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TECHNICAL TRAINING PUBLICATION

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TRANSMISSION TERMS dB, dBm, dBr, dBm0

PROGRAMMED LESSON

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1. INTRODUCTION

1.1 Communication circuits are used to transmit speech, telegraph, data and facsimile information from one point to another. One of the main aims in communication is to convey to the distant end sufficient power to operate such equipment as a telephone receiver, a telegraph machine, or data or facsimile equipment as the case may be.

1.2 Communications circuits include transmission paths and items of equipment which increase or decrease the power level of signals passing through them. An item which increases the signal power is said to have a *gain* and an item which decreases the signal power is said to have a *loss*.

1.3 To ensure that a satisfactory signal level is always received by the communication equipment it is necessary that we can measure, and clearly express, losses, gains and power levels. In addition, as an aid to fault location, and for general circuit performance testing, it is necessary for us to be able to indicate clearly the losses, gains and power levels that we can normally expect in a circuit, and also any deviation from these values that may occur.

1.4 A number of terms are used to express power losses, power gains and power levels etc.; these are dB (decibel), dBm, dBr and dBm0. At the end of the programme you should be able to apply the terms dB, dBm, dBr, and dBm0 in communication circuits.

1.5 The programme will teach you in the following order:

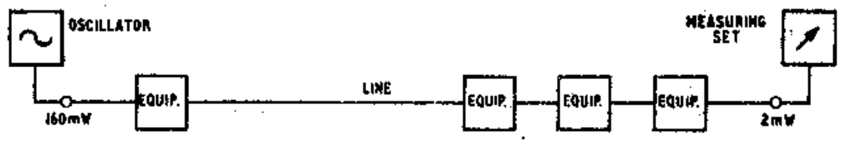
- Revision of the term dB.
- Revision of the term dBm.
- Definition of the term dBr.
- Definition of the term dBm0.
- Simple applications of all terms to communication circuits.

1.6 Log. tables are required for some exercises in the lesson.

2. PROGRAMMED LESSON

1	Let's first consider the term decibel which expresses the logarithmic ratio of powers in a circuit; that is, it expresses power gains or losses as a logarithmic ratio. The formula used to calculate loss and gain in dB is:- $dB = 10\ log.\ \frac{P1}{P2}$ (To simplify calculations P1 is always the larger power). When calculating the loss of an item of equipment which has an input of 100 mW and an output power of 5 mW, the equation is written. $dB = 10\ log.\ \frac{100}{5}$ The loss of an item of equipment with an input of 10 mW and an output of 6 mW is calculated using the formula:- $dB = 10\ log.\ \frac{P1}{P2}$ ...... is substituted for P1 and .... is substituted for P2.	
2	The power gain of an amplifier with an input of 0.1 mW and an output of 200 mW is calculated using the equation:- $dB = 10\ log.\ \frac{200}{0.1}$ An amplifier has an output of 150 mW and an input of 2 mW. Show how these values are substituted in the dB formula. dB = ...	10, 6
3	A technician testing an amplifier applies a test signal of 0.1 mW at the input and measures 100 mW at the output. The gain of the amplifier is:- $dB = 10\ log.\ \frac{100}{0.1}\ (\frac{1000}{1})$ $dB = 10 \times 3$ (The log. of 1000 is 3) dB = 30 dB gain The technician now applies a test signal of 200 mW to an attenuator, and measures 10 mW at the output. What is the loss of the attenuator? ....dB loss	$10\ log.\ \frac{150}{2}$

4



A signal level of 160 mW is applied to a line which includes several items of equipment, and a level of 2 mW is received at the far-end. The loss of the line and equipment is:-

$$dB = 10 \log. \frac{160}{2} \quad (\frac{80}{1})$$

$$dB = 10 \times 1.9 \text{ (The log of 80 = 1.9)}$$

$$dB = 19 \text{ dB loss.}$$

Note that the input power is larger than the output power so the answer is expressed as a loss.

A technician applies a test signal of 0.05 mW to the input of a trunk channel which includes several items of equipment. At the far-end another technician measures 0.5 mW. What is the gain or loss of the trunk channel?

...... dB loss/gain

Answer: 13 dB loss

5 You are a technician in a test laboratory and you are required to test the loss of an attenuation equaliser at 20 kHz. You apply a 20 kHz test signal at a power level of 1 mW, and measure 0.001 mW. What is the loss of the equaliser at 20 kHz?

...... dB loss

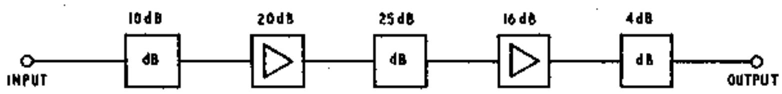
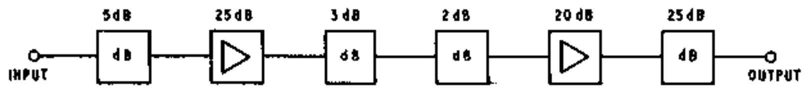
Answer: 10 dB gain

6	The table below shows the losses or gains (in dB) that occur for various power ratios. DON'T PANIC, you don't have to learn the table. It is included to give you some idea of the power losses that occur for various power ratios. The range of ratios shown are typical of those encountered in the communication network. The table may also be used to solve several of the following exercises.	30 dB

Power Ratio	Loss/Gain	Power Ratio	Loss/Gain	Power Ratio	Loss/Gain	Power Ratio	Loss/Gain
1:1	0 dB	2.5:1	4 dB	100:1	20 dB	10000:1	40 dB
2:1	3 dB	5:1	7 dB	200:1	23 dB	20000:1	43 dB
4:1	6 dB	10:1	10 dB	400:1	26 dB	40000:1	46 dB
8:1	9 dB	20:1	13 dB	800:1	29 dB	80000:1	49 dB
16:1	12 dB	40:1	16 dB	1000:1	30 dB	160000:1	52 dB
32:1	15 dB	80:1	19 dB	2000:1	33 dB	320000:1	55 dB
64:1	18 dB	160:1	22 dB	4000:1	36 dB	640000:1	58 dB
128:1	21 dB	320:1	25 dB	8000:1	39 dB	1280000:1	61 dB
256:1	24 dB	640:1	28 dB	16000:1	42 dB	2560000:1	64 dB

TABLE 1. TYPICAL POWER RATIOS EXPRESSED IN dB.

7	Using the table, it can be calculated that an amplifier with an input of 0.1 mW and an output of 3.2 mW (Power ratio 32:1 - in first column) has a gain of 15 dB. Use the table to determine the gain or loss of an item of equipment with an input of 0.001 mW and an output of 10 mW. .... dB gain/loss	
8	From the table determine the gain or loss of an item of equipment with an input of 2000 mW and an output of 0.1 mW. .... dB gain/loss	40 dB gain
9	To calculate the gain of an amplifier which has an input power level of 0.0005 mW and an output power level of 2 mW the equation is written dB = ... and the amplifier gain is	43 dB loss

10	A communication circuit consists of a transmission line plus many items of equipment. Some equipment items introduce gain and some introduce loss so that the transmitted signal is subjected to both gains and losses. The *overall* gain or loss of a circuit is the difference between the sum of the gains and the sum of the losses. That is the *overall power gain/loss = total circuit gain ~ total circuit loss.* Note ~ here means 'difference between'. A typical circuit is shown. It consists of some components which introduce gain (shown with the symbol ▷) and some which introduce loss (shown with the symbol [dB]). The gain or loss of each item is indicated.  The overall gain/loss of the circuit = total gain ~ total loss. total gain = 20 + 16 = 36 dB total loss = 10 + 25 + 4 = 39 dB In this example: Overall loss = total loss - total gain. = 39 dB - 36 dB Overall loss = 3 dB. What is the overall gain/loss of the circuit shown below?  ...... dB gain/loss	dB = 10 log. $\frac{2}{0.0005}$ 36 dB
11	You are a technician at Port Popalong and have a trunk circuit to Coroach Sound. The circuit consists of carrier equipment and a physical line. The 'active' items of equipment introduce a gain of 4 dB; the 'passive' items of equipment introduce a loss of 1 dB, a loss of 7 dB occurs on the line. What is the overall gain or loss of the circuit? ...... gain/loss	10 dB gain

12	You have seen that the decibel is a unit of power ratio. When you state the loss or gain of a circuit in dB you give no indication of the input or output powers but merely indicate the ratio by which the power will change. For example a pad with a loss of 20 dB (power ratio 100:1) will change a power of 100 mW to 1 mW - a reduction of 99 mW. The same pad will change a power of 10 mW to 0.1 mW - a reduction of 9.9 mW. (Refer to Table 1). An amplifier with a gain of 30 dB will change a power of 0.1 mW to ...... mW. The term 30 dB, however, gives no indication of power levels or of the actual power change but indicates that a power ratio of .... exists from input to output of the amplifier. (Refer to Table 1).	4 dB loss
13	In some of the previous exercises you have calculated gains and losses in dB from given input and output power levels expressed in mWs. In practice, power levels throughout a circuit can also be expressed using the same logarithmic ratio as losses and gains but referred to a reference signal power. *In telecommunication, power levels are normally expressed as a logarithmic ratio to a reference power level of 1 mW.* For example, a power level of 100 mW, which is 100 times 1 mW is expressed as being *20 dB above 1 mW*. To obtain this result the formula dB = 10 log. $\frac{P1}{P2}$ is used; 100 mW is substituted for P1 and 1 mW for P2. Thus $dB = 10 \log. \frac{100}{1} \left(\frac{100 \text{ mW}}{1 \text{ mW - Reference power level}}\right)$ $dB = 10 \times 2$ (The log. 100 = 2) $dB = 20$ dB 100 mW is 20 dB above 1 mW. Using the same reasoning, calculate the relationship of 200 mW to the arbitrary power of 1 mW. 200 mW is expressed as being .... above 1 mW.	100 mW 1:1000

14 To express a power level of 0.005 mW as a logarithmic ratio with respect to 1 mW we use the formula dB = 10 log. $\frac{P1}{P2}$ but now because 0.005 mW is less than 1 mW, P1 becomes 1 and P2 becomes 0.005 mW. 23 dB above 1 mW

Remember dB calculations are simplified by keeping the larger power in the numerator (P1 in the formula).

The equation is written dB = 10 log. $\frac{1}{0.005}$ $(\frac{200}{1})$

dB = 10 × 2.3 (The log of 200 = 2.3)

dB = 23

0.005 mW is expressed as being 23 dB below 1 mW.

Now, you take a power level of 0.01 mW and express this relative to 1 mW.

0.01 mW is expressed as being ....

15 Now to simplify the expression of power levels, and to avoid confusion between dB units expressing power gains and losses and dB units expressing power levels, a designation of dBm has been adopted to indicate power levels. *dBm is 'dB with respect to a reference level of 1 mW'.* Any figure given in dBm is therefore an expression of a power level. 20 dB below 1 mW

1 mW is always 0 dBm. (This statement is true regardless of circuit impedance).

Power levels greater than 1 mW are indicated by a +sign preceding dBm. (Example 2 mW is expressed as +3 dBm).

Power levels less than 1 mW are indicated by a -sign preceding dBm (Example 0.001 mW is expressed as -30 dBm).

WITH THE EXCEPTION OF 0 dBm (1 mW), NEVER WRITE THE EXPRESSION dBm WITHOUT a + or a - PREFIX. IT IS MEANINGLESS WITHOUT THIS.

Now this is how you convert power levels into dBm. Take 128 mW as an example.

The formula is written dB = 10 log. $\frac{P1}{P2}$

dB = 10 log. $\frac{128}{1}$

= 10 × 2.1 (The log of 128 = 2.1)

= 21

128 mW expressed in dBm = +21 dBm

See if you can convert 0.05 mW to dBm.

0.05 mW expressed in dBm is ....

<table>
<tr><td>16</td><td>Most transmission measuring sets (T.M.S.s) used for measurements in the communication network are calibrated to record power levels in dBm. When the power level at a point in a circuit is 0.05 mW the meter would record -13 dBm. That is, a 20:1 power ratio exists between 0.05 mW and the arbitrary reference level of 1 mW.

What level (in dBm) would a T.M.S. record when measuring at a point in a circuit with a power level of 0.001 mW present?

....................</td><td>-13 dBm</td></tr>
<tr><td>17</td><td>You have now revised the use of two transmission units used in the communication network. Each term has a special use.

Try yourself out on these questions.

The gain of an amplifier is expressed in: dB/dBm ....

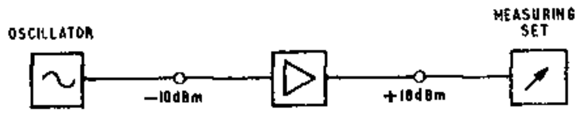
A power level of 2 mW is expressed as:
+3 dB/+3 dBm/-3 dBm/3 dBm. ....

A power level of 1 mW is expressed as:
1 dB/0 dB/0 dBm/+0 dBm. ....

A circuit which includes items of equipment which introduce 15 dB gain and items which introduce 20 dB loss has an: overall gain of 5 dB/overall loss of 5 dB/overall gain of 35 dB/overall loss of -5 dBm.

..................</td><td>-30 dBm</td></tr>
<tr><td>18</td><td>For communication circuits we rarely talk or write of power levels in mW, or of power gains or losses as numerical ratios. We talk and write in dBm and dB because when input and output powers are expressed in dBm the power gain or loss in dB is the difference between them.

In the simple circuit below the input power is -10 dBm and the output power is +18 dBm. The circuit gain is the difference between -10 dBm and +18 dBm; that is, 28 dB gain.



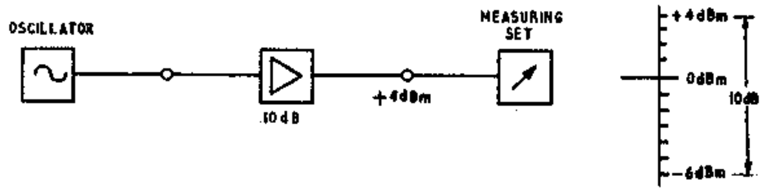
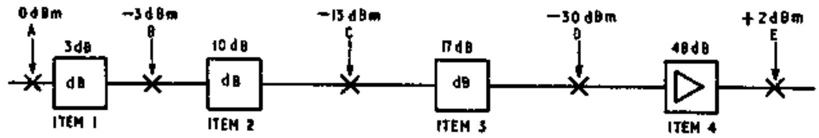
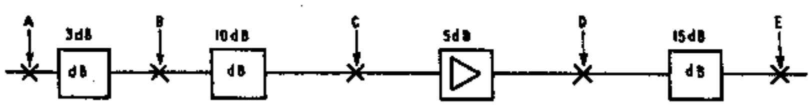
You are a technician checking the loss of an attenuator. You apply a test signal of +23 dBm to the input and measure +11 dBm at the output.

The attenuator loss is ....</td><td>dB

+3 dBm

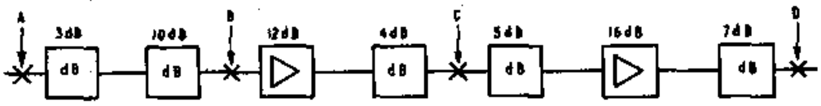
0 dBm

Overall Loss of 5 dB</td></tr>
</table>

19	When the circuit gain or loss is known in dB and the input or output power is known in dBm, the unknown level can be quickly calculated. This is illustrated in the diagram where a circuit gain of 10 dB and an output level of +4 dBm are given. The input power is 10 dB below the output level: +4 dBm - 10 dB = -6 dBm. ∴ the input power is equal to -6 dBm.  Now see if you can calculate the output level of a circuit which has a gain of 26 dB. Assume that a level of -8 dBm is applied to the circuit input. Output level = ...	12 dB
20	You are asked to locate a fault on a telephone circuit. To do this you take power level measurements at the points in the circuit A, B, C, D, E. The power levels you measure are shown on the diagram. The correct working loss or gain of each equipment items is also shown. From this information determine the faulty equipment item, and indicate how much its actual gain or loss varied from its nominal gain or loss.  The faulty equipment item is item .... Gain/loss change .... dB.	+18 dBm
21	In the diagram below the losses and gains of each item of equipment are shown. Now if a test signal of 0 dBm is applied at point A, the levels at the other points are: B -3 dBm, C -13 dBm, D -8 dBm, E -23 dBm.  If a level of -1 dBm is measured at D, what are the levels at A and E? (Assume that the power gains and losses remain unchanged). A .... E	4 gain change 16 dB

22

Now in communication circuits we can relate gains and losses in a circuit to a reference point in the circuit. For example if we make point A a reference point in the circuit below, then point B is 13 dB below point A, and point C is 5 dB below point A.



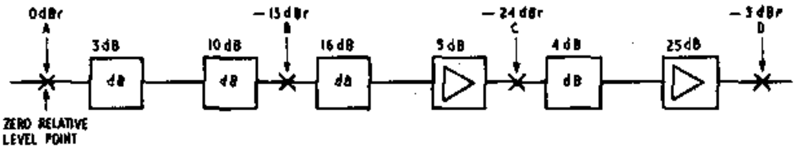
Still assuming point A to be the reference point then point D is ...... dB above/below the reference point.

Answers: +7 dBm; -16 dBm

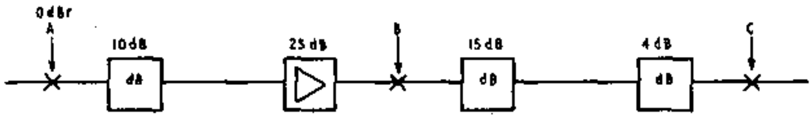
23

This method of expressing losses and gains with respect to a reference point in a circuit is simplified by using the term dBr. dBr *is the decibel ratio of the power of a signal at a point in a transmission path to that of the same signal at a zero relative level point.*

If we make point A the reference point and designate it as the point of *zero relative level,* then point A is designated 0 dBr; that is 0 dB with respect to the signal level present. Point B is a -13 dBr point, point C is a -24 dBr point and point D is a -3 dBr point.



Now in the diagram below point B is designated ...... dBr and point C is designated ...... dBr.

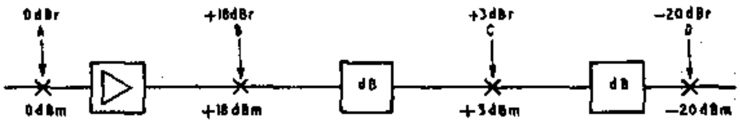


Answer: 1 dB below

24

You should note that dBr expresses relative level only; it gives no indication of the absolute power level present. However, when you know the absolute power level and relative level in dBr at any point, it is possible to calculate the power levels that should exist at other relative level points.

In this diagram 0 dBm is applied at point A and the levels at the other points in the circuit are: point B +18 dBm, point C +3 dBm and point D -20 dBm. From this it can be seen that the expressions dBm and dBr are numerically the same when an absolute power level of 0 dBm exists at the 0 dBr point.



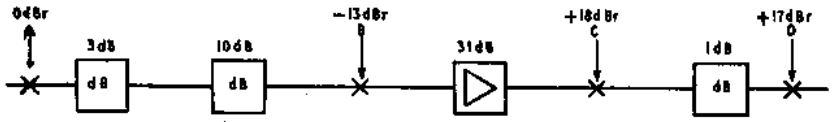
In the communication network the reference signal is generally 0 dBm at the zero relative level point; that is the 0 dBr point. For this reason the terms dBr and dBm are numerically equal when the test signal level is 0 dBm at the zero relative level point.

Answers: +15 dBr; -4 dBr

25

In the diagram below the points A, B, C and D are designated 0 dBr, -13 dBr, +18 dBr and +17 dBr respectively. Assuming that a signal with a power level of -6 dBm exists at point A, then the levels at points B, C and D are -19 dBm, +12 dBm and +11 dBm respectively.

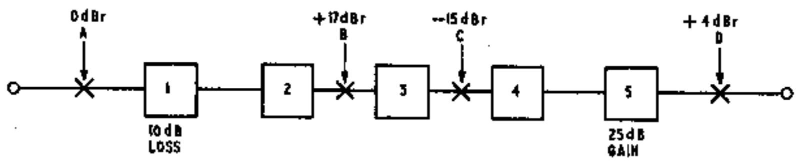
The designations in dBr are still correct because the relative losses and gains in the circuit, with respect to point A (the reference point), are unchanged. However, in this example, dBr and dBm are not numerically the same, because a level other than 0 dBm exists at point A.



From the diagram, calculate the level in dBm at point D, when the level measured at point B is -10 dBm.

26

+20 dBm



Assume that a level of -3 dBm is applied at point A of the circuit. What are the levels (in dBm) at the other points in the circuit?

Point B ....

Point C ....

Point D ....

What are the losses or gains of equipment items 2, 3 and 4?

<u>Item 2</u> ....

<u>Item 3</u> ....

<u>Item 4</u> ....

27

+14 dBm

-18 dBm

+1 dBm

27 dB gain

32 dB loss

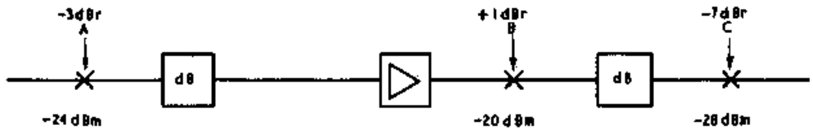
6 dB loss

You learnt in frame 24 that the terms dBm and dBr are numerically the same in the communication network when 0 dBm is applied at the 0 dBr point. You might well ask, why introduce a new term? Consider the example given in frame 25. With a test level of -6 dBm applied at point A, the absolute levels at all other points are 6 dB below the relative level. Therefore, the expression dBm will equal the dBr figure only when the nominal line-up level exists in the circuit. However, although the absolute power levels can change in the circuit, the power losses and gains should remain the same. The expressions in dBr (which in effect represent losses and gains with respect to the circuit zero relative level point) are accurate regardless of the actual power levels that exist in the circuit.

28 In the examples and exercises given in the previous frames, the zero relative level point has been indicated. It should be noted, however, that it is possible to consider relative levels without reference to the zero relative level point in the circuit.

In this diagram, a test signal at a power level of -24 dBm is applied at the -3 dBr point. The power levels at points B and C are -20 dBm and -28 dBm respectively.

What power levels would you expect at points A and B, when you measure a power level of -9 dBm at point C?



A ....

B ....

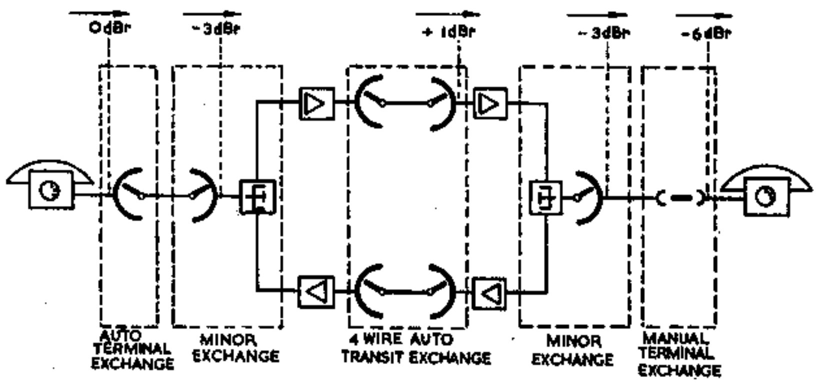
29 In the communication network it is often necessary to consider relative levels without direct reference to the zero relative point.

-5 dBm
-1 dBm

The diagram below shows, in simplified form, a typical subscriber to subscriber call. The <u>send</u> relative levels at the *exchange reference points* are shown for one direction of transmission only.

The *exchange reference point* is the point at which the relative level is defined for an exchange. With the exception of the terminal exchange reference point (send direction), exchange reference points are not necessarily zero relative level points, but of course are related to the zero relative level points.

This example differs from previous examples in the lesson, in that, at a switching centre, the received relative level may not be the same as the send relative level, with the result that the level sent on from that switching point may not conform with the nominal send level for that switching centre. For this reason, special consideration must be given to testing a circuit with intermediate switching centres. The techniques associated with end-to-end testing on circuits of this nature are not covered in this lesson. This lesson is confined to the application of terms within one circuit.

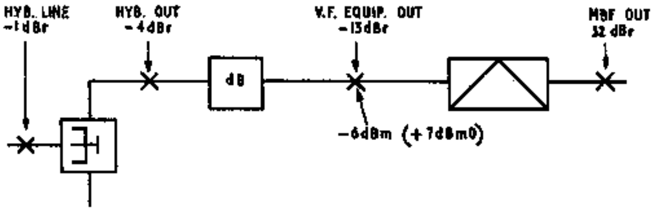


30 In frame 25 the levels measured at the test points were below the nominal levels for those points. We express this variation from the nominal level by using the expression dBm0. dBm0 *is the power level of a signal expressed in dBm but referred to a zero relative level point.*

It can be thought of as the numerical difference between the power level of a signal at a point in a transmission path, and the relative level at that point.

For example, when a test signal measured at a +5 dBr point, has an absolute level of -5 dBm, it is said to be a test signal of -10 dBm0, because at a zero relative level (0dBr) point its absolute level would be -10 dBm. Similarly a test level of -13 dBm applied at a -13 dBr point is a test signal of 0 dBm0, and a test power level of +3 dBm applied at a +1 dBr point is a test signal of +2 dBm0.

A test signal of -6 dBm is measured at V.F. EQUIP. OUT. This is 7 dB above the relative level and is expressed as +7 dBm0.



Referring to the diagram assume that a test signal of -3 dBm0 is applied at HYB. LINE. What are the absolute power levels you would anticipate at HYB. OUT and M.B.F. OUT?

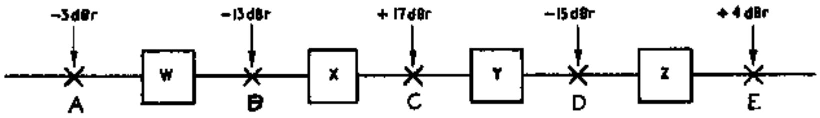
HYB. OUT ....

M.B.F. OUT ....

31 Work through the following exercises to see if you can relate the expressions dB, dBm, dBm0 and dBr.

-7 dBm

-35 dBm



A test signal of -3 dBm applied at point A is expressed as ..... dBm0.

With -6 dBm0 applied at point A, the levels at the other reference point should be:

B ..... dBm, C ..... dBm, D ..... dBm, E ..... dBm.

The gains/losses of items W to Z are:

W ..... gain/loss X ..... gain/loss

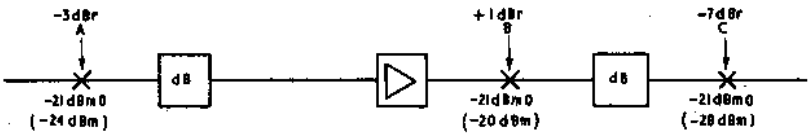
Y ..... gain/loss Z ..... gain/loss

<table>
<tr>
<td>32</td>
<td>

Well, I hope that the previous examples have given a reason for introducing the expression dBm0. Or have they? We could, when testing circuits, consider power levels in dBm (remember, most of our test instruments are calibrated in dBm), and refer these dBm levels to the appropriate relative level points. That's what you did in frame 27 and you found the information you required. Lets see if it is any more simple working in dBm0. We'll consider the following features:

- A testing officer at a receiving station is told that a test signal of 0 dBm0 is transmitted on a circuit. He knows that he should receive 0 dBm0 (or 0 dBm0 plus or minus certain prescribed limits). The test signal sent may be -13 dBm at a -13 dBr point, +1 dBm at a +1 dBr point, etc; but when test levels are expressed in dBm0 the actual sending point does not necessarily concern the testing officer at the receive station. However, if the send test level is nominated in dBm, then the receiving testing officer has to know the relative level at the sending point in order to know what to anticipate at the receive end.
- Another feature is the fact that the term dBm0 is a 'shorthand' method of expressing a certain condition. It gives an indication of actual power level and its relationship to the relative level at a point in a circuit. It does away with a word statement.
- A third feature of the term dBm0 relates to its use to express noise levels, pilot frequency levels, etc.. The power levels of these frequencies are also recorded in dBm0, but no details are given in this lesson.

Let's consider the diagram from frame 28 again. It is repeated below. This time a test signal of -21 dBm0 (-24 dBm) is sent; assuming circuit gains and losses remain unchanged, the levels measured at B and C are -20 dBm and -28 dBm, respectively. That is, -21 dBm0 in both cases.



What dBm0 levels would you anticipate at points A and B, when the power level at C is -2 dBm0? (Assume gains and losses are as shown).

A ....

B ....

</td>
<td>

0 dBm0

B. -19 dBm
C. +11 dBm
D. -21 dBm
E. -2 dBm

W. 10 dB (loss)
X. 30 dB (gain)
Y. 32 dB (loss)
Z. 19 dB (gain)

</td>
</tr>
<tr>
<td>33</td>
<td>The relationship between dBr, dBm and dBm0 is shown in Attachment 1. Assume for each example that the losses and gains remain unchanged. Study the Attachment then move to frame 34.</td>
<td>-5 dBm
-1 dBm</td>
</tr>
<tr>
<td>34</td>
<td>

Complete the table shown in Attachment 2 to show the relationship between dBr, dBm and dBm0. On the diagram show the gain of each amplifier. Assume that losses and gains remain unchanged unless instructions specify otherwise. (Answers given in Attachment 3).

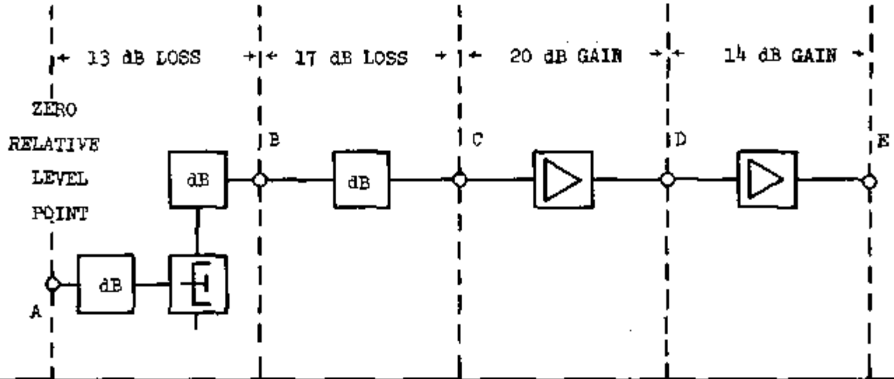
If you have difficulty completing any of the sections, then return to frame 22 and work through to this point again.

</td>
<td></td>
</tr>
</table>

35	Complete the table shown in Attachment 4 to show the relationship between dBr, dBm and dBm0. Once again assume that losses and gains remain unchanged unless otherwise specified. On the diagram indicate losses and gains of any items of equipment not already designated. (Answers given in Attachment 5).	
36	Referring to Attachment 4, technicians testing the circuit between points B and C would send a test signal at a level of -13 dBm and would expect to measure +4 dBm. What send test level would you use to test the circuit between points D and G, and what power level would you expect to receive? (Assume a 0 dBm0 test signal level is to be used).	
37	Answer frame.	-3 dBm +1 dBm

TRANSMISSION TERMS dB, dBm, dBr, dBm0

ATTACHMENT NO. 1



dBr LEVELS	0	-13	-30	-10	+4

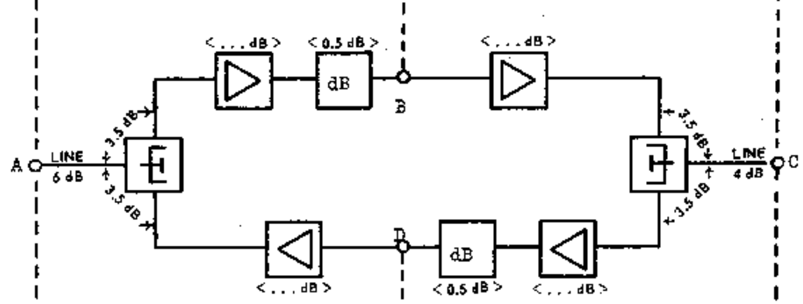
EXAMPLES		A	B	C	D	E
WITH 0 dBm APPLIED AT A, THEN LEVELS AT B, C, D, AND E ARE:	dBm LEVELS	0 dBm	-13 dBm	-30 dBm	-10 dBm	+4 dBm
	dBm0 LEVELS	0 dBm0	0 dBm0	0 dBm0	0 dBm0	0 dBm0
WITH -20 dBm APPLIED AT A, THEN LEVELS AT B, C, D AND E ARE:	dBm LEVELS	-20 dBm	-33 dBm	-50 dBm	-30 dBm	-16 dBm
	dBm0 LEVELS	-20 dBm0	-20 dBm0	-20 dBm0	-20 dBm0	-20 dBm0
WITH -10 dBm MEASURED AT B, THEN LEVELS AT A, C, D AND E ARE:	dBm LEVELS	+3 dBm	-10 dBm	-27 dBm	-7 dBm	+7 dBm
	dBm0 LEVELS	+3 dBm0	+3 dBm0	+3 dBm0	+3 dBm0	+3 dBm0
WITH -10 dBm0 APPLIED AT B, THEN LEVELS AT C, D AND E ARE:	dBm LEVELS	-	-23 dBm	-40 dBm	-20 dBm	-6 dBm
	dBm0 LEVELS	-	-10 dBm0	-10 dBm0	-10 dBm0	-10 dBm0

RELATIONSHIP BETWEEN dB, dBm, dBr and dBm0.

TRANSMISSION TERMS dB, dBm, dBr, dBm0

ATTACHMENT NO. 2

EXAMPLES		A	B	C
1. WITH 0 dBm APPLIED AT A	dBm LEVELS			
	dBm0 LEVELS			
2. WITH -6 dBm APPLIED AT A	dBm LEVELS			
	dBm0 LEVELS			
3. WITH -8 dBm MEASURED AT C	dBm LEVELS			
	dBm0 LEVELS			
	dBr LEVELS	0	-3	-6



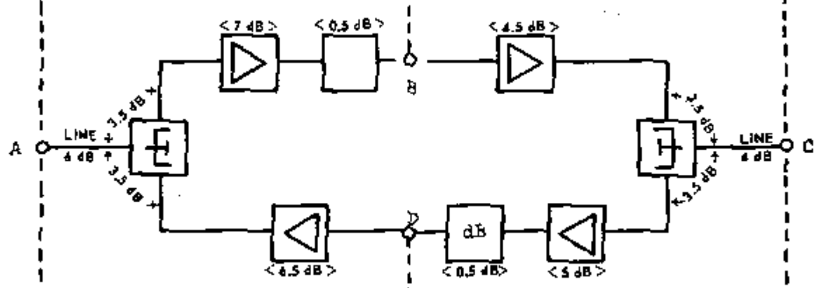
EXAMPLES	dBr LEVELS	-6	-3	0
4. WITH +1 dBm MEASURED AT D	dBm LEVELS			
	dBm0 LEVELS			
5. WITH 0 dBm APPLIED AT C BUT WITH LINE LOSS (C END) INCREASED FROM 4 dB to 8 dB	dBm LEVELS			
	dBm0 LEVELS			
		A	D	C

RELATIONSHIP BETWEEN dB, dBm, dBr and dBm0.

TRANSMISSION TERMS dB, dBm, dBr, dBm0

ATTACHMENT NO. 3.

EXAMPLES		A	B	C
1. WITH 0 dBm APPLIED AT A	dBm LEVELS	0 dBm	-3 dBm	-6 dBm
	dBm0 LEVELS	0 dBm0	0 dBm0	0 dBm0
2. WITH -6 dBm APPLIED AT A	dBm LEVELS	-6 dBm	-9 dBm	-12 dBm
	dBm0 LEVELS	-6 dBm0	-6 dBm0	-6 dBm0
3. WITH -8 dBm MEASURED AT C	dBm LEVELS	-2 dBm	-5 dBm	-8 dBm
	dBm0 LEVELS	-2 dBm0	-2 dBm0	-2 dBm0
	dBr LEVELS	0	-3	-6



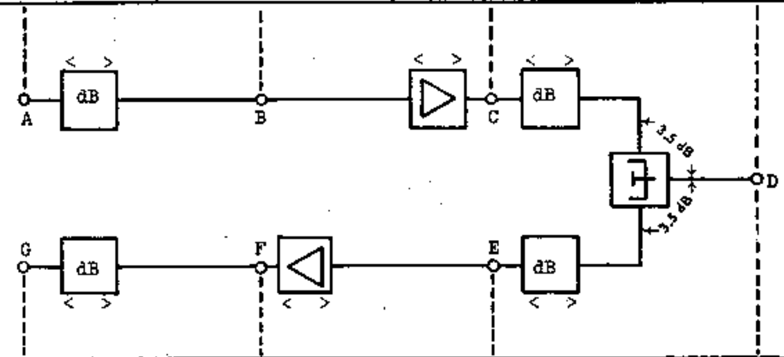
EXAMPLES	dBr LEVELS	-6	-3	0
4. WITH +1 dBm MEASURED AT D	dBm LEVELS	-2 dBm	+1 dBm	+4 dBm
	dBm0 LEVELS	+4 dBm0	+4 dBm0	+4 dBm0
5. WITH 0 dBm APPLIED AT C BUT WITH LINE LOSS (C END) INCREASED FROM 4 dB TO 8 dB	dBm LEVELS	-10 dBm	-7 dBm	0 dBm
	dBm0 LEVELS	-4 dBm0	-4 dBm0	0 dBm0
		A	D	C

RELATIONSHIP BETWEEN dB, dBm, dBr and dBm0.

TRANSMISSION TERMS dB, dBm, dBr, dBm0

ATTACHMENT NO. 4.

EXAMPLES		A	B	C	D
1. WITH -13 dBm APPLIED AT B	dBm LEVELS	-			
	dBm0 LEVELS	-			
2. WITH -5 dBm MEASURED AT C	dBm LEVELS				
	dBm0 LEVELS				
3. WITH -10 dBm APPLIED AT A	dBm LEVELS				
	dBm0 LEVELS				
	dBr LEVELS	-7	-13	+4	-3



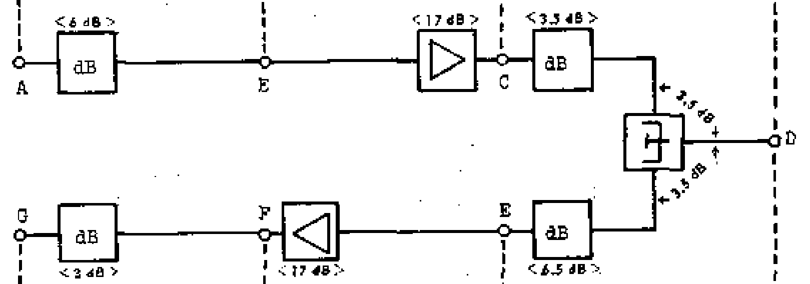
EXAMPLES		G	F	E	D
	dBr LEVELS	+1	+4	-13	-3
4. WITH -3 dBm APPLIED AT D BUT GAIN BETWEEN E AND F DECREASED BY 6 dB	dBm LEVELS				
	dBm0 LEVELS				
5. WITH +2 dBm MEASURED AT G	dBm LEVELS				
	dBm0 LEVELS				

RELATIONSHIP BETWEEN dB, dBm, dBr and dBm0.

TRANSMISSION TERMS dB, dBm, dBr, dBm0

ATTACHMENT NO. 5.

EXAMPLES		A	B	C	D
1. WITH -13 dBm APPLIED AT B	dBm LEVELS	-	-13 dBm	+4 dBm	-3 dBm
	dBm0 LEVELS	-	0 dBm0	0 dBm0	0 dBm0
2. WITH -5 dBm MEASURED AT C	dBm LEVELS	-9 dBm	-15 dBm	+2 dBm	-5 dBm
	dBm0 LEVELS	-2 dBm0	-2 dBm0	-2 dBm0	-2 dBm0
3. WITH -10 dBm APPLIED AT A	dBm LEVELS	-10 dBm	-16 dBm	+1 dBm	-6 dBm
	dBm0 LEVELS	-3 dBm0	-3 dBm0	-3 dBm0	-3 dBm0
	dBr LEVELS	-7	-13	+4	-3



EXAMPLES					
	dBr LEVELS	+1	+4	-13	-3
4. WITH 0 dBm APPLIED AT D BUT GAIN BETWEEN E AND F DECREASED BY 6 dB	dBm LEVELS	-5 dBm	-2 dBm	-13 dBm	-3 dBm
	dBm0 LEVELS	-6 dBm0	-6 dBm0	0 dBm0	0 dBm0
5. WITH +2 dBm MEASURED AT G	dBm LEVELS	+2 dBm	+5 dBm	-12 dBm	-2 dBm
	dBm0 LEVELS	+1 dBm0	+1 dBm0	+1 dBm0	+1 dBm0
		G	F	E	D

RELATIONSHIP BETWEEN dB, dBm, dBr and dBm0.