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1.

$P_{source1}$ = -5 dBm =>-35dB
$P_{source2}$ = 316.22776602uW =>-5dB

At Attenuator stage;
$P_{source2}$ is attenuated by 6bB

-5-6 = -11dB

At first coupler;

source 1
Reduced to -37dB from -35dB by the insertion loss of 2dB

using coupling factor of 8dB

8 = Power incident – power coupled

power coupled = -(8 - (-37)) = -45 dB

source 2
Reduced to -13dB from -11dB by the insertion loss of 2dB

using coupling factor of 8dB

8 = Power incident – power coupled

power coupled = -(8 - (-13))= -21 dB

At PA;
source 1
let power output be Pout1 and input be Pin1
Pout1 = Pin1 + G – 1 ; G=gain

Pout1 = -45 + 30 – 1
= -16 dB

source 2
let power output be Pout2 and input be Pin2
Pout2 = Pin2 + G – 1 ; G=gain

Pout2 = -21 + 30 – 1
= 7dB

At second coupler;

source 1
Reduced to -18 dB from -16 dB by the insertion loss of 2dB

using coupling factor of 8dB

8 = Power incident – power coupled

power coupled = -(8 - (-18)) = -26 dB

source 2
Reduced to 5 dB from 7 dB by the insertion loss of 2dB

using coupling factor of 8dB

8 = Power incident – power coupled

power coupled = -(8 - (5)) = -3 dB

Amplitude for carrier source 1 on SA

-26 dB => 4dBm

Amplitude for carrier source 2 on SA

-3 dB => 27dBm

2.

Yes, one of the outputs is at 27dBm which is beyond the compression point of 20dBm therefore IM3 is expected.

3.

Sketch
Frequency calculation;
$f_{source1}$ = 1.81 GHz ……..f1
$f_{source2}$ = 1.87 GHz ……..f2

the left IM3 = 2f1-f2 = 2(1.81) - 1.87 = 1.75 GHz

the right IM3 = 2f2-f1 = 2(1.87) -1.81 = 1.93 GHz

Power calculation;

using the relation;
IM3low = 2Plow + Phigh – 2*OIP3 for low => f1, high => f2

= 2*4 + 27-2*28 = **-21 dBm**

IM3high = Plow+2*Phigh - 2*OIP3

= 4 + 2*27 – 2*28 = **2dBm**