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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |
| ***Ðàçðàá.*** | *Õèðõ-ßëàí* |  |  |  | ***Ëèò.*** | ***Ëèñò*** | ***Ëèñòîâ*** |
| ***Ïðîâ.*** | *Ñåäîâ Ñ.À.* |  |  |  |  |  |  | ***3*** | ***13*** |
|  |  |  |  |  |  |
| ***Í. êîíòð.*** |  |  |  |  |  |
| ***Óòâ.*** |  |  |  |  |  |

*ÐÒ21.020.526.001 ÏÇ*

*Ãðàôè÷åñêèé ýêâàëàéçåð áûòîâîãî àóäèîêîìïëåêñà*

*ïîÿñíèòåëüíàÿ çàïèñêà*

Ñîäåðæàíèå

1. Òåõíè÷åñêîå çàäàíèå.

 1.1. Íàèìåíîâàíèå è îáëàñòü ïðèìåíåíèÿ.

 1.2. Îñíîâàíèå äëÿ ðàçðàáîòêè.

 1.3. Òåõíè÷åñêèå òðåáîâàíèÿ.

2. Äîêóìåíòû ýñêèçíîãî ïðîåêòà.

 2.1. Ââåäåíèå.

 2.2. Íàçíà÷åíèå è îáëàñòü ïðèìåíåíèÿ.

 2.3. Îáîñíîâàíèå ñòðóêòóðíîé ñõåìû.

3. Äîêóìåíòû òåõíè÷åñêîãî ïðîåêòà.

 3.1. Îáîñíîâàíèå ñõåìîòåõíè÷åñêèõ ðåøåíèé.

 3.2. Ðàñ÷åòû, ïîäòâåðæäàþùèå ðàáîòîñïîñîáíîñòü èçäåëèÿ.

 3.3. Ïîðÿäîê íàñòðîéêè èçäåëèÿ.

4. Ñïèñîê ëèòåðàòóðû.

1. Òåõíè÷åñêîå çàäàíèå

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|  |  |  |  |  |  | ***Ëèñò*** |
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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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1.1. Íàèìåíîâàíèå è îáëàñòü ïðèìåíåíèÿ èçäåëèÿ.

Ðàçðàáàòûâàåìûé ãðàôè÷åñêèé ýêâàëàéçåð ïðåäíàçíà÷åí äëÿ ñîãëàñîâàíèÿ ýëåêòðîàêóñòè÷åñêèõ ïàðàìåòðîâ áûòîâîãî àóäèîêîìïëåêñà, â ÷àñòíîñòè, àêóñòè÷åñêîé ñèñòåìû è àêóñòè÷åñêîãî îôîðìëåíèÿ ïîìåùåíèÿ ìåòîäîì ðåãóëèðîâêè ôîðìû àìïëèòóäíî-÷àñòîòíîé õàðàêòåðèñòèêè êîýôôèöèåíòà ïåðåäà÷è â ðàáî÷åì äèàïàçîíå ÷àñòîò.

1.2. Îñíîâàíèå äëÿ ðàçðàáîòêè.

Îñíîâàíèåì äëÿ ðàçðàáîòêè ÿâëÿåòñÿ çàäàíèå, âûäàííîå êàôåäðîé ðàäèîïðèåìà è îáðàáîòêè ðàäèîòåõíè÷åñêîé èíôîðìàöèè.

1.3. Òåõíè÷åñêèå òðåáîâàíèÿ.

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| ¹ ï/ï | Ïàðàìåòð èëè õàðàêòåðèñòèêà | Åä. | Íîðìà | Èñòî÷íèê |
| 1 | Íîìèíàëüíûé äèàïàçîí ÷àñòîò ïðè ñïàäå À×Õ íà êðàÿõ äèàïàçîíà 3 äÁ | Ãö | 10...30000 | ÃÎÑÒ 24838-87 |
| 2 | Êîýôôèöèåíò ãàðìîíèê ïðè âõîäíîì íàïðÿæåíèè 1Â íà ÷àñòîòàõ 100, 1000 è 10000 Ãö, íå áîëåå | % | 0.05 | ÃÎÑÒ 24838-87 |
| 3 | Íîìèíàëüíîå âõîäíîå íàïðÿæåíèå | Â | 1 | Ðåêîìåíä. |
| 4 | Ìàêñèìàëüíîå âõîäíîå íàïðÿæåíèå | Â | 4 | - |
| 5 | Äèàïàçîí ðåãóëèðîâàíèÿ òåìáðà âî âñåõ ÷àñòîòíûõ ïîëîñàõ | äÁ | ±16 | - |
| 6 | Îòíîøåíèå ñèãíàë/øóì ïðè âõîäíîì íàïðÿæåíèè 1 Â | äÁ | 80 | ÃÎÑÒ 24863-87 |
| 7 | Êðàòíîñòü ðåãóëèðîâêè ðåçîíàíñíûõ ÷àñòîò è äîáðîòíîñòåé | ðàç | 2 | Ðåêîìåíä. |
| 8 | Ìàêñèìàëüíàÿ ïîãðåøíîñòü óñòàíîâêè ðåçîíàíñíûõ ÷àñòîò è äîáðîòíîñòåé | % | 5 | - |
| 9 | Ñðåäíåå âðåìÿ íàðàáîòêè íà îòêàç | ÷àñ | 11000 | ÃÎÑÒ 15150-69 |

2. Äîêóìåíòû ýñêèçíîãî ïðîåêòà

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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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2.1. Ââåäåíèå.

Â ñîâðåìåííûõ óñèëèòåëÿõ, òþíåðàõ è ìàãíèòîôîíàõ èìåþòñÿ ðåãóëÿòîðû òåìáðà, êîòîðûìè îáû÷íî â çíà÷èòåëüíîé ñòåïåíè ðåãóëèðóåòñÿ îñíîâíàÿ ÷àñòü ñïåêòðà çâóêîâûõ ÷àñòîò. Ýòè ðåãóëÿòîðû ïðèãîäíû äëÿ íåáîëüøèõ èçìåíåíèé òîíàëüíûõ çíà÷åíèé çâóêîâûõ ïðîãðàìì, íî îíè ìàëîýôôåêòèâíû äëÿ èñïðàâëåíèÿ íåäîñòàòêîâ ãðîìêîãîâîðèòåëåé è ïîìåùåíèé äëÿ ïðîñëóøèâàíèÿ. Ïîñêîëüêó àìïëèòóäíî-÷àñòîòíàÿ õàðàêòåðèñòèêà îáû÷íîãî ãðîìêîãîâîðèòåëÿ èìååò çíà÷èòåëüíóþ íåðàâíîìåðíîñòü â ðàçëè÷íûõ òî÷êàõ çâóêîâîãî äèàïàçîíà, ýêâàëàéçåð, â ñèëó ñâîèõ îñîáûõ ÷àñòîòíûõ õàðàêòåðèñòèê, â áîëüøåé ñòåïåíè ñïîñîáåí âíåñòè íåîáõîäèìóþ êîððåêöèþ, ÷åì îáû÷íûå ðåãóëÿòîðû òåìáðà.

Ýêâàëàéçåð ïîçâîëÿåò â çíà÷èòåëüíîé ñòåïåíè ñêîìïåíñèðîâàòü íåðàâíîìåðíîñòü àìïëèòóäíî-÷àñòîòíûõ ÷àðàêòåðèñòèê àêóñòè÷åñêèõ ñèñòåì, íåñîâåðøåíñòâî àêóñòè÷åñêèõ ñâîéñòâ ïîìåùåíèé, âîçðàñòíûå èçìåíåíèÿ ñëóõà, îñóùåñòâëÿòü êîððåêöèþ ìàãíèòîôîííûõ çàïèñåé äëÿ óëó÷øåíèÿ èõ êà÷åñòâà. Ýêâàëàéçåð ïîâûøàåò êà÷åñòâî âîñïðèÿòèÿ çâóêîâîé ïðîãðàììû, ïîýòîìó îí ÿâëÿåòñÿ íåîòúåìëåìûì çâåíîì ñîâðåìåííûõ ñèñòåì âûñîêîêà÷åñòâåííîãî çâóêîâîñïðîèçâåäåíèÿ.

2.2. Íàçíà÷åíèå è îáëàñòü ïðèìåíåíèÿ.

Ýêâàëàéçåð ãðàôè÷åñêèé äåñÿòèïîëîñíûé ïðåäíàçíà÷åí äëÿ èñïîëüçîâàíèÿ â ñîñòàâå áûòîâîãî çâóêîâîñïðîèçâîäÿùåãî êîìïëåêñà àïïàðàòóðû âûñøåé è ïåðâîé ãðóïï ñëîæíîñòè.

2.3. Îáîñíîâàíèå ñòðóêòóðíîé ñõåìû.

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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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Ñóùåñòâóþò äâà îñíîâíûõ òèïà ýêâàëàéçåðîâ: ïàðàìåòðè÷åñêèå è ãðàôè÷åñêèå. Â êà÷åñòâå áàçîâîé â ðàçðàáàòûâàåìîì ïðîåêòå âûáðàíà ñõåìà ãðàôè÷åñêîãî ýêâàëàéçåðà, ïîñêîëüêó íåñìîòðÿ íà òî, ÷òî ïðè ðàâíûõ ìàòåðèàëüíûõ çàòðàòàõ íà èçãîòîâëåíèå ïàðàìåòðè÷åñêèé ýêâàëàéçåð îáåñïå÷èâàåò ëó÷øèå âîçìîæíîñòè ðåãóëèðîâêè, ÷åì ãðàôè÷åñêèå, ýêñïëóàòàöèÿ ïàðàìåòðè÷åñêîãî ýêâàëàéçåðà òðåáóåò âûñîêîé êâàëèôèêàöèè ïîëüçîâàòåëÿ.

Ãðàôè÷åñêèå ýêâàëàéçåðû äåëÿòñÿ íà äâà îñíîâíûõ òèïà ïî ñïîñîáó êîððåêöèè ñèãíàëà:

- óñòðîéñòâà ñ ôèëüòðàìè â öåïè ïðÿìîãî ñèãíàëà;

- óñòðîéñòâà ñ ôèëüòðàìè â öåïè îáðàòíîé ñâÿçè.

Â êà÷åñòâå áàçîâîé âûáðàíà ñõåìà ñ ôèëüòðàìè â öåïè îáðàòíîé ñâÿçè, òàê êàê äëÿ óñòðîéñòâà ñ ôèëüòðàìè â öåïè ïðÿìîãî ñèãíàëà ðåðóëèðîâêà â îäíîì êàíàëå âûçûâàåò èçìåíåíèå ïàðàìåòðîâ äëÿ äðóãîãî êàíàëà, ÷òî óõóäøàåò òåõíè÷åñêèå è ýêñïëóàòàöèîííûå õàðàêòåðèñòèêè.

Äëÿ íàèáîëåå ïîëíîé êîððåêöèè ÷àñòîòíûõ èñêàæåíèé, âíîñèìûõ â çâóêîâîé ñèãíàë ÀÑ è àêóñòè÷åñêèìè õàðàêòåðèñòèêàìè ïîìåùåíèé ïðîñëóøèâàíèÿ, íåîáõîäèì, êàê ìèíèìóì, äåñÿòèïîëîñíûé ýêâàëàéçåð [4].

Äëÿ óñòðàíåíèÿ âçàèìíîãî âëèÿíèÿ ðàçðàáàòûâàåìîãî óñòðîéñòâà è ïðåäûäóùèõ êîìïîíåíòîâ áûòîâîãî àóäèîêîìïëåêñà öåëåñîîáðàçíî íà âõîäå óñòàíîâèòü áóôôåðíûé êàñêàä, êîòîðûé ìîæíî ñîâìåñòèòü ñ ôèëüòðîì âåðõíèõ ÷àñòîò ñ ÷àñòîòîé ñðåçà 20 Ãö (ðîêîò-ôèëüð, êîòîðûé îñîáåííî àêòóàëåí ïðè ïðîñëóøèâàíèè ãðàìçàïèñåé).

Òàêèì îáðàçîì, âûáðàíà ñòðóêòóðíàÿ ñõåìà: äåñÿòèïîëîñíàÿ ñ ôèëüòðàìè â öåïè îáðàòíîé ñâÿçè è áóôôåðíûì êàñêàäîì íà âõîäå.

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|  |  |  |  |  |  | ***Ëèò.*** | ***Ìàññà*** | ***Ìàñøò.*** |
| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |  |  |  |  |
| ***Ðàçðàá.*** | *Õèðõ-ßëàí* |  |  |  |  |  |  |  |  |
| ***Ïðîâ.*** | *Ñåäîâ Ñ.À.* |  |  |  |  |  |  |  |  |
| ***Ò. êîíòð.*** |  |  |  |  | ***Ëèñò 1*** | ***Ëèñòîâ*** |
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| ***Í. êîíòð.*** |  |  |  |  |  |
| ***Óòâ.*** |  |  |  |  |  |

*ÐÒ21.020.526.001 Ý1*

*Ãðàôè÷åñêèé ýêâàëàéçåð áûòîâîãî àóäèîêîìïëåêñà*

*ñõåìà ýëåêòðè÷åñêàÿ ñòðóêòóðíàÿ*



3. Äîêóìåíòû òåõíè÷åñêîãî ïðîåêòà

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|  |  |  |  |  |  | ***Ëèñò*** |
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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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3.1. Îáîñíîâàíèå ñõåìîòåõíè÷åñêèõ ðåøåíèé.

Ïîñòðîèòü äåñÿòèïîëîñíûé ýêâàëàéçåð íà áàçå îáû÷íûõ íèçêîäîáðîòíûõ ïîëîñîâûõ ôèëüòðîâ ñëîæíî. Èç-çà ðàçáðîñà íîìèíàëîâ ðåçèñòîðîâ è êîíäåíñàòîðîâ ïîëó÷èòü òî÷íîå ñîîòâåòñâèå ðåàëüíûõ è ðàñ÷åòíûõ ïàðàìåòðîâ è À×Õ òàêèõ ôèëüòðîâ î÷åíü òðóäíî. Ïðè ýòîì, ÷òîáû íàñòðîèòü äåñÿòèïîëîñíûé ýêâàëàéçåð ñ òî÷íîñòüþ ±10% ïî âñåì êàíàëàì, íåîáõîäèì íå òîëüêî ïðåäâàðèòåëüíûé ïîäáîð íîìèíàëîâ ýëåìåíòîâ äî ñáîðêè, íî è äîïîëíèòåëüíàÿ èõ êîððåêöèÿ óæå â ãîòîâîì ôèëüòðå. Íà ïðàêòèêå êàæäûé ôèëüòð ïðèõîäèòñÿ íàñòðàèâàòü â ìàêåòíîì âàðèàíòå è òîëüêî ïîñëå ýòîãî óñòàíàâëèâàòü íà þáùóþ ìîíòàæíóþ ïëàòó. Òàêàÿ íàñòðîéêà îòíèìàåò ìíîãî âðåìåíè, òðåáóåò âûñîêîé êâàëèôèêàöèè, ñïåöèàëüíûõ ïðèáîðîâ è áîëüøîãî ÷èñëà èñïîëüçóåìûõ äëÿ ïîäáîðà ýëåìåíòîâ, ÷òî â èòîãå ïðèâîäèò ê óäîðîæàíèþ óñòðîéñòâà â ïðîöåññå ïðîèçâîäñòâà.

Òàêèì îáðàçîì, ïðèìåíåíèå îáû÷íûõ íèçêîäîáðîòíûõ ôèëüòðîâ íåöåëåñîîáðàçíî.

Ðàññìàòðèâàåìîå ñõåìîòåõíè÷åñêîå ïîñòðîåíèå ôèëüòðà ïîçâîëÿåò ïîëó÷èòü îïòèìàëüíûå ïàðàìåòðû (íåîáõîäèìîå ïðîèçâåäåíèå óñèëåíèÿ íà ÷óâñòâèòåëüíîñòü, ìèíèìàëüíûé øóì è ìàêñèìàëüíûé äèíàìè÷åñêèé äèàïàçîí [3]).

Â êà÷åñòâå àêòèâíûõ ýëåìåíòîâ ñõåìû ïðèìåíÿþòñÿ ìèêðîñõåìû Ê157ÓÄ2, êîòîðûå ñîäåðæàò ïî äâà ÎÓ, ÷òî óìåíüøàåò ãàáàðèòíûå ðàçìåðû èçäåëèÿ.

 Íà ñõåìå ïîêàçàí òîëüêî îäèí ÷àñòîòíûé êàíàë, îñòàëüíûå åìó èäåíòè÷íû.

3.2. Ðàñ÷åòû, ïîäòâåðæäàþùèå ðàáîòîñïîñîáíîñòü èçäåëèÿ.

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|  |  |  |  |  |  | ***Ëèñò*** |
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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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Ïðèâåäåì ïðèíöèïèàëüíóþ ñõåìó ôèëüòðà, êîòîðûé èñïîëüçóåòñÿ â öåïè îáðàòíîé ñâÿçè ýêâàëàéçåðà:



*Ðèñ. 3.1 Âûñîêîäîáðîòíûé ôèëüòð. Ñõåìà ýëåêòðè÷åñêàÿ ïðèíöèïèàëüíàÿ.*

Îñíîâíûå ðàñ÷åòíûå ïàðàìåòðû ôèëüòðîâ ðàçðàáàòûâàåìîãî óñòðîéñòâà [3]:



Ðàññìàòðèâàåìîå ñõåìîòåõíè÷åñêîå ïîñòðîåíèå ôèëüòðà ïîçâîëÿåò ïîëó÷èòü îïòèìàëüíûå ïàðàìåòðû (íåîáõîäèìîå ïðîèçâåäåíèå óñèëåíèÿ íà ÷óâñòâèòåëüíîñòü, ìèíèìàëüíûé øóì è ìàêñèìàëüíûé äèíàìè÷åñêèé äèàïàçîí [3]), â òîì ñëó÷àå, åñëè åìêîñòü Ñ1=Ñ2=Ñ, à ñîïðîòèâëåíèÿ ðåçèñòîðîâ ðàâíû R0=1/(2··fð·Ñ). Ðåçèñòîð R5 îáåñïå÷èâàåò òðåáóåìóþ äîáðîòíîñòü. Åãî ñîïðîòèâëåíèå îïðåäåëÿåòñÿ âûðàæåíèåì [3]:

R5=R0·Qð.

Òî÷íûé ïîäáîð R0 íå òðåáóåòñÿ, äîñòàòî÷íî âûáðàòü ðåçèñòîð ñî ñòàíäàðòíûì íîìèíàëîì Rd, áëèçêèì ê R0. Ðàçíîñòü ìåæäó ýòèìè ñîïðîòèâëåíèÿìè ìîæíî ñêîìïåíñèðîâàòü, ïîäîáðàâ íîìèíàë ðåçèñòîðà R4 ðàâíûì (R0)2/Rd.

Èñõîäÿ èç îïèñàííûõ âûøå çàâèñèìîñòåé ìîæíî ðàñ÷èòàòü ïàðàìåòðû ôèëüòðîâ ýêâàëàéçåðà. Âûáåðåì äåñÿòü ðåçîíàíñíûõ ÷àñòîò ôèëüòðîâ ãðàôè÷åñêîãî ýêâàëàéçåðà, ïðè÷åì êàæäàÿ ïîñëåäóþùàÿ ÷àñòîòà âäâîå áîëüøå ïðåäûäóùåé: 30, 60, 120, 240, 480, 960, 1920, 3840, 7680 è 15360 Ãö.

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Ðàñ÷èòàåì ôèëüòð äëÿ ðåçîíàíñíîé ÷àñòîòû 30 Ãö:

R0=1/(2··fð·Ñ).

Âûáåðåì Ñ=1 ìêÔ.

Òîãäà R0=1/(2··30·1·10-6); R0=5305.32.

Âûáèðàåì çíà÷åíèå ñîïðîòèâëåíèé ðåçèñòîðîâ, ðàâíîå 5.1 êÎì.

Àíàëîãè÷íî ðàñ÷èòûâàåì îñòàëüíûå ôèëüòðû. Ðåçóëüòàòû ðàñ÷åòîâ ïðèâåäåíû â òàáëèöå 3.1.

*Òàáëèöà 3.1*

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| Íîìèíàëû ýëåìåíòîâ | ×àñòîòà íàñòðîéêè ôèëüòðà, Ãö |
| ôèëüòðà | 30 | 60 | 120 | 240 | 480 | 950 | 1920 | 3840 | 7680 | 15360 |
| C, ìêÔ | 1 | 0.5 | 0.22 | 0.1 | 0.068 | 0.033 | 0.015 | 0.0068 | 0.0033 | 0.0015 |
| R, Îì | 5.1 | 5.6 | 6.2 | 6.8 | 4.7 | 5.1 | 5.6 | 6.2 | 6.2 | 6.8 |

Àíàëèç ïðèâåäåííûõ âûðàæåíèé fð, Qð è Êð ïîêàçûâàåò, ÷òî ðåçîíàíñíóþ ÷àñòîòó è äîáðîòíîñòü ìîæíî ðåãóëèðîâàòü ñîîòâåòñòâåííî ðåçèñòîðàìè R4 è R5, èñêëþ÷èâ ïîäáîð íîìèíàëîâ äðóãèõ ïàññèâíûõ ýëåìåíòîâ. Ïðåäåëû ðåãóëèðîâêè ïåðâîãî ïàðàìåòðà ±400% (äàëüíåéøåå èõ ðàñøèðåíèå ìîæåò ïîâëå÷ü çà ñîáîé ñàìîâîçáóæäåíèå ôèëüòðà íà ðåçîíàíñíîé ÷àñòîòå), âòîðîãî - 0...20 (âåðõíåå çíà÷åíèå îãðàíè÷åíî âõîäíûì ñîïðîòèâëåíèåì ÎÓ).

Çàâèñèìîñòü ÷àñòîòû îò èçìåíåíèÿ ñîïðîòèâëåíèÿ ðåçèñòîðà R4 ïðåäñòàâëåíà íà ðèñ. 3.2.

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*Ðèñ. 3.2 Ðåãóëèðîâêà ÷àñòîòû ôèëüòðà ðåçèñòîðîì R4.*

Çàâèñèìîñòü äîáðîòíîñòè îò èçìåíåíèÿ ñîïðîòèâëåíèÿ ðåçèñòîðà R5 ïðèâåäåíÿ íà ðèñ. 3.3.

*Ðèñ 3.3 Ðåãóëèðîâêà äîáðîòíîñòè ôèëüòðà ðåçèñòîðîì R5.*

Ðåãóëèðîâî÷íûå õàðàêòåðèñòèêè ýêâàëàéçåðà, ïðèâåäåííû íà ðèñ. 3.4.

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*Ðèñ 3.4 Ðåãóëèðîâî÷íûå õàðàêòåðèñòèêè ýêâàëàéçåðà.*

Àìïëèòóäíî-÷àñòîòíàÿ õàðàêòåðèñòèêà áóôôåðíîãî êàñêàäà ïðåäñòàâëåíà íà ðèñ. 3.5.

*Ðèñ 3.5 Àìïëèòóäíî-÷àñòîòíàÿ õàðàêòåðèñòèêà áóôôåðíîãî êàñêàäà.*

Äàííûå ðàñ÷åòû áûëè ïðîèçâåäåíû äëÿ ôèëüòðà ñ ðåçîíàíñíîé ÷àñòîòîé 960 Ãö ñ ïîìîùüþ ÑÀÏÐ MICRO-CAP III ôèðìû Spectrum Software.

3.3. Ïîðÿäîê íàñòðîéêè èçäåëèÿ.

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Ïåðåä íàëàæèâàíèåì ýêâàëàéçåðà îòêëþ÷àþò åãî ôèëüòðû îò ÎÓ DA1, çàòåì ïîäàþò íà íèõ íàïðÿæåíèå ïèòàíèÿ è ïðîâåðÿþò ïîñòîÿííîå íàïðÿæåíèå íà èõ âûâîäàõ. Åñëè â êàêîì ëèáî ôèëüòðå îíî ïðåâûñèò ±20 ìÂ, çàìåíÿþò ñîîòâåòñòâóþùèé ÎÓ.

Òàê ïîñòóïàþò è â ñëó÷àå ñàìîâîçáóæäåíèÿ ôèëüòðà, ðàçóìååòñÿ, ïðîâåðèâ ïðåäâàðèòåëüíî ïðàâèëüíîñòü ìîíòàæà. Ïîñëå ýòîãî íà âõîä êàæäîãî èç ôèëüòðîâ ïîî÷åðåäíî ïîäàþò ñèíóñîèäàëüíûé ñèãíàë ñ ÷àñòîòîé, ðàâíîé ðåçîíàíñíîé ÷àñòîòå ôèëüòðà, è, ïîäêëþ÷èâ ê åãî âûõîäó ìèëèâîëüòìåòð ïåðåìåííîãî òîêà èëè îñöèëëîãðàô, ðåçèñòîðîì R12 íàñòðàèâàþò ôèëüòð ïî ìàêñèìóìó íàïðÿæåíèÿ íà åãî âûõîäå. Äëÿ óñòàíîâêè òðåáóåìîé îïòèìàëüíîé äîáðîòíîñòè ôèëüòðîâ Qð=1,4, êîòîðàÿ âûáðàíà èç óñëîâèÿ ìèíèìóìà øóìîâ, íà èõ âõîäû òàêæå ïîäàþò ñèíóñîèäàëüíûé ñèãíàë ñ ÷àñòîòîé, ðàâíîé ðåçîíàíñíîé. Èçìåðèâ íàïðÿæåíèå íà âûõîäå ôèëüòðà, óâåëè÷èâàþò èëè óìåíüøàþò ÷àñòîòó âäâîå è ðåçèñòîðîì R8 óñòàíàâëèâàþò íà âûõîäå ôèëüòðà â÷åòâåðî ìåíüøåå íàïðÿæåíèå.

Ïîñëå íàñòðîéêè ôèëüòðà ïåðåìåííûå ðåçèñòîðû R8 è R12 ìîæíî çàìåíèòü ïîñòîÿííûìè, ïîäîáðàâ èõ ñîïðîòèâëåíèå ñ òî÷íîñòüþ ±3%. Ïðîâåäÿ ýòó îïåðàöèþ äëÿ âñåõ ôèëüòðîâ, ñîåäèíÿþò èõ ñ ÎÓ DA1 è ðåçèñòîðàìè R5.

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| ***Ðàçðàá.*** | *Õèðõ-ßëàí* |  |  |  |  |  |  |  |  |
| ***Ïðîâ.*** | *Ñåäîâ Ñ.À.* |  |  |  |  |  |  |  |  |
| ***Ò. êîíòð.*** |  |  |  |  | ***Ëèñò 1*** | ***Ëèñòîâ*** |
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| ***Óòâ.*** |  |  |  |  |  |

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*Ãðàôè÷åñêèé ýêâàëàéçåð áûòîâîãî àóäèîêîìïëåêñà*

*ñõåìà ýëåêòðè÷åñêàÿ ïðèíöèïèàëüíàÿ*

4. Ñïèñîê ëèòåðàòóðû

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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

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| *Ïîç. îáîçíà÷åíèå*

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| ***Ïðîâ.*** | *Ñåäîâ Ñ.À.* |  |  |  |  |  |  | ***1*** | ***2*** |
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| ***Óòâ.*** |  |  |  |  |  |

*ÐÒ21.020.526.001 ÏÝ3**Ãðàôè÷åñêèé ýêâàëàéçåð áûòîâîãî àóäèîêîìïëåêñà**ïåðå÷åíü ýëåìåíòîâ* | *Íàèìåíîâàíèå* | *Êîë.* | *Ïðèìå÷àíèå* |
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| *Ïîç. îáîçíà÷åíèå*

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| ***Èçì.*** | ***Ëèñò*** | ***¹ äîêóì.*** | ***Ïîäïèñü*** | ***Äàòà*** |  |  |

*ÐÒ21.020.526.001 ÏÝ3**2* | *Íàèìåíîâàíèå* | *Êîë.* | *Ïðèìå÷àíèå* |
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