THE INFLUENCE OF MULTIPLE-DEVIATION COEFFICIENT n TO PARAMETRIC GENERATING REGIONS N = 3, 5, 7

Nguyen Vu Cam Binh, Vo Ly Thanh Ha, Nguyen Dang Lam,

Do Thi Minh Nguyet, Vu Anh Phi

Department of Physics, College of Science, VNU

Abstract: By varying the ratio of two resonance frequencies ($n = \varpi_{20}/\varpi_{10}$) in parametric resonance system, we heve excited parametric regions N = 3, 5, 7, N = $2\varpi_0/p$, where p is pumping frequency, ϖ_{20}, ϖ_{10} are the resonance frequencies of the system. We have put forward comments of characteristics of these regions and conjectures about values of n summed up from experimental results. From then, we could be able to choose the ratio of ϖ_{20} and ϖ_{10} suitably. Excited high-level parametric regions make us know reality of research at different frequency bands in the future.

This report summarizes the experimental result operated in three separate parametric panels (*Figure 1*) giving out the influence of multiple-deviation coefficient ($n^{(*)}$-factor) to parametric generations by low-pumping frequencies.

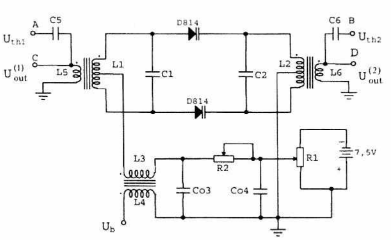

Fig.1: Experimental diagram

Circuit L_2C_2 having high resonant frequency f_{20} is selected to main contour (the contour II) and circuit L_1C_1 that has low resonant frequency f_{10} is selected to secondary contour (the contour I). When the capacitance C_1 is fixed constantly, altering C_2, the multiple - deviation coefficient between two contours will be got as desired. For propose of choosing the relation between L_1 and L_2, thus altering C_2 does not make affection to the resonant frequency of the secondary contour I significantly. On contrary, altering C_1 will make a considerable affection to the resonant frequency of main contour.

1. Considered the parametric generating region N = 3, corresponding to $f_b = 2/3\ f_{20}$, n is altered from 2.56 to 3.87 (*Figure 2*).

Realize that if n 3 (for example n = 3.05; 3.54; 3.79; 3.87;...), the parametric region is separated from the region N=1, ($f_b = 2f_{10}$, also called the parametric generating region of low frequency contour).

The width of the parametric generating region N=3 is narrow about 15 ÷ 20 KHz and not being altered following alteration of the pumping amplitude. The alteration of its down-threshold and up-threshold depend on n. The parametric generating amplitude is high, and rapidly decreases at two limits, $n=f_{20}/f_{10}$, *(f_{10}, f_{20} are resonant frequencies of the contour I and II)*

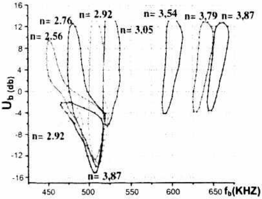

Fig. 2: The parametric exciting regions N = 1 and N = 3 depending on the n- factor

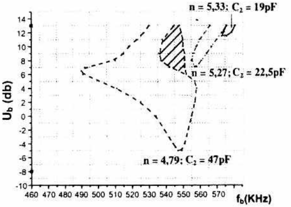

Fig. 3: The parametric exciting region N = 5 when varying the capacitor C_2

There are always the synchrony between $U_{out}^{(1)}$ and $U_{out}^{(2)}$ or between the pumping and the signal taken out from the contour I or II. The signal frequency taken out from the contour I is always equal to half of the pumping frequency ($f_1 = f_b/2$) and the relation of $f_1 = f_{20}/3$ is also maintained, (note that f_1 is not equal to f_{10} and it can be not necessary to resonate with the contour I).

As n > 4, we had also observed the shrink of the parametric region N=3. It up-threshold is lower than +13db. As n ≈ 3 (n = 2.96 ÷ 2.98), two regions N = 3 and N = 1 are integrated into one area. In case of n = 2.96, as Q_2 is high ($Q_2 = 77$), the region N = 1 can be divided into two separate regions (in which one of two is "island" located at side of frequency that is lower than f_b, $f_b \approx 2f_{10}$). We can observe parametric amplification under these regions. There may be auto-modulation between two regions that the cause is not due to bias circuit. In addition, there is also amplitude delay. As n = 2.56 the parametric region N = 3 is slanted into left side and it is unable to observe the region N=3 when continuing to decrease n.

2. Considered the parametric generation around n=5 (*figure 3*)

As n = 5.27 or n =5.33, we had also observed the parametric region N = 5, ($f_b = 2/5f_{20}$), that separated from area N = 1. This region is slightly slanted into side of high frequency, its width is at about 15 ÷ 20 KHz, U_b^N increases when n is deviated from 5.

As $n \approx 5$, two areas are integrated into one area, there is also amplitude or frequency delay. As for area N=5, when $f_b \approx 2f_{10}$, there is "branching" at the up-side of the region N= 1, and auto-modulation phenomenon and forming "island".

When altering the capacitance C_2, we can excite the region N = 3 and N = 5 with the same pumping frequency. In the contour I, there is always case of $f_1 = f_b/2$ ($f_1 \neq f_{10}$) and f_1 always synchronous with f_2 and f_b in all generating band. As n<<5, we can not observe the region N=5.

3. Consideration of the parametric generating region N = 7 ($f_b = 2/7\ f_{20}$)

When n = 7.064, two regions N = 1 and N = 7 are separated, but when n = 6.842, they are integrated into one area. We can also observe amplitude delay. Because of high n-factor so we can not observe "branching" or auto-modulation phenomenon at the region I. Among parametric generating regions, we can see the non-linear multiplying regions (just when the pumping amplitude is high), the nonlinear parametric multiplication (just when $f_b \approx 2f_{20}$).

Conclusions

With systems having no high Q-factor (Q at about 45 ÷ 50), by choosing suitable n-factor, we can excite parametric generating region N = 3, 5, 7.

If n = (2.953 ÷ 3.9) we had parametric generation area of N = 3, $f_b = 2/3\ f_{20}$.

If n = (3.9 ÷ 5.7) we had parametric generation area of N = 5, $f_b = 2/5\ f_{20}$.

If n = (5.86 ÷ 7.54) we had parametric generation area of N = 7, $f_b = 2/7\ f_{20}$.

Above experimental data concluded from an experience modulus has oriental characteristic (these different modules may have rather small different results).

With available varicabs and the existence of the secondary contour, we can excite parametric generation and amplification at the regions having the pumping frequency lower than f_{th} (signal frequency) or f_{20}.

New parametric generating and amplifying regions may open up the capacity of applications and parametric oscillation in general.

References

1. N. V. C. Binh, *Graduation thesis*, Department of Physics, College of Science, VNU, (2004).
2. N. T. H. Hanh, N. V. C. Binh, D. T. Kien, V. A. Phi, *About one experimental modulus having excited the parametric phenomena by low pumping frequency, Science Report, Science Seminar*, Department of Physics, College of Science, VNU, (2004).
3. D. T. M. Nguyet, *Graduation thesis*, Department of Physics, Hanoi University of Science, VNU, (2004).