SIH

IE

Noise

Wit)

Receiver Model:

Latha H.N

·Demod

4

Band pays Filter

alt

outpect signal.

جيم

N+244)

Fig: Noisy receiver model

incoming modulated signal, and wit) denote the front-*end* receiver wit.

In this figure, sit) denote the

the

the bandpass filter

1

represent &

combined filtering

action of the tuned amplifiere

receiver for the purpose of signal amplification

used in the actual

prior to demodulation.

The bandwidter of this

band-pass filter

is sent

wide enough

to

pay the modulated

modulated signal s(t)

without dinterben

Lebu Let me

ации

noise wit)

い

additive,

white

and Gaussian

in nature.

P.S.D. of noise

is

wit) is

denoted by No% or 2/2

where

No

is the

average noise power perun't

bandwidth measured

at the

front *and*

of the

reaiur.

a narrowe band Cantoni caffer on

The filterned noise not) as moise represented in tec

= n2lt) (ol (20fet) - halt) sin (2sfet).

not) —

ù the

Where

ME (H)

na it)

ù de

in phase moise Component

quadrature noice Commat

(5) med neith relbect to the

Carrier wave

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adrata

•Ac.cos (20fet), the filtered signal x(t) available

for de modulachen

is defined by

seet) = sul +nce).

The detaile of S(+) depend

on the type of

Modulabien used.

nut i a

band-limited Cavarrowband aroused with te

following poceser spectral densig

Ne

SN (t) =

Вт

te. BT/ ≤1+1 ≤ to +35/2

other wine

Figure

of Merit!

Rigeene of Merit 2

(SNR)

(SNR)

where

(SNR)

aug. power of message signal

of message signal at te recivveront

・rower of noise at the receiver output

Aug-tower

(SNR) c =

Aug.1

rower of

не modulated message signal at the

recciur inpur

at the recur input.

aug. rower of noise in message bandwidty

for the burbose of comparing ditterent medication systems*,*

performance by dividing se

rabic by Channel SN'

We normalize the reaiver Autput - Signal - to mine

te value that

Fom has the better te mille bertemance of the recur

It'sgher

1

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Lalla HN

Noise

in

DSB-SC

- Receivers!.

Fig.

Shown below shows

resing

a

Coherent

The

the

Model

of

a DSB-SC reciva

defecter!

use of coherent defection requires multiplication

filtered signal xit) by a

of the

Sinusoidal wave

the product.

(+)

locally generated

Cos ( 21fet) and then low pay filtering

Сосоран

DSB-SC

1967)

Signal

SIH -

ΑΣ

M

Band-pass Hiker

Product

Madalah

L.P.f

Dylt)

21H

Acosanfet

Noise. Wit)

L.O

Figi

Model of DSB-SC receiver

using coherent detec

The DSB-SC Component

Component of the

filtered signal s(t)

-

expressed as

where

s(t) = C.Ac Cos (2nfet) mct).

Ac.cas *(*2nfet) is the sinusoidal carrier

mit)

is the message signal.

C: a constant

{

-

wave

a sutem-dependent scalier factor.

The Purbose of which

the

8

in to ensure that

Signal component 281) is measured conte same cenits as the additive noise componens nut.

Assume - that, mit) is a sample function of

mocess of zero

densiy

mean,

whose

Sty(t) in limited to

a stationary

power (bectral

a maximum

freq Why are tot (or fm) is the message bandwidth

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The

+

Aug.

Poccer of the Message rignd

Bit

P= /^ SM (Hdf.

te DSB-SC modulated signal component

Aug. Doceser of te

841

C2 Ac2 P

2

the Message bava

and

Aug

• Noise power in

No/2x *No2* x 2W =

W No

-

2

C2AC2P

3.a

2.WNO

from equation and

... (SNR) CIDSO

where the Constant c2 in the

that this ratio

Let v

defermine!

numerater ensure

output signal to noise ratio of the

DCH) = SHH) + NL)

3

System

2 CAC Cars (20Set) mit) + Mylt) (as (zuifer) - na hinz

where Milt) and natt) →

are

VI) = x) Col

act) Coesfet

4

Product mod - output

namon hand noise (In phay

and quadrature Components.

(CAC. Cos (anfet) met)) (082 Tifel-

+ MI (t) Cos2 (20teb) - now) for sufer (insurfer.

=/C Acım(t) +/2 NICH

2

+ 1/1⁄2 [CAC MIH) + HICH] Cos (4Afet - Achatt) sit

The Low-pass filter in the coferent detecter high freqs components of out, yielding

remover the

a receiver output

Yot) = 1/1⁄2 C Acm(t) + 1/2 MILE)

J

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Equation

indicater the following:

1. The Message signal mat) and in-phase noise component

appear additiudy NIH) of the filterned noise nit)

at the receiver output-

2. the quadrature Component nalty of the mesize

net is completely rejected by the

The Message signal component

- CACM(H)/2. Aug. poner

Norse rows

:. (SNR)

Coherent detector

at the reaiur outr

C2 A2 7.9/4

22AC2 P.

B. and 5

From

Equabier B.u

시

2P

4

WNO/2

Here Figure of Mon't = (SNR)

WNO.

<2 Ac2 P

24 NO

22 CAC

C2 Ac2P

2WN0

*O*

(SNR) C

950

c2 422 P

2~20

c2

is common to both the output

and channel

signal to noi'ne ration. and theretve

Cancels out in

Evaluating the figure

of menit.

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Noise (ท

SSB Receivers!

›

→→ Consider

the

Case of a receiver

detection

1

with an incoming SSB.

cesing coheneur

→→ Assume that any the Lower sideband in transmitte

s(t) = 1 GAG. Cos (2nfet) met) + 1/2 CAC. Sin (21fet) in (A)

where

Witch in the HiT *of* mit).

The -in-thase and quadrature

Components of the modulated

signeel sett Contribute.

an *aug*. bower

of *CALD*

2

each

8

where. Pù the

Ang lower

of the message signal

M(H).

→ They

the

Aug.

Power of s(t)

C2AE2P

4

2

"C2 Ac2P

Aug. Noise power in the Message band reddith is is WNO.

:. (SNR) COSSB

4 No.

Illy.

2

(SNR) OLSSO

C2 Ai2P

4WN0

F.O.M =

(SNR)o

2.2

= 1.

4240

CSNRIs

CA

4w

1. For the same aug**.**

**An**

• baneenthed Signal konver

and the

samer ang miser power **in** the message band hard thy

Cea D.

All have

exactly the same sugur signal so nots

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Noise in

AM. RRS!

Let

SH! = Ac [It Kamit)] Cascantet).

Am signal

Σ

Band pass filter

scit

Envelope detect

+

ouspect signy YUH

Mise

Rig: Noisy Model of sm Ra!

+ The Avg Power of the Carrier Component on see

Анд

Day signal bolt) is

sas

Ac72.

Ac2ka2 P/2.

2

where

→→ The Aug power of the information bearing component

Аид

Аскать) Солтвен

ù

aug power of message signal on it).

-". The vang power of the full AM signal sett

therefore equal to

A 22 (1 +kap)*/2*.

puitre

..

(SNR) (IAM)

Ac2 (1+ka2p)

2 WNO.

To Evaluate the output signal-to-noise rate

Host represent to filtered

nove not in terms

of

its imphare and quadratione Components.

-'. SCHH) = SILT MA

m

= [Ac the Kamuis] Casarett With Col 20 fet-nal sincent

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Envelope of set)

Yetez

envelope of xer)

$

an

ideal envelope

= √ { Ac +Ackamit's" +h[CH]2 + 1}{4}

Ther signal Yo! deffing**,** the outout of

defecter.

Expression definiing GH) is somewhat

Complex and In order

-The

уж

needs to be simplified cos

to approximate the JHH)

some manner.

output yu) 2

Аскаши)

-

A

the may approximate the

YCH) ~ Ac. + Ackamit) + holt)

of the

dic or conitaut term Ac. im

The Presence of

the Envelope defeeber

ù due to

Carrier wave.

уж

output yet) of equation

démodulation of tea

baremitted

Hence.

the term

may be neglected.

DSB-SC Rowery

Yo) ~ Ackamit) + hilt)

Lo

wow it in similar

. (SNR)

O AN

22. Ac2 ka2p

2

2

*P*

21000

Equation B is valid only is

Coherent detecties

B

the following

are satisfied.

two conditiery

I. the Aug Noise powier

is small compared to the atrage dug carrier power at the

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envelope

2. The

detector

output.

The amplitude serviting ka is adjusted for a

bercentage modulation less than or equal to look

(SNR) (SNR)**C**

Ka2 *P*

*1*+ka2p.

Ex: 1: Jora Single tone modulabron.

Let

m4)

= Am. col 20fm b

the Cornerpending Asri wave

is

SH) = Ac [1 + μl-co120hot] cozafet.

where μl = ka Am. ù the modulation factor

P = 1/2 Am2

(SNR)

LSNR)C

1/1⁄2 Ka2 Am2

liz

1 + 11⁄2 ka2 Aurz

**2**+42

when M*=*I, which Cerreeponds to 100%, figure of Men't equal to 1/3.

to this means that, oker factors being equal,

hee get g

as AM systems

(using envelope defection) meet brancuit three times as

power of

a

So syteen Suppressed-Carrier (DSB

much ang

saptam i in order bo

achieve the

quality of noise besformare.

даше

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VSB: [Vestigial sideband bransmission]

SSB - suitable

for voice signals.

\* when the baseband signal contains significant Component at extremely low freq. Componente { ex.T.V. and Telegraphit

The

age *of* SSB Modulation

is in approfmate

for the transmission of such baseband signals due to

diffically of inplating one sidebane

the

\* VSB in used for T.V. Transmission!

VSB

filty

LPf

A

SIH

4 cosanfet

SHH))

Cas 211fe

-fe-in-Ifc

-fm

for

ש.

E

golt)

signal spectrum at A

fe-sm

Spectrum at B

VSB AHOY Characteriskuad

C

fe**-su**

-Hetty

The-w to fetti,

-fettw

-fcitu

2218

-fr

0

fo

feby He fetfor spectrom

Scanned with CamScanner

*C*

Spector

5

24c

Let us derive the frankter function for USB fiter

Spectrum at A in Proportional to M(*)*

X

Spectraus

at B!

is proportional to

& [ M(f- fc) +M (f +fcl]

Spectram at C. H (f) [ M(+- fc) + M(+ +tel]

Spectrum at D!

the

D! 1. H(t-fc)] [ M(f.) + M (f ~2 fc)]

100

[M

+Y/2 HCf+fc) [ MCF) +M(+ *+242*]

性

Central lobe of the spectrum at i'

should be

M (+)

M (+) = = [# C++ fc) M (t) + H (4-fe) M(+) J

नत

2

Heve

#(++fe) +H (frfc) = 2

H(c) = 1/2

H(f+fc) +HCF-fe) = 1

H(+) 7 odd Immels in the neighorhood

f=fc.

and 50% response level at fc.

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ד

represented in the dime demain

VSB Signal can be represented in the

се

SH)

= mit) Cos 2nfet

1

ms it) sinalfet

Generation:

MCH

where mol): output of the filter of transter

function

As (t), where

Hs (t) = √ [H(+-fc) -H (f+fc)]

Product Modulata

J

Д содестве

Lose

Σ

VSB-Sigul

filter

#sft)

98 phasesh

Sin2Tfe

Product

Mod

Sif)

= mit) Cosanfet

-

msl) finalfet

(V.C. BSB)

VSB

Lush

-LSR

mit) Cop2iffel + mg (t) Simfe

Envelope detection *of*

a VSB signal wave + Carrier signali

VSB Can be detected by envelope detection, if a

large amount of carrier is added.

This is normally done in Commercial TV.

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SH) = cos sifet +/2 kamit) Cosfet - / Kamylt) simanfet

alt)

Evelope of

873N

17

[I+ 1⁄2 ka met] (as 2 Ifel - 1 kams (t) sin 217fet

Ka + determing the /% Modulation

2

√ (1+ }, Kani(t)2 + [ '1⁄2

[1+11⁄2 (t)]]

= [1 + 11⁄2 kam (t)]

[ 1/2 kamet)] 2

2

[/1⁄2

Ica Wilt) ]

[1+'/skauts]

1+11⁄2 Kam()

1/2

bistation in Contributed by the quadrature Component of

VER war

the incoming

The distortion cau

be reduced by Reducing %

atypical a's: suggest a suitable AM technique to bansmet a

Message signal which containe significat Comboney

at Extremly low frequey such as

Med (ka)

TV signal and provide a creaticales of filter fræenter function (CF) of a sidelsand

-shaping filter to extract to the

designed madulard wal

Considering coherent detector output

@ Juctily the USB signal + carrier canto de moduladd

F

usory Enuclose defecter.

Formulate to Expresson for USB signel.

then, the envelope will

Le

Scanned with CamScanner

207

P

9

= Am⋅ cos *(*21fmt) is

The single tone modulating signal mot) lised to generate the following USB signal:

SH) = 1/2 & Am Ac{[Cos[an (fet fm) t] +2 AMAC (1-x) Cos [2T (fe-fm) \*] where x in constant, less than unity, representing the attenuatio

of the cepper sible freq.

(i) Determine the quadrature Combonent of the USB signal sut,

(ii) The VSB signal, plus the Carrier Ac. Cos (21fet), i bassed

an envelope detector

2

through distortion produced by the quadrature Component.

setermine the

of Constant

L' for whier

this distortion reaches

its

worst

possible Condition.

(iii) what will be the value

\* we know that any signal SI) can be expressed in terms

of in thase and quadrature Component

as

SHI = Salt) Cos anfet

1

Salt) sinzifet.

Expanding

the geven bignal - S(+)

COSCA +B) = COSA COB

- Sima Sinca*)*

Cos(A-131

= COTA COMB

SCH = 1/2 AmAm (as (lifet) Cas (20fmt) - LANAc Sim (arifet) sim (2filt

ThinkFin

+1/2 (1-a) Ac Am. Ces *(*2nifet) cos (20ft) + 1/2 (1-0) Amde sim (211fet) Simz lift.

SH) = 1/2 An Ac Col (2ffee) cos(20thmt) +/1⁄2 AMAC (1-2) Ain carted) Sincarent)

Compartiry:

Salt) = -1; Ac Am (1-2x) sin(mt)

(") The USB signal after adding carrier signal

Acces (2nfet) will be

Sit) = Ac [I+ Am. Coll>chant] [& 2 lifet +1), AcAm (1-20) Sin (ament)

2

then, the envelobe will to equ

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id

all) = Ac] [1 +), Am Cassanent)] ]

9171.

*N*

=

2

-1/Am. +

*(*217

Ac [1 +1, Am (cs (20fent)]

[ = Am (1-24) Sin (zambon +-)] 2

alt) = Ac [1+1, Am Caslin

Am (1-2α) sin (11hmt)

1 + 1/2 Am (as (21hmt*)*

Am-Cas*(*zilent det)

where dit). dintation term

24+) =

2

+

1/2 Am (1-2α) sin (>rifmt)

2

1 +1% Am (of sifonts,

The dintation noll be maximum when 4=0.

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9

℗ Evaluate the Condition for distortionless demodulation

a

*of*

a VSB signal, initial generated by

DSB signal through

a

generated by passing USB filter, lesing

Synchron detec

mit) Cos anfet

SIH) USB.

VSB

filter

DSB.

MH

message

Cos pafer

fo

Sit)

DSB

mit) Cosanfet.

↳ S(f)

5 [8]

DSA

Specham

[[M(f\_fc) + M (f +fc)]

H(+)

Transfer

tanchion of

of VSB-fitter

->

VSB

them

S(f)

=

VSB

S(+)

VSB

S(f) •H(f)

DSB

// [ Mcf- fic] +M (f +fc] H(f)

dit

Lpf

D

yet)

SH)

SB

Coffet

For demodulation using synchronys demodular, see have

del =

SH). Col fet

VSB

Taking

Jouny

Dif) =

St-fe) + S(f the

-

2

2

VSB

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From. equations C and @

2

Slf-fc)

1⁄2 [M (t-fc-fe] M [f-fe+de]] H (f-fc)

fc fc

S (f +fc) = 1/1⁄2 [ M (f+fe-fc] + M ( + + e +fo] ] #1 (£14c]]

D(+) = 21.1 [M (8-24e) ++

(£~2fe) + M(+)] H (f-fc)

D(f) =

- 1 +

[

+ (M (f) +m (f +2fc)] H (++fe)]

M(f) [H(f-fc) + H (f +fc)] + M (4-24c) ((f-de)

+ M (f +2fc) H(fete)./

(eliminat the sepects at ofc)

Lpf's output

Y(+)

=== [MC+1] [[ #C+ -fe) ++ # (t+te)]

4

of

H(f-fc) +H(t+tc)

Content = to

tere

ther

Y(+) = 1 M(A). K

yu)

4

= MG) K

1=

k`'mlt)

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• Frequery Tranebetion!

(Also called a

\* Suppose that we have.

Spectrum i Centered

3 a

10

freq mixing, they changers)

a modulated wave silt) whose

Camior Aeg $1,

and

i to hamlate it upward En

the requirements

traquy such that

new value £2.

ife Carrier freq in changed

from f, to a

→

This requirements may be

accomplished cessing

the

mixer

al

as Sharon below.

Modulated was 5,14),

with Carrier

frey *+,*

Product

Modulater

D

Band pass

filter

+ Modulated ware S2H) with Carrier trg £z

AL COS Canf2t)

Bleac diagrams of Mixer!

сваджень

à a

The Mixer

device that consists *of* a product

a bandpass fitter.

modulater followed by a

The BPF in designed

in designed to a equal to that of

as input.

f2= f1+fL

have a

a tome madulated

Bandwidth

8, It) used

Signal

f1 = f2-f1.

Liv

i handlated

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upward

ff

f1 >t2,

brandlated doconward.

FDM-

Freq. division

division Multigler.

(fe = f1-fr).. the carrier fig.

Demod

Messayon

18 D/LPED Med

BPP

[\

୮

2

+ LOF & Med

BPP

+DEM fel

BPR DEM → LPF

+LPF

mi1t)

2

2

Demar LPP

A+BPF

54c2

inte

3214

Common Channu

LPF

Med

BPF

N

Hefen

Carrier

Sirm

Trane mitter

BPF

1-D | Demid bLPs

DN

Block diagrams of FDM syltem!

fer

fur

#

Carrier Signer

Scanned with CamScanner