES / BW = 1,5 MHZ
SUPERGR 1
SUPERGR 2
SUPERGR 3
SUPERGR 4
SUPERGR 5
300 KHZ
Frec
EXTRAGRUPO / 1500 CANALES / BW 4,5 MHZ
MAST GRUP 1
MAST GRUP 2
MAST GRUP 3
MAST GRUP 4
MAST GRUP 5
1,5 MHZ

MUX ANALOGICO



1 Jerarquía digital plesiócrona (PDH)

1.1 Velocidades binarias normalizadas (PDH) (CCITT G.702)

Hasta ahora ha habido en todo el mundo dos jerarquías múltiplex.

En los Estados Unidos y en algunos otros países se ha utilizado una jerarquía con velocidad binaria básica de 1,5 kbit/s.
Las velocidades binarias empleadas han sido o son:

- 1.544 kbit/s
- 6.312 kbit/s
- 44.736 kbit/s

En Europa, Australia y en algunas otras regiones se ha basado la técnica en una velocidad binaria básica de 2 Mbit/s según el ETSI (European Telecommunications Standards Institute).
Esto ha supuesto la utilización de las siguientes velocidades binarias:

- 2.048 kbit/s
- 8.448 kbit/s
- 34.368 kbit/s
- 139.264 kbit/s

Ambas variantes han sido resumidas por el CCITT en la Recomendación G.702 de jerarquía digital plesiócrona PDH.

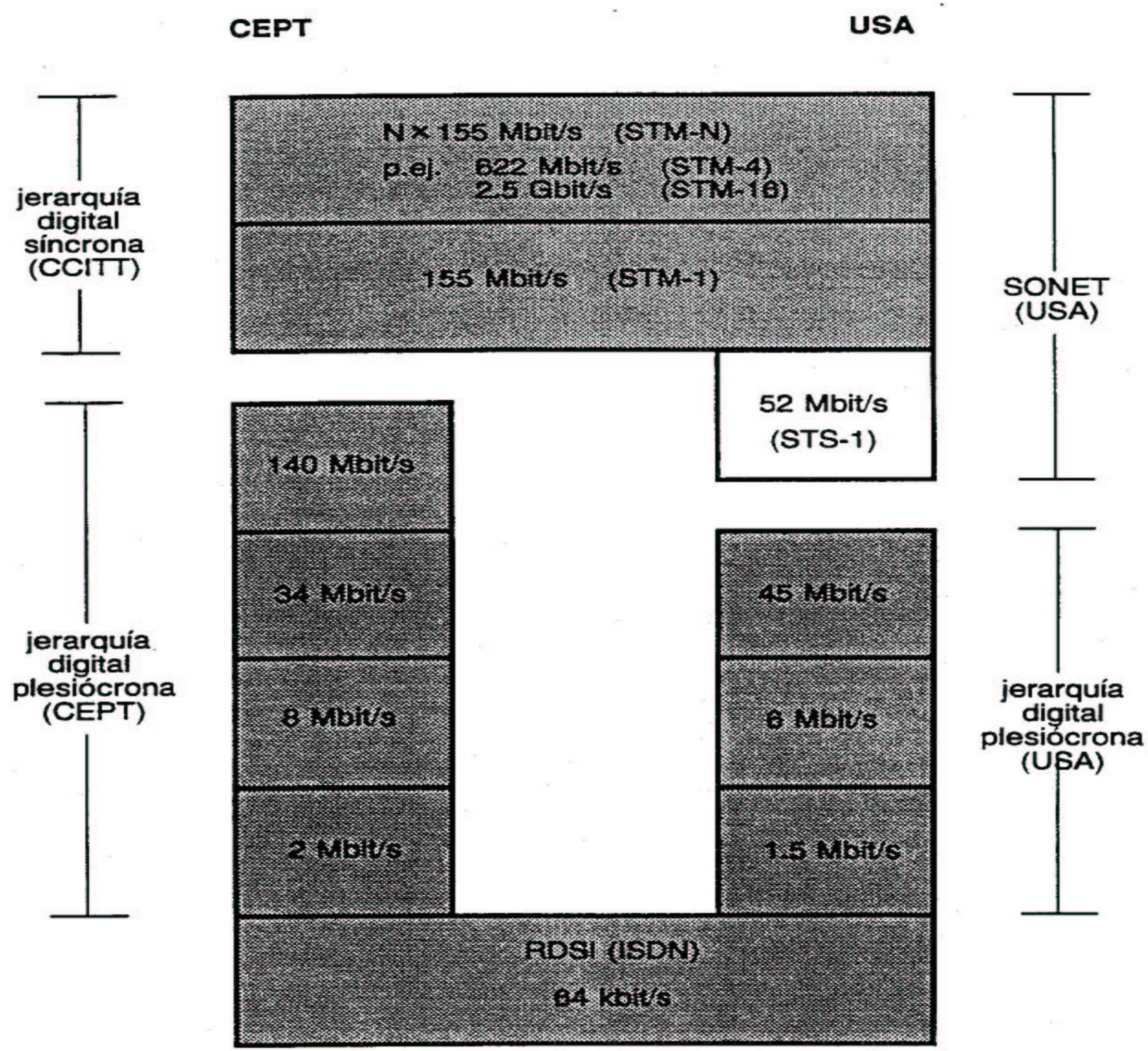


Fig. 4 Comparación de las jerarquías múltiplex CEPT y USA

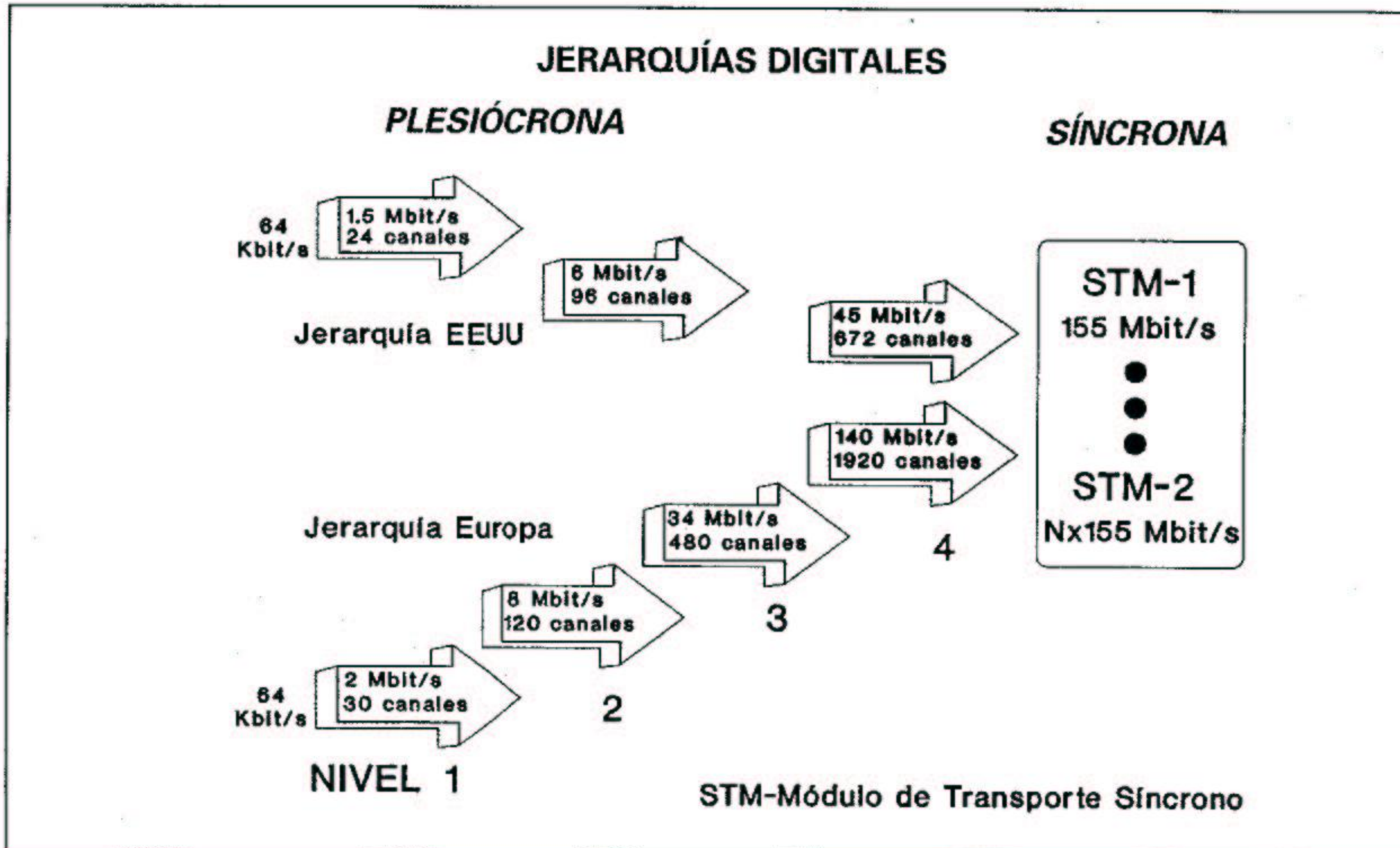


Fig. 5.5. *Evolución de la jerarquía digital plesiócrona (JDP) hacia la síncrona (JDS).*

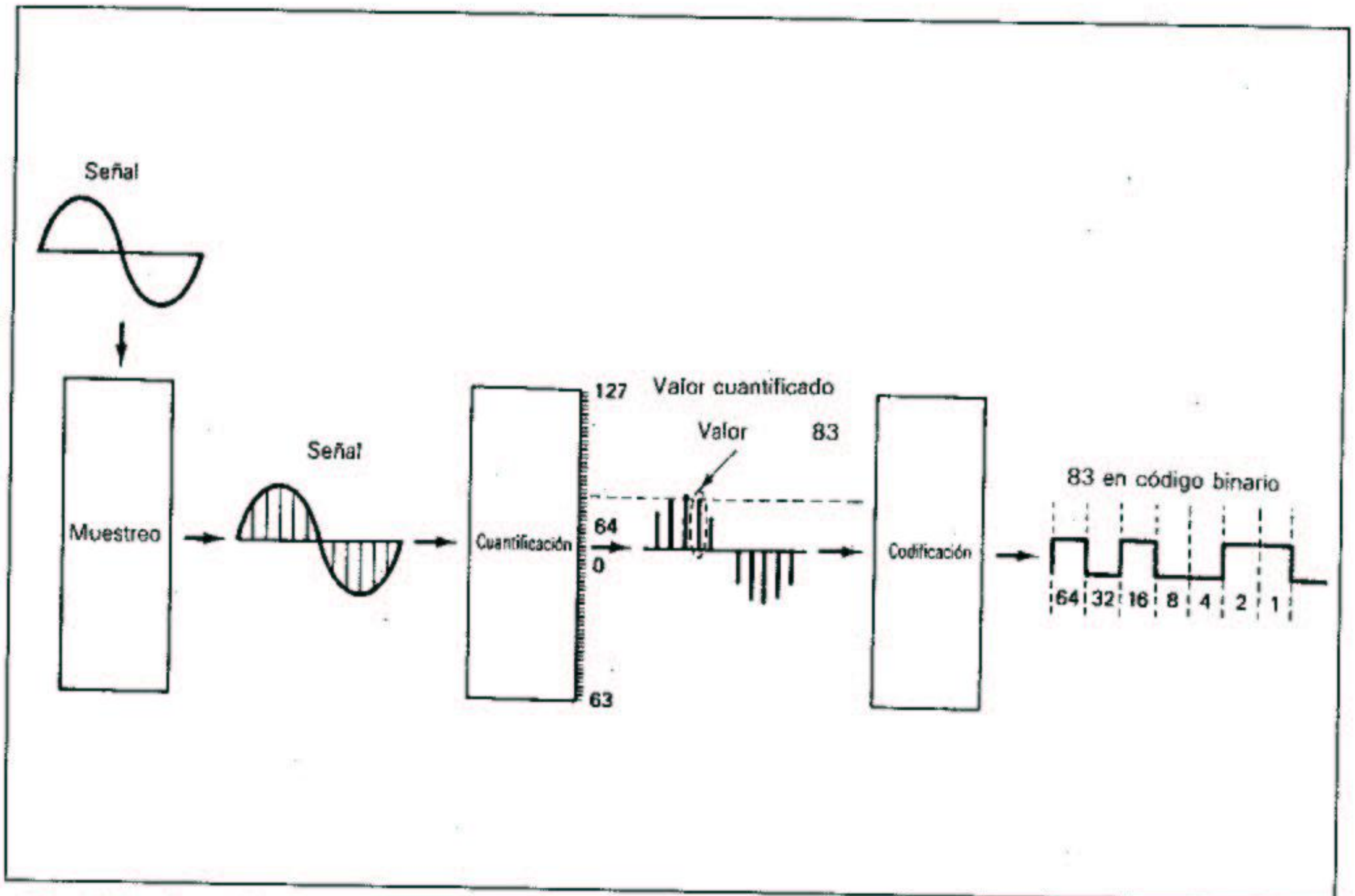
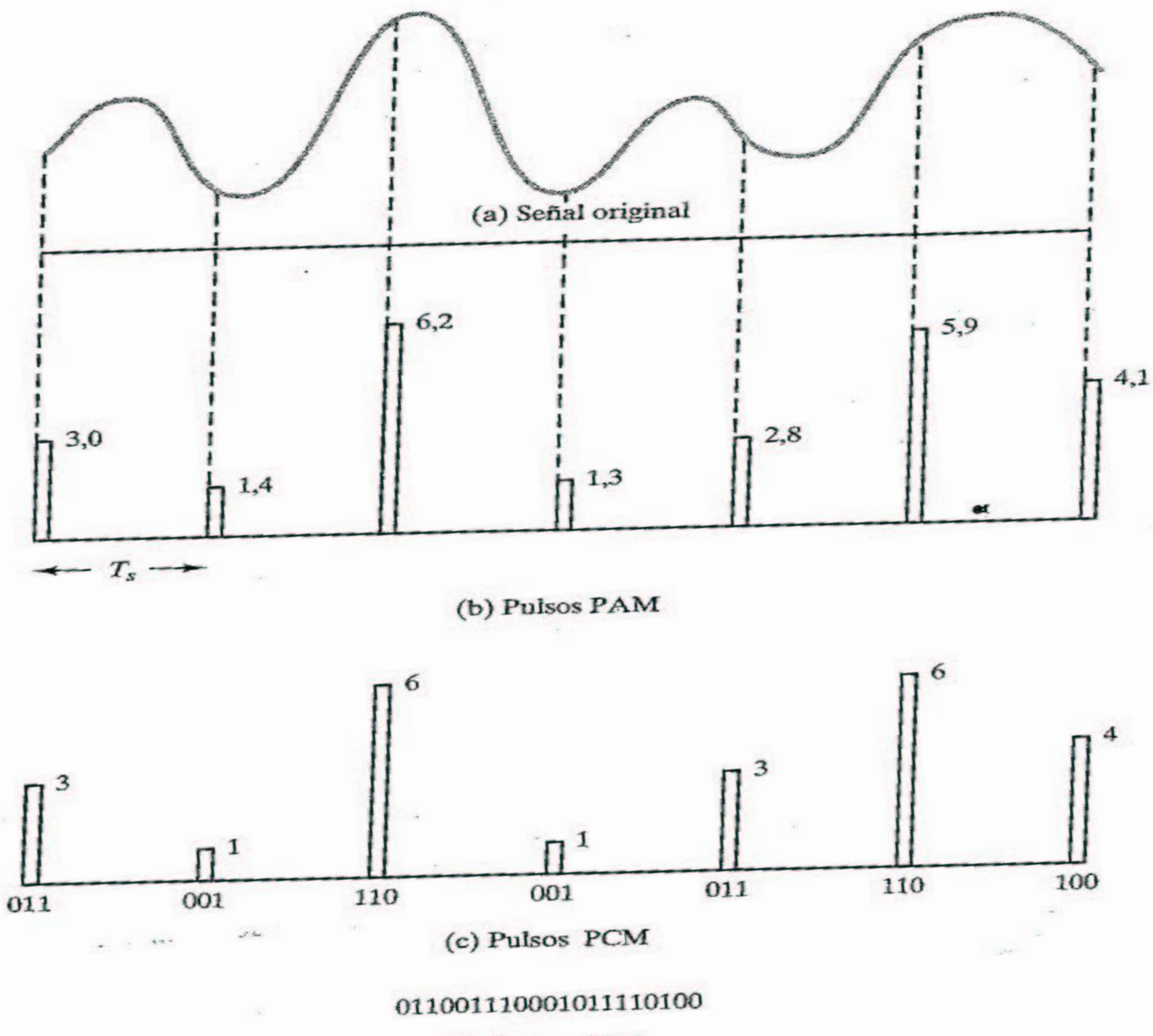
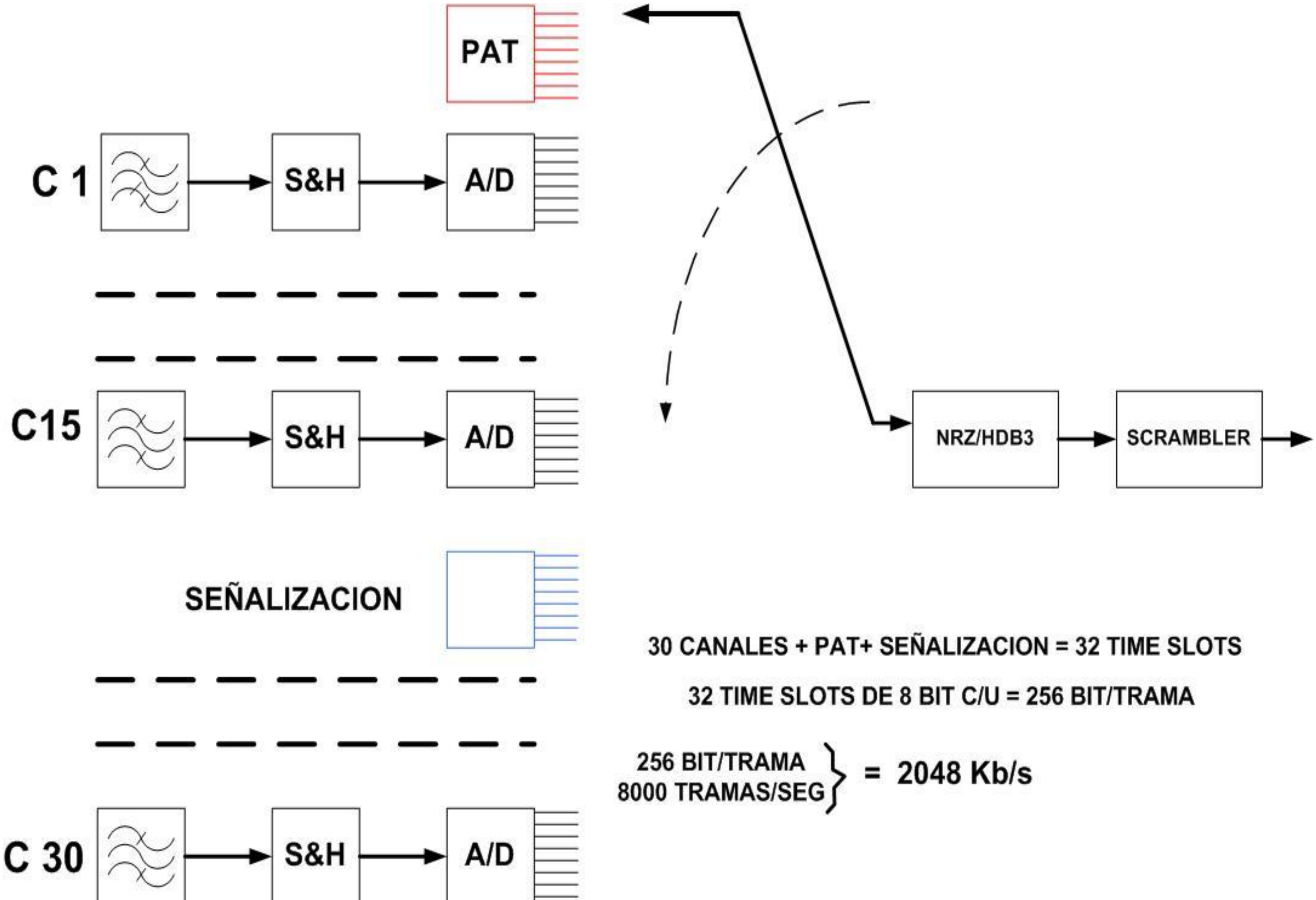


Fig. 5.2. *La técnica de modulación MIC se basa en el muestreo, cuantificación y codificación de una señal analógica, para su transformación en digital.*


(a) Señal original
3,0
1,4
6,2
1,3
2,8
5,9
4,1
T_s
(b) Pulsos PAM
3
1
6
1
3
6
4
011
001
110
001
011
110
100
(c) Pulsos PCM
011001110001011110100
(d) Salida PCM

MUX DIGITAL TRAMA E1



30 CANALES + PAT+ SEÑALIZACION = 32 TIME SLOTS

32 TIME SLOTS DE 8 BIT C/U = 256 BIT/TRAMA

$$\left.\begin{array}{r}\text{256 BIT/TRAMA}\\ \text{8000 TRAMAS/SEG}\end{array}\right\} = \text{2048 Kb/s}$$

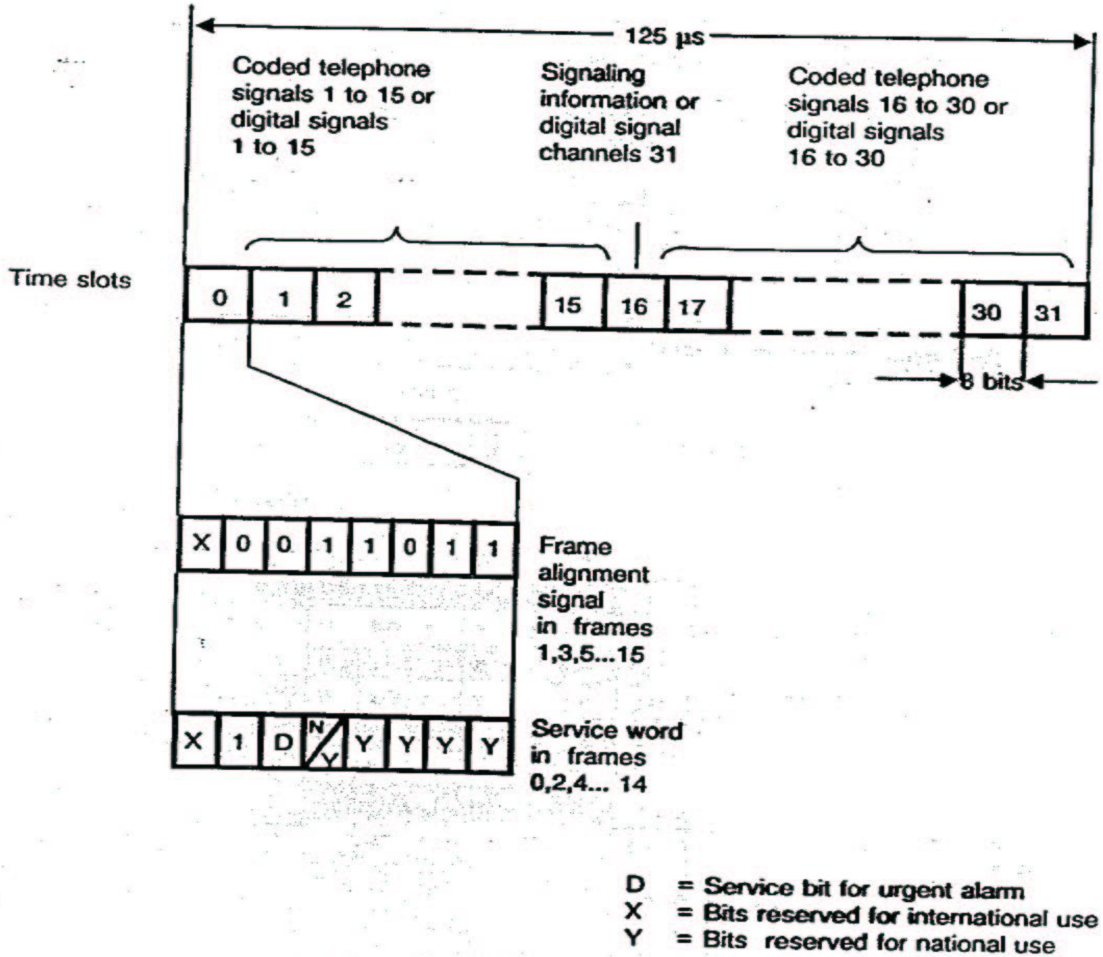
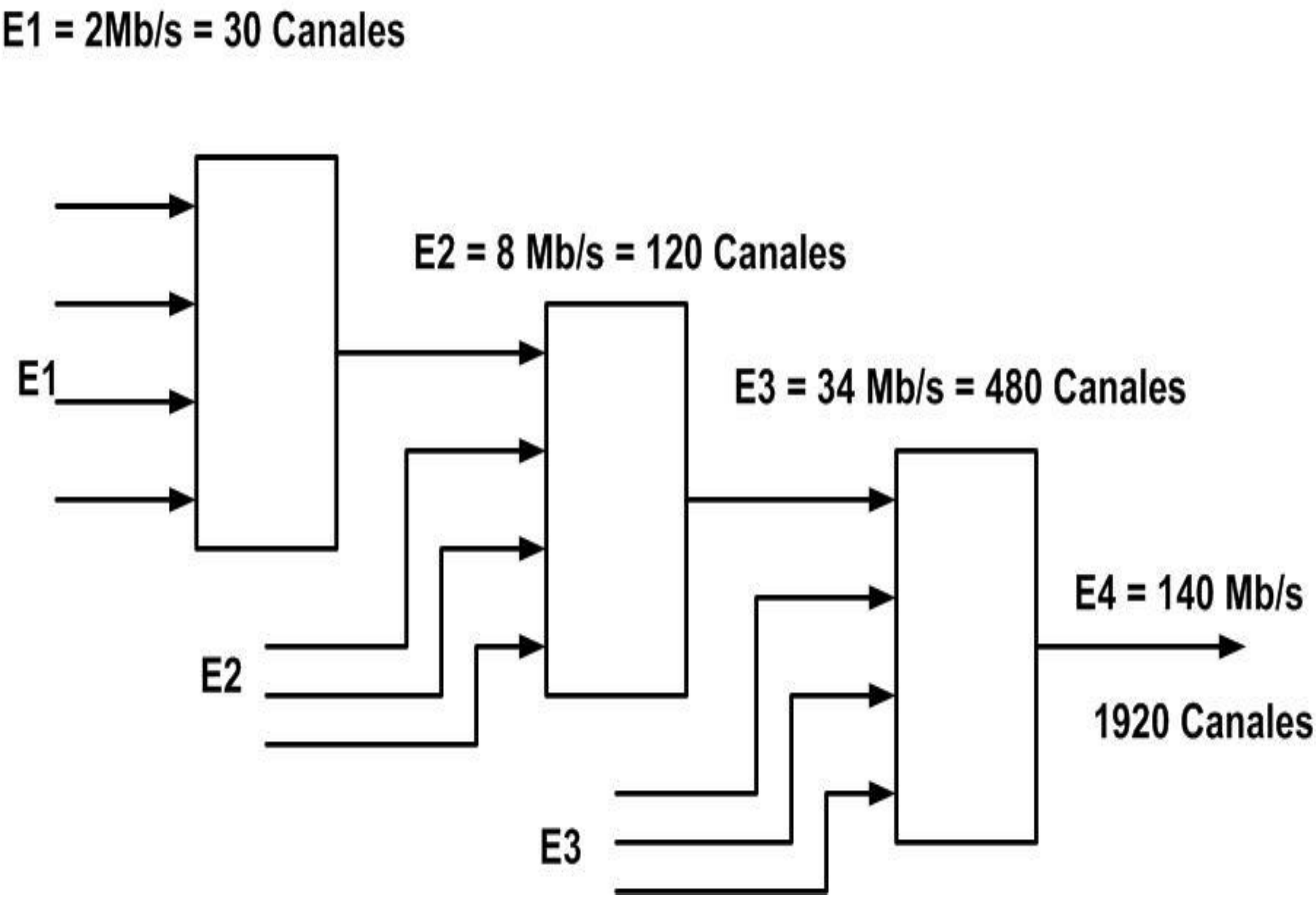

125 µs
Coded telephone signals 1 to 15 or digital signals 1 to 15
Signaling information or digital signal channels 31
Coded telephone signals 16 to 30 or digital signals 16 to 30
Time slots
0
1
2
15
16
17
30
31
8 bits
X 0 0 1 1 0 1 1
Frame alignment signal in frames 1,3,5...15
X 1 D N/Y Y Y Y Y
Service word in frames 0,2,4... 14
D = Service bit for urgent alarm
X = Bits reserved for international use
Y = Bits reserved for national use

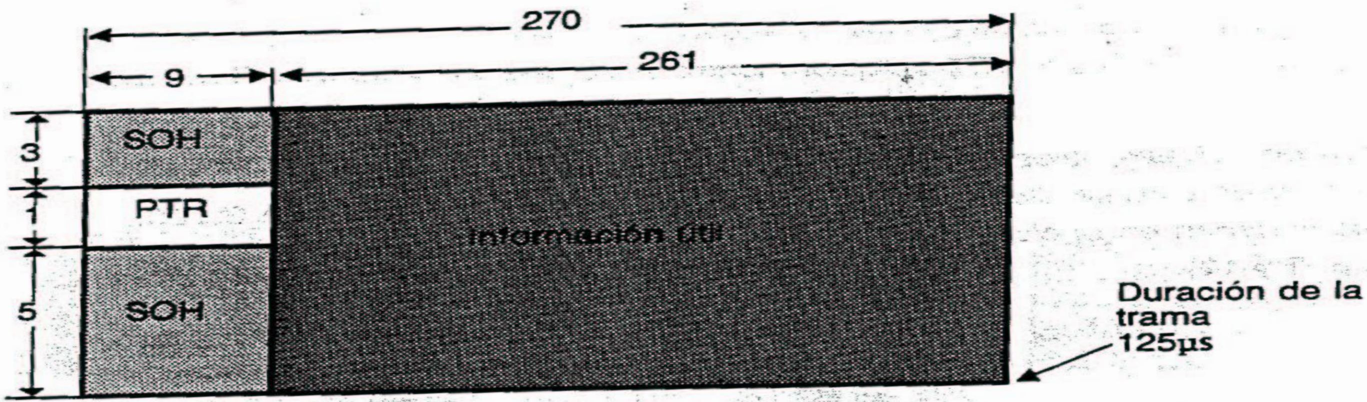
Fig. 1

JERARQUIA PDH



La trama STM 1 contiene 3 bloques:

a) Bloque section-overhead (SOH)
b) Bloque de señal útil (Payload)
c) Bloque de pointers (PTR)



SOH (Section Overhead): Información de transporte

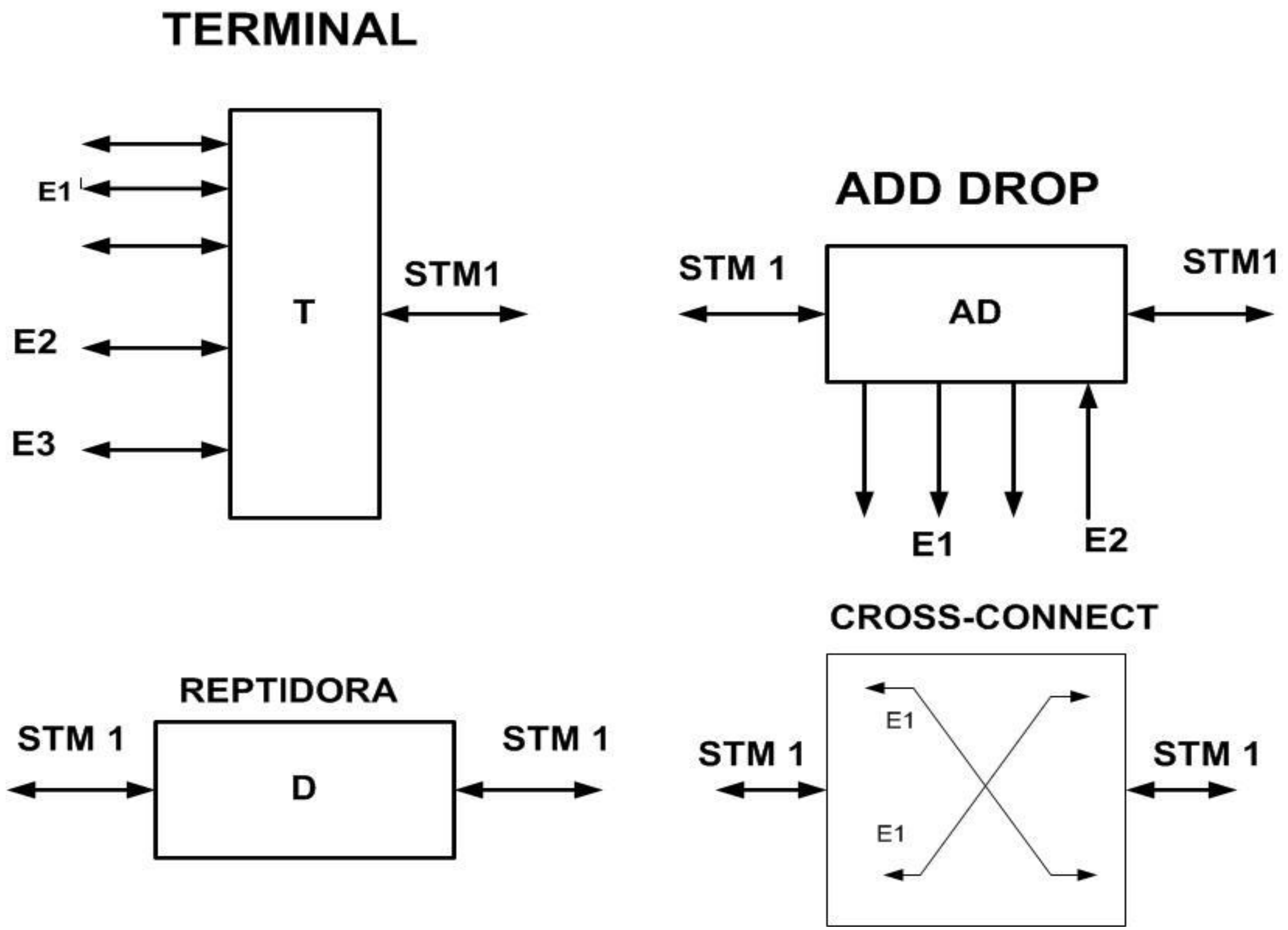
PTR (Pointer): Dirección de comienzo de la información útil

Todas las indicaciones en bytes

Fig. 2 Estructura de la trama STM 1

Los bytes individuales de la trama STM se transmiten por renglones, comenzando por la primera columna y el primer renglón. Con ello se transmiten alternadamente 9 bytes SOH (4o. renglón: 9 bytes PTR), seguidos de 261 bytes de información útil.

TOPOLOGIAS SDH



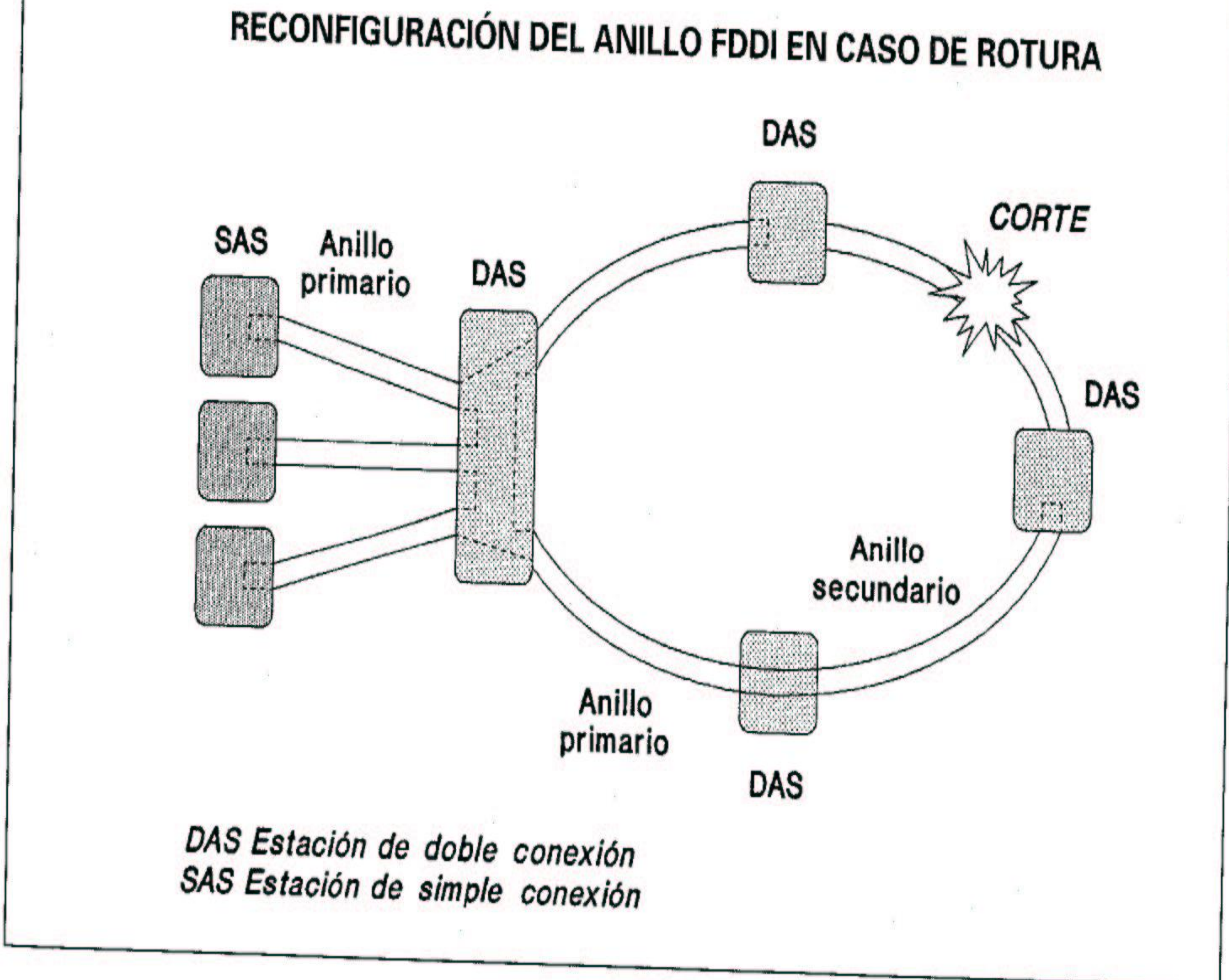
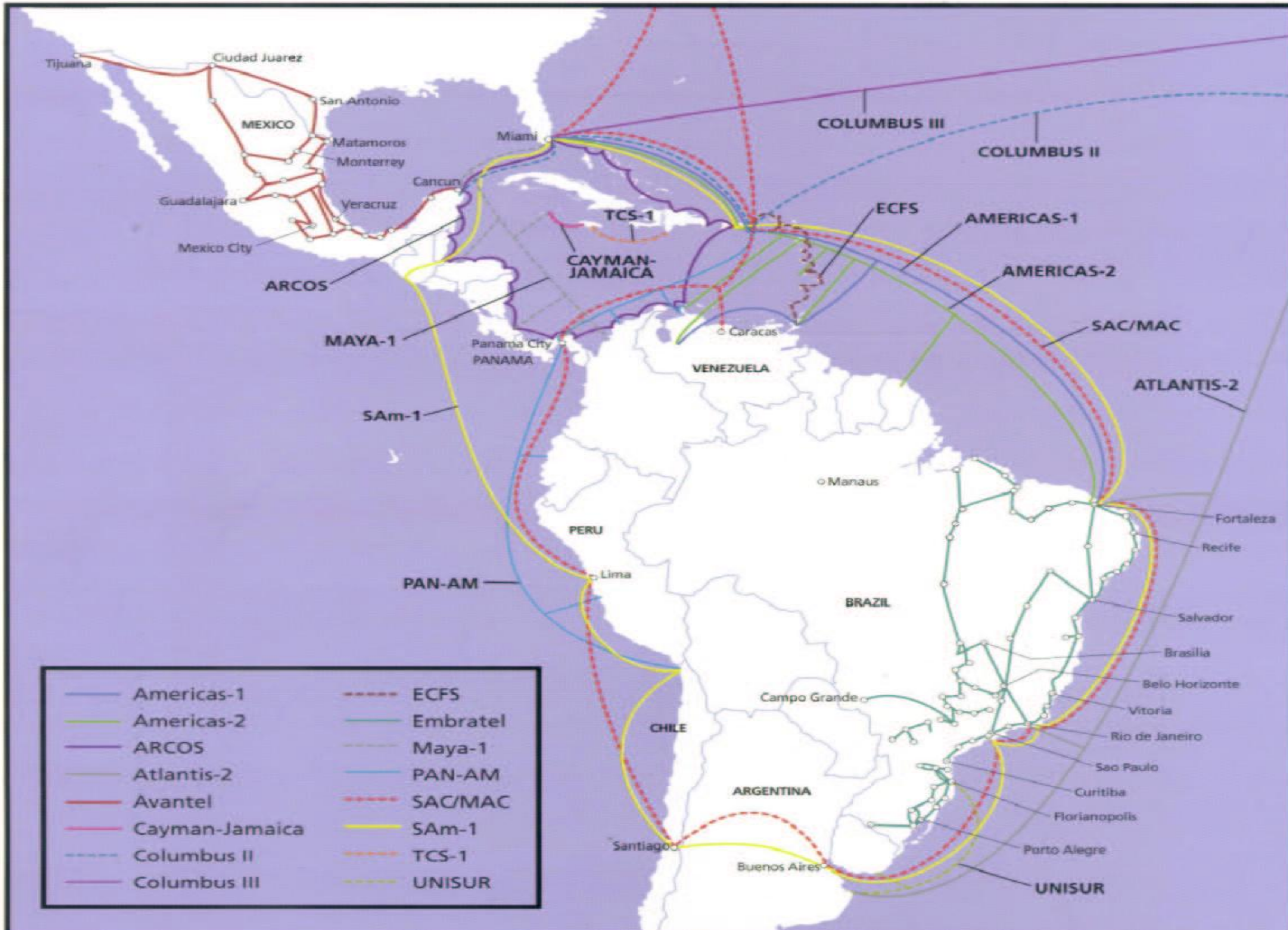


Fig. 5. 10. *Configuración en doble anillo de una red FDDI.*



For more information visit www.verizonbusiness.com or contact your local Verizon Business Account Manager.

PRECAUCIONES

Siemens Telecomunicazioni

Documento 08-0001-501/S
Edición 2, Noviembre 1990

3. IDENTIFICACION DE LOS COMPONENTES ESDS

Todas las unidades, los grupos de microondas y los sub-grupas que contienen los dispositivos ESDS están señalados como se indica en los párrafos siguientes.

En el caso de operaciones relacionadas con los componentes que contienen dispositivos sensibles a las descargas electroestáticas, hay que equiparse con una adecuada protección para reducir eventuales daños.
La protección consiste en (veáse Figura 1):

- una pulsera que se ata a la muñeca
- un cordón espiral que se conecta con la pulsera y con la respectiva toma situada en el bastidor.

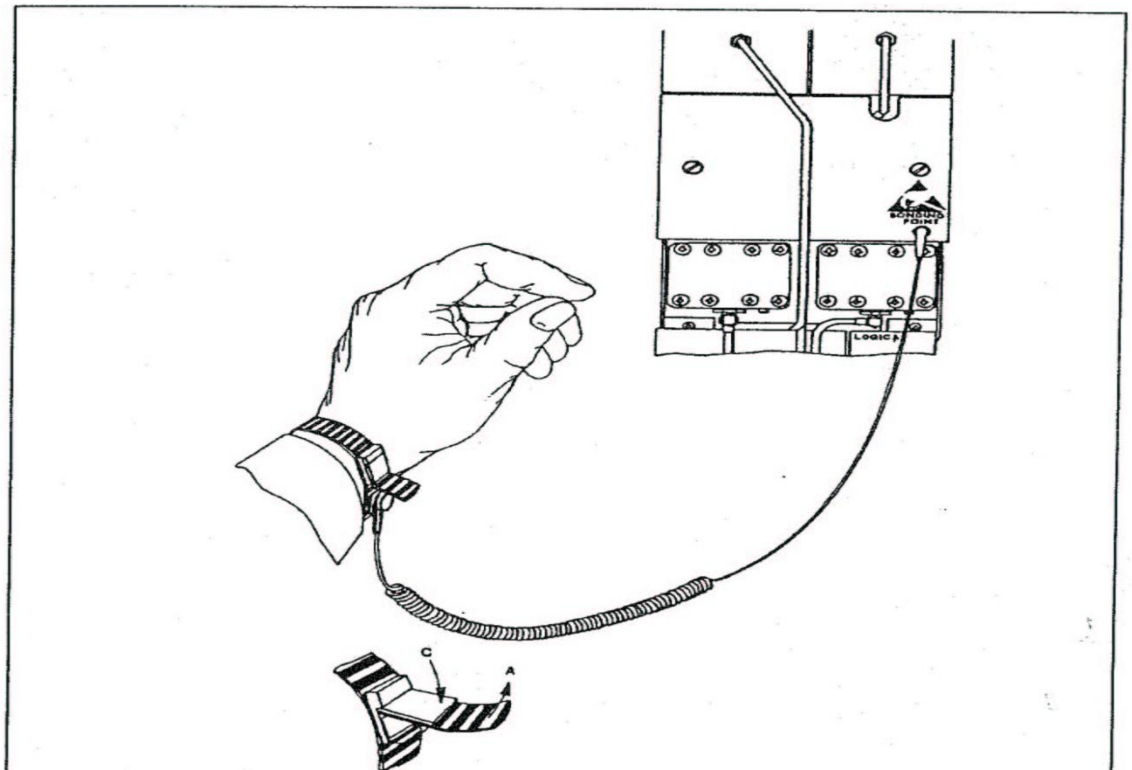


FIGURA 1

PRECAUCIONES

3.01 Identificación de las unidades con componentes ESDS

Las unidades que contienen los componentes ESDS están señaladas con una tarjeta adhesiva ESDS situada en la parte frontal, o bien sobre la caja.

Algunas unidades no tienen la tarjeta; en substitución de ésta, las letras serigrafadas sobre la parte frontal de la unidad, son de color rojo.

3.02 Identificación de los grupos mecánicos de mircoondas con componentes ESDS

Los grupos mecánicos de microondas, se pueden identificar por medio de la tarjeta autoadhesiva indicada en la Figura 2.

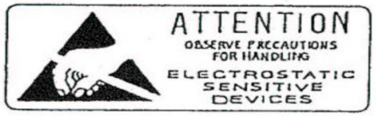


FIGURA 2

3.03 Identificación de los circuitos híbridos de pelicúla delgada con componentes ESDS

Los circuitos híbridos de pelicula delgada, se pueden identificar por medio de la señal de la Figura 3 fotograbada sobre la placa.

FIGURA 3

TRANSMISORES

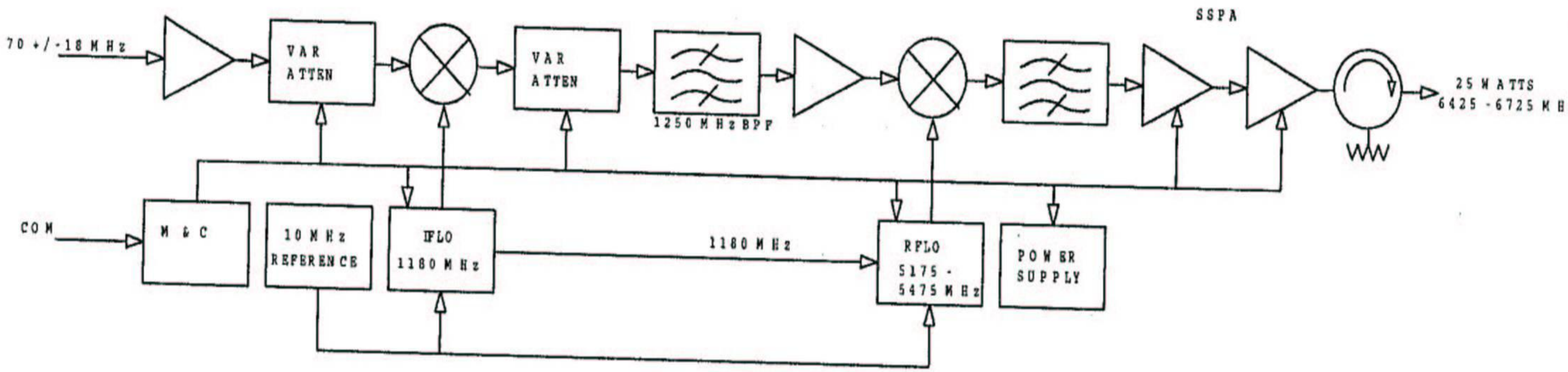


Figure D-2. Functional Block Diagram of the Upconverter Section

RECEPTOR

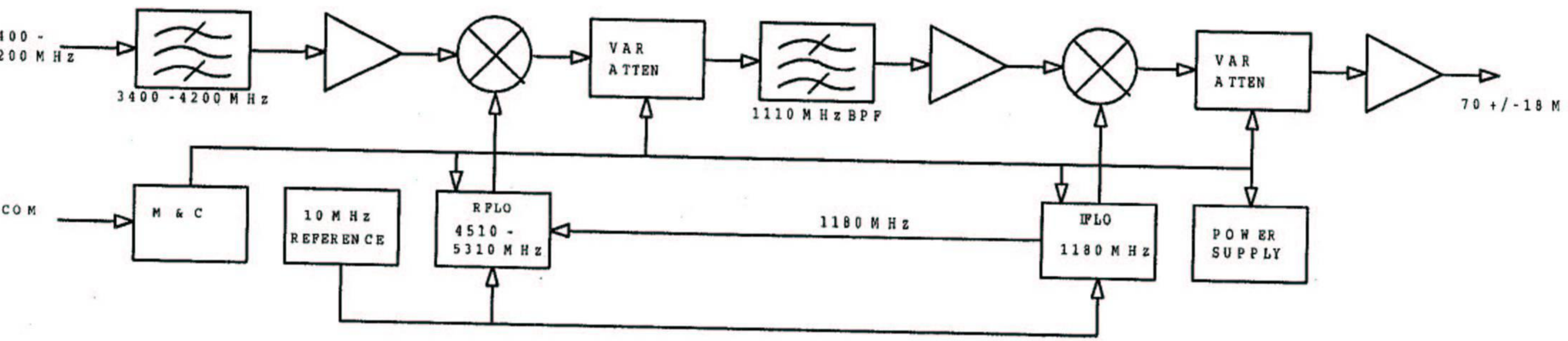
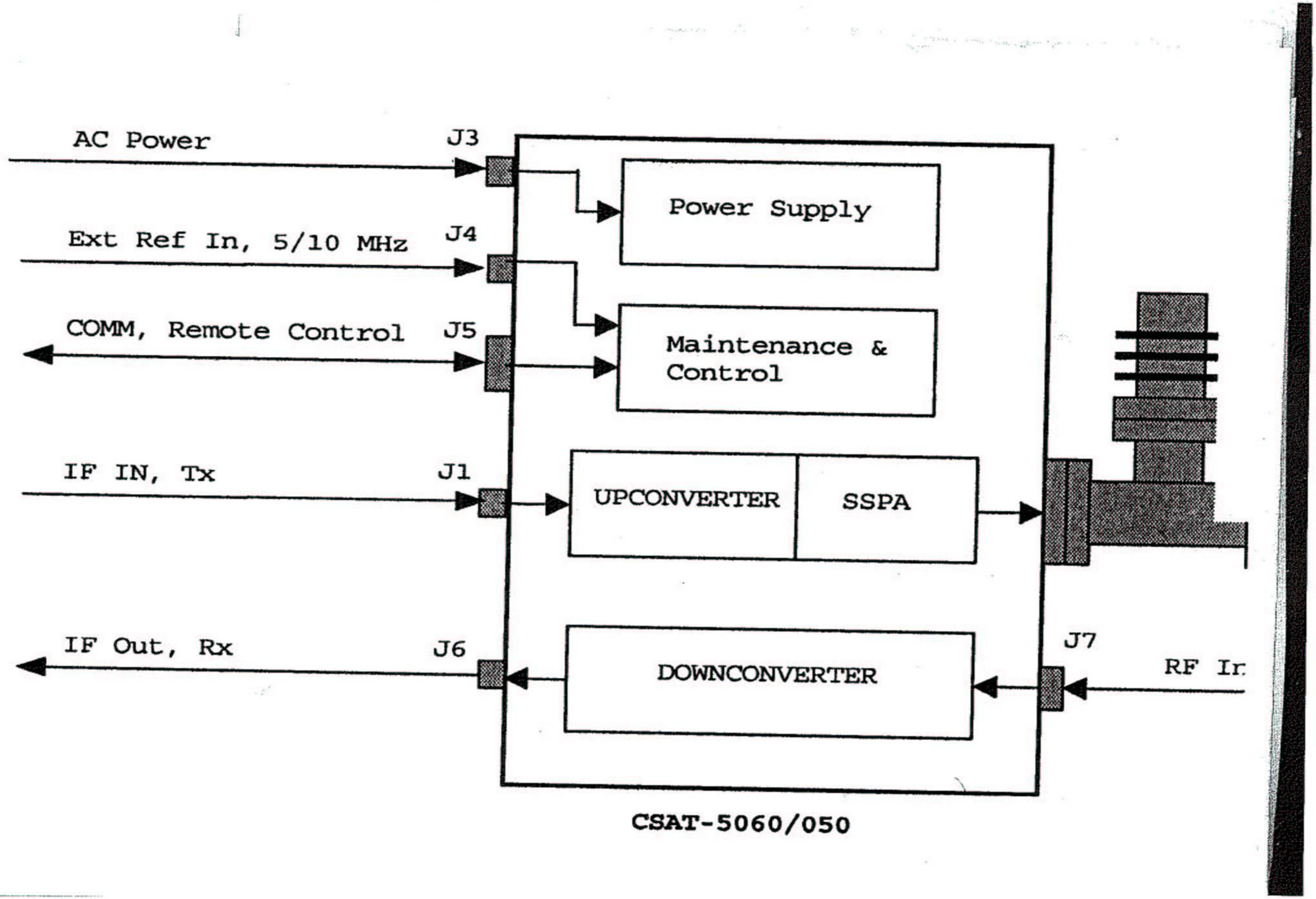


Figure D-1 Functional block diagram of the downconverter section

TRANSCEPTOR



TRANSCEPTOR 1 + 1

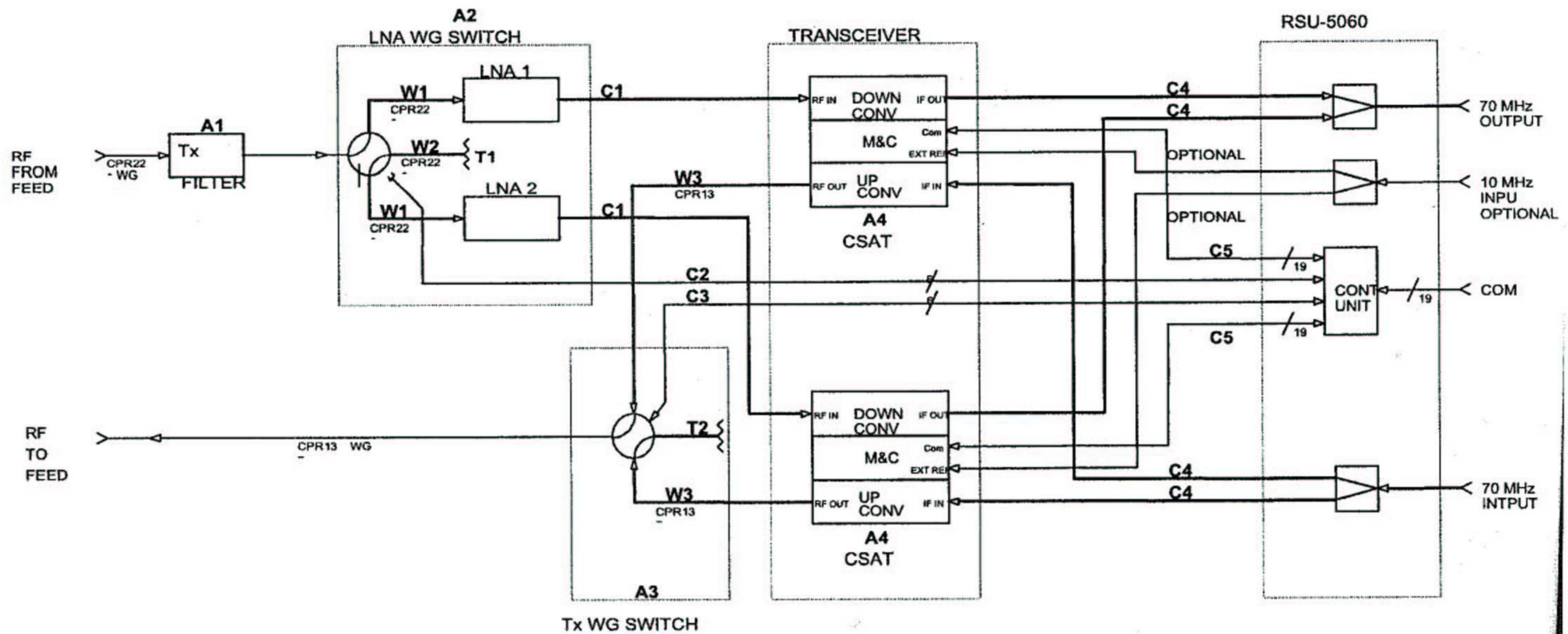


Figure B-1. Typical CSAT Redundant System

TRANSCEPTOR 1 + 1. LOGICA DE CONTROL

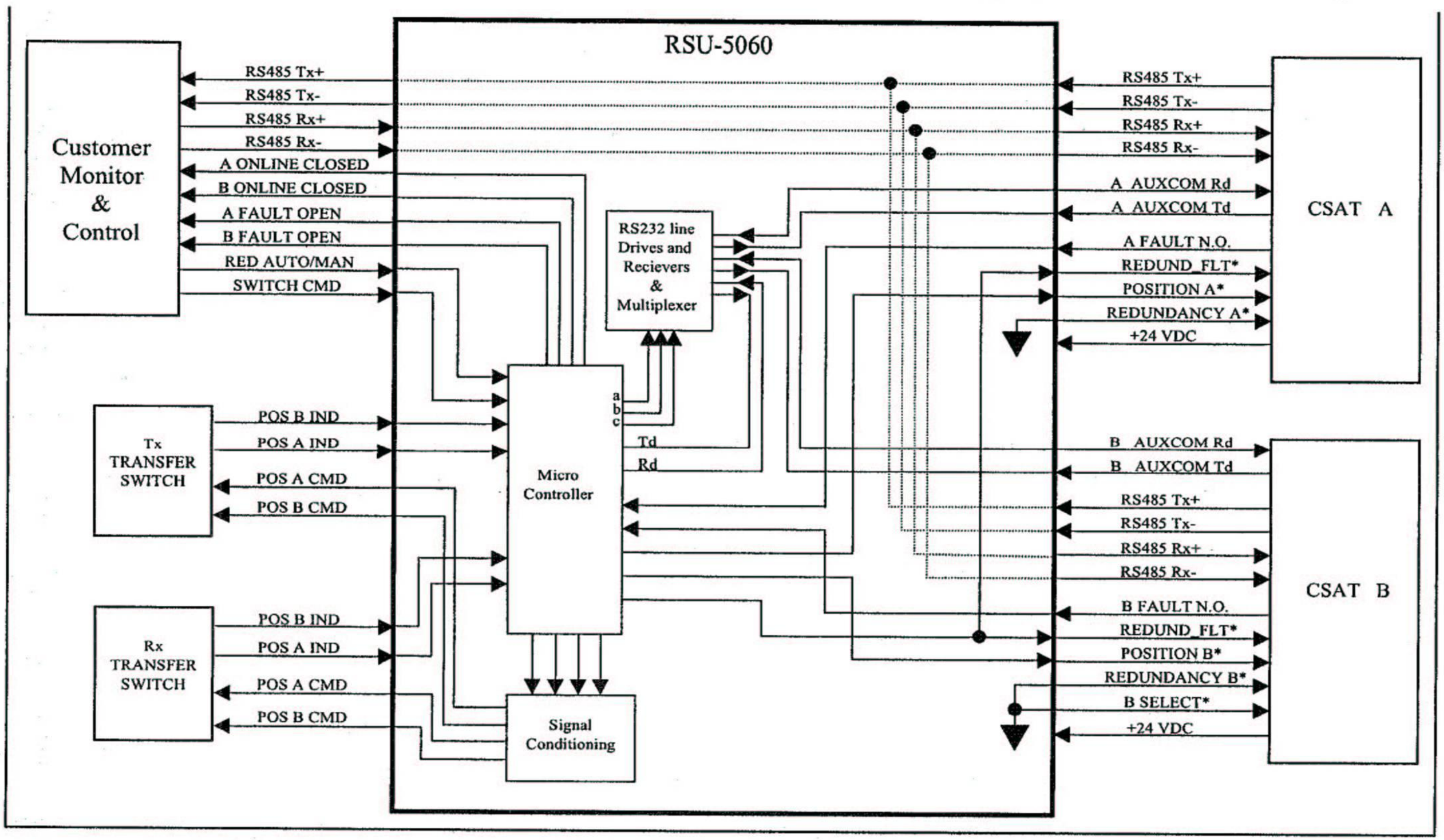


Figure B-3 RSU-5060 Functional Block Diagram

RADIO DIGITAL

Siemens Telecomunicazioni

Documento 52-2107-102/S
Edición 1, Marzo 1991

Transceptor 702-210/05

(1)	Modem 2 Mb/s	: 612-309/01	
	2×2 Mb/s	: 612-309/02	
	8 Mb/s	: 612-309/03	
(2)	Transmisor RF	: 606-036/94A,B	Versión estándar
		: 606-036/94A,B + 606-038/41A,B	Versión alta potencia
(3)	Oscilador Local	: 607-008/81A,B	
(4)	Receptor RF	: 605-046/81A,B	Versión 2, 2×2 Mb/s
		: 605-046/82A,B	Versión 8 Mb/s
(5)	Alimentador	: 611-046/86	

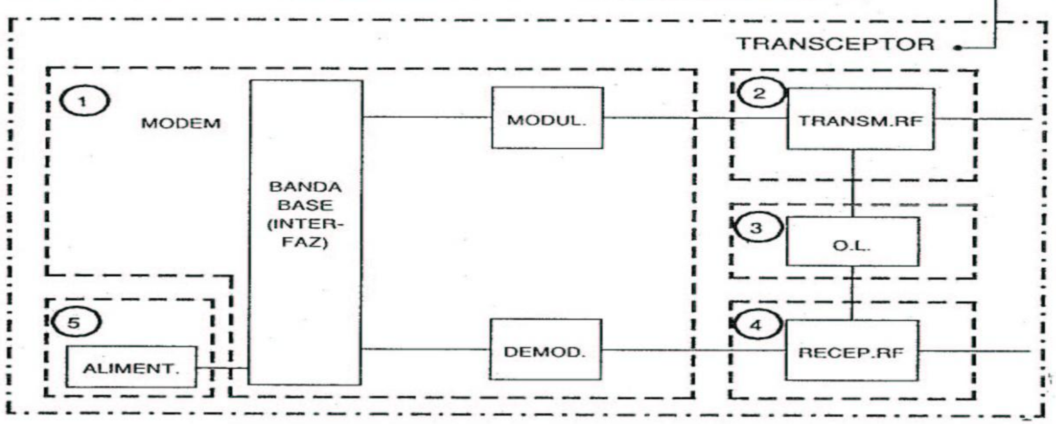
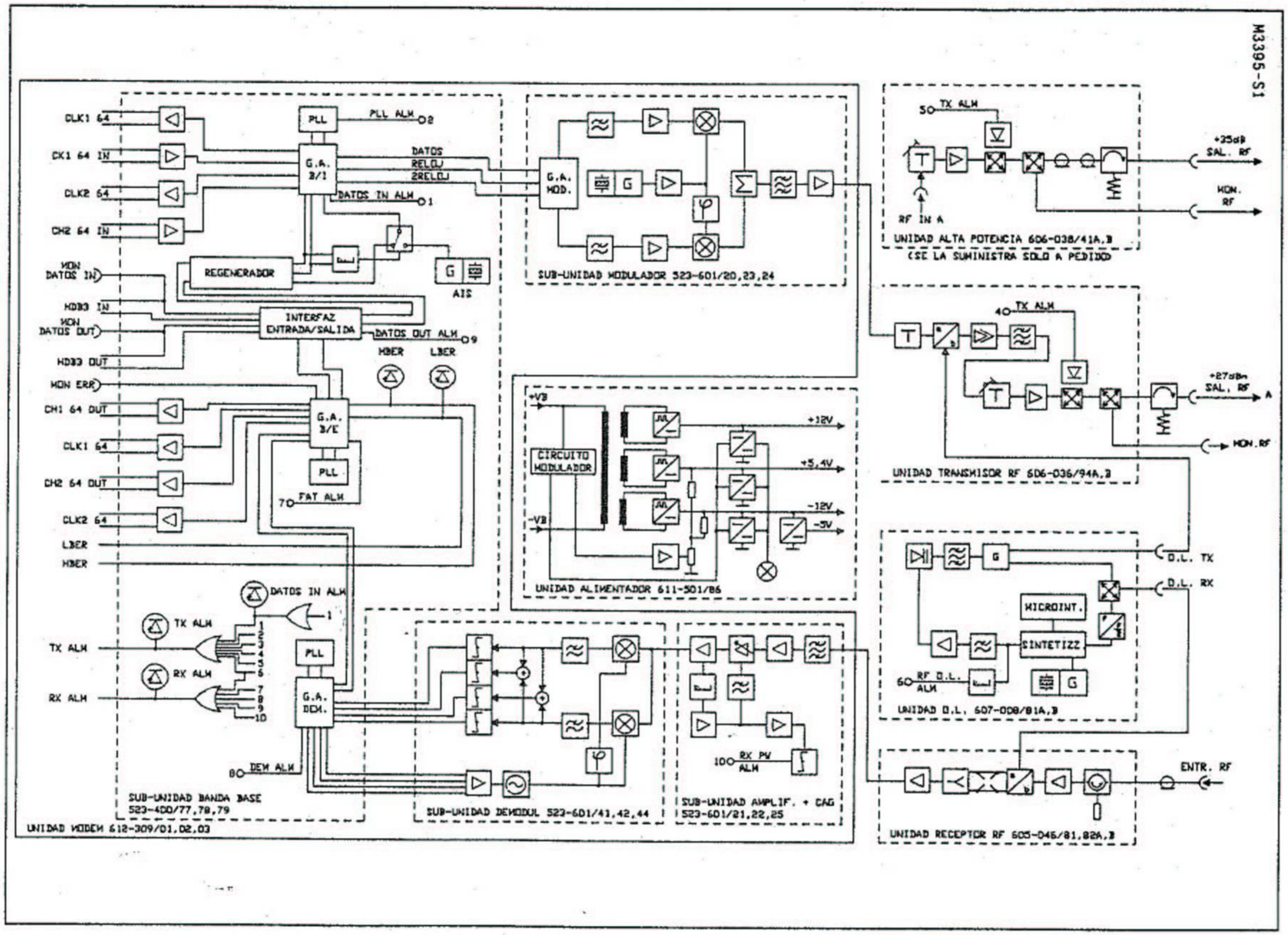


Fig. 6 - Composición del transceptor

RADIO DIGITAL. TRANSCEPTOR

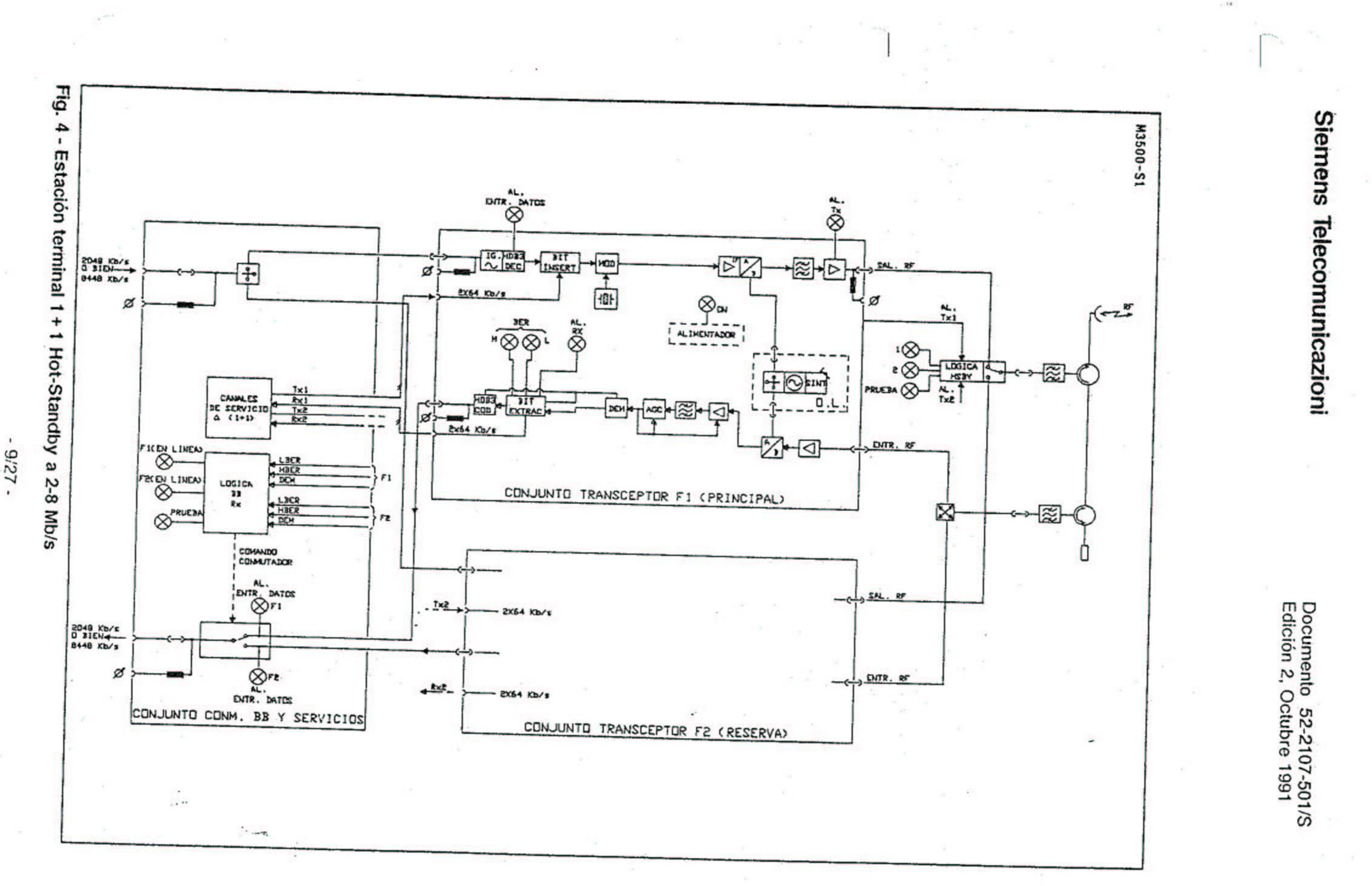
FIGURA 3



Siemens Telecomunicazioni

Documento 52-2107-103/S
Edición 2, Octubre 1991

RADIO DIGITAL. TRANSCEPTOR



TRANSCEPTORES. ESQUEMAS DE REDUNDANCIA

Siemens Telecomunicazioni

Documento 52-2107-100/S
Edición 2, Octubre 1991

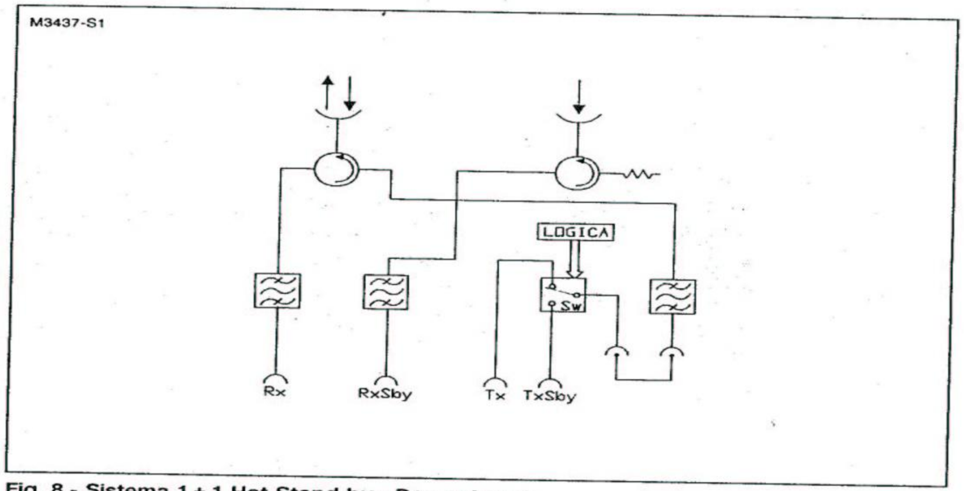


Fig. 8 - Sistema 1 + 1 Hot Stand-by - Dos antenas

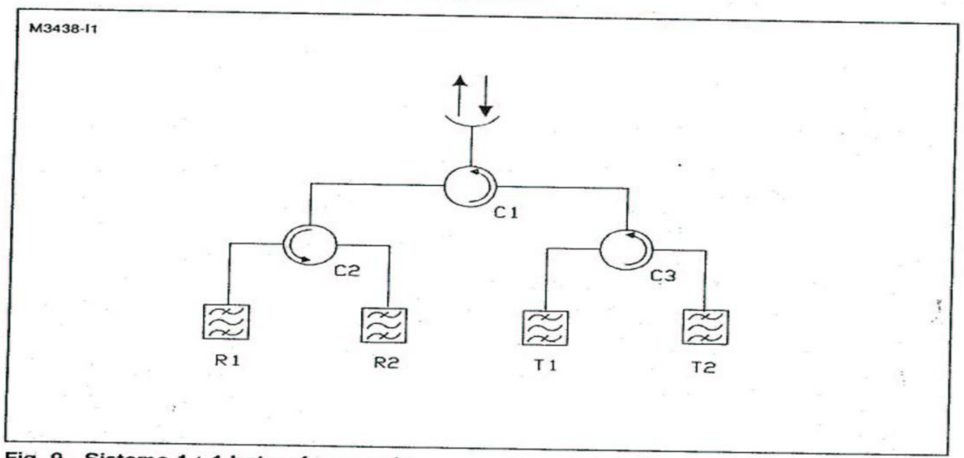


Fig. 9 - Sistema 1 + 1 heterofrecuencia

TRANSCEPTORES. ESQUEMAS DE REDUNDANCIA

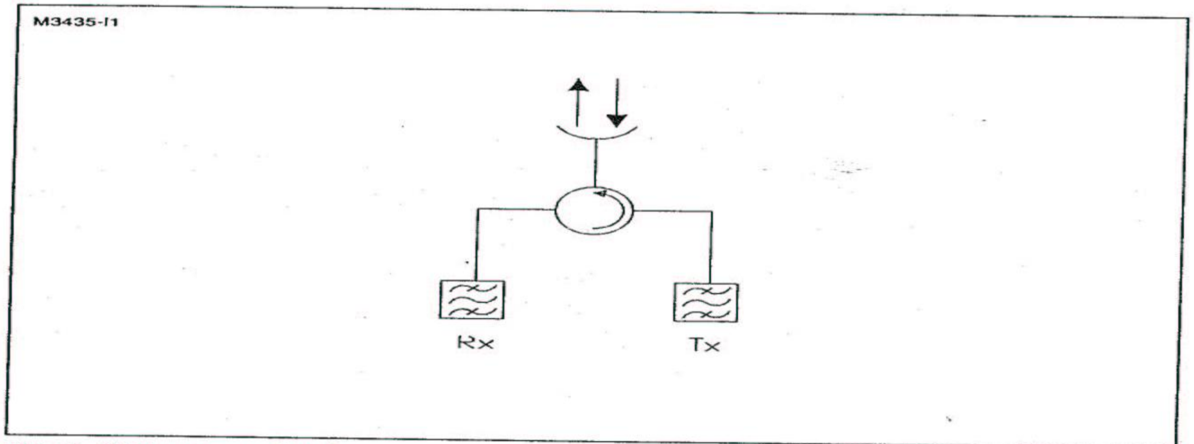


Fig. 6 - Sistema en simple

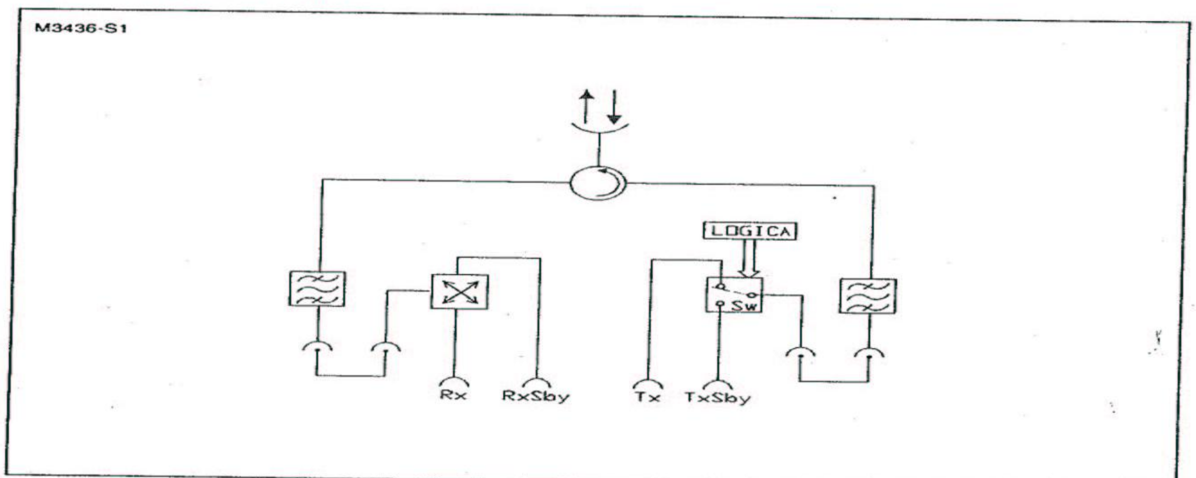


Fig. 7 - Sistema 1 + 1 Hot Stand-by - Antena única

TRANSCEPTORES. ESQUEMAS DE REDUNDANCIA

Siemens Telecomunicazioni

Documento 52-2107-100/S
Edición 2, Octubre 1991

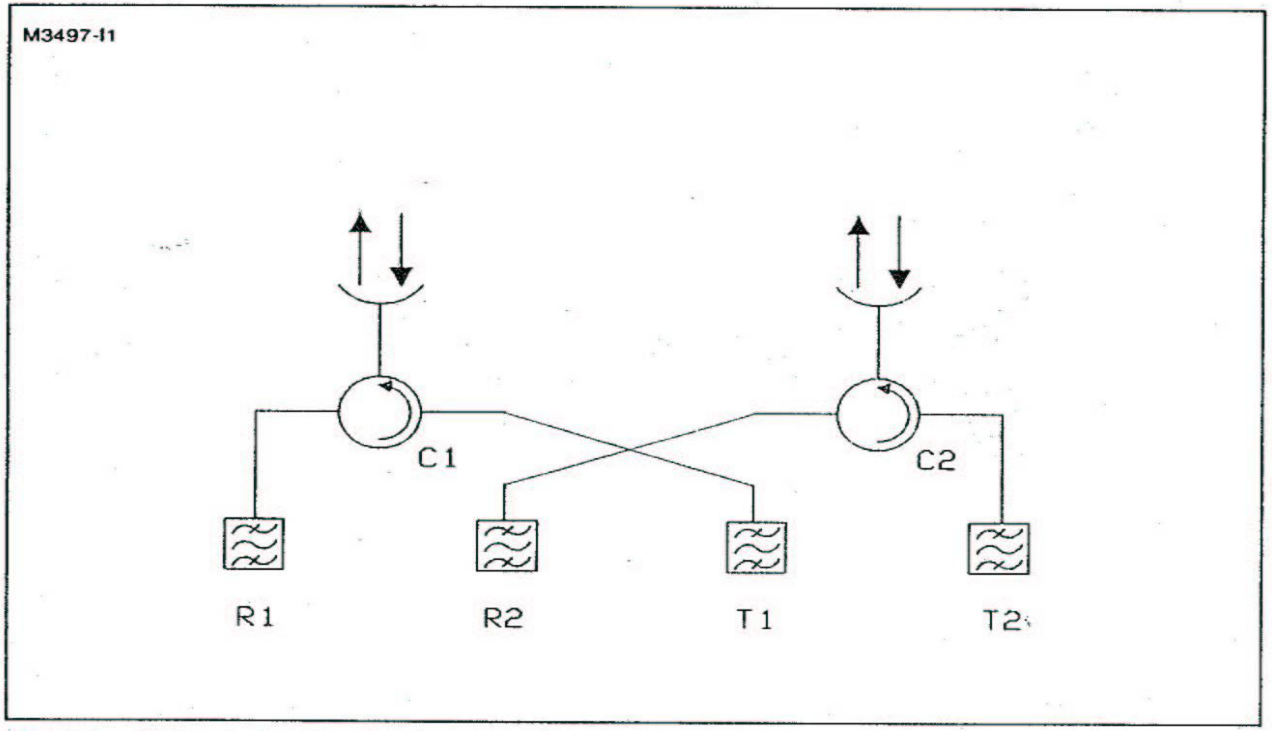


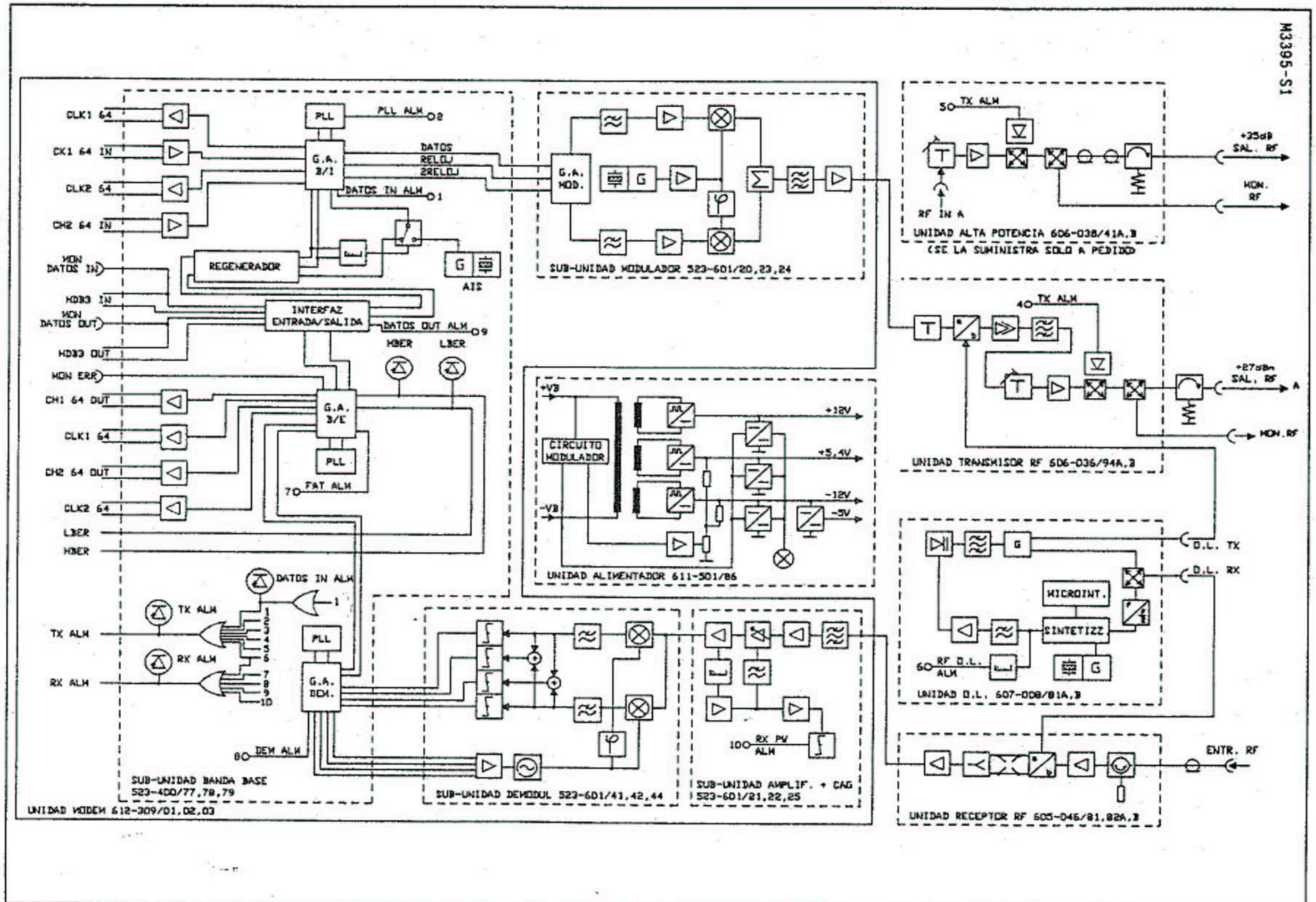
Fig. 10 - Sistema 1 + 1 heterofrecuencia con dos antenas

3. **DESCRIPCION ELECTRICA**

3.01 <u>Descripción general del Transceptor</u>

RADIO DIGITAL. TRANSCEPTOR

FIGURA 3



Siemens Telecomunicazioni

Documento 52-2107-103/S
Edición 2, Octubre 1991

RADIO DIGITAL. BANDA BASE

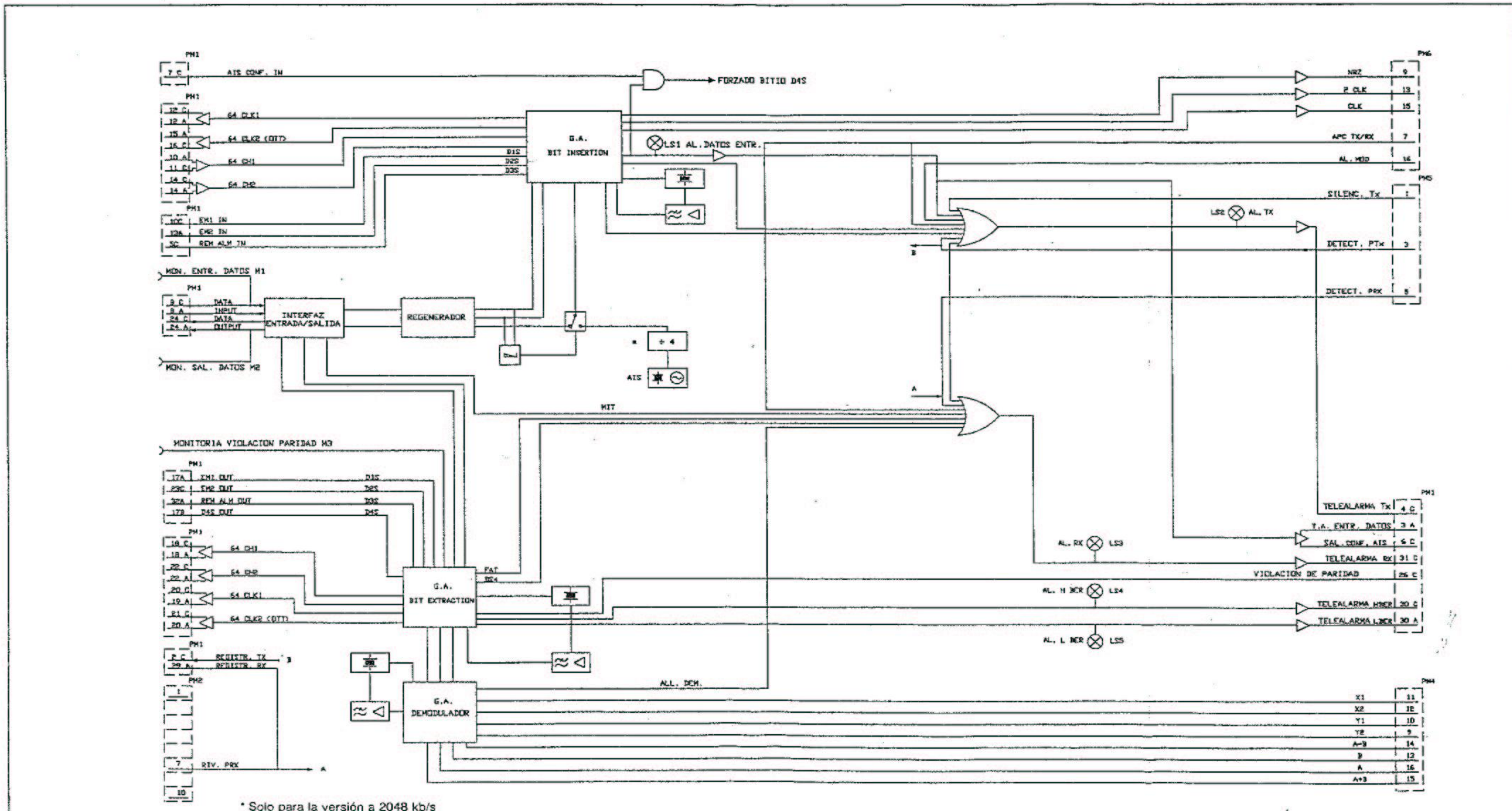


Fig. 4 - Sub-unidad Banda Base a 2-8 Mb/s

Como se puede observar en la Figura 5, el reloj de lectura está enganchado al de escritura por medio de un PLL cuyos filtro y amplificador de anillo son externos al Gate Array.

Todas las temporizaciones se efectúan por medio de un decodificador constituido por divisores predisponibles, obteniéndose todas las sincronizaciones de trama y de sector; el mismo decodificador, mediante GEN. FIN, permite además la temporización para el bloque de las direcciones de lectura de la memoria elástica en los intervalos de tiempo en los cuales se deben insertar en la trama los bitios de servicio.

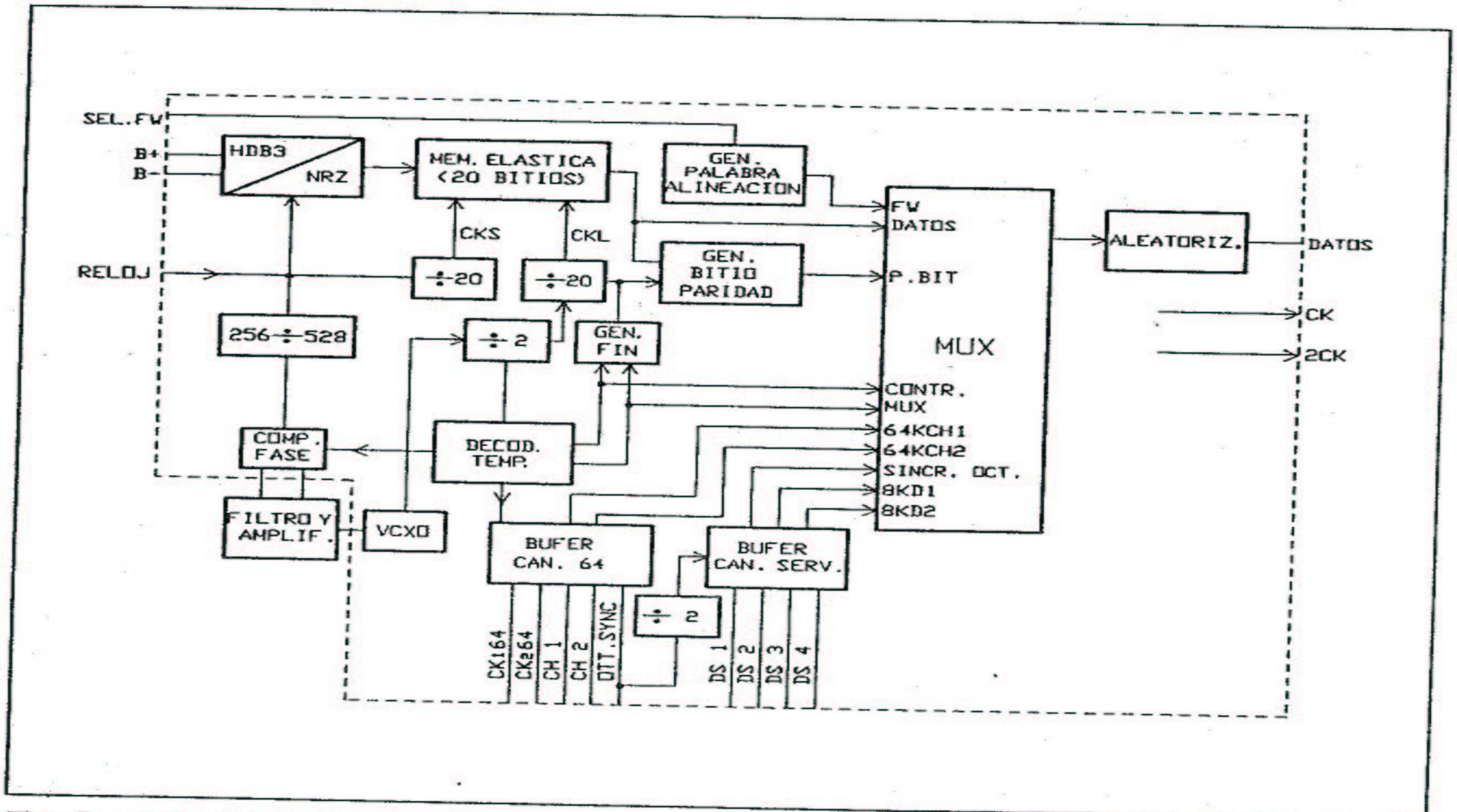


Fig. 5 - Gate Array Bit Insertion

RADIO DIGITAL. BIT EXTRACTION

Siemens Telecomunicazioni

Documento 612-309/01,03-TM/S
Edición 2, Octubre 1991

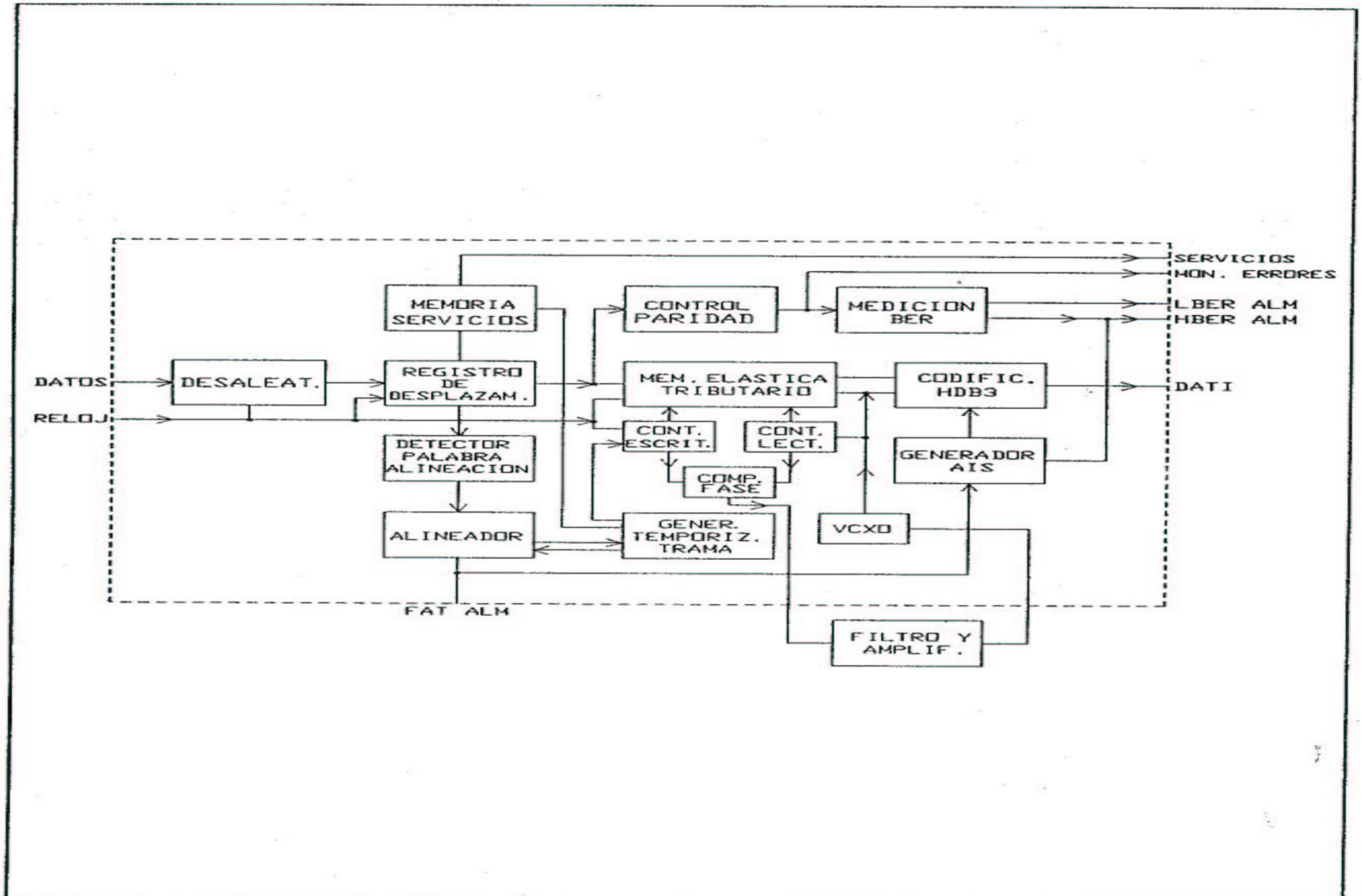


Fig. 8 - Gate Array Bit Extraction

RADIO DIGITAL. CARACTERISTICAS

Siemens Telecomunicazioni

Documento 52-2107-107/S
Edición 2, Octubre 1991

CTR 210/1.5

SISTEMA RADIO DIGITAL A 1,5 GHz

CARACTERISTICAS ELECTRICAS DEL EQUIPO

CONTENIDO:

1. CARACTERISTICAS TRANSMISOR RF

- Potencia de salida (en la salida del amplificador)	≥ 27 dBm
- Impedancia circuitos de entrada O.L., salida RF y monitoria	50 ohmios
- Impedancia de entrada FI	50 ohmios
- Nivel nominal entrada FI	-5 dBm ± 1 dB
- Potencia de salida monitoria	≥ -5 dBm
- Nivel nominal entrada O.L.	+ 12 dBm ± 1 dB
- Umbral alarma	3 dB inferior al nivel nominal de salida (histéresis aprox. 1 dB)
- Adaptación de salida RF	≥ 22 dB
- Supresión de la 2 $f_{O.L.}$	≥ 20 dB (*)
- Rechazo de imagen	≥ 15 dB (*)

(*) Con respecto a la portadora RF.

RADIO DIGITAL. CARACTERISTICAS

Siemens Telecomunicazioni

Documento 52-2107-107/S
Edición 2, Octubre 1991

2. CARACTERISTICAS AMPLIFICADOR DE ALTA POTENCIA

- Impedancia característica de los conectores de entrada, salida y monitoria RF	50 ohmios
- Potencia de entrada RF	≥ +27 dBm
- Potencia salida RF (en toda la gama)	+34 dBm ± 0,5 dB
- Potencia de salida monitoria	3 dBm ± 2 dB
- Potencia de salida en saturación	≥ 35,5 dB
- Pérdidas de retorno entrada RF	≥ 15 dB
- Pérdidas de retorno salida RF	≥ 22 dB

3. CARACTERISTICAS RECEPTOR RF

- Factor de ruido (en la entrada del "front-end")	≤ 2,5 dB
- Máximo nivel nominal de entrada RF:	
. 2 Mb/s	-35 dBm
. 2x2 Mb/s	-35 dBm
. 8 Mb/s	-35 dBm
- Ganancia RF/FI	35 dBm ± 1 dB
- Impedancia de entrada RF	50 ohmios
- Impedancia de salida FI	50 ohmios
- Impedancia de entrada O.L.	50 ohmios
- Adaptación de entrada RF	≥ 22 dB
- Nivel nominal de entrada O.L.	+12 dBm ± 1 dB
- Umbral BER = 1x10-3 (excluidas las pérdidas del sistema de derivación):	
. 2 Mb/s	-97,5 dBm
. 2x2 Mb/s	-94,5 dBm
. 8 Mb/s	-91,5 dBm
- C/I para 1 dB de degradación del umbral de BER 1x10-3	≤ 21 dB

4. CARACTERISTICAS OSCILADOR LOCAL

- Paso de síntesis frecuencia O.L.	62,5 kHz
- Gama de frecuencia (Nota):	
. Semigama baja	677 ÷ 705,9375 MHz
. Semigama alta	766 ÷ 803,9375 MHz
- Estabilidad de frecuencia (5 ÷ 40°C)	± 10 ppm
- Nivel de salida	+12 dBm ± 1 dB

Nota: la frecuencia de síntesis O.L. es la frecuencia real de trabajo del oscilador local; la frecuencia virtual del O.L. es la segunda armónica a la cual trabajan los convertidores de Tx y de Rx.

RADIO DIGITAL. SENSIBILIDAD RX

Siemens Telecomunicazioni

Documento 52-2107-501/S
Edición 2, Octubre 1991

Tabla 4 - Curvas de BER en función del campo recibido

Configuración	Frec. de shifter (MHz)	2 Mb/s	2×2 Mb/s	2 Mb/s	BER
No redundada	40 ÷ 51 51 ÷ 65,5	≤ -95,5dBm ≤ -96,2dBm	≤ -93 dBm - ≤ -93,7 dbm	≤ -90,5 dBm ≤ -91,2 dBm	≤ 10^{-3}
Heterofrec. 1 + 1 con una antena	40 ÷ 51 51 ÷ 65,5	≤ -95 dBm ≤ -95,7 dBm	≤ -92,5 dBm ≤ -93,2 dBm	≤ -90,3 dBm ≤ -91 dBm	
Hot- Stand-by vía preferencial	40 ÷ 51 51 ÷ 65,5	≤ -94,6 dBm ≤ -95,4 dBm	≤ -91,7 dBm ≤ -94,5 dBm	≤ -89,2 dBm ≤ -90,6 dBm	
Hot- Stand-by vía secundaria	40 ÷ 51 51 ÷ 65,5	≤ -85 dBm ≤ -86 dBm	≤ -82,5 dBm ≤ -83,5 dBm	≤ -80 dBm ≤ -81 dBm	
No redundada	40 ÷ 51 51 ÷ 65,5	≤ -94,1 dBm ≤ -94,8 dBm	≤ -92 dBm ≤ -92,7 dBm	≤ -89,1 dBm ≤ -89,8 dBm	≤ 10^{-4}
Heterofrec. 1 + 1 con una antena	40 ÷ 51 51 ÷ 65,5	≤ -93,6 dBm ≤ -94,3 dBm	≤ -91,5 dBm ≤ -92,2 dBm	≤ -88,6 dBm ≤ -89,3 dBm	
Hot- Stand-by vía preferencial	40 ÷ 51 51 ÷ 65,5	≤ -93,2 dBm ≤ -94 dBm	≤ -90,7 dBm ≤ -91,5 dBm	≤ -87,8 dBm ≤ -88,6 dBm	
Hot- Stand-by vía secundaria	40 ÷ 51 51 ÷ 65,5	≤ -83,6 dBm ≤ -84,6 dBm	≤ -81,5 dBm ≤ -84,5 dBm	≤ -78,6 dBm ≤ -79,6 dBm	
No redundada	40 ÷ 51 51 ÷ 65,5	≤ -92,9 dBm ≤ -93,6 dBm	≤ -90,7 dBm ≤ -91,4 dBm	≤ -87,9 dBm ≤ -88,6 dBm	≤ 10^{-5}
Heterofrec. 1 + 1 con una antena	40 ÷ 51 51 ÷ 65,5	≤ -92,4 dBm ≤ -93,1 dBm	≤ -90,2 dBm ≤ -90,9 dBm	≤ -87,4 dBm ≤ -88,1 dBm	
Hot- Stand-by vía preferencial	40 ÷ 51 51 ÷ 65,5	≤ -92 dBm ≤ -93,1 dBm	≤ -89,4 dBm ≤ -91 dBm	≤ -84,6 dBm ≤ -88,2 dBm	
Hot- Stand-by vía secundaria	40 ÷ 51 51 ÷ 65,5	≤ -84,4 dBm ≤ -83,4 dBm	≤ -80,2 dBm ≤ -81,2 dBm	≤ -77,4 dBm ≤ -78,4 dBm	
No redundada	40 ÷ 51 51 ÷ 65,5	≤ -91,7 dBm ≤ -92,4 dBm	≤ -89,1 dBm ≤ -89,8 dBm	≤ -86,7 dBm ≤ -87,4 dBm	≤ 10^{-6}
Heterofrec. 1 + 1 con una antena	40 ÷ 51 51 ÷ 65,5	≤ -91,2 dBm ≤ -91,9 dBm	≤ -88,6 dBm ≤ -89,3 dBm	≤ -86,1 dBm ≤ -86,1 dBm	
Hot- Stand-by vía preferencial	40 ÷ 51 51 ÷ 65,5	≤ -90,8 dBm ≤ -91,6 dBm	≤ -87,8 dBm ≤ -88,6 dBm	≤ -85,4 dBm ≤ -86,2 dBm	
Hot- Stand-by vía secundaria	40 ÷ 51 51 ÷ 65,5	≤ -81,2 dBm ≤ -82,2 dBm	≤ -78,6 dBm ≤ -79,6 dBm	≤ -85,2 dBm ≤ -86,2 dBm	

Sigue

RADIO DIGITAL. SENSIBILIDAD RX

Siemens Telecomunicazioni

Documento 52-2107-501/S
Edición 2, Octubre 1991

Continuación

Configuración	Frec. de shifter (MHz)	2 Mb/s	2×2 Mb/s	2 Mb/s	BER
No redundada	40 ÷ 51 51 ÷ 65,5	≤ -90,5 dBm ≤ -91,2 dBm	≤ -88,2 dBm ≤ -88,9 dBm	≤ -85,4 dBm ≤ -86,1 dBm	$\leq 10^{-7}$
Heterofrec. 1 + 1 con una antena	40 ÷ 51 51 ÷ 65,5	≤ -90 dBm ≤ -90,3 dBm	≤ -87,7 dBm ≤ -87,6 dBm	≤ -84,9 dBm ≤ -84,8 dBm	
Hot- Stand-by vía preferencial	40 ÷ 51 51 ÷ 65,5	≤ -89,6 dBm ≤ -90,4 dBm	≤ -86,9 dBm ≤ -87,6 dBm	≤ -84,1 dBm ≤ -84,9 dBm	
Hot- Stand-by vía secundaria	40 ÷ 51 51 ÷ 65,5	≤ -80 dBm ≤ -81 dBm	≤ -77,7 dBm ≤ -78,7 dBm	≤ -74,2 dBm ≤ -75,2 dBm	

RADIO DIGITAL. SENSIBILIDAD RX

Siemens Telecomunicazioni

Documento 52-2107-501/S
Edición 2, Octubre 1991

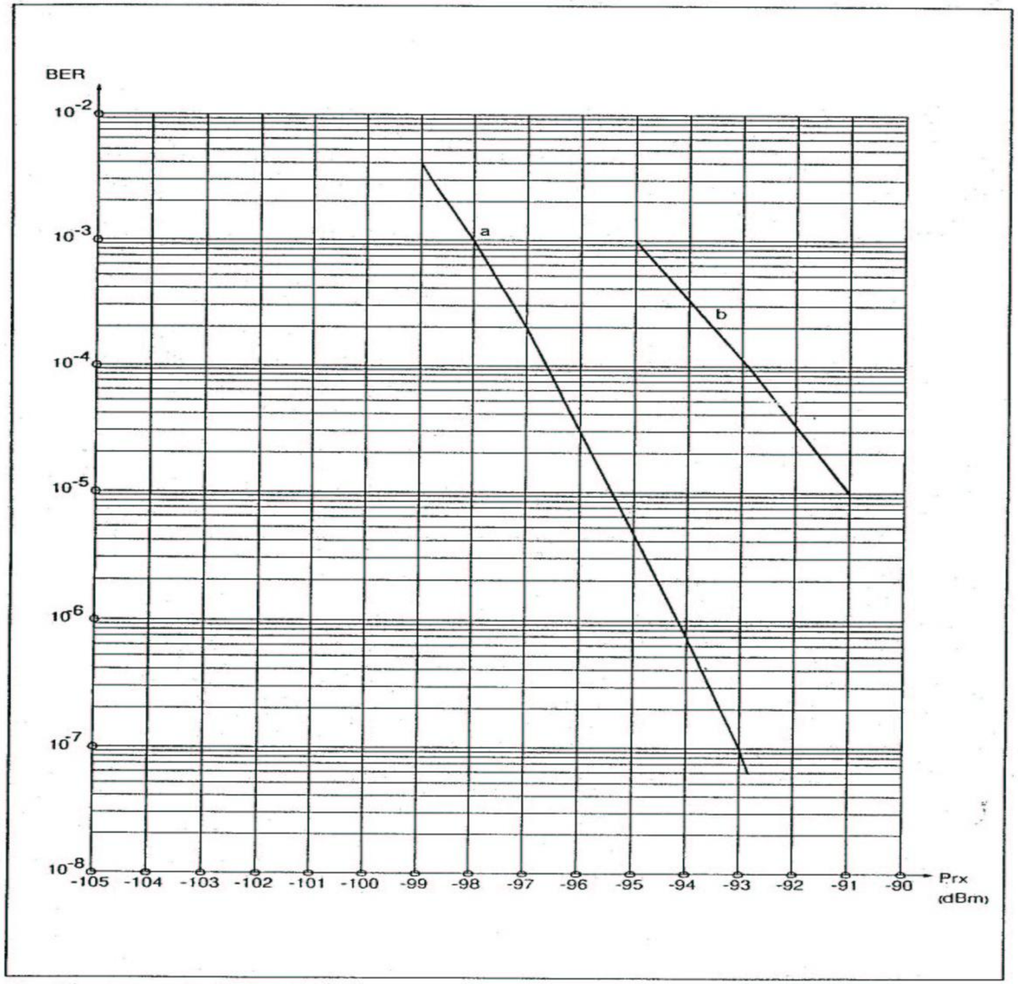


Fig. 13 - Curva de BER a 2 Mb/s

MEDICION DE TASA DE ERROR

Siemens Telecomunicazioni

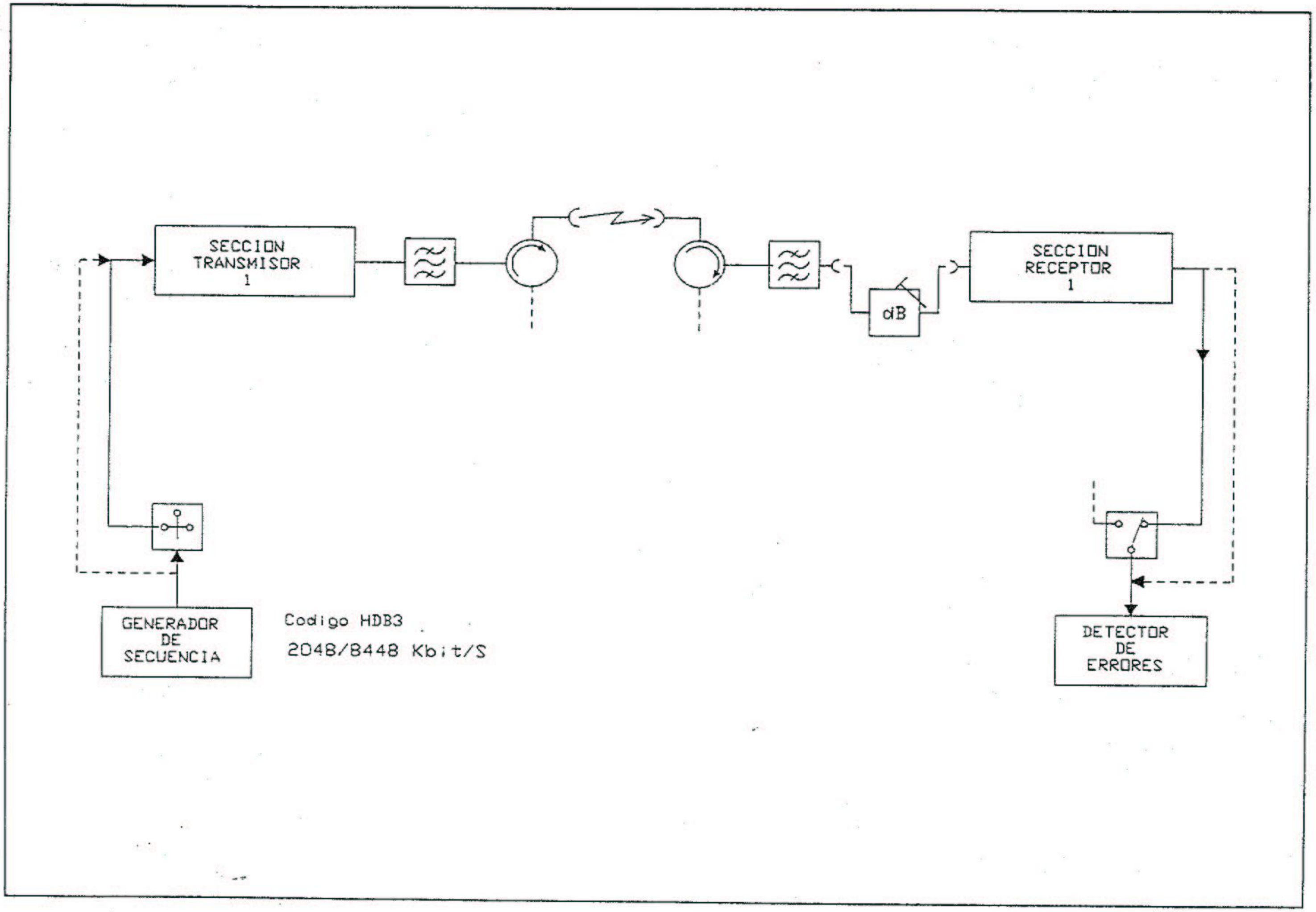


Fig. 10 - Esquema de medición de la BER en el flujo a 2/8 Mb/s

Documento 52-2107-501/S
Edición 2, Octubre 1991

TRANSCEPTOR DE DATOS. EJEMPLO

LEDR™ Subrate Series

Non-ETSI

LEDR 400S 330-512 MHz
LEDR 900S 800-960 MHz
LEDR 1400S 1350-1535 MHz
LEDR Protected
LEDR Fractional T1/E1 Interface

industrial wireless PERFORMANCE

MDS...Global wireless solutions. Industrial Wireless Performance.
For nearly two decades, Microwave Data Systems (MDS) has been providing highly secure, industrial strength mission critical wireless communications solutions for a broad spectrum of public and private sector clients worldwide. With an installed base approaching 1,000,000 radios in 110 countries, MDS offers both licensed and license-free solutions with applications in SCADA, telemetry, public safety, telecommunications, and online transaction markets.

Features

- Frequency Range: 330 MHz to 512 MHz, 800 MHz to 960 MHz, or 1350 MHz to 1535 MHz
- Data Rates: Scalable from 64 kbps to 768 kbps
- Spectrally Efficient: Selectable 64 QAM*, 32 QAM, 16 QAM or QPSK
- Excellent Sensitivity: Better than –102 dBm @ 10^{-6} BER at 64 kbps
- Advanced Modem Features: FEC, Interleaver and Adaptive Equalizer
- Front Panel Displays for Easy Maintenance and Link Monitoring
- Built-in NMS Element Manager
- SNMP Network Management for Fault, Configuration, Performance and Security Management
- Integrated HTML web server allows network wide management via the Internet
- Built-in 9600 bps Data Service Channel
- Local Loopback and Remote Loopback
- 8 Relay Alarm Contacts per Radio
- DTMF Compatible Orderwire
- Optional interfaces for direct connection to Fractional T1/E1 circuits
- Optional 1+1 hot standby protected configuration
- Optional space diversity configuration
- Optional Integrated voice/data multiplexer

*** Consult Factory**

Applications

- Point-to-point transmission applications
- Cost effective thin route applications
- Long haul telecommunication links
- Cellular backhaul
- Last mile links
- Trunked radio
- SCADA

Product Overview

The new subrate LEDR microwave radio family provides full duplex, scalable bandwidth and capacity from 64 kbps to 768 kbps in a 200 kHz channel. These radios are designed to operate in a point-to-point environment with a wide range of applications. They are especially effective for telecommunications access and transport links, wireless backbones for SCADA systems, and for use as backhauls to extend existing telecommunication channels. The subrate LEDR microwave radio is designed to connect to any industry standard EIA-530, V.35, fractional T1 or E1 source.

industrial/wireless/performance

MDS

TRANSCEPTOR DE DATOS. EJEMPLO

LEDR™ Subrate Series Specifications

Non-ETSI

General Specifications

Frequency Ranges	
LEDR 400S	330-512 MHz
LEDR 900S	800-960 MHz
LEDR 1400S	1350-1535 MHz
RF Occupied Bandwidth	25, 50,100, and 200 kHz
User Data Rates	64 kbps, 128 kbps, 256 kbps, 384 kbps, 512 kbps, 768 kbps
Modulation Type	64 QAM*, 32 QAM, 16 QAM, QPSK
FEC	Reed Solomon
Temperature Range	−10° to 50° C
Humidity	<95% non-condensing
Voltage Range	±12 Vdc (w/external power supply) (±20%) ±24 Vdc, or ±48 Vdc (±20%)
Power Consumption	Non-Protected: < 60 W, Protected: < 135 W
Size	4.5cm (1U) x 48cm x 30cm 1.75in x 19in x 12

System Performance

Channel Spacing		25 kHz	50 kHz	100 kHz	200 kHz
Capacity*	incl. overhead	72 kbps	152 kbps	360 kbps	800 kbps
	w/o overhead	64 kbps	128 kbps	256 kbps	768 kbps
Receiver Sensitivity (10^{-6} BER)[1] (16 QAM)		-102 dBm	-100 dBm	-97 dBm	-92 dBm
System Gain (10^{-6} BER) (16 QAM)		133 dB	131 dB	128 dB	123 dB

Modulation Type	Threshold Differential	System Gain Differential	Normalized Bandwidth for Fixed Rate	Normalized Rate for Fixed Bandwidth
QPSK	- 3 dB	-3 dB	2.0	0.5
16 QAM	0 dB	0 dB	1.0	1.0
32 QAM	+ 1.5 dB	+2.5 dB	0.80	1.25
64 QAM*	+4 dB	+6 dB	0.67	1.50

1. Receiver sensitivity specs. for 10^{-3} BER are typically 3 dB better.

Transmitter

Power Output at antenna port	+31 dBm (16 QAM) +30 dBm (32 QAM) +29 dBm (64 QAM)
Output Control Range	10 steps of up to 10 dB
Frequency Stability	1.5 ppm
Spurious Outputs	<-60 dBc

Receiver

Residual BER	$<1 \times 10^{-10}$
Dynamic Range	>65 dB

Interfaces

Data	EIA-530 / G.703 (option available)
Orderwire	DTMF capable
Data Service Channel	RS-232, 300-9600 bps
Ethernet NMS	10 Base-T
Console Port	RS-232, 300 bps to 115.2 kbps
Alarms	4 programmable outputs, 4 programmable inputs
Antenna	50 Ohms Impedance

Options

Space Diversity
Hot-standby Protected
Bandwidth Upgrade Kits (consult factory for details)
Bandpass Duplexers
Integrated Multiplexers (see separate specifications sheet)

Network Management

Local LED Indicators	Front Panel LED status indicate: Power, Active, General Alarm, Rx Alarm, Tx Alarm, I/O Alarm.
Front Panel LCD	Display & keypad for management of local & remote radio.
Element Management	Full management of LEDR network via command line interface.
SNMP Management	Full IP-based management of LEDR network and SNMP-enabled peripherals via custom enterprise MIB
HTML Webserver	Full IP-based management of LEDR network and web-enabled peripherals via any web browser (e.g. Netscape™ or Internet Explorer™)

*** Consult Factory**

Accessories

110/240 Vac , 50/60 Hz Power Supply
Orderwire Handset
G.703 120 Ohms to 75 Ohms balun

Protected

Configuration	2 x LEDR radios, connected via protected switch box
Total Size	2 x 1 RU high + 1 x 2 RU high
Transmit Branching Loss	2 dB
Receive Branching Loss	5 dB
Receive Switching	Hitless

Agency Approvals

LEDR 400S	Transmission: FCC Part 90, IC RSS-119 EMC: ETS 300 385, FCC Part 15
LEDR 900S	Transmission: FCC Part 101, IC RSS-119 EMC: FCC Part 15
LEDR 1400S	Transmission: ETS 300 630, MPT 1717, Class 3 Environmental: ETS 300 019, Class 3.2 EMC: ETS 300 385 Safety: CE Mark

LEDR Fractional T1/E1 Interface Card

General Specifications

Line rate	T1 (1.544 Mbps); E1 (2.048 Mbps)
Channel Size	200 kHz
Data Rate	768 kbps (12 x 64 kbps)
Framing	SF, ESF (T1); FAS, CAS, CRC (E1)
Signaling	RBS (T1); Time Slot 16 CAS (E1)
Line Codes	AMI, B8ZS, B7ZS (T1); AMI, HDB3 (E1)
Interface	RJ48C Balanced Interface 100 Ohms (T1), 120 Ohms (E1)

Physical

Size	15.24 cm x 12.7 cm (6 in x 5 in)
Configuration	Option card, fitted internal to LEDR chassis
Availability	Fractional T1: LEDR 400S, LEDR 900S, LEDR 1400S
	Fractional E1: LEDR 400S, LEDR 900S, LEDR 1400S

industrial/wireless/performance

MDS

MICROWAVE DATA SYSTEMS INC.
175 SCIENCE PARKWAY
ROCHESTER, NEW YORK 14620, USA
PHONE (585) 242-9600
FAX (585) 242-9620
WWW.MICROWAVEDATA.COM

EAIII-INTRODUCCION- EL RECEPTOR DE RADIO

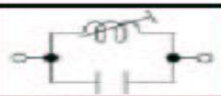
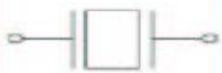
FILTROS DE RF

- LC
- RESONADOR HELICOIDAL
- CAVIDAD
- CERAMICOS
- CRISTAL
- MECANICOS

FILTROS COMPARACION DE RESONADORES

following table.

The features of each type of resonator

Name	Symbol	Price	Size	Adjustment	Initial frequency tolerance
LC		Inexpensive	Large	Necessary	+/-2.0%
CR		Inexpensive	Small	Necessary	+/-2.0%
Quartz crystal resonator		Expensive	Large	Unnecessary	+/- 0.001%
Ceramic resonator		Inexpensive	Small	Unnecessary	+/-0.5%

FILTROS. LC PASABANDA

TOKO JAPAN

Japanese English Chinese Gl

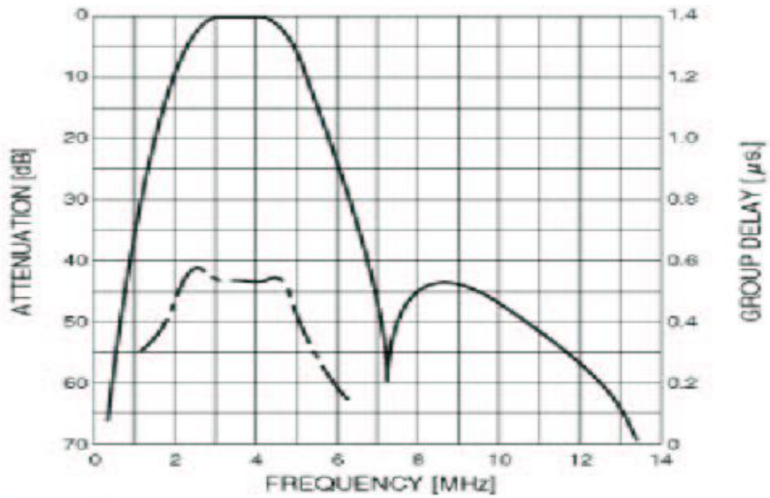
Products Information | Investor Relations | Environmental Activities | Corporate Profile

Home > Products Information > Products Catalog > LC filters for HDTV and VCR > 4FFH > ##692CF-0152

LC filters for High Definition TV and VCR

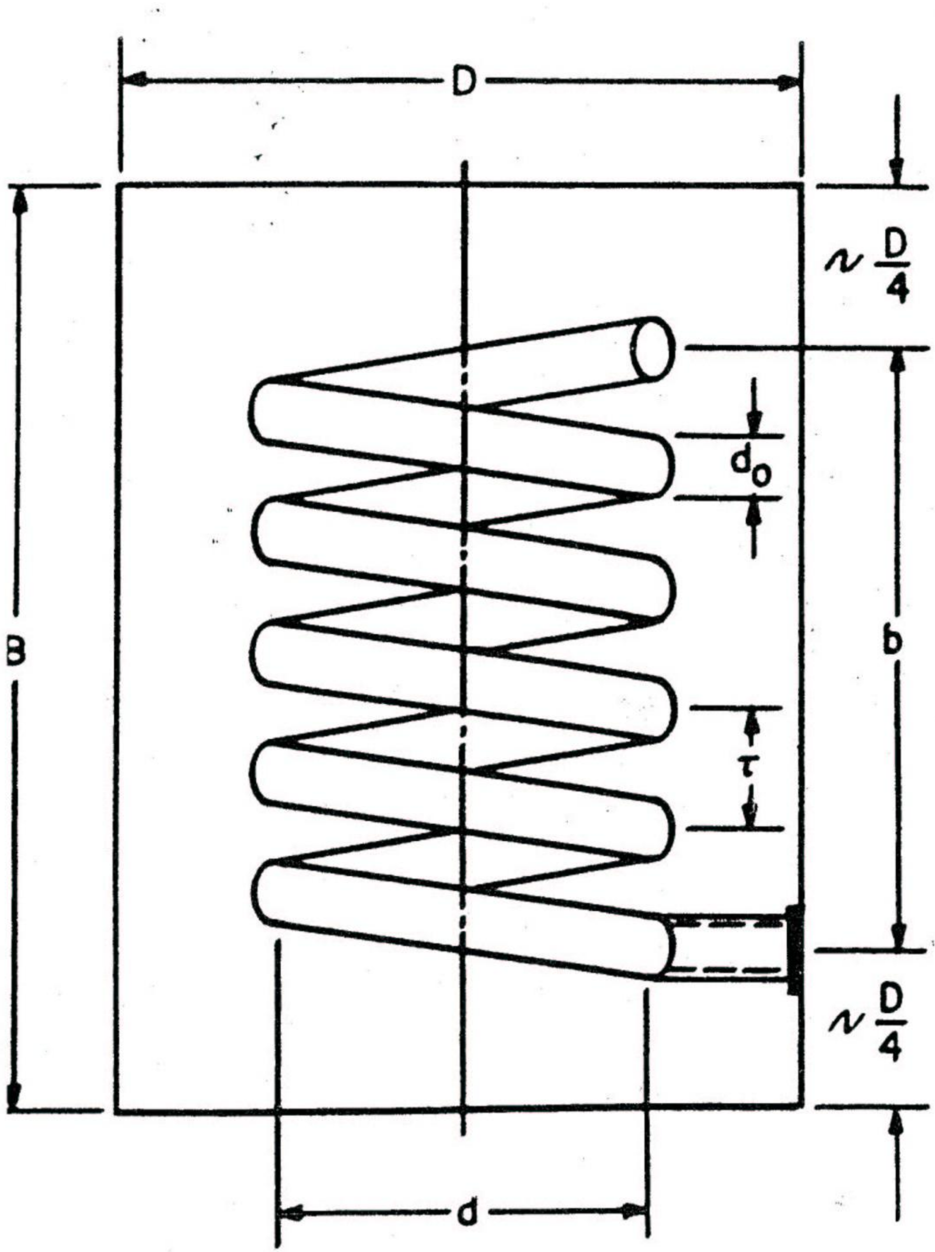
Characteristics

##692CF-0152 3.58MHz-BPF

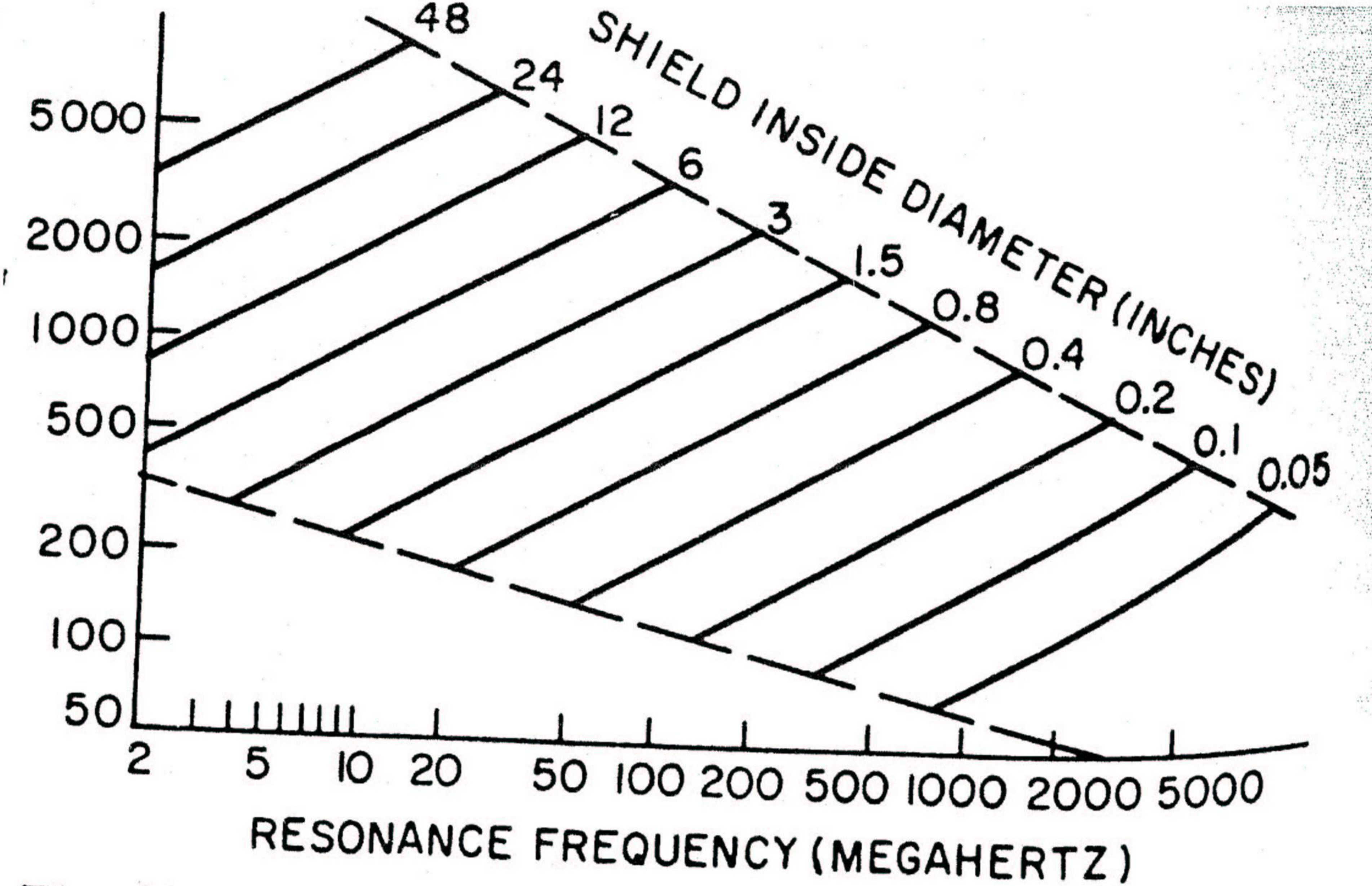


[Terms of Us

FILTROS. RESONADOR HELICOIDAL



FILTROS. RESONADOR HELICOIDAL



FILTROS. RESONADOR HELICOIDAL

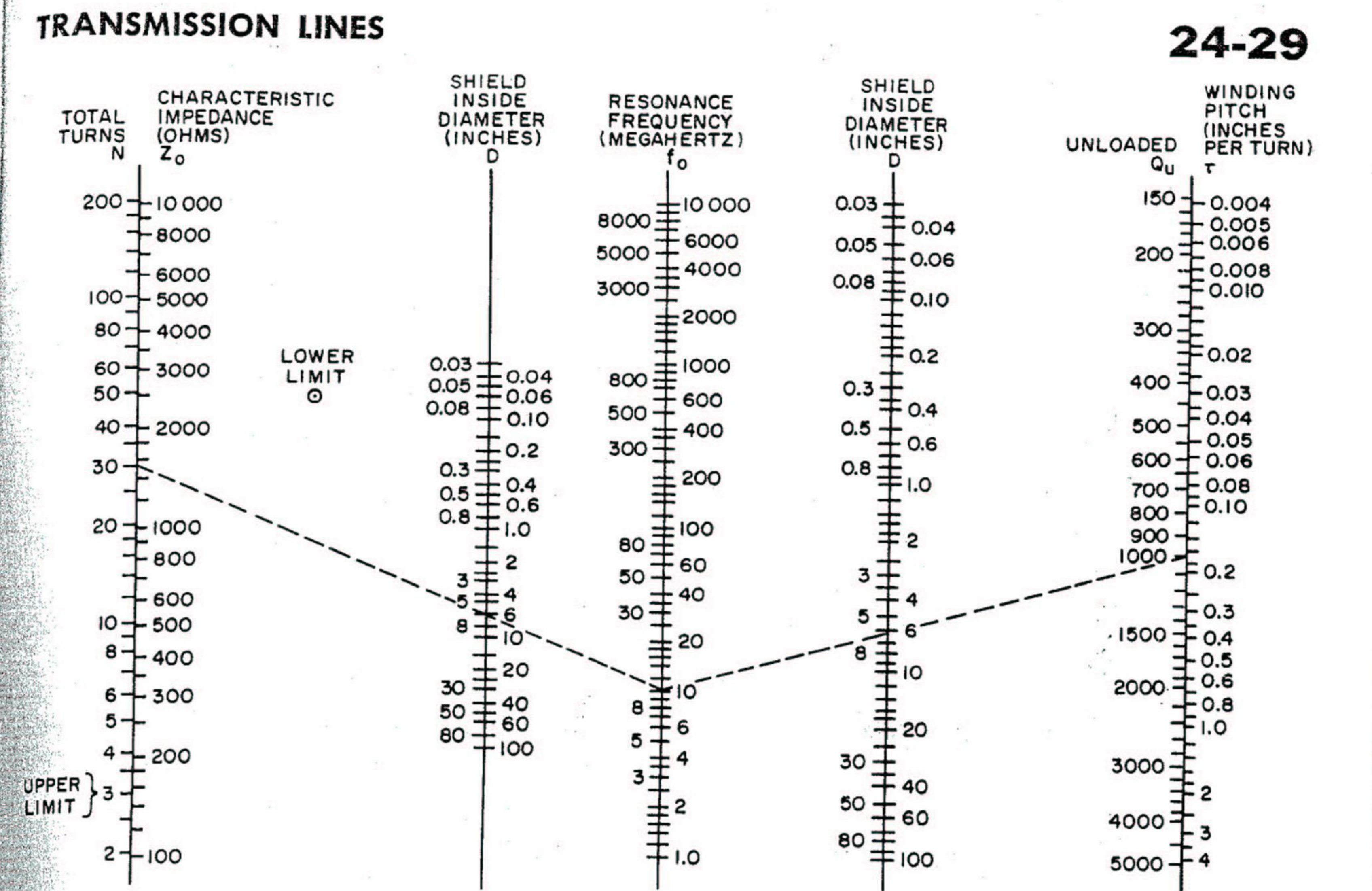


Fig. 34—Design chart for quarter-wave helical resonators. *W. W. Macalpine and R. O. Schildknecht, "Coaxial Resonators with Helical Inner Conductor." Proceedings of the I.R.E. vol. 47, no. 12, p. 2101; December 1959* © 1959

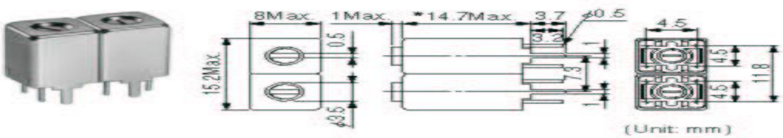
FILTROS HELICOIDALES

TOKO — **Radial Type Helical Filters**
ラジアルタイプヘリカルフィルタ

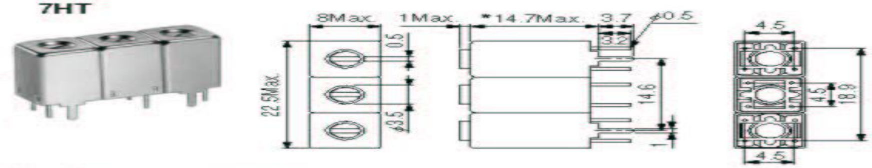
TYPE **7HW** **7HT**

7HW Double Tuned
7HT Triple Tuned
Frequency Range: 350MHz~1.2GHz
RoHS compliant

7HW



7HT



*Either 11 or 12.9mm height is possible.　高さ11mm、12.9mmも可能です

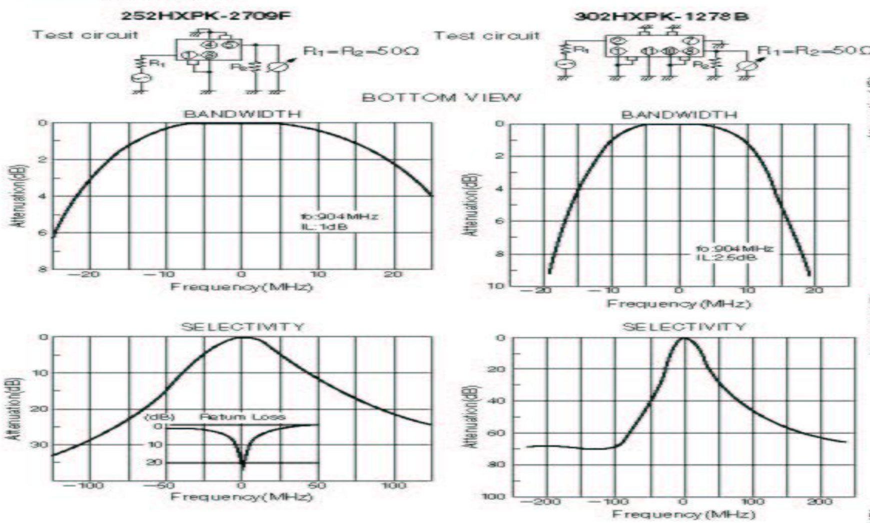
Features

- Compact low-profile helicalfolters, ideal for mobile communications equipment.
- RoHS compliant

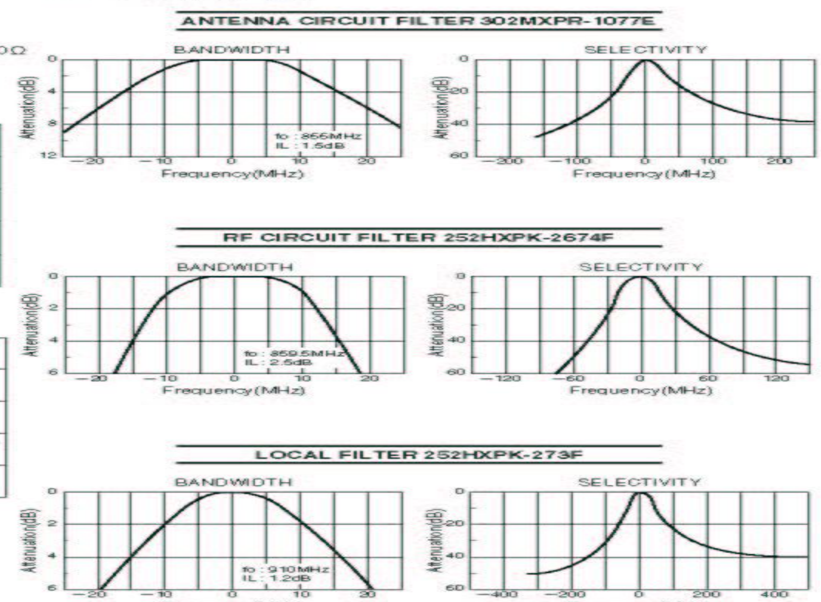
特　長

- 移動体通信に最適な小型薄形のヘリカルフィルタ
- RoHS 指令対応

Examples of 900MHz frequency response
900MHz周波数感度例



Typical characteristic for MCA radio use
MCAラジオ用代表特性曲線



continued on next page
次頁へ続く

FILTROS HELICOIDALES

TOKO **Helical Filters**

TYPE
7HW
7HT

continued from previous page

SELECTION GUIDE FOR STANDARD FILTERS

TYPE 7HW (Double tuned)

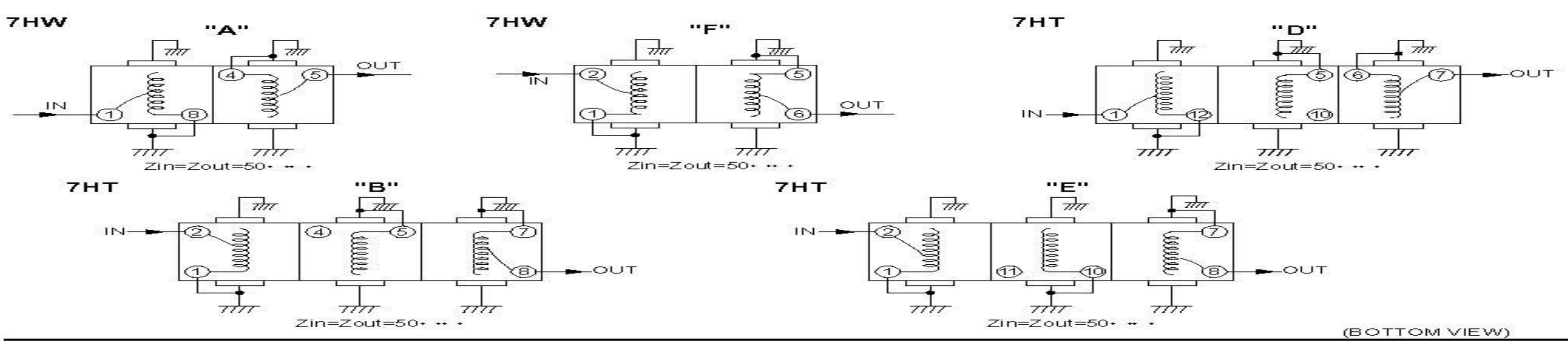
TOKO Part Number	Center Frequency (MHz)	Bandwidth (-1dB) (MHz) Min.	Selectivity Fo - 50MHz (dB) Min.	Selectivity Fo + 50MHz (dB) Min.	Ripple (dB) Max.	Insertion Loss (dB) Max.
7HW-35515A-360	360	7.0	35	25	0.5	3.0
7HW-36020A-370	370	7.0	35	25	0.5	3.0
7HW-37020A-380	380	7.0	35	20	0.5	3.0
7HW-38025A-390	390	7.0	28	20	0.5	3.0
7HW-39525A-410	410	7.0	25	18	0.5	3.0
7HW-40525A-420	420	8.0	25	18	0.5	3.0
7HW-42025A-435	435	8.0	25	18	0.5	3.0
7HW-43525A-450	450	8.0	25	18	0.5	3.0
7HW-45025A-460	460	8.0	20	16	0.5	3.0
7HW-46025A-475	475	8.0	20	16	0.5	3.0
7HW-47530A-490	490	10.0	18	14	0.5	3.0
7HW-49030A-505	505	10.0	18	14	0.5	3.0
7HW-51030A-525	525	10.0	14	12	0.5	3.0

TYPE 7HT (Triple tuned)

TOKO Part Number	Center Frequency (MHz)	Bandwidth (-1dB) (MHz) Min.	Selectivity Fo - ( )MHz (dB) Min.	Selectivity Fo + ( )MHz (dB) Min.	Ripple (dB) Max.	Insertion Loss (dB) Max.
302MXPR-1138D	370	*6.0	35(30)	30(30)	1.0	4.5
302MXPR-1137D	390	*7.0	30(30)	25(30)	1.0	4.0
302MXPR-1136D	410	*8.0	30(30)	25(30)	1.0	3.5
302MXPR-1109D	415	13.0	40(50)	30(50)	1.0	3.5
302MXPR-1110D	465	12.0	40(50)	30(50)	1.0	4.0
302MXPR-1108D	500	13.0	36(50)	27(50)	1.0	3.5
302MXPR-1119D	680	10.0	43(50)	34(50)	1.0	4.5
302HXPK-1111B	833	*18.0	30(50)	23(50)	1.0	4.0

*Bandwidth: 13dB

Test circuits



DTV READY!

NEW!

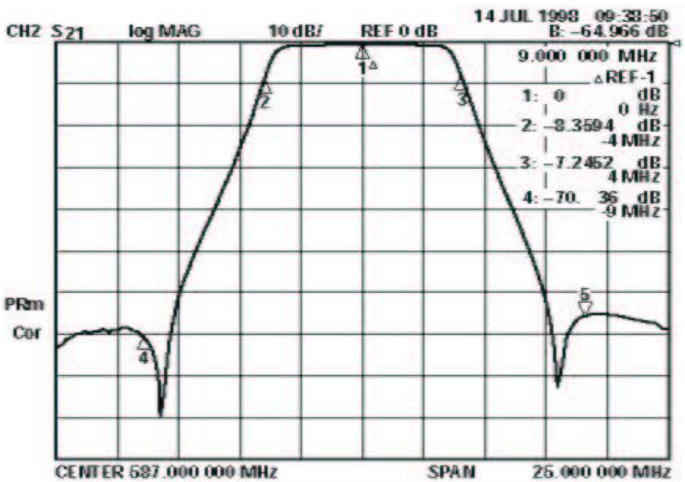
These patent pending filters are the most practical solution for single amplifier installations. Modular system design economically preserves your expansion options.

30 kW UHF Band-pass D-MasK™ Filters for DTV Broadcast

- *Multi-Mode*
- *Low Insertion Loss*
- *Superior Rejection*
- *Temperature Compensated*
- *Lightweight Aluminum Construction*
- *Compact Size*
- *Low VSWR*
- *Average Powers to 30 kW*

D-MasK Series DTV Bandpass Filters

Andrew has recently revolutionized the DTV filter market with a temperature compensated, mixed mode, band-pass filter to meet the latest FCC performance specifications. This filter uses patented technology to suppress unwanted spurious signals to desirable levels while compensating for drifts in temperature due to RF heating and ambient changes.



Specifications

Average Power Rating, kW	30
Frequency	UHF-TV
Passband VSWR	1.08 or better
Insertion Loss, dB, max.	0.3
Rejection, dB at Fc ± 9.0 MHz	-64
Group Delay Variation, ns, max.	150
Impedance, ohms	50
Connections	4-1/16" EIA
Dimensions, in (mm)	72 x 54 x 54 (1829 x 1372 x 1372)

P05E.pdf
08.2.13

Ceramic Filters (CERAFIL®)/ Ceramic Discriminators for Communications Equipment

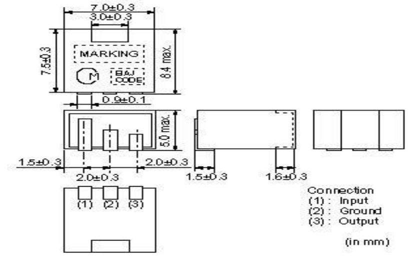
muRata *Innovator in Electronics*

Murata Manufacturing Co., Ltd.

Cat.No.P05E-13

CERAFIL® kHz SMD Type SFPKA Series

The SFPKA series is comprised of small, high performance, economical, thin (5.0mm) filters consisting of 4 ceramic elements.
Their innovative construction is perfect for shrinking mobile communication products such as cordless phones, pager and transceivers.



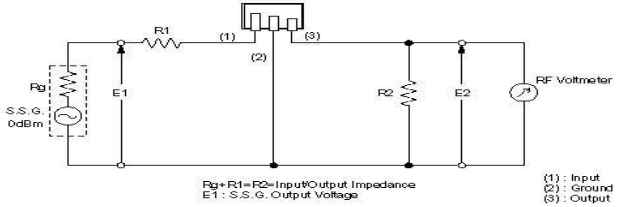
■ Features

1. The filters are mountable by automatic placers.
2. The filters can be reflow soldered and withstand washing.
3. They are slim, at only 5.0mm maximum thickness.
4. The bandwidth ranges from D to H.
5. Operating temperature range: -20 to +80 (degree C)
   Storage temperature range: -40 to +85 (degree C)

Part Number	Center Frequency (fo) (kHz)	6dB Bandwidth (kHz)	Stop Bandwidth (kHz)	Stop Band Attenuation (dB)	Insertion Loss (dB)	Ripple (dB)	Input/Output Impedance (ohm)
SFPKA455KD4A-R1	455 ±1.5kHz	fn±10.0 min.	fn±20 max. [within 40dB]	27 min. [within fn±100kHz]	4 max. [at minimum loss point]	2 max. [within fn±7kHz]	1500
SFPKA455KE4A-R1	455 ±1.5kHz	fn±7.5 min.	fn±15 max. [within 40dB]	27 min. [within fn±100kHz]	6 max. [at minimum loss point]	1.5 max. [within fn±5kHz]	1500
SFPKA455KF4A-R1	455 ±1.5kHz	fn±6 min.	fn±12.5 max. [within 40dB]	27 min. [within fn±100kHz]	6 max. [at minimum loss point]	1.5 max. [within fn±4kHz]	1500
SFPKA455KG1A-R1	455 ±1.0kHz	fn±4.5 min.	fn±10.0 max. [within 40dB]	25 min. [within fn±100kHz]	6 max. [at minimum loss point]	1.5 max. [within fn±3kHz]	1500
SFPKA455KH1A-R1	455 ±1.0kHz	fn±3 min.	fn±9 max. [within 40dB]	35 min. [within fn±100kHz]	6 max. [at minimum loss point]	1.5 max. [within fn±2kHz]	2000

Center frequency (fo) defined by the center of 6dB bandwidth.
(fn) means nominal center frequency 455kHz.
For safety purposes, connect the output of filters to the IF amplifier through a D.C. blocking capacitor. Avoid applying a direct current to the output of ceramic filters.
The order quantity shoud be an integral multiple of the "Minimum Quantity" shown in package page in this catalog.

■ Test Circuit



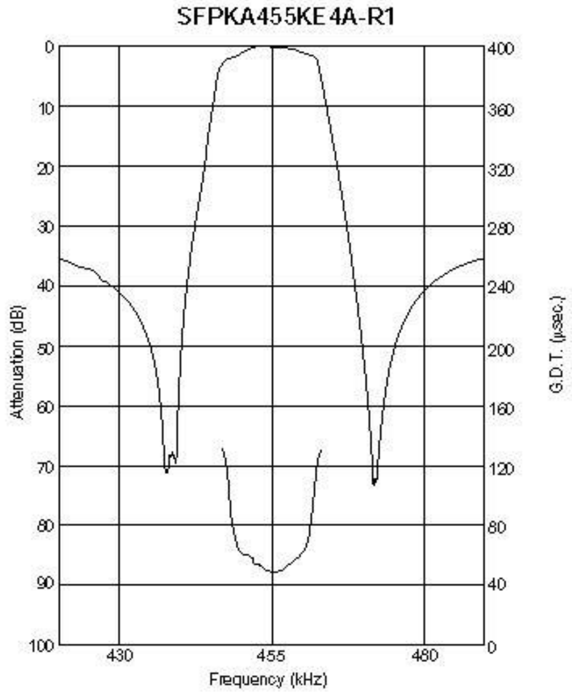
FILTROS CERAMICOS

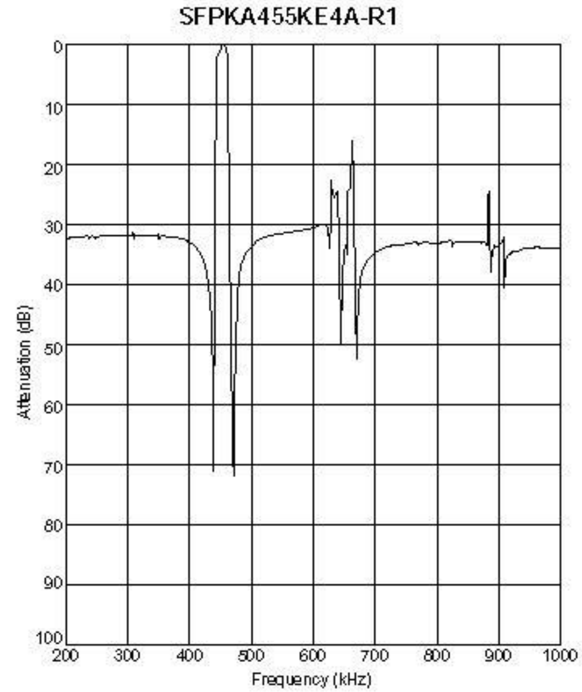
⚠Note · This PDF catalog is downloaded from the website of Murata Manufacturing co., ltd. Therefore, it's specifications are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering.
· This PDF catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

P05E.pdf
06.2.13

1

■ Frequency Characteristics

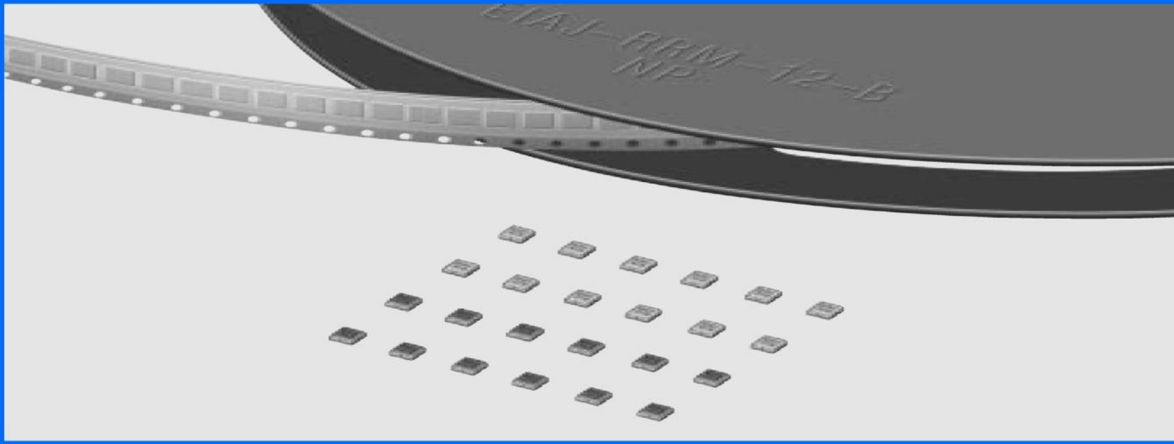




P36E.pdf 02.8.5

SAW Resonators

SURFACE ACOUSTIC WAVE RESONATORS



GLOBAL PART NUMBERS
JUNE 2001

muRata
Innovator in Electronics
Murata Manufacturing Co., Ltd.

Cat.No.P36E

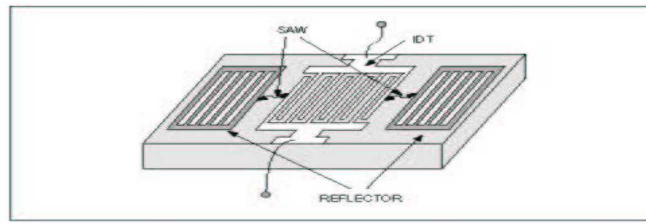
Applications and Data of SAW Resonator

■ Application

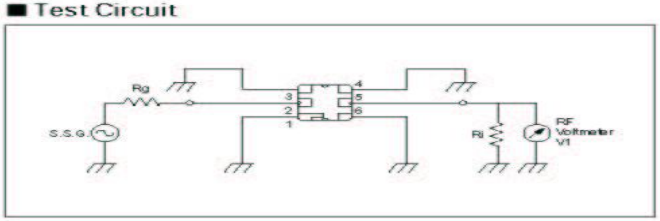
SAW RESONATER has generally 2 types of 1-port type and 2-port type.
1-port SAW RESONATOR is basically a 2 terminal device and its application is similar to that of quartz bulk wave resonator or ceramic resonator. Most of the application circuit is Colpitts or similar type that can be made with low cost. 1-port SAW RESONATOR is also applicable to VCO (Voltage Controlled Oscillator) application.
2-port SAW RESONATOR is a kind of very narrow, low loss band-pass filter. Oscillation circuit is mostly like a RF amplifier with feedback loop.
SARCC series is 1-port SAW RESONATOR. Later application data is oscillation circuit by 1-port SAW RESONATOR.

■ Basic structure of 1-port SAW RESONATOR

1-port SAW RESONATOR has one IDT (Inter Digital Transducer), which generates and receives SAW, and two grating reflectors, which reflect SAW and generate a standing wave between the two reflectors. IDT and reflectors are fabricated on quartz crystal substrate by photolithographic process. Cut angle of the substrate shall be selected carefully. SAW RESONATOR chip is encapsuled in a ceramic package.

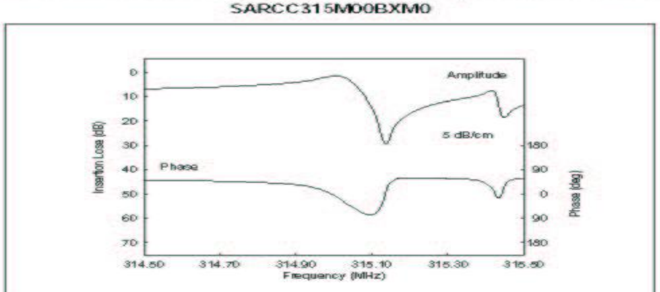


■ Test Circuit

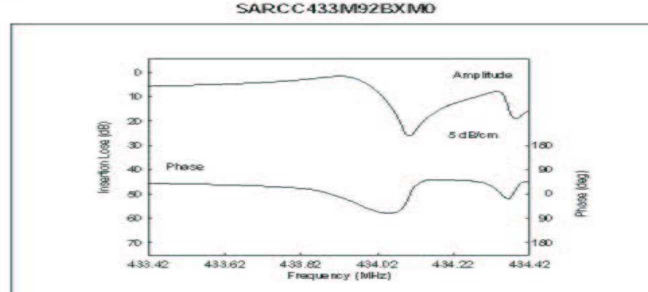


■ Transmission Characteristics of 1-port SAW RESONATOR

SARCC315M00BXM0



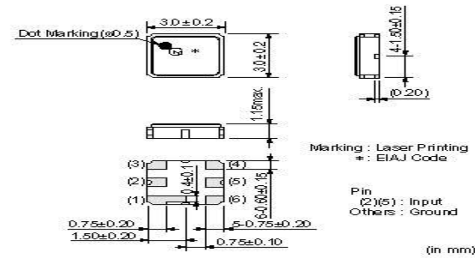
SARCC433M92BXM0



Continued on the following page.

SAW Resonators

SARCC Series



SAW Resonator utilizes Surface acoustic Wave, and is able to be applied to high frequency circuit where conventional crystal, ceramic resonators are not available, as SAW Resonator oscillates stably with its fundamental mode over frequency range from 50 MHz to around 1 GHz.
Murata SAW Resonator - SARCC series - has high stability, good temperature characteristics provided by quartz crystal substrate and is developed with SAW technology accumulated for SAW filters through Murata's long experience.
SAW Resonator can be applied to many types of high frequency devices including RF remote controls, CATV FSK demodulators and CATV 2nd local oscillators.

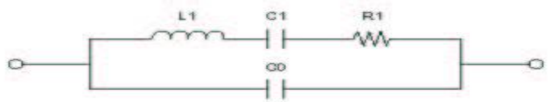
■ Features

1. High Oscillation Frequency Stability
   Both initial tolerance and temperature coefficient of oscillating frequency of SAW Resonator are between quartz bulk resonator's and LC's / RC's.
   Temperature coefficient of oscillating frequency for quartz crystal :
   10**-6/degree C, LC : 10**-3-10**-4/dgree C,
   while SAW Resonator : 5x10**-6/dgree C.
   (The number following ** means multiplier.)
2. Adjustment Free
   As SAW Resonator utilizes mechanical vibration of piezoelectric material, while LC/RC utilizes electrical resonance, oscillator using SAW Resonator is stable against peripheral circuit or supply voltage fluctuation, and is basically free from adjustment.
3. Simple/Low Cost Circuit by Fundamental Oscillation
   Multiplying circuit necessary for quartz bulk wave resonator is not required as SAW Resonator oscillates with its fundamental mode over the frequency range of 50 MHz to 1 GHz. Therefore, oscillation circuit is simple and low cost.
4. Quartz Crystal Substrate
   SARCC series realizes better temperature characteristics, higher stability against peripheral circuit, by utilizing quartz crystal substrate, compared to SAW Resonators with other materials.
5. Small Size Package
   SARCC series use small size ceramic package with 3.0x3.0x1.15mm. This is good for high density mount.
6. They can be applied Corpitts Oscillator circuit.
7. Components do not contain lead.

Part Number	Resonant Loss (dB)	Resonant Frequency (MHz)	Parallel Capacitance (at 1MHz) (pF)
SARCC304M30BXL0	2.2 max.	304.300	2.4
SARCC304M30BXM0	2.2 max.	304.300	2.4
SARCC304M30BXP0	2.2 max.	304.300	2.4
SARCC315M00BXL0	2.2 max.	315.000	2.4
SARCC315M00BXM0	2.2 max.	315.000	2.4
SARCC315M00BXP0	2.2 max.	315.000	2.4
SARCC423M22BXL0	2.5 max.	423.220	2.1
SARCC423M22BXM0	2.5 max.	423.220	2.1
SARCC423M22BXP0	2.5 max.	423.220	2.1
SARCC433M87BXL0	2.5 max.	433.870	2.1
SARCC433M87BXM0	2.5 max.	433.870	2.1
SARCC433M87BXP0	2.5 max.	433.870	2.1
SARCC433M92BXL0	2.5 max.	433.920	2.1
SARCC433M92BXM0	2.5 max.	433.920	2.1
SARCC433M92BXP0	2.5 max.	433.920	2.1
SARCC434M15BXL0	2.5 max.	434.150	2.1
SARCC434M15BXM0	2.5 max.	434.150	2.1
SARCC434M15BXP0	2.5 max.	434.150	2.1

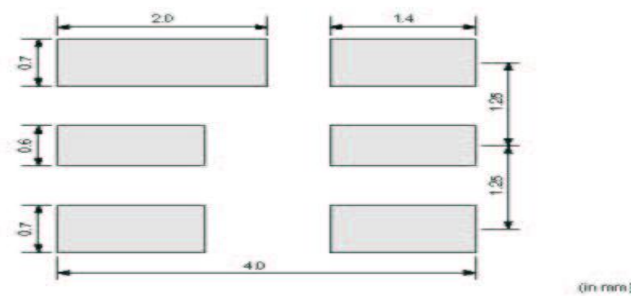
Operating Temperature Range: -40 to +85 dgree C, Storage Temperature Range: -40 to +85 dgree C

■ Equivalent Circuit



Part Number	L1 (μH)	C1 (pF)	R1 (Ω)	C0 (pF)
SARCC304M30BX_0	164.495	0.001663	22.0	2.37
SARCC315M00BX_0	159.331	0.001602	22.0	2.25
SARCC423M22BX_0	110.088	0.001284	22.2	2.00
SARCC433M87BX_0	92.747	0.001451	20.2	2.00
SARCC433M92BX_0	96.529	0.001394	22.1	2.112
SARCC434M15BX_0	95.288	0.00141	20.0	1.97

■ Recommended Land Pattern

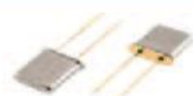


Golledge

Showcase

Leaded Crystals

Click on one the images to view product details. Alternatively you can view a table of Leaded Crystals.

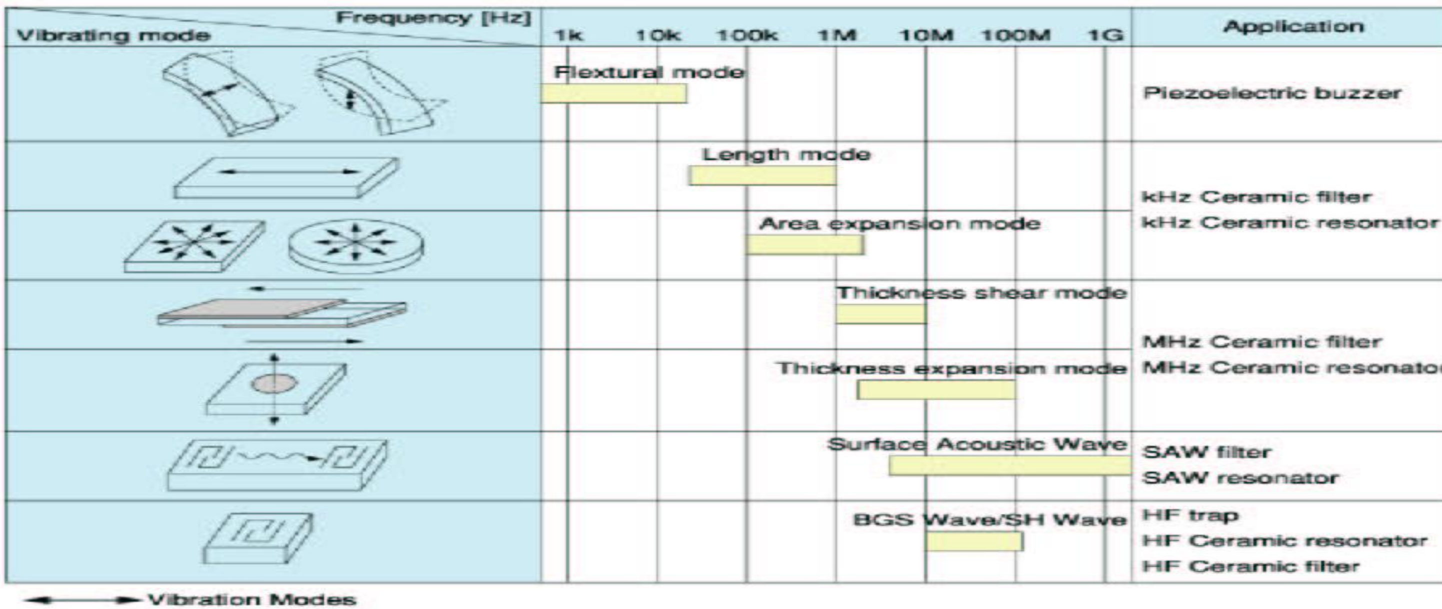
 GCX-39	 GDX-1	 ★GWX-26
 ★GWX-38	 ★HC49	 HC49-3H
 ★HC49-4H	 UM-1	 UM-4
 UM-5		

★ denotes our 'Key Products', especially selected for value & availability.

Click here for our non-preferred Leaded Crystal range.

Golledge Electronics Ltd
Tel:+44 1460 256 100 Fax:+44 1460 256 101 email: sales@golledge.com

A piezoelectric element is a resonator using the mechanical resonance of piezoelectric ceramics. The vibration behaviors (mode vary depending on the resonant frequency.
The relationship between resonant frequency and vibration mode ca be summarized in the following table.



The differing vibration modes provide the following characteristics:

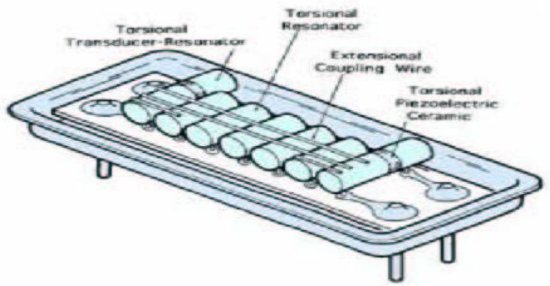
1. **Flextural vibration**
   Vibration in bending directions.

2. **Length vibration**
   Length vibration that expands or contracts a thin plate.

FILTRO MECANICO

Rockwell Collins
Building trust every day

How mechanical filters work



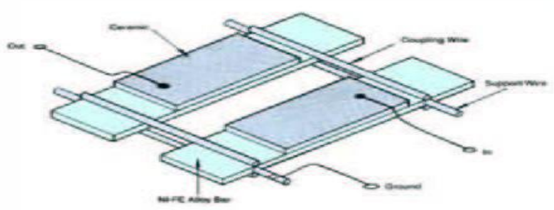
Seven-resonator torsional mechanical filter

The principles of operation of a mechanical filter are quite simple. By analogy, electrical tuned circuits are replaced by mechanical metal alloy resonators, and the coupling inductors are replaced by stiff coupling wires, as shown in the filter drawing on this page. An electrical signal applied to one of the filter's ports will produce an electrical field across the piezoelectric transducer. This causes the transducer resonator, to vibrate in torsion. The mechanical vibration is coupled from resonator to resonator by means of the coupling wires. Vibration of the output transducer causes a filtered voltage to be generated at the filter's output port.

Types of Mechanical Filters

Rockwell produces three types of mechanical filter. These are a torsional mode, a bar flexural mode and a disk flexure mode filter.

The torsional mode filter uses rods that vibrate in torsion. Electrical energy is coupled in by means of a piezoelectric ceramic transducer into torsional motion. We build these filters with center frequencies from below 100 kHz to above 700 kHz.
Bandwidths range from .05 to 5 percent of center frequency. Designs can have as many as twelve poles.



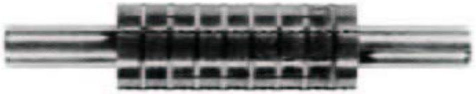
Bar Flexural Mode Filter

The bar flexural mode mechanical filter is used for low frequency designs. The

FILTRO MECANICO

Mechanical Filters Page 2 of 2

available center frequency range is from 5 to 100 kHz and bandwidths of .2 to 1.5 percent.



Disk Wire Filter

Disk wire filters use a drumhead mode of vibration of a disk. While these are no longer designed, we still produce many of the 2000 designs created over the years.

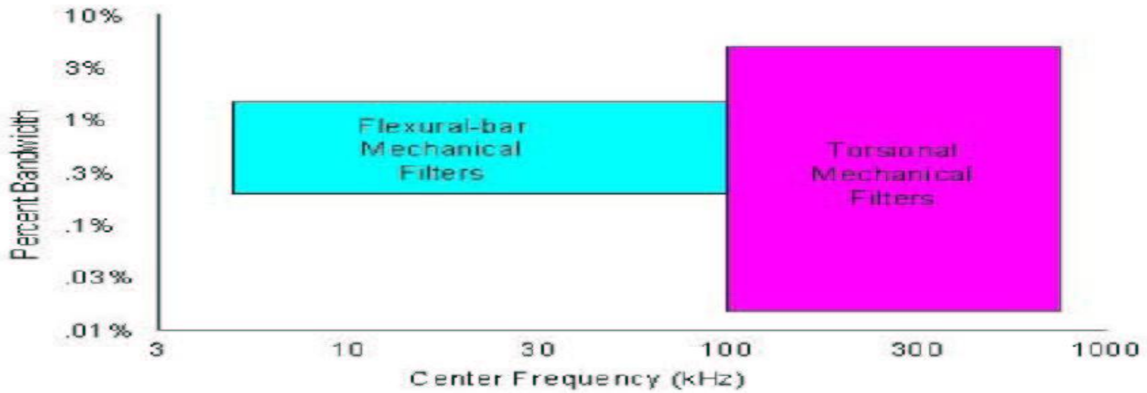
Application Range

Our engineers are prepared to design filters for your specific applications. The center frequency range of torsional filters is from under 100 kHz to over 700 kHz with bandwidths as low as 0.02 percent and as high as 5 percent of the center frequency. Bandwidths above 1 percent may require tuning inductors in the termination circuit. The inductor-less filters simply require a specified parallel capacitance and resistance for proper termination as shown in the typical test circuit. We design and manufacture filters that have as few as two resonators and as many as twelve resonators.

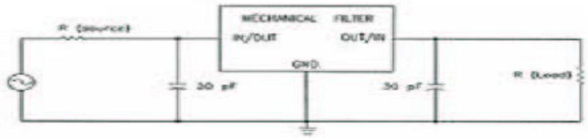
Please provide us with your frequency, phase or delay response requirements, and we will quickly give you an estimate of the complexity and characteristics of a mechanical filter that will do the job.

The FP and PS packages will enclose up to 8 resonators and the LP and PL packages will enclose up to 12 resonators. The FP and LP are hermetically sealed metal packages. The PS and PL are non-hermetic plastic packages. Smaller plastic packages are available for two resonator filters. A surface mount package is also available similar to the PS package in size.

Application Range



Typical Filter Test Circuit



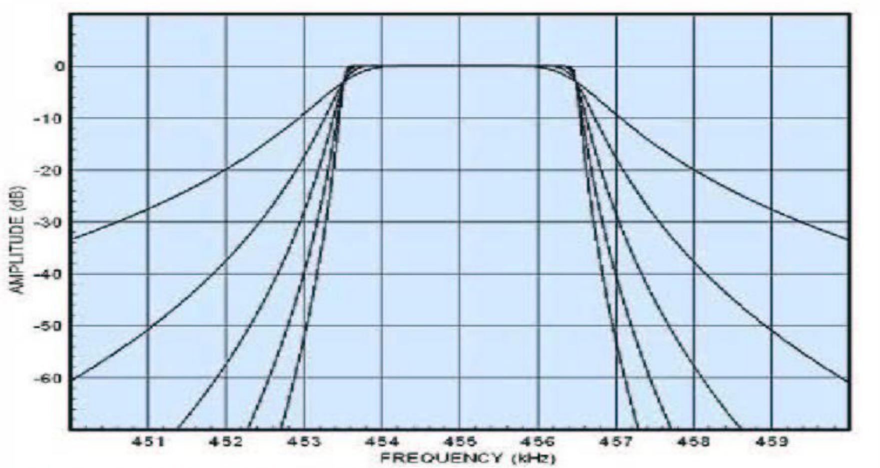
Rockwell Collins
Building trust every day

Application Notes

- Selectivity
- Ripple
- Insertion loss
- Delay
- Intermodulation distortion
- Shock and vibration
- Phase matching
- Packages

Selectivity

Rockwell Collins builds filters from two poles to 12 poles; *selectivity* is a function of the number of poles and the type of design. The adjacent figure shows the selectivity for a .01 dB Chebyshev design with 3, 5, 7, 9 and 11 poles. The 3 dB bandwidth of all the filters is 3 kHz.



3, 5, 7, 9 and 11 Pole Designs

The closer a design is to a Butterworth function the greater its stability but the lower the selectivity. For optimum stability, Rockwell Collins designs all filters of more than three poles with designs ranging from Butterworth to .05 dB Chebyshev.

Ripple

The filters are designed using theoretical models with ripple less than .05 dB. Actual ripple, due to process variations, will be higher. A typical Low-cost filter has room temperature ripple of less than 1 dB. Ripple over temperature is conservatively specified as less than 3 dB.

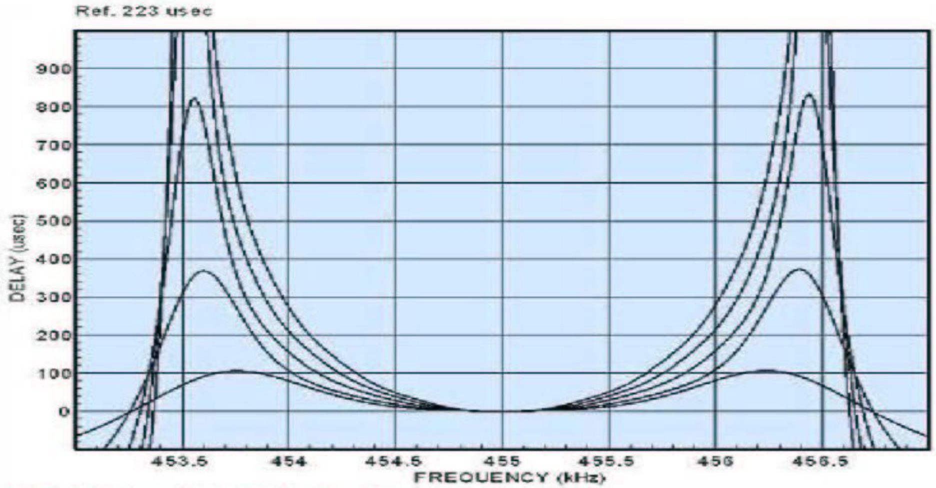
Ripple is defined in several ways. The definition we use most often is the difference between the minimum loss and the lowest dip within the passband. Using this method a monotonic round top filter would have 0 dB ripple. A second method to define ripple is from the highest to lowest points within a specified frequency range. A third method, which is never used by Rockwell Collins Filter Products, is to use the largest adjacent peak to dip value. This method understates the true ripple.

Insertion loss

Insertion loss, for our torsional series, is typically two dB or less for filters with a bandwidth of greater than 1000 Hertz. Filters of lesser bandwidth can have insertion losses that are several dB higher. Loss will increase with temperature, nearly doubling at 85°C.

TOP

Delay



3, 5, 7, 9 and 11 Pole Designs

Delay is also a function of the number of poles and type of design. A Chebychev filter will have more delay than a Butterworth filter. The delay for a 3 dB bandwidth .01 dB Chebychev is shown above for 3, 5, 7, 9 and 11 poles.

Delay compensation can be achieved by bridging across two resonators within a filter. This is shown in the plot below.

Rockwell Collins

COLLINS TORSIONAL MECHANICAL FILTER

7- POLE DESIGN

ELECTRICAL	0°C TO +60°C	
	VALUE	TOLERANCE
CENTER FREQUENCY	455.00 kHz	± 0.09 kHz
BANDWIDTHS		
F3H - F3L	0.300 kHz	± 0.06 kHz
F60H - F60L	1.000 kHz	max.
PASSBAND RIPPLE	3.0 dB	max.
INSERTION LOSS	10.0 dB	max.
STOPBAND		
355 kHz to F60L	60 dB	min.
F60H to 555 kHz	60 dB	min.

NOTE: The maximum signal input voltage is 1.0 volt RMS.

ROCKWELL COLLINS FILTER PRODUCTS 14101 MYFORD ROAD, TUSTIN, CA 92780		526-8733-010	
Engineer:	D. P. Havens	Filter Type: SYM	Rev. Ltr. B
Approved:	L. G. Cornett	FSCM No.: 2X491	Date: 5-27-98

ENVIRONMENTAL REQUIREMENTS:

OPERATING TEMPERATURE RANGE: 0°C to +60°C

NON-OPERATING TEMPERATURE RANGE: -30°C to +85°C

VIBRATION: MIL-STD-202, Method 201, 10 G's, 10 Hz to 55 Hz

SHOCK: MIL-STD-202, Method 213B, 50 G's, 11 ms, half-sine

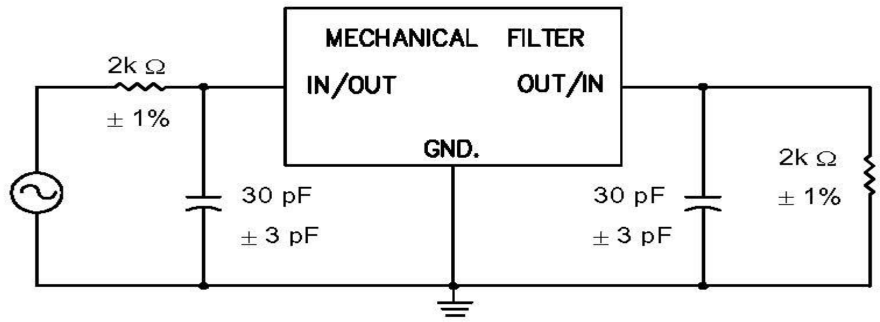
MECHANICAL REQUIREMENTS:

CONSTRUCTION: Sealed, Non-Hermetic

CASE STYLE: PS

MARKING: Rockwell Collins Part Number
Date Code

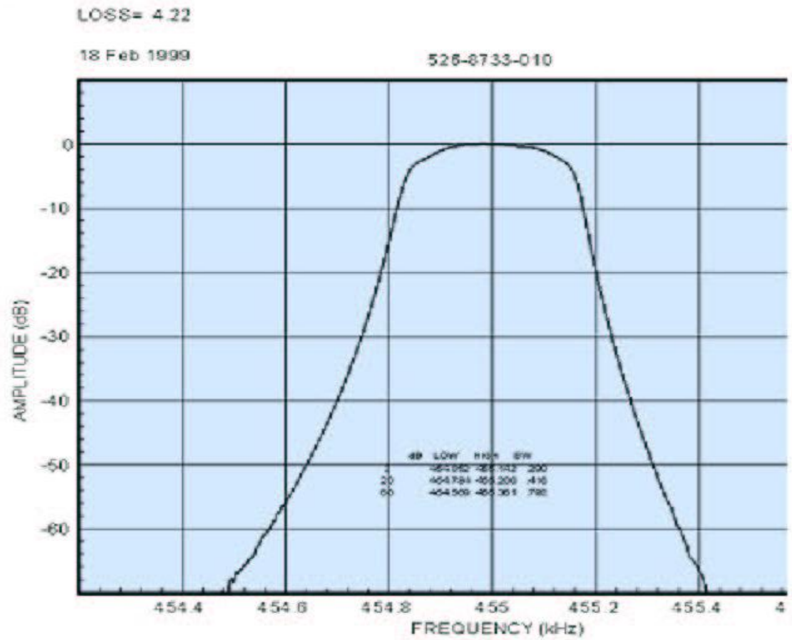
TEST CIRCUIT:

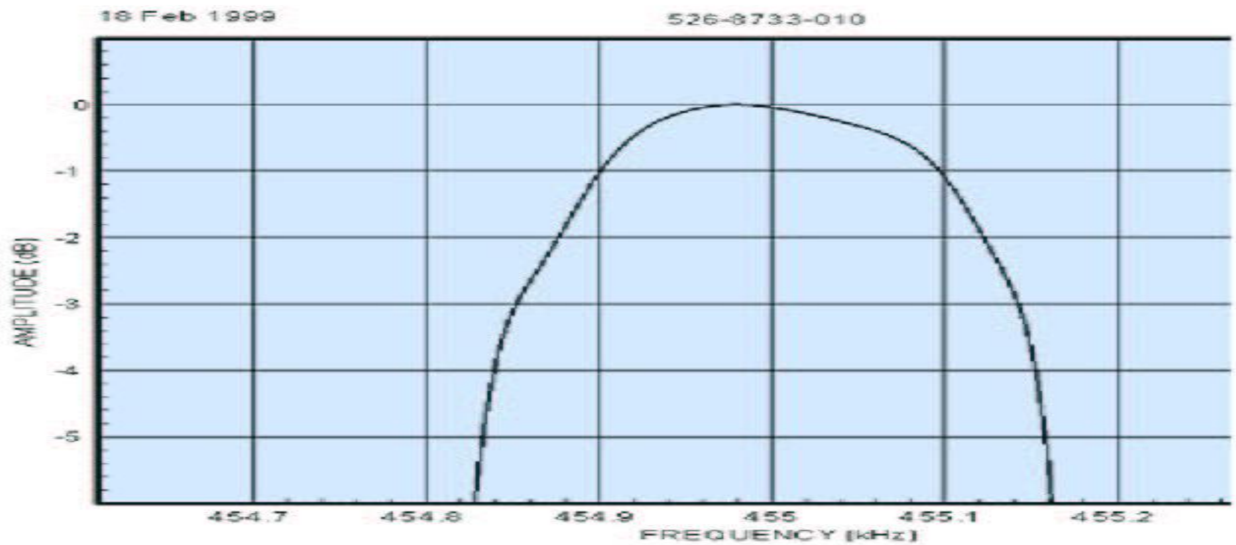


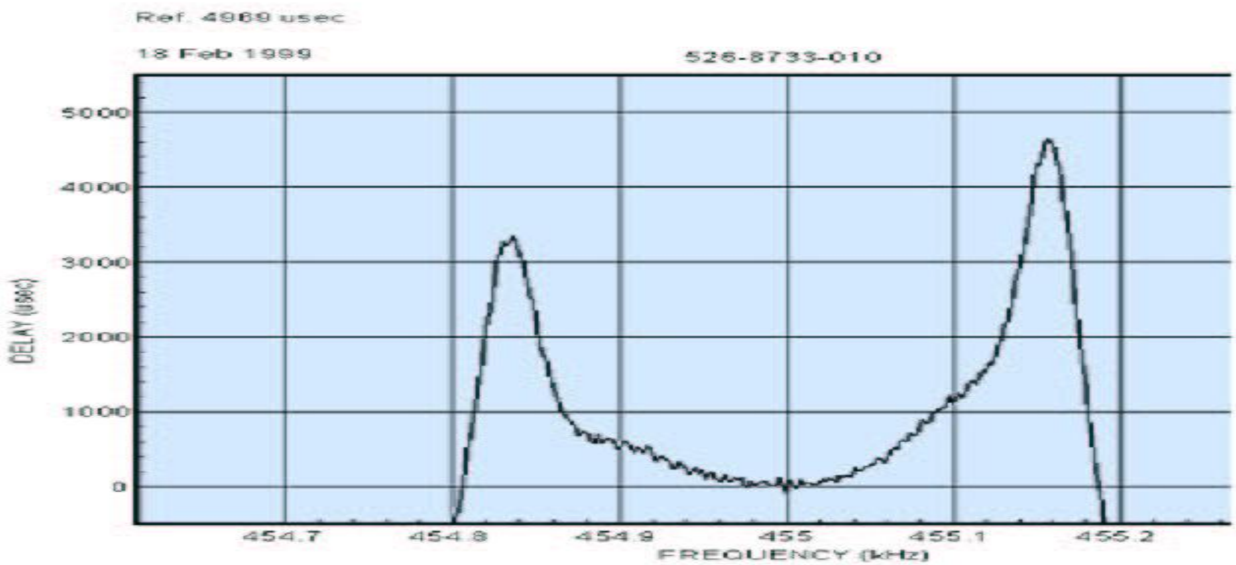
NOTE: 30 pF Includes any board stray capacitance.

ROCKWELL COLLINS FILTER PRODUCTS 14101 MYFORD ROAD, TUSTIN, CA 92780	526-8733-010

Plots of 526-8733-010




18 Feb 1999
526-8733-010
AMPLITUDE (dB)
0
-1
-2
-3
-4
-5
454.7
454.8
454.9
455
455.1
455.2
FREQUENCY (kHz)


Ref. 4989 usec
18 Feb 1999
526-8733-010
DELAY (usec)
5000
4000
3000
2000
1000
0
454.7
454.8
454.9
455
455.1
455.2
FREQUENCY (kHz)

FILTRO MECANICO