5. tiha vaja iz VISOKOFREKVENČNE TEHNIKE - 23.1.2017

1. Frekvenčni sintetizator za f=450MHz vsebuje VCO s kvaliteto Q_{VCO}=30. Kolikšno izboljšanje faznega šuma L(Δf) lahko pričakujemo pri frekvenčnem odmiku Δf=500kHz, ko VCO uklenemo s PLL s primerjalno frekvenco f_{REF}=25kHz na referenco Q_{XTAL}=3000?

(A) 0dB (B) 20dB (C) 40dB (D) 60dB

2. V fazno-sklenjeni zanki uporabimo sito z dvema kondenzatorjema C_1=1μF, C_2=3.3μF in uporom R=10kΩ. Kolikšno je razmerje med frekvenco pola in frekvenco ničle $\omega_{POL}/\omega_{NIČLA}$=? prevajalne funkcije H(ω) povratne vezave?

(A) 3.30 (B) 4.30 (C) 10.9 (D) 18.5

3. Za neznani VCO izmerimo odziv: 0V=420MHz, 1V=425MHz, 2V=431MHz, 3V=436MHz, 4V=440MHz, 5V=444MHz, 6V=447MHz, 7V=450MHz in 8V=452MHz. Kolikšen je največji K_{VCOMAX}=? merjenega vezja?

(A) 3MHz/V (B) 4MHz/V (C) 5MHz/V (D) 6MHz/V

4. Letalska radijska postaja mora pokriti frekvenčni pas f=118.000-137.000MHz v kanalih s frekvenčnim razmakom Δf=8.333kHz. V kolikšnem območju se giblje faktor deljenja N=? sintetizatorja s fazno-sklenjeno zanko in skrbno izbrano primerjalno frekvenco?

(A) 118000-137000 (B) 23600-27400 (C) 14160-16440 (D) 4270-5480

5. PLL sintetizator smatramo uklenjen, ko se fazna napaka zmanjša pod $|\Delta\phi|\leq$10mrd. Kolikšna je tedaj širina impulzov Δt=? na izhodu frekvenčno/faznega primerjalnika, če sintetizator dela s primerjalno frekvenco f_{REF}=25kHz?

(A) 64ns (B) 400ns (C) 6.4μs (D) 40μs

6. V LC oscilatorju uporabimo varikap diodo z razponom kapacitivnosti C_{MIN}=10pF do C_{MAX}=50pF. Varikap diodi je vezana vzporedno kapacitivnost vezja C_0=20pF. Kolikšen frekvenčni razpon Δf=? pokrije VCO s tuljavo L=1μH?

(A) 5MHz (B) 7MHz (C) 10MHz (D) 14MHz

7. Pri uglaševanju radijskega sprejemnika najdemo isto radijsko postajo na frekvenci f_1=15.55MHz ter na frekvenci f_2=16.46MHz. Iz opažanj sklepamo, da radijski sprejemnik uporablja mešanje na medfrekvenco vrednosti:

(A) 16.005MHz (B) 32.01MHz (C) 910kHz (D) 455kHz

8. V radijski sprejemnik vgradimo mešalnik, ki ima vhodno presečno točko tretjega reda P_{IIP3}=+7dBm. Šumno število izboljšamo z linearnim LNA G=15dB. Zrcalni odziv zadušimo s sitom, ki ima vstavitveno slabljenje a=3dB. Kolikšen je P_{IIP3}'=? celega sprejemnika?

(A) -8dBm (B) -5dBm (C) -2dBm (D) -11dBm

9. Vitroplast FR4 ima v področju radijskih frekvenc tangens izgubnega kota tgδ=0.02. Če iz dvostranskega vitropasta izdelamo kondenzator tako, da pustimo bakreno folijo na obeh straneh, bo imel kondenzator najvišjo kvaliteto Q=?

(A) 25 (B) 50 (C) 100 (D) 200

10. V tehniki mikrotraktih vodov izdelamo glavnikasto pasovno sito za f_0=1GHz. Četrtvalovni rezonatorji so na enem koncu ozemljeni preko via lukenj ter na drugem koncu odprti. Sito bo imelo prvi neželjen odziv pri frekvenci približno:

(A) 1.5GHz (B) 2GHz (C) 3GHz (D) 4GHz

11. V super-regenerativnem sprejemniku dosežemo gašenje visokofrekvenčnega oscilatorja s primernim načrtovanjem vezja za nastavitev njegove delovne točke. Frekvenco gašenja v tem primeru izbiramo z:

(A) sklopom antene (B) Q nihajnega kroga (C) f_T tranzistorja (D) RC vezjem

12. Visokofrekvenčno vezje vgradimo v zaprto kovinsko ohišje v obliki kvadra z notranjimi izmerami a=20cm, b=15cm in c=10cm. Pri kateri najnižji frekvenci f=? pričakujemo prvo notranjo rezonanco ohišja? ($c=3\cdot10^8$m/s)

(A) 1.25GHz (B) 1.68GHz (C) 1.8GHz (D) 1.95GHz

Priimek in ime: Elektronski naslov:

5th midterm exam HIGH-FREQUENCY TECHNOLOGY - 23.1.2017

1. A frequency synthesizer for f=450MHz includes a VCO with a Q_{VCO}=30. What improvement of the phase noise L(Δf) can be expected at an offset Δf=500kHz, when the VCO is locked with a PLL with a comparison frequency f_{REF}=25kHz to a reference Q_{XTAL}=3000?

(A) 0dB (B) 20dB (C) 40dB (D) 60dB

2. A PLL uses a lead-lag loop filter with two capacitors C_1=1μF, C_2=3.3μF and resistor R=10kΩ. What is the ratio between the pole and zero frequency $\omega_{POLE}/\omega_{ZERO}$=? of the feedback transfer function H(ω)?

(A) 3.30 (B) 4.30 (C) 10.9 (D) 18.5

3. The response of an unknown VCO is measured: 0V=420MHz, 1V=425MHz, 2V=431MHz, 3V=436MHz, 4V=440MHz, 5V=444MHz, 6V=447MHz, 7V=450MHz and 8V=452MHz. What is the maximum K_{VCOMAX}=? of the measured circuit?

(A) 3MHz/V (B) 4MHz/V (C) 5MHz/V (D) 6MHz/V

4. An aviation radio should cover the frequency range f=118.000-137.000MHz with a Δf=8.333kHz channel spacing. What is the range of the divider modulo N=? of a PLL synthesizer with a carefully chosen comparison frequency?

(A) 118000-137000 (B) 23600-27400 (C) 14160-16440 (D) 4270-5480

5. A PLL synthesizer is considered locked when the phase error is below $|\Delta\phi|\leq$10mrd. What is the corresponding pulse width Δt=? at the output of the frequency/phase comparator if the synthesizer uses a comparison frequency f_{REF}=25kHz?

(A) 64ns (B) 400ns (C) 6.4μs (D) 40μs

6. A LC oscillator is tuned with a varactor with a capacitance range from C_{MIN}=10pF to C_{MAX}=50pF. The circuit capacitance connected in parallel to the varactor is C_0=20pF. What is the VCO frequency coverage Δf=? when using a coil L=1μH?

(A) 5MHz (B) 7MHz (C) 10MHz (D) 14MHz

7. While tuning a radio receiver we find the same station at a frequency f_1=15.55MHz and at a frequency f_2=16.46MHz. From our observations we conclude that our receiver is using an intermediate frequency of:

(A) 16.005MHz (B) 32.01MHz (C) 910kHz (D) 455kHz

8. A radio receiver includes a mixer with the input third-order intercept point of P_{IIP3}=+7dBm. The noise figure is improved by a linear LNA G=15dB. The image response is attenuated with a filter with an insertion loss a=3dB. What is the receiver P_{IIP3}'=?

(A) -8dBm (B) -5dBm (C) -2dBm (D) -11dBm

9. The glass-fiber-epoxy laminate FR4 has a loss tangent of tanδ=0.02 in the radio-frequency range. If a capacitor is made from a double-sided piece of FR4 with the copper foil in place on both sides, the capacitor will achieve a maximum Q=?

(A) 25 (B) 50 (C) 100 (D) 200

10. A comb band-pass filter for f_0=1GHz is built as a microstrip circuit. The quarter-wavelength resonators are grounded on one end through via holes and are left open at the other end. The filter has its first unwanted response at about the frequency:

(A) 1.5GHz (B) 2GHz (C) 3GHz (D) 4GHz

11. In a super-regenerative receiver the radio-frequency oscillator quenching is achieved with an appropriate design of the bias circuit of its active component. The quenching frequency is selected by:

(A) antenna coupling (B) resonator Q (C) transistor f_T (D) RC network

12. A radio-frequency circuit is installed in a closed rectangular metal box with the internal dimensions a=20cm, b=15cm and c=10cm. At which lowest frequency f=? the first internal resonance of the metal box is expected? ($c=3\cdot10^8$m/s)

(A) 1.25GHz (B) 1.68GHz (C) 1.8GHz (D) 1.95GHz

Name: Email: