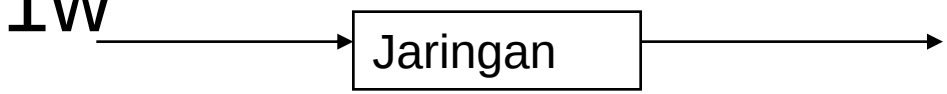
dB

Adalah satuan yang menggambarkan suatu perbandingan.

Merupakan suatu log dengan bilangan dasar 10

“ Suatu perbandingan antara dua besaran tenaga (power) dengan skala logarithma”

Dalam domain daya dikatakan :



Using Decibels

- In manual calculation of RF power levels, unwieldy large and small numbers occur as a product of painful multiplication and division.
- It is popular and much easier to work in Decibels (dB).
  - rather than **multiply and divide** RF power ratios, in dB we can **just add & subtract**

Ratio to Decibels

$$db = 10 * Log (X)$$

Decibels to Ratio

$$X = 10^{(db/10)}$$

Decibel Examples

Number N	dB
1,000,000,000	+90
100,000,000	+80
10,000,000	+70
1,000,000	+60
100,000	+50
10,000	+40
1,000	+30
100	+20
10	+10
4	+6
2	+3
1	0
0.5	-3
0.25	-6
0.1	-10
0.01	-20
0.001	-30
0.0001	-40
0.00001	-50
0.000001	-60
0.0000001	-70
0.00000001	-80
0.000000001	-90

Pemahaman dB

dB is a ratio of two power entity in logaritmis form

$$G = 10 \log p_2 / p_1 \text{ dB}$$

$$g = p_2 / p_1$$

p_1 = 6 mw dan g = 15 maka p_2=90 mw → p_2=6×15

G= 10 log 15 = 11,8 dB

p_1=0,10 watt dan g=1/5 maka p_2=0,02→p_2=10×1/5

G = 10 log 1/5 = -7 dB

Bahwa jaringan mempunyai Gain 3 dB, jadi Gain

$$(\text{dB}) = 10 \log \frac{\text{Outp}}{\text{Inpt}} = 10 \log \frac{2}{1} = 10 \times 0{,}3013$$

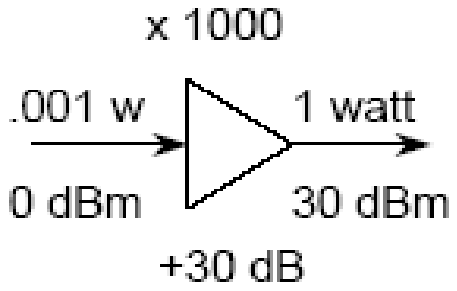
$$= 3{,}0103 \text{ dB}.$$

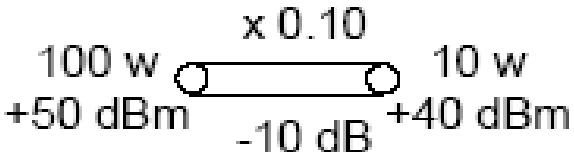
1000 w → Jaringan → 1 w, Jaringan mempunyai

rugi – rugi sebesar 30 dB.

$$\text{Rugi-rugi (dB)} = 10 \log \frac{\text{Inp}}{\text{Out}} = 10 \log \frac{1000}{1} = 30 \text{ dB}$$

Decibels - Relative and Absolute





- Decibels normally refer to power ratios -- in other words, the numbers we represent in dB usually are a ratio of two powers. Examples:
  - A certain amplifier amplifies its input by a factor of 1,000. (P_{out}/P_{in} = 1,000). That amplifier has 30 dB gain.
  - A certain transmission line has an efficiency of only 10 percent. (P_{out}/P_{in} = 0.1) The transmission line has a loss of -10 dB.
- Often decibels are used to express an absolute number of watts, milliwatts, kilowatts, etc.... When used this way, we always append a letter (W, m, or K) after "db" to show the unit we're using. For example,
  - 20 dBK = 50 dBW = 80 dBm = 100,000 watts
  - 0 dBm = 1 milliwatt

Prefixes for Large and Small Units

Summary of Units

Number N	$x10^{y}$	Prefix
1,000,000,000,000	$x10^{12}$	Tera
1,000,000,000	$x10^{9}$	Giga-
1,000,000	$x10^{6}$	Mega-
1,000	$x10^{3}$	Kilo-
100	$x10^{2}$	hecto-
10	$x10^{1}$	deca-
1	$x10^{0}$	
0.1	$x10^{-1}$	deci-
0.01	$x10^{-2}$	centi-
0.001	$x10^{-3}$	milli-
0.000001	$x10^{-6}$	micro-
0.000000001	$x10^{-9}$	nano-
0.000000000001	$x10^{-12}$	pico-
0.000000000000001	$x10^{-15}$	femto-

Large and small quantities pop up all over telecommunications and the world in general.

We like to work in units we can easily handle, both in math and in concept. So, when large or small numbers arise, we often use prefixes to scale them into something more comfortable:

- **Kilo**meters
- **Mega**hertz
- **Milli**watts
  - etc....

Secara umum :

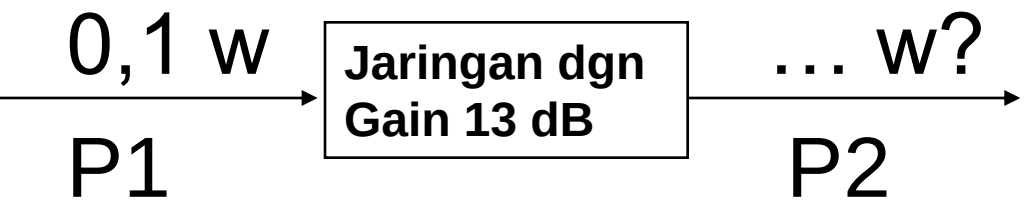
Daya (dB) = 10 log $\frac{P2}{P1}$ → daya yg lebih besar

P1 → daya yg lebih kecil

dB (Tegangan)= 20 log $\frac{E2}{E1}$ → Teg lebih tinggi

E1 → Teg lebih rendah

PR :



dBm

Adalah level daya dikaitkan dgn 1 mW

Dimana 0 dBm = 1 mW

Persamaan $dBm = 10 \log \frac{\text{daya (mW)}}{1mW}$

Contoh:

penguat punya keluaran = 20 w, berapa dalam dBm?

Jaringan dengan input = 0,0004 w, berapa dalam dBm?

dBW

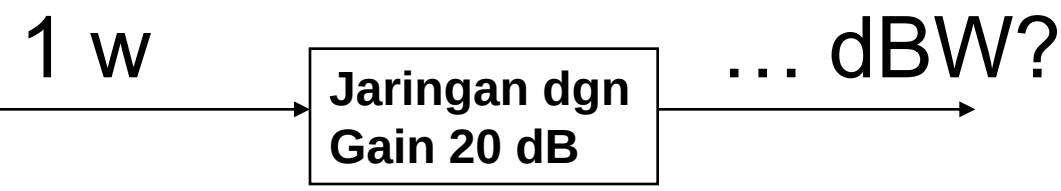
Direferensikan terhadap 1 W,

adalah satuan dB Absolut.

Banyak dipakai dalam MIKROWAVE

Dimana : + 30 dBm = 0 dBW

- 30 dBW = 0 dBm



dB_m,dB_w convertion

If p_1 = 1 watt maka

P_1=10 log 1watt/1watt= 0 dBw or

P_1=10 log 1 watt/1mw=30 dBm

0 dBw = 30 dBm

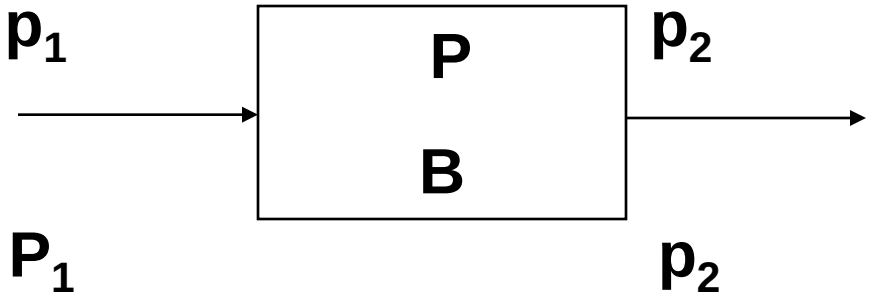
10 dBw = dbm

10 dBw = 40 dbm

20 dBm = dBw

20 dBm = - 10 dBw

dBm , dBW dll.



if $G = 10 \log p_2/p_1$ dB

$P_1 = 10 \log p_1/1$ mw dB_m OR

$= 10 \log p_1/1$ w dB_w

w or m after dB is written as an index to mark that the ratio is to mwatt or wat.

dBm,dBW dan dB is dimention less

dBmV

Adalah suatu level tegangan dapat dinyatakan dalam dB diatas atau dibawah 1 mV pada 75 ohm dikatakan bahwa level dalam dBmV.

$$\text{Level teg (dBmV)} = 20 \log \frac{\text{teg (mV)}}{1 \text{ mV}}$$

Bila tegangan diukur pada level input 75 ohm,

dBmV = 20 log (teg dalam mV pada 75 ohm

Np

Dipakai dinegara-negara Eropa Utara sebagai alternative dB.

1 Np = 8,686 dB ; 1 dB = 0,1151 Np

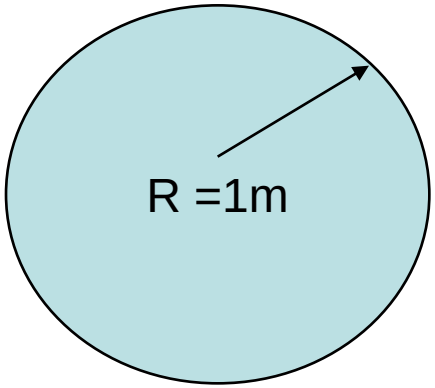
$$Np = \frac{1}{2} \ln \frac{P2}{P1}$$

P2 → Higher

P1 → Lower

dBi

Adalah satuan penguat pada Antena Isotropic.



Sumber ada di pusat bola

dB Calculation without calculator

Num	1	1,6	2	2,5	3	4	5	6	7	8	9	10
dB	0	2	3	4	5	6	7	8	8,5	9	9,5	10
					(4,77)			(7,77)			9,54	

Num 10.000 → 40 dB 36 = 6 x 6 atau 9 x 4

num 37 = dB num 72 = 18,54 dB

num 37 = 15,6 dB num 73 = 18,62 dB

What is the numerik of

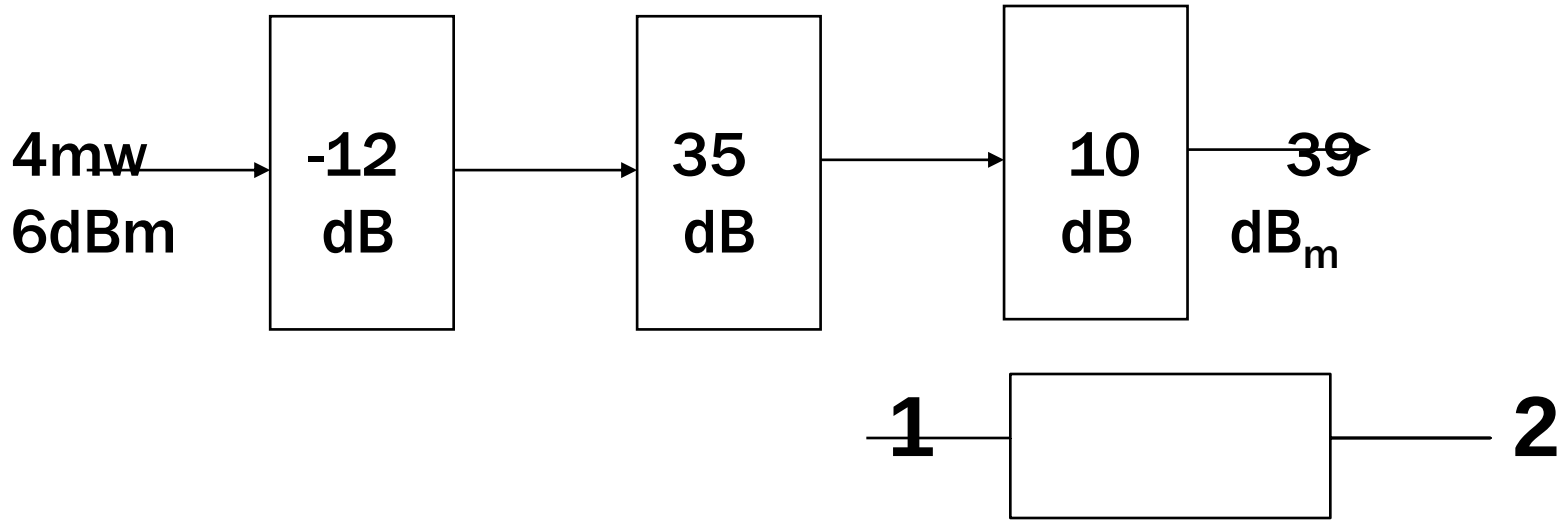
47 dB = x - 53 dB = x

40 + 7 → 5. 10^4 x - 60 +7 → 5 10^{-6} **X**

P_{ower} D_{ensity} =– 100 $dB_{w/Hz}$ or pd= 10^{-10} $w/_{Hz}$

if bandwdith = 10000 H_z What is the power?

ans : P = - 100 $dB_{w/Hz}$ + 40 dB_{Hz}= - 60 dB_w

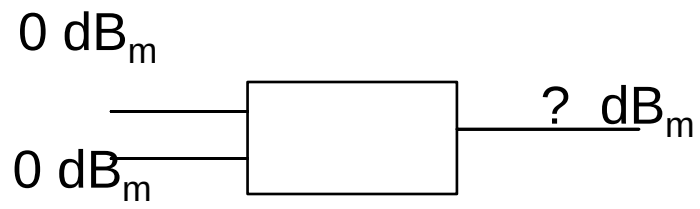


If the voltage at 1 = E1

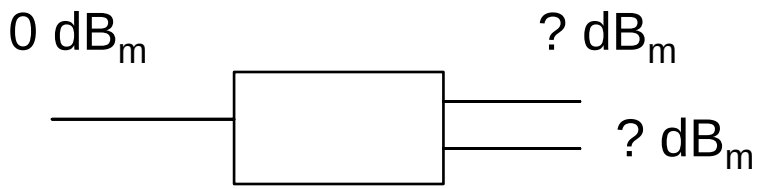
and voltage at 2 = E2

$G = 10 \log (E2/E1)^2$

Because E is a voltage



ans: 3 dBm because 0 dbm=1mw



Thowput is - 3 dBm each

- 0 dbm+0 dBm=3dBm 20 dBm+20 dBm=20dBm + 3db
- 6 dbm+6 dBm=6 dBm+3 dB 23 dBm+23 dBm=23dbm + 3dB

P_1	P_2	P_1+P_2	Δ	koreksi	
20	20	23	0	3.0	
20	19	22.5	1	2.5	0.5
20	18	22.1	2	2.1	0.4
20	17	21.8	3	1.8	0.3
20	16	21.5	4	1.5	0.3
20	15	21.2	5	1.2	0.3
20	14	21	6	1.0	0.2
20	13	20.8	7	0.8	0.2
20	12	20.6	8	0.6	0.2
20	11	20.5	9	0.5	0.1
20	10	20.4	10	0.4	0.1
20	9	20.3	11	0.30	0.1
20	8	20.25	12	0.25	0.05
20	7	20.21	13	0.21	0.04
20	6	20.18	14	0.18	
20	5	20.15	15	0.15	
20	4	20.12	16	0.12	

- Calculate :43 dBm+40 dBm =……

  Δ=3 correction =1,8 ∴ans. =44,8 dbm

- 25dBm+20dBm+27dbm+19dBm+28dBm=

  Δ=5 cor 1,2 Δ=8 cor 0,6

  26,2dBm 27,6dBm 28dbm =

  Δ=1,4 kor 1,3

  29.9 dbm 28 dbm

  Δ=2 kor 2,1

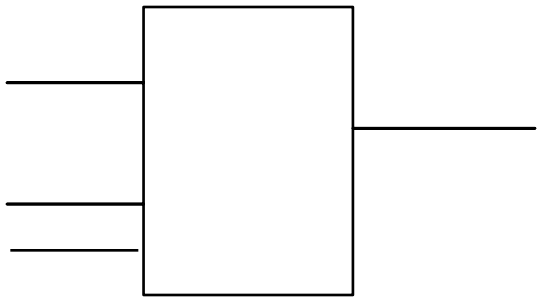
  = 32 dbm

Calculate :

3 dBm +4 dBm +5 dBm =

-23dbm+-15dbm+-18dbm+–26dbm= dbm

c/n_1=a (numeric) c/n_2 = b (numeric)



$n_1=c/a$ $n_2=c/b$ $n_1+n_2=c/a + c/b$

And $c/(n_1+n_2)= 1/(a^{-1}+b^{-1})$ or $c/n_t=1/(c/n_1^{-1}+c/n_2^{-1})$

in dB $\rightarrow$ $C/N_t=10\log[1/(c/n_1^{-1}+c/n_2^{-1})]$

C/N_1 = 20 dB C/N_2=20 dB

How much is the $C/(N_1+N_2)$?

ans : $N_1=N_2$ and $N_1+N_2 = 2\ N_1$ $C/N_t= C/N_1 - 3$ dB

C/N1	C/N2	C/Nt=	Δ	corr. to the nearest
20	20	17	**0**	**3**
20	21	16,5	**1**	**2,5**
20	22	17,9	**2**	**2,1**
20	23	18,2	**3**	**1,8**
20	24	18,5	**4**	**1,5**
20	25	18,8	**5**	**1,2**
20	26	19	**6**	**1**
20	27	19,2	**7**	**0,8**
20	28	19,4	**8**	**0,6**
20	29	19,5	**9**	**0,5**
20	30	19,6	**10**	**0,4**
20	31	19,7	**11**	**0,3**
20	32	19,75	**12**	**0,25**
20	33	19,79	**13**	**0,21**

- tentukan C/Nt jika C/N1=17 C/N2=23 C/N3=20 C/N4=28 dan C/N5=16 dB dengan menggunakan kalkulator dan juga tabel diatas. Jawab. 14.4 dB