TYPE CQF 33C-14

68-88 Mc/s

Radiotelefon Model "Stornophone"

Type CQFx3C-14

1. Generel Beskrivelse

1.1. Introduktion

Det stationære radiotelefonanlæg model "Stornophone" er beregnet for radiotelefonkommunikation med mobile eller fast opstillede radiotelefonstationer på forud fastlagte frekvenser i eet af nedenstående frekvensbånd, som er godkendt til mobil trafik:

152-174 MHz, type CQF13C-14
68-88 MHz, type CQF33C-14

Anlægget er konstrueret for skiftetale (simplex) med mulighed for omskiftning mellem max. 6 krystalstyrede nabokanaler med en minimal frekvensafstand på 25 kHz.

Anlæggets driftsspænding kan være enten 220 V AC eller 110 V AC.

1.2. Den komplette station

Den komplette stationære radiotelefonstation, model Stornophone, består af følgende dele:

Stationskabinet indeholdende sender, modtager og strømforsyning.
Betjeningsbox med for-forstærker og betjeningshåndtag.
Diverse installationsmateriel.

De enkelte dele er nærmere beskrevet i de følgende kapitler.

1.3. Radiodelens konstruktion

Sender, modtager og strømforsyning danner tilsammen selve radiodelen. Enhederne er monteret på et fælles chassis, som er sammenbygget med forpladen. Radiodelen er anbragt i et lakeret stationskabinet som en skuffe og fastholdes til dette med to snaplåse. Stationskabinettet er fuldstændig lukket og den indsatte pakning mellem forplade og kabinet gør udstyret støv- og drypsikkert.

På forpladen er anbragt nettilslutningskonnektor, styrekabelkonnektor og antennekabelkonnektor. På chassiset er monteret et antal målebøsninger, som er forbundet med de vigtigste kredsløb i stationen. Ved at sammenligne eventuelle måleresultater med værdierne i det medfølgende måleblad, kan man danne sig et indtryk af stationens øjeblikkelige tilstand.

Sende-modtage krystallerne er i type CQF13C-14 anbragt i en termostatstyret krystalovn for at opnå maksimal frekvensstabilitet.

1.4. Radiodelens elektriske opbygning

Senderdelen indeholder en talebegrænser, lavfrekvensforstærker, krystaloscillator, frekvensmultiplikator, push-pull drivertrin og push-pull udgangsforstærker. Alle rør er indirekte opvarmede, og der er ingen forsinkelse af højfrekvensudgangseffekten ved tast af senderen. Senderens data opfylder de amerikanske EIA minimumskrav (EIA standard RS-152).

Modtagerdelen indeholder en signalfrekvensforstærker med fire afstemte signalfrekvens-kredse, en 1. blandingstriode, fire afstemte 1. mellemfrekvenskredse, en 2. blandingspentode, to mellemfrekvensrør med 12 afstemte mellemfrekvenskredse, to begrænsere med pentode, en diskriminator, en lavfrekvens-triode, en udgangspentode samt en elektronisk squelch. Modtageren anvender dobbelttransponering med eet krystal, og de nødvendige lokalsignalspændinger til blandingsrørene fås fra en krystaloscillator efterfulgt af en frekvensmultiplikator. Med dette konstruktionsprincip er de amerikanske EIA minimumskrav opfyldt (EIA standard RS-204).

Strømforsyningen er opbygget omkring to transformatorer, en manøvrespændingstransformator som afgiver den fornødne manøvrespænding, samt en driftsspændingstransformator, der afgiver anodespænding til henholdsvis modtager og sender, idet et relæ sørger for den nødvendige omkobling.

1.5. Betjening

Radiostationen styres fra en betjeningsbox, som kan anbringes op til ca. 35 m fra radiostationen. Betjeningsboxen er ved et mangekoret kabel forbundet med radiodelen.

I almindelighed har betjeningsboxen følgende funktioner.

Kanalvælger - afbryder.
Lydstyrkeregulering.
Squelchregulering.
Tast af sender.

Desuden er følgende kontrollamper anbragt på betjeningsboxens forplade:

Kontrollampe for start (viser samtidig kanalnummer).
Kontrollampe for tast (rød).
Kontrollampe for nettilslutning (grøn).

Iøvrigt henvises til kapitlet med beskrivelsen af den til anlægget hørende betjeningsbox.

2. Tekniske data

2.1. Frekvensområde

156 - 174 MHz eller 68-88 MHz.

2.2. Maximalt frekvenssving

5 kHz.

2.3. Driftsspænding

220 V AC eller 110 V AC.

2.4. Antennebelastningsimpedans

50 ohm. SWR op til 2 kan tillades.

2.5. Senderudgangseffekt

Ca. 12 W.

2.6. Max. antal kanaler

6 kanaler, afhængig af den anvendte type betjeningsbox.

2.7. Max. båndbredde ved flerkanaldrift

0,4 MHz - 0,6 MHz afhængig af frekvensbåndet.

2.8. Min. kanalafstand

25 kHz.

2.9. Modtagerfølsomhed

12 dB signal/støj forhold for mindre end 0,8 μVemk.

2.10. Driftsform

Kontinuert stand-by/modtagning samt intermitterende drift af senderen (20 %). Een enkel sendeperiode må ikke overstige 5 minutter.

2.11. Effektforbrug

Stand-by: 60 W
Modtagning: 70 W
Sending: 125 W.

2.12. Dimensioner og vægt

Højde: 150 mm eller 5 3/4" excl. beslag.
Længde: 450 mm eller 17 3/4".
Bredde: 310 mm eller 13 3/4" incl. beslag.
Vægt: 12,7 kg eller 28 lbs incl. beslag.

Radiotelefon Model "Stornophone"

Type CQM/F33C-12/13/14

1. Modtagerdelen

1.1. Generelt

Modtagerdelen i radioanlægget CQM/F33C-12/13/14 er beregnet til kommunikation i frekvensområdet 68-88 MHz. Den kan modtage frekvensmodulerede signaler i området 300 Hz til 3000 Hz med et maksimalt frekvenssving på 5 kHz.

Modtageren er krystalstyret, hvorved der opnås en frekvensstabilitet bedre end $\pm 15 \cdot 10^{-6}$ under normale forhold. Indenfor en maksimal båndbredde på 0,4 MHz kan anlægget forsynes med indtil 6 kanaler. Der anvendes dobbelttransponering med kun et krystal.

Modtagerens kaskodeindgang har et meget lavt støjtal, hvilket giver modtageren en meget stor følsomhed. 1. mellemfrekvens ligger i frekvensområdet 7,15 MHz til 9,38 MHz, mens anden mellemfrekvens er 455 kHz. Det mobile anlægs LF-udgangseffekt er 0,5 W, mens det faste anlægs LF-udgangseffekt er 1W. LF-udgangseffekten i de mobile anlæg kan dog forhøjes til 1W ved simple strapninger som angivet på hoveddiagrammet.

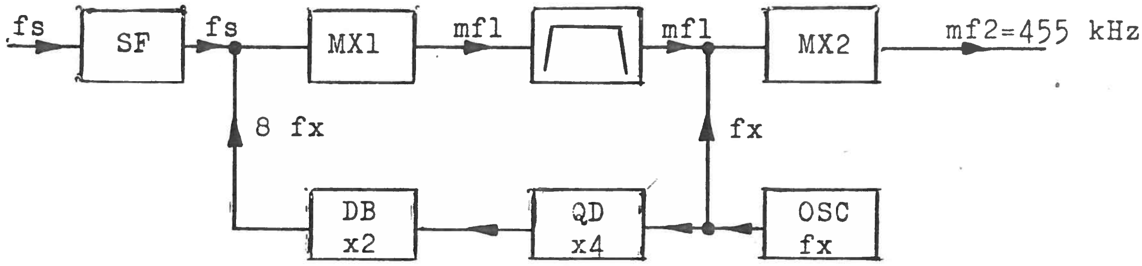
1.2. Kredsløbsanalyse

Det modtagne signal føres fra antennen gennem antennekonnektor J3, et lavpasfilter og kontakten på antennerelæet Re3 (C) til antennelinken L1, som er induktivt koblet til signalfrekvensforstærkerens gitterkreds (V1). SF-røret er en dobbelttriode ECC84, som af hensyn til et lavt støjtal er forbundet i kaskodekobling.

For at opnå stor indgangsselektivitet og dæmpning af uønskede frekvenser, efterfølges kaskodetrinet af et båndpasfilter.

Signalfrekvensen tilføres styregitteret på 1. blandingstrin MX1 (V2a) sammen med lokalsignalfrekvensen, der er den 8. harmoniske af krystallets grundfrekvens. 1. blandingstrin (V2a) udgør første halvdel af dobbelttrioden ECC81, mens den anden halvdel benyttes som doblertrin (V2b), hvorfra lokalsignalfrekvensen fås.

I anoden på MX1 selekteres den ønskede 1. mellemfrekvens, som gennem et firekredsfilter ledes til 2. blandingsrør MX2 (V3), der er en pentode 5654/M8100. Såvel krystaloscillatorens grundfrekvens som 1. mellemfrekvens påtrykkes MX2's styregitter.



Blandingsprincippet

Som det fremgår af ovennævnte blokskema, anvendes der dobbelt transponering med kun eet krystal. Dette medfører bl.a., at resonansfrekvensen af den 1. mellemfrekvens bliver afhængig af signalfrekvensen. Udfra ovenstående skema kan der opstilles følgende ligninger for blandingsprincippet:

$$fs = 8fx + mf1 \qquad (1)$$
$$mf1 = fx - 0{,}455 \qquad (2)$$

Ved at løse ligningerne med hensyn til fx fås:

$$fx = \frac{fs + 0{,}455}{9} \text{ MHz} \qquad (3)$$

hvor fs indsættes i MHz.

Såfremt ligningerne løses med hensyn til mf1 fås:

$$mf1 = \frac{fs - 3.64}{9} \qquad (4)$$

Af ligning (4) fremgår det, at for en given ændring af signalfrekvensen, bliver den absolutte frekvensændring i 1. mellemfrekvens:

$$\Delta mf1 = \frac{\Delta fs}{9}$$

Oscillatoren OSC (V10a) er opbygget omkring heptodedelen i ECH81 som en Pierce-Colpitt oscillator med krystallet anbragt mellem styregitter og skærmgitter. Herved opnås, at krystallet kører med et meget lavt driftsniveau, og at krystalfrekvensen bliver meget lidt afhængig af variationer af gløde- og anodespændinger. Oscillatorens anodekreds er afstemt til krystallets grundfrekvens, der tilføres dels 2. blandingstrin og dels styregitteret på firedobleren.

Firedobler QD (V10b) er opbygget omkring triodedelen i ECH81. Anodens dobbelt afstemte båndpasfilter frafiltrerer den 4. harmoniske af krystalfrekvensen, der fra filtrets sekundærside føres til doblerrørets styregitter.

Doblertrin DB (V2b) er opbygget omkring den ene triodedel i ECC81. I anodekredsen frafiltreres den 8. harmoniske af krystalfrekvensen, hvorved den ønskede lokalfrekvens til første blandingstrin er frembragt.

Modtageren (oscillatoren) kan forsynes med 6 kanaler, d.v.s. 6 faste krystalstyrede frekvenser (X1-R til X6-R), som skiftes ved hjælp af relæerne Re5 til Re10. I forbindelse med hvert krystal er monteret en trimmer (C81 til C86), hvormed krystalfrekvensen kan justeres nøjagtig til krystallets påstemplede værdi. Krystaller, trimmere og relæer er monteret på en krystalskifteenhed, som er anbragt lige bag anlæggets forplade.

Krystalskifteenheden (for både sender og modtager) fås i udgaver til henholdsvis 1, 2, 4 og 6 kanaler.

Den højselektive mellemfrekvensforstærker på 455 kHz består af 2 trin med ialt 12 afstemte kredse, og dens båndbredde er ca. 11 kHz. De 12 afstemte kredse er fordelt med 4 kredse mellem hver af forstærkerrørene MX2, IF1, IF2 og LI1. Begge mellemfrekvensforstærkerrørene (V4 og V5) er af typen 5654/M8100. Over gitterafledderen på V5 udtages en AGC spænding, der føres tilbage til signalfrekvensforstærkeren for at forhindre denne i at blokere for kraftige indgangssignaler.

Fra MF-forstærkeren ledes signalet til en effektiv 2-trins begrænser LI1 (V6) og LI2 (V7), hvor begge rør er af typen 5654/M8100. Mellem de to begrænsertrin er indskudt en bredbåndskreds (L15). Fra sidste begrænsertrin føres signalet til diskriminatoren.

Diskriminatoren (L16, E1 og E2) er en konventionel Foster-Seeley detektor, som demodulerer fasemodulationen i signalet. Diskriminatorudslaget som normalt skal være 0, kan kontrolleres i målepunkt 3.

Fra diskriminatoren ledes signalet dels til støjforstærkeren NA (V9b) og dels til lavfrekvensforstærkeren.

Lavfrekvensforstærkeren AF (V8a) er den ene triode i ECC83. Inden signalet tilføres dette trin passerer det et betoningsudligningsfilter (R44, C63), som giver modtageren en demodulationskarakteristik på -6 dB/oktav i området 300 Hz til 3000 Hz. Lavfrekvensspændingen til V8's styregitter kan reguleres med R45. Denne justering er foretaget på fabrikken, og yderligere justering er normalt ikke nødvendig. Gitterafledderen på V8a er ført til squelchrøret V8b, hvis funktion er beskrevet nedenfor.

Lavfrekvenssignalet føres ind på styregitteret på udgangsrøret PA (V9a), som er pentodedelen i ECL80. Udgangseffekten fra 3,2 ohms viklingen på udgangstransformatoren føres over kontakterne på relæ Re3 (C) til konnektoren J1 på udstyrets forplade.

Som nævnt under senderbeskrivelsen anvendes V9a også som modulationsforstærkerrør i senderen. Under sending foretages en omkobling af udgangstransformatorens sekundærvikling og rørets driftsspændinger.

Udgangsrøret afgiver normalt en udgangseffekt på 0,5 watt, men ved at flytte ensretterventilen E8 i strømforsyningen fra udtag 10 til udtag 11 på transformator T3 og ved at fjerne strapningen over modstanden R54, vil udgangseffekten kunne hæves til ca. 1 watt.

Støjforstærkerrøret NA (V9b) er triodedelen i ECL80. Støjspændingerne fra diskriminatoren tilføres dette trin gennem to RC-led (C65, R55 - R56, C73), der har båndfiltervirkning og forhindrer talespændinger og 455 kHz spændinger i at nå støjforstærkeren. I støjforstærkerens anode er indskudt et potentiometer (sq-reg.), som er monteret i anlæggets betjeningsbox. Ved hjælp af potentiometeret kan støjforstærkningen reguleres. De forstærkede støjspændinger ensrettes i diodekredsløbet E3 og tilføres squelchrøret gennem et filter (R62, C79).

Squelchrøret.SQ (V8b) er den ene triodedel i ECC83. Den tilførte støjspænding fra ensretterkredsløbet giver røret en negativ gitterforspænding, som er stor, når støjspændingen er stor (hvilket svarer til meget lille eller slet intet signal på modtagerens antenneindgang).

Herved blokeres squelchrøret.

En negativ spænding på ca. 50 volt fra ensretteren E9 er gennem modstanden R65 ført til squelchrørets katode. Når der ikke går anodestrøm i squelchrøret (intet signal), og der derfor er stor støjspænding til stede, vil katoden på squelchrøret antage samme negative spænding i forhold til stel, som er til stede over ensretteren E9. Gennem en spændingsdeler ledes denne negative spænding til lavfrekvensrørets gitter (V8a), og lavfrekvensrøret blokeres og forhindrer lavfrekvensspændingerne i at blive tilført udgangsrøret (V9a).

For at formindske udstyrets stand-by forbrug tilføres den fulde negative spænding også til udgangsrørets gitter.

Når der kommer signal på modtagerens antenneindgang, vil støjspændingen forsvinde, og dermed forsvinder den negative spænding over gitterkatodestrækningen på V8b, som derfor trækker anodestrøm. Katodens jævnspændingspotential bliver herved større end stelpotential, og dioden E4 bliver ledende. Da diodens fremadmodstand er lav i sammenligning med modstanden R64, vil den sørge for, at spændingerne til gitrene på V8a og V9a altid vil være på stelpotential uanset hvor høj katodespændingen på V8b bliver. Der sikres derfor lavfrekvensrørene V8a og V9a et veldefineret arbejdspunkt, så snart antennespændingen på modtagerindgangen bliver større end squelchens tærskelværdi.
Når udgangsrøret V9a anvendes som modulationsforstærker i senderen, er det nødvendigt at lægge styregitterets "bund" på stelpotential, hvilket sker med tastrelæet R-3 (C).

Mellem senderens anodespænding og squelchledningen til V8a's gitter er anbragt et RC-led, som frembringer en stor negativ spænding på squelchledningen i det øjeblik, der skiftes fra sending til modtagning. Man undgår herved det kraftige, men kortvarige sus i højttaleren umiddelbart efter, at senderens tastkontakt er sluppet.

2. Tekniske data

2.1. Følsomhed

12 dB signal/støjforhold for mindre end 0,6 μVemk (EIA standard RS-204 pkt. 3).

2.2. Frekvensstabilitet

Bedre end ±15 . 10^{-6} ved omgivelsestemperaturer fra -10° til +40°C.

2.3. Støjtal

Ca. 5 dB.

2.4. Squelchfølsomhedens tærskelværdi

0,5 μVemk svarende til et signal/støjforhold på 6 dB (EIA standard RS-204 pkt. 5.2.1).

2.5. Maksimal frekvensafstand mellem yderkanalerne

0,4 MHz ved en reduktion i følsomheden på ca. 1 dB.

2.6. Spurious selektivitet

Bedre end 85 dB.
(EIA standard RS-204 pkt. 8).

2.7. Modtager udstråling

Mindre end 2 x 10^{-9} W.

2.8. Mellemfrekvensselektivitet

For ±6 kHz er dæmpningen højst 6 dB.
For ±12 kHz er dæmpningen mindst 40 dB (målt efter eenfrekvens-metoden med reference til 1. begrænser) eller 80 dB (målt efter to-frekvensmetoden med det uønskede signal i 25 kHz afstand i overensstemmelse med EIA standard RS-204 pkt. 7).

2.9. Intermodulationsdæmpning

70 dB (EIA standard RS-204 pkt. 9).

2.10. Lavfrekvensudgangseffekt

Mobilt udstyr: 0,5 W, som kan forhøjes til 1,0 W ved simple omkoblinger.
Fast udstyr: 1,0 W.
Klir er i begge tilfælde mindre end 10 % ved et frekvenssving på 5 kHz ved 1000 Hz (EIA standard RS-204 pkt. 10).

2.11. Lavfrekvensudgangsimpedans

3,2 ohm.

2.12. Lavfrekvenskarakteristik

-6 dB/oktav i området 300 Hz til 3000 Hz +1, -4 dB relativt til 1000 Hz. (EIA standard RS-204 pkt. 11).

2.13. Brum- og støjspændinger

Dæmpet mere end 45 dB ved fuld udgangseffekt ved 5 kc/s frekvenssving og en modulationsfrekvens på 1000 Hz.
(EIA standard RS-204 pkt. 12).

2.14. Krystalfrekvensmultiplikation

4 . 2 = 8.

2.15. Krystalfrekvensberegning

$$\text{Krystalfrekvens} = \frac{\text{modtagerfrekvens i MHz} + 0{,}455}{9} \text{ MHz.}$$

2.16. Krystalfrekvensområde

7.60 MHz til 9.83 MHz.

2.17. Kvartskrystal

Holder: HC-6/U, NATO type 1 eller DEF 5271 style D.
Krystalbelastningskapacitet: 30 pF.
Ordring af krystaller: Frekvensen opgives med mindst 6 cifre.

2.18. Frekvensjustering

Med kvartskrystaltrimmerne kan krystalfrekvensen ændres mere end $\pm 25 \cdot 10^{-6}$ fra den nominelle værdi.

2.19. Frekvensområde for 1. mellemfrekvens

7,15 MHz til 9,38 MHz.

2.20. Rørbestykning

	Europ.	U.S.
Signalfrekvensforstærker	ECC84	6CW7
1. blander og dobler	ECC81	12AT7
Oscillator og 1. firedobler	ECH81	6AJ7
2. blander	5654/M8100	6AK5
1. mellemfrekvensforstærker	5654/M8100	6AK5
2. mellemfrekvensforstærker	5654/M8100	6AK5
1. begrænser	5654/M8100	6AK5
2. begrænser	5654/M8100	6AK5
Støjforstærker og udgangsforstærker	ECL80	6AB8
Lavfrekvensforstærker og squelchrør	ECC83	12AX7

Radiotelefon Model "Stornophone"

Type CQM/F33C-12/13/14

1. Senderdelen

1.1. Generelt

Senderdelen i radioanlægget CQM/F33C-12/13/14 er beregnet til kommunikation i frekvensområdet 68-88 MHz, og den er fasemoduleret i området 300 - 3000 Hz. Endvidere er senderdelen forsynet med en talebegrænser, som hindrer frekvenssvinget i at overstige 5 kHz og sikrer god udmodulering.

Senderen er krystalstyret, hvorved der opnås en frekvensstabilitet bedre end $\pm 15 \cdot 10^{-6}$ under normale forhold. Indenfor en maksimal båndbredde på 0,4 MHz kan anlægget forsynes med indtil 6 kanaler.

Krystaloscillatorens udgangsfrekvens multipliceres i de efterfølgende trin med 24. Push-pull udgangsforstærkeren kan afgive ca. 10 W højfrekvenseffekt.

1.2. Kredsløbsanalyse

Den krystalstyrede oscillator arbejder i frekvensområdet 2,83 MHz - 3.66 MHz - afhængig af den ønskede udgangsfrekvens. Oscillatoren efterfølges af et frekvensdoblertrin, et firedoblertrin samt et tredoblertrin. Den nøjagtige krystalfrekvens kan derfor beregnes ved at dividere udgangsfrekvensen med 24.

Oscillatoren svinger i et Pierce-Colpitt kredsløb, hvor krystallet er anbragt mellem styregitter og skærmgitter i den pentodekoblede heptode ECH81 (V12a). Dette arrangement sikrer meget lille tilbagevirkning fra fasemodulatoren ligesom krystalfrekvensen bliver meget lidt afhængig af anode- og glødespændingsvariationer.

Senderen kan forsynes med op til 6 kanaler, der skiftes med relæerne Re5 til Re10. Med trimmerne C116 til C121 kan krystalfrekvensen justeres nøjagtigt til kvartskrystallets påstemplede værdi. Krystaller til både sender og modtager samt relæer og trimmere er monteret på en speciel krystalskifteenhed, som er anbragt bag forpladen. Oscillatorspændingen føres til fasemodulatorrøret V11b, hvis gitter også får tilført modulationsspændingen. Princippet i fasemodulatoren tillader meget store frekvenssving med lav forvrængning. Fasemodulatoren efterfølges af et doblertrin DB (V12b), der er triodedelen i ECH81. Det dobbelt afstemte båndfilter L23 er justeret til krystalfrekvensens anden harmoniske.

HF-spændingen føres videre til firedobleren QD (V13), som er pentode af typen 5654/M8100. Det dobbelt afstemte båndfilter L24 er anbragt i anoden på dette rør, og filtret er afstemt til den 8. harmoniske af krystalfrekvensen.

Firedoblertrinnet efterfølges af tredobleren TRP (V14), som er en pentode af typen 5654/M8100. Anodekredsen L36 er afstemt med en cylindertrimmer C145, og sekundærkredsen L37 er afstemt med to små cylindertrimmere, som ved resonans skal være tilnærmelsesvis lige meget inddrejet. Sekundærkredsen er koblet direkte til driverrørets gitre.

Som push-pull driver anvendes dobbelttetroden QQE 03/12 (V15). Anodekredsen L27 er afstemt til senderens udgangsfrekvens som er den 24. harmoniske af krystalfrekvensen. Primærkredsen er afstemt med to små cylindertrimmere, som ved resonans skal være tilnærmelsesvis lige meget inddrejet. Sekundærkredsen er uafstemt og koblet direkte til udgangsrørets gitre.

Udgangstrinet PA (V16) er en push-pull forstærker med dobbelttetroden QQE 03/12. Anodespolen afstemmes med butterflykondensatoren og er induktivt koblet til antennelinken L30. Diodekredsløbet E7 er et målekredsløb.

Udgangseffekten tilføres kontakterne c4 på relæet Re3 (C). For yderligere at begrænse udstrålingen af uønskede frekvenser er der mellem relækontakten og antennekonnektoren indskudt et flerkreds lavpasfilter. Når senderen tastes, trækker relæ Re3, og udgangseffekten føres via lavpasfilter og antennekonnektor til antennen. I stand-by er relæ Re3 ikke trukket, og modtageren er koblet til lavpasfiltret (antennekonnektoren).

I tilfælde af svigtende udstyring af rørene er disse sikret mod overbelastning, dels ved anvendelse af katodemodstande, og dels ved anvendelse af fast negativ gitterforspænding.

Modulationsforstærkeren i senderen består af pentodedelen i ECL80 (V9a), som også anvendes som udgangsrør i modtageren. Røret efterfølges af talebegrænserkredsene omkring E5 og E6 samt lavfrekvensforstærkertrinet AF (V11a), som er den ene triode i ECC81.

Modulationsspændingerne fra mikrofon eller mikrofonforstærker føres ind på transformatoren T2. Over sekundærsiden af denne transformator er anbragt et potentiometer R53, hvormed modulationsspændingen kan indstilles til det ønskede niveau. Modulationsspændingen forstærkes i V9a og kobles til kondensatoren C110 i talebegrænseren gennem udgangstransformatoren. Da V9a benyttes både i sender og modtager, er det nødvendigt at foretage en del omskiftninger, hvilket sker med relæerne Re2 (B) og Re3 (C). Ved tastning afbrydes bl.a. 3,2 ohm viklingen på T1's sekundærside med kontaktsættet c1 og kobles i serie med 1.5 kohm viklingen.

Talebegrænserens differentialsled (C110 og R82) giver modulationsfrekvenserne en forbetoning på 6 dB/oktav i området fra 300 Hz til 3000 Hz. De jævnstrømsforspændte dioder (E5 og E6) klipper modulationsspændingen over en bestemt værdi; det gælder både positive og negative spændingsspidser. I det efterfølgende integrationsled (C112 og R86) gives modulationsfrekvenserne en betoningsudligning på -6dB/oktav i frekvensområdet fra 300 Hz til 3000 Hz. Frekvenskarakteristikken fra modulationsindgang til AF-rørets gitter er altså retliniet indenfor ovennævnte frekvensområde, når klipperen ikke er trådt i funktion.

Diodernes forspænding kan reguleres indenfor ret snævre grænser med R80, men denne justering er foretaget på fabrikken, således at frekvenssvinget ikke overstiger 5 kHz. Både modulationsspændingspotentiometeret (R53) og forspændingspotentiometeret (R80) skal justeres med skruetrækker og er forsynet med låseanordning.

Lavfrekvensforstærkeren AF (V11a) forstærker modulationsfrekvenserne i den ene halvdel af dobbelttrioden ECC81. De harmoniske forvrængningsprodukter hidrørende fra talebegrænseren dæmpes kraftigt af en frekvensafhængig kreds (C113, R88 og C114, R89), der giver røret en lavpasfiltervirkning med afskæring over 3000 Hz.

Fra lavfrekvensforstærkeren føres modulationsspændingerne over et RC-led til fasemodulatorens gitter, der også får tilført HF-spændingerne fra senderoscillatoren.

2. Tekniske data

2.1. Udgangseffekt

Min. 10 watt.

2.2. Maksimalt frekvenssving

±5 kHz. Sikret med effektiv talebegrænser.

2.3. Frekvensstabilitet

Bedre end ±15 . 10^{-6} ved omgivelsestemperaturer fra -10° til +40°C.

2.4. Udstråling af uønskede frekvenser

Harmoniske af udgangsfrekvensen er dæmpet mere end 65 dB (mindre end $2x10^{-5}$ W). Harmoniske af krystalfrekvensen er dæmpet mere end 80 dB (mindre end $2x10^{-7}$ W) (EIA standard RS-152, pkt. 3 og 4).

2.5. Frekvensmultiplikation

2 . 4 . 3 = 24.

2.6. Maksimal frekvensafstand mellem yderkanalerne

0,4 MHz ved ca. 1 dB dæmpning.

2.7. Krystalfrekvensberegning

$$\text{Krystalfrekvens} = \frac{\text{senderfrekvens}}{24}$$

2.8. Modulationskarakteristik

Fasemodulation i området 300 til 3000 Hz med en afvigelse på højst +1, -3 dB relativt til 1000 Hz (EIA standard RS-152 pkt.6).

2.9. Modulationsfølsomhed

Med fuldt opdrejet potentiometer er følsomheden bedre end 0,1 V for et frekvenssving på 5 kHz ved 1000 Hz.

2.10. Modulationsindgangsimpedans

Ca. 600 Ω.

2.11. Modulationsforvrængning

Mindre end 5% ved 1000 Hz og et frekvenssving på 3,3 kHz (EIA standard RS-152 pkt. 5).

2.12. Modulationsbegrænsning

Talebegrænser og lavpasfilter hindrer frekvenssvinget i at overstige 5 kc/s og nedsætter modulationssplatter i nabokanalen. (EIA standard RS-152 pkt. 8).

2.13. FM brum- og støjniveau

Dæmpet mere end 30 dB under standard frekvenssving, 3,3 kHz (EIA standard RS-152 pkt. 7).

2.14. AM brum- og støjniveau

Dæmpet mere end 40 dB (EIA standard RS-152 pkt. 16).

2.15. Sidebåndsstøj

Dæmpet mere end 60 dB (EIA standard RS-152 pkt. 17).
Sidebåndsstøj på nabokanal er mindre end 12 μW (GPO standard W6289 pkt. 4.2.2).

2.16. Krystalfrekvensområde

2,83 MHz til 3,66 MHz.

2.17. Kvartskrystal

Holder: HC-6/U, NATO type 1 eller DEF 5271 style D.
Krystalbelastningskapacitet: 30 pF.
Ordring af krystaller: Frekvensen opgives med mindst 6 cifre.

2.18. Frekvensjustering

Med kvartskrystaltrimmerne kan krystalfrekvensen ændres mere end $\pm 25 \cdot 10^{-6}$ fra den nominelle frekvens.

2.20. Rørbestykning

Lavfrekvensforstærker og fasemodulator	ECC81	12AT7
Oscillator og dobler	ECH81	6AJ8
Firedobler	5654/M8100	6AK5
Tredobler	5654/M8100	6AK5
Driverrør	QQE03/12	6360
Push-pull effektforstærker	QQE03/12	6360

Desuden anvendes modtagerens udgangsrør ECL80 som modulationsforstærkerrør under sending.

Radiotelefon model "Stornophone"

Type CQFx3C-3b/14

1. Strømforsyningsdel

1.1. Generelt

Strømforsyningsdelen er beregnet for tilslutning til 220 V vekselspænding, men nettransformatorens primærside er yderligere forsynet med udtag for tilslutning til 110 V vekselspænding.

Netspændingen tilføres radioanlægget gennem en 16-polet konnektor J2, idet fasen og nul indføres gennem henholdsvis ben b7 og ben a7.

Strømforsyningsdelen består af to transformatorer, tre selenensretterventiler, et filterkredsløb for anodespændingen, et filterkredsløb for den negative gitterforspænding og et filterkredsløb for manøvrespændingen. Til strømforsyningsdelen hører endvidere tre relæer: startrelæ Re1 (A), samt tastrelæerne Re2 (B) og Re3 (C).

Transformatoren T5 har tre sekundærviklinger, en for anodespændingen, en for gitterforspændingen og en for glødespænding til radiorørene. Anodespændingen ensrettes i en broensretter E8 og filtreres i et filterkredsløb bestående af dobbelelektrolytten C164 og drosselspolen T4. Den negative gitterforspænding ensrettes i broensretteren E9 og filtreres i filterkredsløbet bestående af elektrolytten C165, modstanden R122 og elektrolytten C166.

Transformator T6 har en sekundærvikling for manøvrespænding, der ensrettes i broensretteren E10 og filtreres med elektrolytten C206.

1.2. Kredsløbsanalyse

Driftsspændingen tilføres netkonnektoren J2 og såfremt ETA sikringerne S1 og S2 er indkoblet, vil der være manøvrespænding på anlægget. Når startkontakten i betjeningsudstyret lægges om, stelsluttes ben a2 i J2 og startrelæet Re1 (A) trækker. Radioanlægget får derved tilført glødespænding, modtagerdelen tilføres anodespænding og tastrelæerne tilføres manøvrespænding.

Når senderen tastes (i betjeningsudstyret) stelsluttes ben a3 i J2, hvorved tastrelæerne Re2 (B) og Re3 (C) trækker.

Re2 (B) har følgende funktioner ved tast:

Kontaktsæt b4 skifter ventilen fra den lavere modtagertransformatorspænding til den højere sendertransformatorspænding.
Kontaktsæt b2 skifter den ensrettede spænding fra modtager til sender.
Kontaktsæt b1 skifter anodespændingstilførslen til modtagerrøret V9a fra modtagerspænding til senderspænding.

Re3 (C) har følgende funktioner ved tast:

Kontaktsæt c1 skifter sekundærviklingen på udgangstransformatoren fra højttaleren til sendertalebegrænserens indgang.
Kontaktsæt c2 slutter spænding til den eventuelle transistorforstærker i betjeningsudstyret.
Kontaktsæt c3 stelforbinder V9a's gitterafleder.
Kontaktsæt c4 skifter antennen fra modtager til sender.

Iøvrigt henvises der til beskrivelsen over det til radiostationen hørende betjeningsudstyr.

2. Tekniske specifikationer

2.1. Netspændingstilslutning

220 V~ eller 110 V~

2.2. Gitterforspænding

Stand-by: -50 V.
Sending: -29 V.

2.3. Anodestrøm

Stand-by: ca. 53 mA/212 V.
Modtagning: ca. 76 mA/200 V.
Sending: ca. 185 mA/285 V.

2.4. Glødestrøm

5,4 A/6,3 V.

2.5. Effektforbrug

Stand-by: ca. 65 W.
Modtagning: ca. 70 W.
Sending: ca. 125 W.

Fejlretning og Vedligeholdelse

1. Almindeligt

1.1. Generelt

Fejlretning og vedligeholdelse bør kun udføres af fagkyndigt personale, som råder over de nødvendige måleinstrumenter.

For at lette lokaliseringen af de enkelte komponenter, er de vigtigste komponenters position afmærket på chassiset. Denne afmærkning svarer til afmærkningen af komponenterne i hoveddiagrammet og gælder rør, relæer, spoledåser, transformatorer, filterspoler, m.m.

På hoveddiagrammet er angivet de vigtigste spændinger på rør og strømtilførsler. Til måling og kontrol skal benyttes et instrument med høj indre modstand (20.000 Ω/V). De angivne værdier er omtrentlige og kan variere en del fra station til station. Spændingsværdierne skal derfor kun tjene som en rettesnor under en eventuel fejlfinding.

1.2. Målepunkter

For i videst muligt omfang at lette fejlretning og vedligeholdelse er radioudstyret forsynet med jævnstrømsmålepunkter, hvor man på en simpel måde kan få et relativt mål for de vigtigste spændinger og strømme i sender og modtager.

Målepunkterne er på chassiset afmærket med et tal indskrevet i en cirkel, f.eks. ③. Selve målepunktet er udformet som en bøsning i en isolator. Målingerne skal foretages med et 50-0-50 µA instrument, f.eks. et STORNO serviceinstrument SI04 eller SI05, som begge har en indre modstand på 1 kΩ. Alle målinger skal foretages i forhold til stel.

Pas på, at det følsomme instrument ikke beskadiges ved med målepinden at ramme spændingsførende dele.

1.3. Liste over målepunkter

1 Gitterstrøm i 1. begrænser (LI1 - V6)
2 Gitterstrøm i 2. begrænser (LI2 - V7)
3 Diskriminatorudslag (normalt 0)
4 Modtageroscillatorens gitterstrøm (OSC - V10a)
5 1. multiplikatortrins gitterstrøm (V10b)
6 2. multiplikatortrins gitterstrøm (V2b)
7 Senderoscillatorens gitterstrøm (OSC - V12a)
8 1. multiplikatortrins gitterstrøm (V12b)
9 2. multiplikatortrins gitterstrøm (V13)
10 3. multiplikatortrins gitterstrøm (V14)
11 Drivertrinnets gitterstrøm (V15)
12 Udgangstrinnets gitterstrøm (PA - V16)
13 Spænding over antennekablet.

1.4. Måleblad

Under slutprøven på Storno eftertrimmes og inspiceres radioudstyret og samtidig noteres målepunkternes måleværdier på et specielt måleblad, som følger med hver station. Ved senere kontrolmålinger bør måleresultaterne altid vurderes i forhold til tidligere målinger og målebladet. Af hensyn til sammenligningen bør målingerne altid foretages ved den driftsspænding, som er specificeret på målebladet.

Der kan almindeligvis tillades et fald i måleresultaterne på ca. 30% før de enkelte trins effektivitet er så forringet, at rørudskiftning er nødvendig.

Såfremt der konstateres et stærkt fald ved en af målingerne, kan man prøve at efterjustere kredsene, før rørudskiftningen foretages. Ved rørudskiftning skal både anode- og gitterkreds efterjusteres.

1.5. Forebyggende service

Ved rutinemæssigt at inspicere og kontrollere anlægget holdes det på topydelse. Hvor hyppigt disse eftersyn skal foretages, afhænger af de forhold, som udstyret arbejder under. Et rutineeftersyn bør omfatte følgende punkter:

a. Kontrol af målepunkterne ved sammenligning med målebladet.
b. Rensning af udstyret for støv og snavs med en blød børste. Trykluft kan anvendes med forsigtighed, men pas på ikke at forrykke justeringerne.
c. Kontrol af rørene og udskiftning af defekte rør. Den nemmeste måde at prøve et rørs effektivitet på er at udskifte det med et godt rør af samme type.
d. Kontrol af driftsspændingen. Den bør ikke falde udenfor værdierne 6,6 V ±10%, 13,2 V ±10% og 26,4 V ±10%.
e. Eftersyn af akkumulatoren. Den bør holdes i orden med tilstrækkeligt destilleret vand og gode, ikke tærede klemforbindelser.

NB: Punkterne d og e vedrører kun mobile anlæg.

Det er meget vigtigt, at sender- og modtagerfrekvenserne er helt nøjagtige, og de bør derfor kontrolleres jævnligt. Senderfrekvensen bestemmes udelukkende af senderkrystallet, hvorimod modtagerfrekvensen - foruden at være bestemt af modtagerkrystallet - også bestemmes af 2. mellemfrekvens (455 kHz), der lettest kontrolleres med en krystalgenerator på 455 kHz.

Hvis radiotelefonsystemets hovedstation vides at have nøjagtige sender- og modtagerfrekvenser, kan de mobile stationers frekvenser eventuelt lægges ind efter hovedstationens frekvenser.

2. Senderdelen

2.1. Generelt

Målepunkterne 7,8,9,10,11,12 og 13 er forbundet med kredsløb i senderdelen, og de benyttes ved justering af højfrekvenskredsene, idet samtlige kredse skal justeres til maximum udslag ved måling af det efterfølgende rørs gitterstrøm. Vedrørende justering henvises iøvrigt til afsnittet om justering.

2.2. Krystaloscillatoren

Krystaloscillatorens frekvenser er på fabrikken justeret til krystallets påstemplede værdi med en nøjagtighed, som er bedre end $3x10^{-6}$. I flerkanaludstyr skiftes der mellem de forskellige krystaller ved hjælp af relæer. Relækontaktfjedrenes kapacitet indgår i krystallets belastningskapacitet, og har derfor indflydelse på krystalfrekvensen. Hvis man således fjerner et af skifterelæerne i krystalskifteenhed, flytter frekvensen sig på samtlige øvrige krystaller. Derfor skal relæerne altid være isat skifteenheden, inden justering påbegyndes. Om nabokrystallerne er isat eller ej betyder derimod intet ved justeringen.

2.3. Modulationsforstærkeren

Modulationsforstærkeren er justeret og kontrolleret på fabrikken, og medmindre der er opstået en direkte fejl i forstærkeren, som f.eks. nødvendiggør udskiftning af en komponent, bør den ikke efterjusteres.

Til brug ved fejlfinding i modulationsforstærker og talebegrænser kan angives følgende omtrentlige signalværdier:

Målested	50 kHz	25 kHz
Spænding på V9a, ben 9	ca. 0,3 V	ca. 0,2 V
Spænding over R81	ca. 3,0 V	ca. 2,0 V
Spænding over R82	ca. 0,55 V	ca. 0,3 V
Spænding over C112	ca. 0,045 V	ca. 0,03 V
Spænding på V11a, ben 1	ca. 1,0 V	ca. 0,7 V
Spænding over R97	ca. 0,8 V	ca. 0,5 V

Bemærk: Målingerne i 50 kHz modellerne er foretaget ved Δf = 5 kHz og fm = 1000 Hz, og i 25 kHz modellerne ved Δf = 3.3 kHz og fm = 1000 Hz.

3. Modtagerdelen

3.1. Modtageroscillatoren

Oscillatorens gitterstrøm kan kontrolleres i målepunkt 4. Gitterstrøm er nødvendig for at oscillatoren svinger, og den er normalt ca. 30 µA, men kan iøvrigt variere en del. Den må falde til ca. 12 µA før rørudskiftning er nødvendig.

Ved udskiftning af oscillatorrøret (V10a) bør krystalfrekvensen kontrolleres og eventuel efterjusteres med krystaltrimmerne C81 til C86. Kontrol af krystalfrekvensen foretages nemmest med et frekvensmeter, som kan måle med en nøjagtighed, der er bedre end 3.10^{-6}.

Ved udskiftning af rørene V2 og V10 skal rørenes gitter- og anodekredse efterjusteres. Udslagene i multiplikatorens målepunkter (5 og 6) kan tåle at falde til ca. 15 µA, før rørudskiftning er nødvendig. Men husk altid at efterjustere kredsene før rørudskiftningen foretages, idet en for lille styregitterstrøm kan skyldes en forstemning af en af kredsene.

3.2. Mellemfrekvens- og begrænsertrin

For at modtageren har fuld undertrykkelse af impulsstøj (f.eks. tændstøj og motorstøj), er det vigtigt, at mellemfrekvenskurven er symmetrisk omkring centerfrekvensen (455 kHz), samt at diskriminatorens centerfrekvens ligger nøjagtigt på 455 kHz. En anden betingelse er, at diskriminatorudslaget - ved modtagning af senderen - ligger tæt ved 0 eller i nærheden af diskriminatorudslaget for modtagerens egenstøj. Afvigelsen bør ikke være mere end ca. 5 µA.

Måleudslaget i målepunkt 1 er et udtryk for det modtagne signals styrke. Styregitterspændingen i 2. begrænser LI2 kan kontrolleres i målepunkt 2. Er modtageren forsynet med nye rør, er udslaget - målepunkt 2 stort allerede for modtagerens egenstøj, hvilket konstateres, ved, at udslaget ikke forøges væsentligt, når antenneindgangen tilføres et signal. Udslaget for modtagerens egenstøj må imidlertid falde til ca. 15 µA før det er nødvendigt at udskifte de foran værende rør.

Diskriminatorens jævnspænding kan kontrolleres i målepunkt 3.
Ved modtagning af senderen må udslaget højst være forskudt ca. 5 µA.

En eventuel forskydning kan skyldes:

a) En afvigelse af senderfrekvensen.
b) En afvigelse af modtagerens krystalfrekvens.
c) En afvigelse af diskriminatorens resonansfrekvens.

Udskiftning af V4, V5, V6 og V7 kan finde sted uden efterjustering af kredsene.

3.3. Lavfrekvensforstærker

Rørene V8 og V9 kan udskiftes uden efterjustering. Med potentiometer R45 bør udgangseffekten indstilles til 0,5 W (1 W ved forhøjet udgangseffekt). For at lette fejlfinding angives følgende signalværdier, som kan måles med et almindeligt AF-voltmeter forskellige steder i lavfrekvensforstærkeren:

	50 kHz	25 kHz
Spænding over C61	5,6 V	3,7 V

Potentiometer R45 indstilles til ca. 0,1 V på styregitteret af V8a for ΔF = 10 kHz ved 1000 Hz i en 50 kHz model og for 3,3 kHz ved 1000 Hz i en 25 kHz model.

Gittervekselspænding på V9a (0,5 W udgangseffekt): 2,2 volt.
Gittervekselspænding på V9a (1,0 W udgangseffekt): 2,5 volt.
Udgangsspænding over højttaler (0,5 W udgangseffekt): 1,3 volt.
Udgangsspænding over højttaler (1,0 W udgangseffekt): 1,8 volt.

3.4. Støjforstærker og squelchtrin

Som nævnt under 3.3. kan V8 og V9 udskiftes uden efterjustering, idet dog squelchpotentiometeret (der er ført ud på forpladen af kontrolboxen) bør indstilles på ny. Følgende spændingsværdier kan opgives:

	50 kHz	25 kHz
Støjspænding		
Mellem ben 4 på diskriminator og stel	3,4 V	2,0 V
Mellem ben 2 på V9b og stel	0,5 V	0,2 V
Ensrettet støjspænding		
Målt over R58 med et DC voltmeter	-3,5 V	-5,0 V
Katodespænding		
Mellem ben 8n på V8b og stel (DV-voltmeter)	-44 V	-44 V

Ovennævnte værdier gælder, når der ikke er noget antennesignal eller udefra kommende støjspændinger på modtagerindgangen, samt når squelch-potentiometret i betjeningsboksen er stillet til maksimum lukning. Værdierne kan variere temmelig meget fra udstyr til udstyr uden at squelchfølsomheden forringes, idet variationerne udlignes ved indstilling af squelchpotentiometret.

Radiotelephone model "Stornophone"

Type CQFx3C-14

1. General Description

1.1. Introduction

This type of radiotelephone equipment, model "Stornophone", is designed for radiotelephone communication with other mobile or base radiotelephone stations on fixed crystal controlled frequencies within one of the following frequency bands allocated for mobile VHF communication.

152 - 174 Mc/s, type CQF13C-14
68 - 88 Mc/s, type CQF33C-14.

The equipment utilizes simplex operation with facilities for shifting between a max. of 6 crystal controlled channels with a min. channel separation of 25 kc/s.

The equipment is designed to operate at 220 volts main supply with tappings for 200, 210, 230 and 240 volts. The equipment may also be operated from 100, 110 or 120 volts supply.

For correct wiring of socket see main diagram and relevant installation instructions.

1.2. A complete "Stornophone"

The complete radiotelephone equipment, "Stornophone 33", comprises the following accessories:

Radio cabinet housing transmitter, receiver and power supply.
Control box with pre-amplifier and controls.
Installation Kit.

These items are described in the following chapters.

1.3. Mechanical construction

The transmitter, the receiver and the transistorized power supply form the radio units. The three sections are built-up on a common chassis, which is suspended on the front face. The common chassis is housed in a radio cabinet as a drawer and kept in the cabinet by two snap-fasteners. The radio cabinet is completely sealed and a packing piece between front plate and cabinet makes the equipment dust and splash proof.

The battery plug, control cable and antenna sockets are situated on the front face of the radio cabinet. On the common chassis a number of test points are situated, each connected to a circuit in the equipment. By means of these test points it is possible to obtain readings of all important currents and voltages in the equipment. A frequent comparison between obtained readings and values stated in the attached test report will clearly indicate the present condition of the equipment and draw the attention to any decrease in overall performance.

In the radiotelephone equipment type CQF13C-14 the transmit-receive quartz crystals are housed in a thermostat-controlled oven for max. frequency stability.

1.4. Electrical construction

The transmitter section comprises a speech limiter, an audio amplifier, a crystal oscillator, a frequency multiplier chain, a push-pull driver stage and a push-pull power amplifier. All valves are indirectly heated and keying of the transmitter causes no delay in RF power

The transmitter exceeds the American EIA specification (RS-152).

The receiver section consists of a signal frequency amplifier with four tuned SF-circuits, a 1st mixer, four tuned 1st IF-circuits, a 2nd mixer, two 2nd IF-amplifier valves with 12 tuned IF-circuits, two limiters, a discriminator, an audio amplifier, an output pentode and an electronic squelch. Double conversion with one crystal is used and the necessary local oscillator voltages for the frequency changer valves are supplied from a crystal oscillator succeeded by a frequency multiplier.

Using this principle of construction the American EIA specifications are exceeded (EIA standard RS-204).

The three radio sections are described in more detail in the following chapters.

1.5. Operation

The equipment is operated from a control box which may be up to 100 feet away from the equipment. If a greater distance is involved then additional equipment and a different control box must be used.

Generally the following functions may be controlled from the remote control box:

On/off.
Volume.
Channel shifting.
Squelch.
Transmitter keying.
Pre-heating for transmitter valves.

Further the following pilot lamps can be seen on the front plate of the remote control box:

Pilot lamp for stand-by (also indicating number of channel).
Pilot lamp for keying (red).
Pilot lamp for pre-heating (green).

For further details refer to the description of the control box.

2. General Specifications

2.1. Frequency range

152 - 174 Mc/s or 68 - 88 Mc/s.

2.2. Max. frequency deviation

5 kc/s.

2.3. Antenna load impedance

50 Ω (SWR up to 2 is permissible).

2.4. Transmitter output power

Approx. 10 Watts.

2.5. Max. number of channels

6 channels.

2.6. Max. frequency separation between extreme channels

0.4 Mc/s to 0.6 Mc/s depending upon the frequency range utilized.

2.7. Min. channel separation

25 kc/s.

2.8. Receiver sensitivity

12 dB signal-to-noise ratio for less than 0.8 µVemf.

2.9. Audio output power

1.0 watt.

2.10. Type of operation

Continous stand-by/reception and intermittent operation of transmitter (20 %). A single transmitting period should not exceed 5 minutes.

2.11. Input voltage

220 VAC ±10%.
110 VAC ±10%.

2.12. Total power consumption

Stand-by 60 W.
Receiver 70 W.
Transmitter 125 W.

2.13. Dimensions and weight

Height .... 150 mm or 5 3/4" excl. fittings
Length .... 470 mm or 18 ½"
Width .... 310 mm or 13 3/4" incl. fittings
Weight .... 13.0 kg or 29 lbs. incl. fittings.

Radiotelephone model "Stornophone"

Types CQM/F33C-12/13/14

1. Transmitter section

1.1. General

The transmitter section in the radiotelephone types CQM/F33C-12/13/14 is designed for communication within the frequency range 68-88 Mc/s. The transmitter is phasemodulated in the range 300-3000 c/s. Further it contains a speech limiter which keeps the frequency deviation within 5 kc/s and ensures a satisfactory modulation.

The transmitter is crystal controlled thus obtaining a frequency stability better than $\pm 15 \cdot 10^{-6}$ under normal conditions. The equipment may be supplied with 6 channels within a max. band width of 0.4 Mc/s.

The output frequency of the crystal oscillator is multiplied 24 times in the succeeding stages. The push-pull power amplifier is capable of delivering approx. 10 W of RF-power.

1.2. Circuit analysis

The crystal controlled oscillator operates in the frequency range 2.83-3.66 Mc/s - depending upon the output frequency desired. The oscillator stage is succeeded by a frequency doubler, a quadrupler and tripler stages together with a driver and power amplifier stages. The exact crystal frequency can be calculated by dividing the output frequency by 24.

The oscillator operates as a Pierce-Colpitt oscillator with the crystal inserted between control grid and screen grid in the pentode coupled heptode ECH81 (V12a). This circuitry keeps the feedback from the phasemodulator small and prevents the crystal frequency from being dependent on variation in plate and filament voltages.

The transmitter may be supplied with max. 6 channels, which are shifted by relays Re5 to Re10. The crystal frequency can be adjusted to the exact stated value by the trimming condensers C116 to C121. Crystals for both transmitter and receiver are mounted on a special crystal shift chassis together with relays and trimming condensers. This crystal shift chassis is located immediately behind the front face of the equipment.

The oscillator output is fed to the phasemodulator (V11b) which is also fed by any modulation voltages. The principle of modulation used has low distortion figure for a large deviation rate.

The signal is now fed to a doubler stage DB (V12b) which is the triode section of an ECH81. L23 in the plate circuit is tuned to the second harmonic of the fundamental oscillator frequency.

This signal is coupled to the grid of an 5654/M8100 (V13), whose plate circuit (L24) is tuned to the 8th harmonic. Direct coupling is used to couple this signal to the tripler stage TRP (V14) which is an 5654/M8100 and its plate circuit (L36) is situated in a compartment in the screened RF section of the transmitter. The plate circuit is tuned to the 24th harmonic by means of the cylindrical capacitor C145.

The 24th harmonic, which is the radiated frequency, is inductively coupled to L37, which is a centre tapped coil in the grid of the driver stage. The driver stage is a QQE03/12 double tetrode and has balanced grid and anode circuits tuned by C146, C147 and C149, C149 respectively, which are separated by a screening plate. At resonance, the pairs of capacitors should have approximately the same value.

The signal, having passed through the driver stage is coupled via L27 to the final output stage, whose plate circuit is screened from the driver stages and is tuned for maximum power with C150, a split stator capacitor. The power valve is a QQE03/12.

The power is coupled to the antenna link L30 and then to the antenna change over contact C4 on relay Re3 (C). On pressing the transmit key, relay Re3 (C) is energized and the antenna is connected to the transmitter.

For servicing purposes there is a power monitor circuit E7, R120 and C152, which produces a voltage proportional to RF power.

In the event of the grid signals disappearing the valves are protected against excessive loading partly by using cathode resistors and partly by using fixed grid bias.

To minimise battery drain in the pre-heat condition of a mobile installation i.e. transmitter valve heaters on but transmitter off. Only half of the power amplifier filament is energized. On depressing the transmit key, contact b4 on relay Re2 (B) closes and the whole filament is energized.

In a mains driven installation (a fixed station) and in a 24V battery driven installation (CQM33C-13) this economy is not practicable and transmitter heaters are fully on, when the pre-heat switch is on.

The modulator amplifier in the transmitter section comprises the pentode section of ECL80 (V9a), but this valve is also used as final amplifier in the receiver section. This valve is succeeded by the speech limiter network containing E5 and E6 and the audio amplifier stage AF (V11a), which is one section of an ECC81.

The modulating voltages from microphone or microphone amplifier are applied to transformer T2. A potentiometer R53 is inserted in the secondary of T2, and the modulating voltage can be adjusted to the desired level. The modulating voltage is amplified in V9a and coupled through the final output transformer to the condenser C110 in the speech limiter. Due to V9a being used in both the transmitter and receiver, the transformer T1 in the plate circuit has to be altered. Contact C1 on relay Re3 (C) puts the 3.2 Ω winding in series with the 1.5 kΩ winding on transmit.

The differential network (C110 and R82) in the speech limiter gives the modulating frequencies a pre-emphasis of 6 dB/octave in the range 300-3000 c/s. The DC-biased diodes (E5 and E6) clip the modulating peak voltages above a certain level (set by R80). This holds good for both positive and negative voltage peaks. In the succeeding integrating network (C112 and R86) the modulating frequencies are given a de-emphasis of 6 dB/octave in the frequency range 300-3000 c/s. The frequency characteristic from the modulator input to the grid of the audio amplifier valve is consequently linear within the frequency stated above on the assumption that the clipper has not come into action.

The bias voltage of the diodes is adjustable within rather close limits by potentiometer R80, which is factory adjusted in order to keep the frequency deviation within 5 kc/s. Both potentiometers for adjustment of modulating voltage and of the bias voltage are screwdriver adjustments, the settings of which can be locked.

The audio amplifier AF (V11a) amplifies the modulating frequencies in one half of the double triode valve EC 81. The products of the harmonic distortion originated in the speech limiter are attenuated strongly by a frequency dependent network (C113, R88 and C114, R89) giving the valve a low-pass cut-off effect above 3000 c/s.

From the AF-amplifier stage the modulating voltages are fed through a RC-network and applied to the grid of the phasemodulator valve.

2. Technical Specifications

2.1. RF-output power

10 W minimum.

2.2. Max. frequency deviation

±5 kc/s. Protected by an effective speech limiter.

2.3. Frequency stability

Better than $\pm 15 \cdot 10^{-6}$ at ambient temperatures from -10° to $+40^{\circ}$C.

2.4. Harmonic radiations

Harmonics of RF-frequency are attenuated more than 2×10^{-5} W.
Harmonics of crystal frequency are attenuated more than [illegible] $\times 10^{-7}$ W.
(EIA standard RS-152, sections 3 and 4).

2.5. Frequency multiplication

$2 \times 4 \times 3 = 24$.

2.6. Max. separation between extreme channels

0,4 Mc/s at an attenuation of approx. 1 dB.

2.7. Calculation of crystal frequency

$$\text{Crystal frequency} = \frac{\text{transmitter output frequency}}{24}$$

2.8. Audio frequency response

Should not vary more than +1 or -3 dB from a true 6 dB preemphasis characteristic from 300 to 3000 c/s as referred to the 1000 c/s level (EIA standard RS-152, section 6).

2.9. Modulation sensitivity

With potentiometer fully clockwise the sensitivity is better than 0,1 V at a frequency deviation of 5 kc/s at 1000 c/s.

2.10. Modulation input impedance

Approx. 0.6 kΩ.

2.11. Modulation distortion

Less than 5 % at 1000 c/s and at a frequency deviation of 3.3 kc/s. (EIA standard RS-152, section 5).

2.12. Modulation limiting

The speech limiter and the low-pass filter prevents the frequency deviation from exceeding 5 kc/s (EIA standard RS-152, section 8).

2.13. FM hum and noise level

Attenuated more than 30 dB below standard test modulation at 3.3 kc/s. (EIA standard RS-152, section 7).

2.14. AM hum and noise level

Attenuated more than 40 dB (EIA standard RS-152, section 16).

2.15. Side band noise level

Attenuated more than 60 dB (EIA standard RS-152, section 17).
Side band noise in adjacent channel is less than 12 µW (GPO standard W6289, section 4.2.2).

2.16. Crystal frequency range

2.83 Mc/s to 3.66 Mc/s.

2.17. Quartz crystal

Socket: HC-6/U, NATO type 1 or DEF 5271 style D.
Crystal loading capacity: 30 pF.
Ordering: frequency to be stated with at least 6 significant figures.

2.18. Frequency alignment of crystal

The crystal frequency can be changed more than $\pm 25 \cdot 10^{-6}$ by the trimming condenser.

2.19. Valve complement

AF-amplifier and phasemodulator	ECC81	12AT7
Oscillator and 1st doubler	ECH81	6AJ8
Quadrupler	5654/M8100	6AK5
Tripler	5654/M8100	6AK5
Push-pull Driver	QQE03/12	6360
Power amplifier	QQE03/12	6360

Radiotelephone model "Stornophone"

Types CQM/F33C-12/13/14

1. Receiver section

1.1. General

The receiver section in the radiotelephone types CQM/F33C-12/13/14 is designed for reception within the frequency range 68- 8 Mc/s of frequency modulated signals (300 - 3000 c/s) at a max. frequency deviation of 5 kc/s.

By crystal controlling the receiver, a frequency stability better than $\pm 15 \cdot 10^{-6}$ is obtained under normal conditions. The e uipment may be supplied with up to 6 channels within a max. bandwidth of 0.4 Mc/s. Double conversion with one crystal only is used.

The cascode input circuit of the receiver enables a very low noise figure and consequently a very great receiver sensitivity to be achieved. 1st intermediate frequency is within the frequency range 7.15 - 9.38 Mc/s, but 2nd intermediate frequency is 455 kc/s fixed. The final amplifier is fixed installations delivers an AF-output of 1 Watt, and in mobile equipment the stage delivers only 0.5 Watt. This can, however, be increased o 1 Watt by a simple modification. Furthermore the receiver section contains a squelch circuit which mutes the receiver noise during periods when no signals are received.

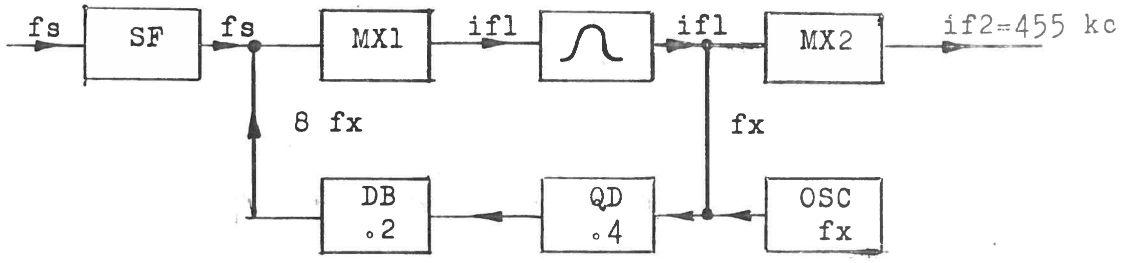
1.2. Circuit analysis

The received signals are routed from the antenna (J3) through a low-pass filter, and the contact of the antenna relay Re3 (C) to antenna link L1, which is inductively coupled to the grid of the SF-amplifier (V1). The SF-valve is a double triode ECC84 connected in cascode in order to obtain a low ov rall noise figure.

The cascode stage is succeeded by a band-pass filter thereby containing an excellent input selectivity and a good attenuation of spurious frequencies.

The signal frequency is fed to the 1st mixer valve MX1 (V2a) and applied to the control grid together with the local oscillator frequency, which is the 8th harmonic of the crystal fundamental frequency. The first half of the double triode ECC81 (V2a) is utilized as 1st mixer stage, and the second half is used as a doubler stage (V2b).

From the plate circuit of MX1 the 1st intermediate frequency is obtained, which is fed through a four-circuit filter and applied to the 2nd mixer valve MX2 (V3), which is a pentode 5654/M8100. Both the fundamental frequency of the oscillator and the 1st intermediate frequency are applied to the control grid of the 2nd mixer valve MX2.



As seen from the above schematic diagram, double superhetrodyne reception with one crystal is used, and that the resonance frequency of the first intermediate frequency is dependent on the signal frequency. From the block diagram it can be seen that:

$$fs = 8\ fx + if1 \qquad (1)$$

$$\text{and } if1 = fx - 0.455 \qquad (2)$$

Solving the equations for fx:

$$fx = \frac{fs + 0.455}{9}\ \text{Mc/s} \qquad (3)$$

Solving for if1:

$$if1 = \frac{fs - 3.64}{9} \qquad (4)$$

From equation (4) it is seen that the change of 1st intermediate frequency for a given change in signal frequency is:

$$\Delta if1 = \frac{\Delta fs}{9}$$

The oscillator OSC (V10a) is a Pierce-Colpitt oscillator with the crystal inserted between control grid and screen grid in the pentode section of ECH81. This arrangement allows the crystal to operate at a low level and the crystal frequency is independent of normal variations in filament and plate voltages. The plate circuit is tuned to the fundamental frequency of the crystal, which is fed both to the 2nd mixer stage and to the control grid of the quadrupler.

The 1st quadrupler QD (V10b) utilizes the triode half of an ECH81. The double-tuned band-pass filter in the plate is tuned to the 4th harmonic of the crystal frequency. This 4the harmonic is taken from the secondary side of the filter and applied to the grid of the doubler valve.

The doubler stage DB (V2b) utilizes one half of an ECC81. The plate circuit is tuned to the 8th harmonic of the crystal frequency which is injected into the first mixer stage.

The receiver (oscillator) may be provided with 6 channels, i.e. 6 crystal controlled frequencies (X1-R to X6-R, which are shifted by means of low cap. relays Re5 to Re10. With each crystal there is a trimming condenser (C81 to C86) by means of which the crystal frequency is tuned to the exact stated value. Crystals, trimming condensers and relays are mounted on a crystal shift chassis located immediately behind the front face of the equipment.

The crystal shift chassis (common for both transmitter and receiver) is supplied in four standard versions for 1, 2, 4 an 6 channels.

The highly selective IF-amplifier (455 kc/s) comprises 2 stages having a total of 12 tuned circuits. The bandwidth is approx. 11 kc/s. The 12 circuits are distributed with 4 circuits between each of the valves, MX2, IF1, IF2, and LI1. Both IF-amplifier valves (V4 and V5) are of the type 5654/M8100.

The AGC-voltage is taken across the grid leak resistor of V5 and fed back to the signal frequency amplifier in order to prevent this stage from blocking any strong signals.

The output signal from the IF-amplifier chain is applied to an effective limiter, comprising LI1 (V6) and LI2 (V7). Both valves are of the type 5654/M8100. Coupling between the two limiter stages is by a broadband circuit (L15). The limiter output is fed to the discriminator stage.

The discriminator (L16, E1 and E2) is a conventional Foster-Seeley detector, which demodulates the signal. The meter deflection of the discriminator should be zero under normal conditions, and the deflection can be checked at testpoint 3.

The signal from the discriminator is fed partly to the noise amplifier NA (V9b) and partly to the audio amplifiers.

The audio amplifier AF (V8a) utilizes one half of the triode ECC83. Before being applied to this stage the signal passes through a deemphasis network (R44 and C63) which gives the receiver a demodulating characteristic of -6 dB/octave within 300 - 3000 c/s. The AF-voltage for the control grid of V8 is adjusted by R45. This is a factory adjustment and further regulation should not be necessary. The grid leak resistor of V8a is connected to the squelch valve V8b.

The AF-signal is applied to the control grid of the final output Valve PA (V9a), which is the pentode section of ECL80. The AF-output power from the 3,2 Ω winding of the output transformer is routed through the relay contacts of Re3 (C) to the connector J1 on the front face of the cabinet.

As previously mentioned the valve V9a is used also as a modulating valve in the transmitter section. The secondary windings of the output transformer and the voltages for the valve are altered for transmission.

The final amplifier stage of the mobile equipment, normally delivers an output power of 0.5 watt, but by changing the selenium rectifier E8 from tag 10 to tag on transformer T3 and by removing the strapping across the resistor R54 the output power may be raised to approx. 1 watt, whilst the output on the fixed installation is fixed at 1 watt.

The noise amplifier valve NA (V9b) is the triode half of an ECL80. The noise voltages from the discriminator are applied to this stage through two RC-networks (C65-R55 and R56-C73), which act as a band-pass filter and prevent speech voltages and 455 kc/s voltages from reaching the noise amplifier. A potentiometer (sq-reg.) which forms part of the noise amplifier plate circuit is situated in the control box. (SQUELCH). The noise amplification may be adjusted by this potentiometer (see the chapter on alignment). The amplified noise voltages are rectified in the diode circuit E3 and fed to the squelch valve through a filter (R62 and C79).

The squelch stage SQ (V8b) utilizes one triode half of the ECC83. The applied noise voltage from the rectifier circuit gives the valve a negative bias voltage proportional to the noise voltage (which corresponds to a small or no input signal to the receiver). Thus the squelch valve is cut-off.

A negative voltage (approx. 50 V) from rectifier E9 is fed through resistor R65 to the cathode of the squelch valve. When the squelch valve is non-conducting (no signal) due to the applied noise voltage, the cathode assumes the same negative voltage (with respect to ground) as is present across the rectifier E9. Through a voltage divider network this negative voltage is applied to the grid of the audio amplifier valve (V8a), which cuts off the valve and this prevents the audio signals being fed to the final amplifier valve (V9a).

The grid of the final amplifier valve has this negative bias voltage applied to it in order to decrease the overall current consumption in the stand-by condition.

When a signal is received, the noise voltage disappears and the negative bias voltage is removed whereby V8b conducts. The voltage drop across the cathode resistor rises above ground potential and diode E4 conducts. As the forward-resistance of the diode is low compared to the resistor R64, the diode provides ground potential for the grids of V8a and V9a regardless of the rise of the cathode voltage of V8b. Thus the audio amplifier valves V8a and V9a obtain a well-defined operation-point as soon as the antenna voltage on the receiver input terminal is greater than the threshold value of the squelch circuit.

When the final audio amplifier valve V9a is utilized as modulating amplifier in the transmitter section it is necessary to ground the lower end of the grid circuit. This is performed by relay Re3 (C).

Between the transmitter plate voltage supply and the squelch connection to the grid of V8a an RC-network is inserted. This network holds a large negative bias on the control grid of V8a whilst the equipment is reverting to the receive condition after a transmission. The plate voltage is being changed to a lower value and the negative bias ensures that the valve remains cut off during this change, thus there is no noise fed to the audio stages for this brief period.

2. Technical Specifications

2.1. Sensitivity

12 dB signal-to-noise ratio for less than 0.6 µVemf.
(EIA standard RS-204, section 3).

2.2. Frequency stability

Better than ±15 . 10^{-6} at ambient temperatures from -10 to +40°C.

2.3. Noise figure

Approx. 5 dB.

2.4. Sensitivity of threshold squelch

0.5 µVem corresponding to a signal-to-noise ratio of 6 dB. (EIA standard RS-204, section 5.2.1).

2.5. Max. separation between extreme channels

0.4 Mc/s at 1 dB points.

2.6. Spurious response attenuation

Better than 85 dB (EIA standard RS-204, section 8).

2.7. Receiver radiation

Less than 2×10^{-9} watts.

2.8. Selectivity of intermediate frequency

At ±6 kc/s the attenuation is max. 6 dB.
At ±12 kc/s the attenuation is at least 40 dB (measured according to the single-frequency method with reference to 1st limiter) or 80 dB (measured according to the two-frequency method with the spurious signal 25 kc/s apart from the desired signal. With reference to the EIA standard RS-204, section 7.

2.9. Intermodulation spurious attenuation

70 dB (EIA standard RS-204, section 9).

2.10. Audio power output

For fixed equipment: 1 watt
For mobile equipment: 0.5 watt
The mobile equipment may be modified to give 1 watt by a simple alteration.

At 0.5 and 1 watt the harmonic distortion is less than 10% at a frequency deviation of 3,3 kc and a reference frequency of 1000 c/s (EIA Standard RS-204. Section 10).

2.11. AF-output impedance

3.2 Ω.

2.12. Audio frequency response

6 dB/octave de-emphasis curve the variation not exceeding +1, -4 dB over the frequency range 300 to 3000 c/s. Reference frequency is 1000 c/s. (EIA standard RS-204, section 11).

2.13. Hum and noise ratio

Attenuated more than 42 dB at full output power, at 3,3 kc frequency deviation, and at 1000 c/s modulating frequency (EIA standard RS-204, section 12).

2.14. Crystal frequency multiplication

4.2 = 8.

2.15. Calculation of crystal frequency

$$\text{Crystal frequency} = \frac{\text{receiver frequency Mc/s} + 0.455}{9}$$

2.16. Crystal frequency range

7.60 Mc/s to 9.83 Mc/s.

2.17. Quartz crystal

Socket: HC-6/U, NATO type 1 or DEF 5271 style D.
Crystal loading capacity: 30 pF.
Ordering: Frequency to be stated with at least 6 significant figures.

2.18. Frequency adjustment

The crystal frequency may be changed more than $\pm 25 \cdot 10^{-6}$ from the nominal value by the trimming condensers.

2.19. 1st intermediate frequency

7.15 Mc/s to 9.38 Mc/s.

2.20. Valve complement

	Europ.	U.S.
SF-amplifier	ECC84	6CW7
1st mixer and doubler	ECC81	12AT7
Oscillator and quadrupler	ECH81	6AJ7
2nd mixer	5654/M8100	6AK5
1st IF-amplifier	5654/M8100	6AK5
2nd IF-amplifier	5654/M8100	6AK5
1st limiter	5654/M8100	6AK5
2nd limiter	5654/M8100	6AK5
Noise amplifier and final amplifier	ECL80	6AB8
Audio amplifier and squelch	ECC83	12AX7

Radiotelephone model "Stornophone"

Type CQFx3C-3b 14

1. Power supply section

1.1. General

The power supply section is designed to operate with input voltages of 220, ±10 and ±20 volts, also with 110 ±10 volts. The circuits employed are conventional full wave rectifier circuits using selenium rectifiers and smoothing is by a capacity input filter. An independent circuit supplies the energising voltage for the relays.

1.2. Circuit Description

The mains is fed via the 16 way plug and socket, to transformer T6. The secondary voltage is rectified by E10 and smoothed by C206 and supplies the relays with a negative operating voltage. Power is not applied to the transformer T3 until the equipment is switched on.

When the equipment is switched on, a2 on plug J2 is shorted to ground, relay Rel (A) is energised and a2 contact closes, and power is applied to the transformer T5. This transformer has three functions:

a. Supplies the plate voltages for transmitter and receiver via the bridge rectifier E8 and capacity input filter C164 and T4.
b. Supplies negative bias for certain valves, and the transistorized microphone pre-amplifier.
c. Supplies the valve filaments.

When the transmitter is keyed, relays B and C are energised and contact b4 changes the tapping on T5, thus increasing the plate voltage for transmitting purposes.

For a more detailed operation of relays, see the description of the control box supplied with the equipment.

2. Technical specifications

2.1. Mains Supply

220 V AC ±10 or ±20. 110 V AC ±10V.

2.2. Bias Voltages

Stand-by - 50V dc.
Transmit - 29V dc.

2.3. Plate currents

Stand-by - approx. 53 mA at 212 V dc.
Receive - approx. 76 mA at 200 V dc.
Transmit - approx. 185 mA at 285 V dc.

2.4. Filament Current

5.4 A at 6.3 V AC.

2.5. Power consumption

Stand-by - approx. 65 watts.
Receiver - approx. 75 watts.
Transmit - approx. 125 watts.

Fault Location and Maintenance

1. General

1.1. Introduction

Fault location and maintenance work should be carried out only by skilled personnel who have the necessary test equipment.

To assist the location of components, the main items have been marked on the chassis. The designations correspond to those given in the main diagram. These are valves, transformers, chokes, potentiometers etc.

All important voltages in the circuits are stated in the main diagram. For the measurements an instrument having a high internal resistance (20.000 Ω/V) must be used. The values stated are approximate and may vary from equipment to equipment. The voltage stated should only be considered as a guide during fault location.

1.2. Test Points

Fault location and maintenance in the radio equipment have been made easier by test points incorporated for DC-measurements. By using these test points the technician can obtain relative measurements of all important voltages and currents in the equipment.

The test points are marked on the chassis by a number, which is encircled as ③. The test point itself is a small insulated socket. The measurements must be performed by a 50-0-50 µA instrument, e.g. a Storno service instrument type SI04 or type SI05, the internal resistance in both cases being 1 kΩ. All measurements are made with respect to chassis.

Do not damage the sensitive instrument by touching any high voltage points with the testprod.

1.3. List of Test Points

1 Grid current in 1st limiter (LI1 - V6)
2 Grid current in 2nd limiter (LI2 - V7)
3 Discriminator current (normally zero)
4 Grid current in receiver oscillator (OSC - V10a)
5 Grid current in 1st multiplier (V10b)
6 Grid current in 2nd multiplier (V2b)
7 Grid current in transmitter oscillator (OSC - V12a)
8 Grid current in Doubler (V12b)
9 Grid current in Quadrupler (V13)
10 Grid current in Tripler (V14)
11 Grid current in Driver (V15)
12 Grid current in power amplifier (PA - V16)
13 Voltage across the antenna.

1.4. Final Test Reports

During final testing at the factory, the equipment is thoroughly inspected mechanically and electrically, and correctly aligned.

The various voltages and currents are measured at the test points (1 to 13) and the results recorded on the Final Test Report which is shipped with the equipment. Subsequent measurements should be compared with these readings.

Comparison is only valid when the input to the equipment is as stated on the test report sheet.

Normally a decrease in the measuring values of approx. 30 % is permissible until replacement of the valve in the relevant circuit becomes necessary.

If a decrease in stated voltage is noticed at any test point, it is advisable to check the tuning of the particular stage. If there is no improvement in conditions, then the valve may be changed. If a valve is changed then grid and plate circuits must be re-tuned.

1.5. Preventive Maintenance

Frequent inspection of the equipment ensures peak performance. The frequency of inspections depend upon the operating conditions. A normal inspection should include the following points:

a. Check the test points and compare the readings with the values stated in the test report.
b. Remove dust and dirt with a soft brush. Forced air may be used if extreme care is taken to avoid alteration of the adjustment settings.
c. Check the valves and replace the defective ones. The easiest way to test these is to replace the suspect valves with new ones known to be good.
d. Check the battery voltage. It must be within the limits 6.6 V ±10% or 13.2 V ±10 % or 26.4 V ±10 % depending on the type of equipment. The nominal voltage is marked on the set and on the battery input plug.
e. Inspection of the storage battery. If necessary, top up with distilled water and clean the terminals to avoid corrosion.

NB. (Items (d) and (e) refer to mobile installations only).

It is of great importance that the transmitter and receiver frequencies are correctly adjusted. Therefore the frequencies should be checked at regular intervals.

The transmitter frequency is solely determined by the transmitter crystal, whereas the receiver frequency is determined by the receiver crystal and the 2nd IF-frequency (455 kc/s).

If the base station of the system is known to have correct transmitter and receiver frequencies, it is possible to "net" the frequencies in the mobile stations to the frequencies of the main station.

2. The Transmitter Section

2.1. Transmitter Test Points

The test points no. 7, 8, 9, 10, 11, 12 and 13 are connected to circuits in the transmitter section. The test points are used in adjusting the RF-circuits, and all circuits are tuned to obtain max. deflection by measuring the grid current in the succeeding valve. Further information concerning the adjustment is given in a separate section ("Alignment Procedure").

2.2. Crystal oscillator

The frequencies of the crystal oscillators have been adjusted to the frequency stated on them with an accuracy better than 3×10^{-6}. In multi-channel equipment the different crystals (channels) are shifted by means of low-cap relays. The capacitance of the relay contacts are included in the loading capacity of the crystals and consequently they have influence on the crystal frequency. Removal of one of the shifting relays from a crystal-shift chassis causes alteration in the frequencies of the remaining crystals. Before performing the adjustment it should be ascertained that the relays are inserted in the chassis. Removal of crystals themselves do not affect the frequency of the remaining channels.

2.3. The Modulation Amplifier

The modulation amplifier has been adjusted and tested at the factory, and it should not be readjusted unless the amplifier is found to be faulty, requiring replacement of components.

The following approximate signal values stated may prove valuable during fault location in the modulation amplifier and speech limiter:

Position	50 kc/s	25 kc/s
AC Voltage between V9a (pin 9) and chassis	0.3 V	0.2 V
AC Voltage drop across R81	3.0 V	2.0 V
AC Voltage drop across R82	0.5 V	0.3 V
AC Voltage measured across C112	.045 V	0.03V
AC Voltage between V11a (pin 1) and chassis	1.0 V	0.7 V
AC Voltage drop across R97	0.8 V	0.5 V

Note. For 50 kc/s models (-3b/10/11), Δf = 5 kc/s at 1000 c/s and for 25 kc/s models (-12/13/14), Δf = 3.3 kc/s at 1000 c/s. All readings are approximate only.

3. The Receiver Section

3.1. The Receiver Oscillator

The grid current of the oscillator may be checked in test point no. 4. Grid current is necessary for the oscillation of the oscillator, and normally this current is approx. 30 µA, but may vary to some extent. The permissible decrease is approx. 12 µA when replacement of the valve becomes necessary.

The crystal frequency should to be checked and if necessary readjusted by the trimming condensers C81 to C86. When the oscillator valve (V10) is replaced the crystal frequency must be checked with a frequency meter capable of measuring frequencies with an accuracy better than 3×10^{-6}. When replacing the valves V2 or V10 the grid and plate circuits must be readjusted. The currents measured in the test points in the multiplier (5 and 6) may decrease to approx. 15 µA before replacement of the valves becomes necessary. But before any replacement is carried out, always readjust the circuits, as a small grid current can be due to a detuning of one of the preceeding circuits.

3.2. Intermediate Frequency and Limiter Stages

In order that the receiver fully suppresses the pulse noise (e.g. ignition noise and generator noise) it is important that the IF-curve is placed symmetrically round the centre frequency (455 kc/s) and that the centre frequency of the discriminator is exactly 455 kc/s. Another requirement is that during reception the discriminator deflection is placed as close as possible to zero or the discriminator deflection for the receiver noise. The deviation should not exceed approx. 5 µA.

The measured deflection at test point no. 1 is expressive of the strength of the received signals. The control grid voltage in the 2nd limiter LI2 may be checked at test point no. 2. In case where the receiver is equipped with new valves the deflection at test point 2 is large for receiver noise alone, and this is checked by applying a signal to the receiver, whereby the deflection should only increase slightly. The deflection for receiver noise may decrease to approx. 15 µA when it becomes necessary to replace the preceding valves.

The DC-voltage of the discriminator may be checked at test point no. 3. During reception the discriminator deflection should not be displaced more than 5 µA. A possible greater displacement may be due to:

a) A deviation in the transmitter frequency.
b) A deviation in the crystal frequency of the receiver.
c) A deviation in the resonance frequency of the discriminator.

The valves V4, V5, V6 and V7 may be replaced without readjustment of the circuits.

3.3. Audio amplifier

The valves V8 and V9 are replaceable without readjustment. With potentiometer R45 the output power for the loudspeaker is adjusted to 0.5 W or 1.0W (in case of increased output power). The following signal measurements can be carried out in the audio amplifier by a normal AF-voltmeter and may be of assistance in fault location:

	50 kc/s	25 kc/s
Voltage across C61	5.6 V	3.7 V

With the potentiometer R45 **adjusted** to approx. 0.1 V on control grid of V8a with a 10 kc/s deviation at 1000 c/s for 50 kc/s equipment and 3.3 kc/s at 1000 c/s for 25 kc/s equipment, the following measurements may be taken.

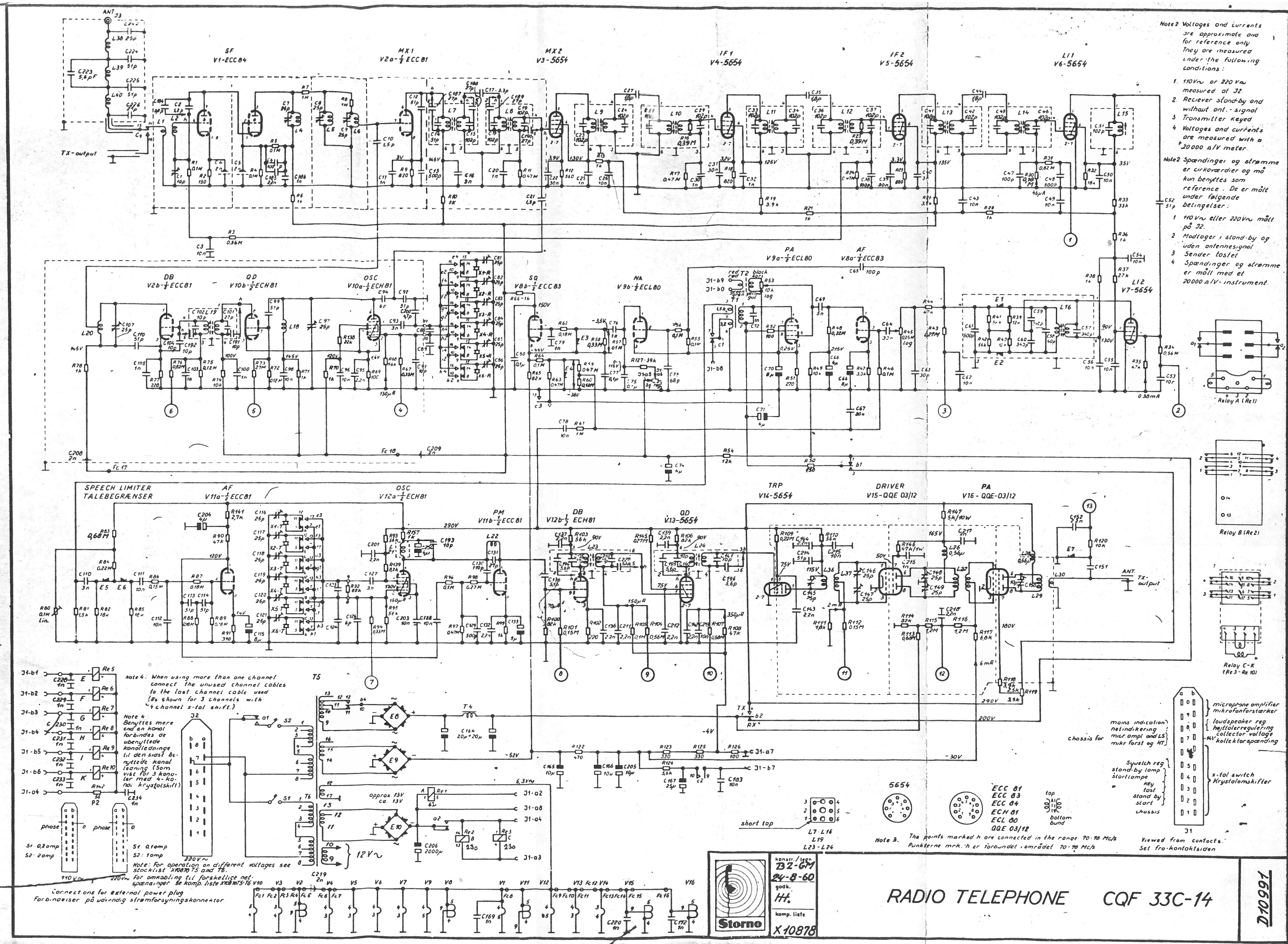
1) Grid AC-voltage on V9a for .5 W output power: 2.2 V
2) Grid AC-voltage on V9b for 1.0 W output power: 2.5 V
3) Voltage across loudspeaker for .5 W output: 1.3 V
4) Voltage across loudspeaker for 1.0 W output: 1.8 V

3.4. Noise Amplifier and Squelch Stage

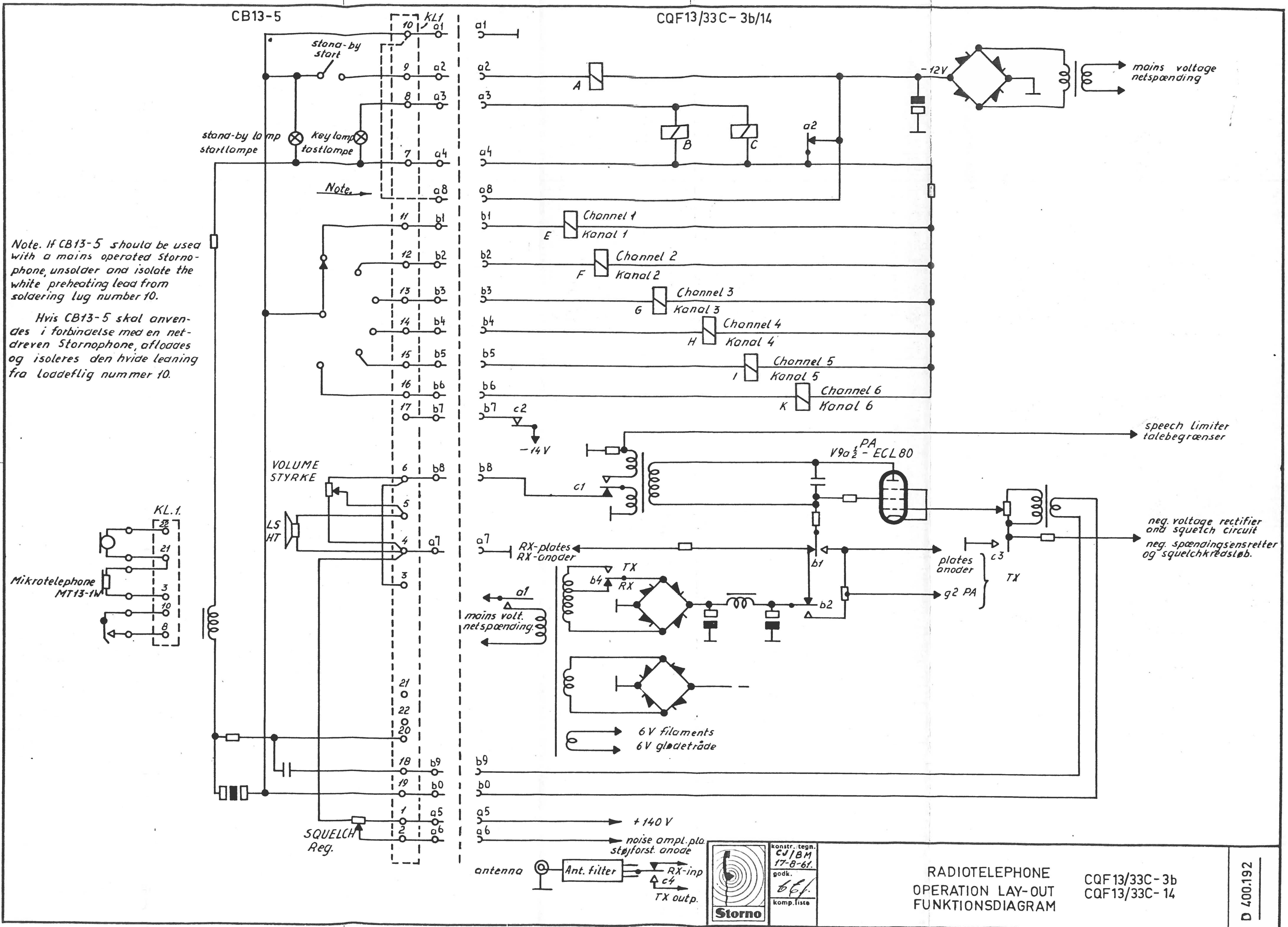
As previously mentioned in 3.3. the valves V8 and V9 may be replaced without any readjustment, but the squelch threshold level should be reset by the squelch potentiometer (located at the front of the control box). The following voltage measurement can be carried out:

	50 kc/s	25 kc/s
Noise Voltage		
Between pin 4 of discriminator and ground	3.4 V	2.0 V
Between pin 2 of V9b and ground	0.5 V	0.2 V
Rectified noise voltage		
Across R58 using a DC valve voltmeter	-3.5 V	-5.0 V
Cathode Voltage		
Between pin 8 of V8b and ground (DC Valve voltmeter)	-44 V	-44 V

The values given above apply when no antenna signal or external noise voltages are present on the antenna input terminal and when the squelch potentiometer in the control box is set for max. cut off. The values may vary from equipment to equipment without any decreasing in the squelch sensitivity, as any variations are equalized by the setting of the squelch potentiometer.



Note 2 Voltages and currents are approximate and for reference only. They are measured under the following conditions:
1. 110V~ or 220V~ measured at J2.
2. Reciever stand-by and without ant.-signal
3. Transmitter keyed
4. Voltages and currents are measured with a 20000 Ω/V meter.
Note 2 Spændinger og strømme er cirkaværdier og må kun benyttes som reference. De er målt under følgende betingelser:
1. 110V~ eller 220V~ målt på J2.
2. Modtager i stand-by og uden antennesignal
3. Sender tastet
4. Spændinger og strømme er målt med et 20000 Ω/V-instrument.
Note 4. When using more than one channel connect the unused channel cables to the last channel cable used (Re shown for 3 channels with 4 channel x-tal switch.)
Note 4 Benyttes mere end en kanal forbindes de ubenyttede kanalledninger til den sidst benyttede kanal ledning (Som vist for 3 kanaler med 4-kanal krystalskift)
Note: For operation on different voltages see stocklist X10878 T5 and T6.
For omkobling til forskellige netspændinger se komp. liste X10878 T5-T6
Connections for external power plug
Forbindelser på udvendig strømforsyningskonnektor
Note 3. The points marked h are connected in the range 70-78 Mc/s
Punkterne mrk. h er forbundet i området 70-78 Mc/s
Viewed from contacts. Set fra kontaktsiden
SPEECH LIMITER
TALEBEGRÆNSER
SF V1-ECC84
MX1 V2a-½ECC81
MX2 V3-5654
IF1 V4-5654
IF2 V5-5654
LI1 V6-5654
DB V2b-½ECC81
QD V10b-½ECH81
OSC V10a-½ECH81
SQ V8b-½ECC83
NA V9b-½ECL80
PA V9a-½ECL80
AF V8a-½ECC83
LI2 V7-5654
AF V11a-½ECC81
OSC V12a-½ECH81
PM V11b-½ECC81
DB V12b-½ECH81
QD V13-5654
TRP V14-5654
DRIVER V15-QQE 03/12
PA V16-QQE-03/12
ANT.
TX-output
Relay A (Re1)
Relay B (Re2)
Relay C-K (Re3-Re10)
microphone amplifier mikrofonforstærker
loudspeaker reg. højttalerregulering
collector voltage kollektorspænding
x-tal switch krystalomskifter
mains indication netindikering
micr ampl and LS mikr forst og HT
Squelch reg
stand-by lamp standlampe
key tast
stand by
start
chassis
short tap
L7-L16 L19 L23-L24
5654
ECC 81 ECC 83 ECC 84 ECH 81 ECL 80 QQE 03/12
top
bottom bund
konstr./tegn. B2-GM 24-8-60
godk. Ht.
komp. liste X 10878
Storno
RADIO TELEPHONE CQF 33C-14
D10991
2-63
29-9-61



Note. If CB13-5 should be used with a mains operated Stornophone, unsolder and isolate the white preheating lead from soldering lug number 10.

Hvis CB13-5 skal anvendes i forbindelse med en netdreven Stornophone, afloades og isoleres den hvide leaning fra loddeflig nummer 10.

Storno

konstr./tegn. CJ/BM 17-8-61.

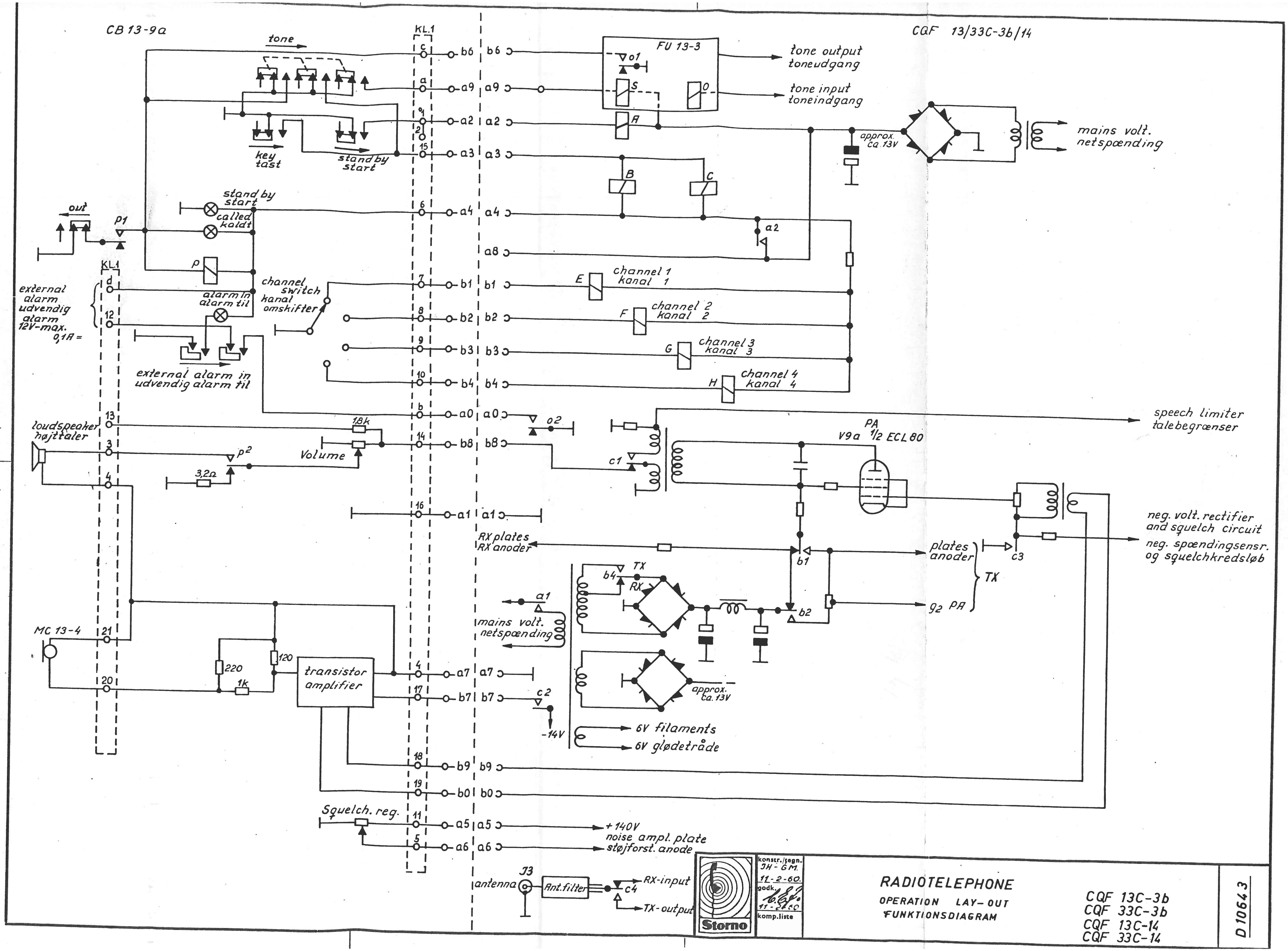
godk.

komp. liste

RADIOTELEPHONE
OPERATION LAY-OUT
FUNKTIONSDIAGRAM

CQF13/33C-3b
CQF13/33C-14

D 400.192



Storno

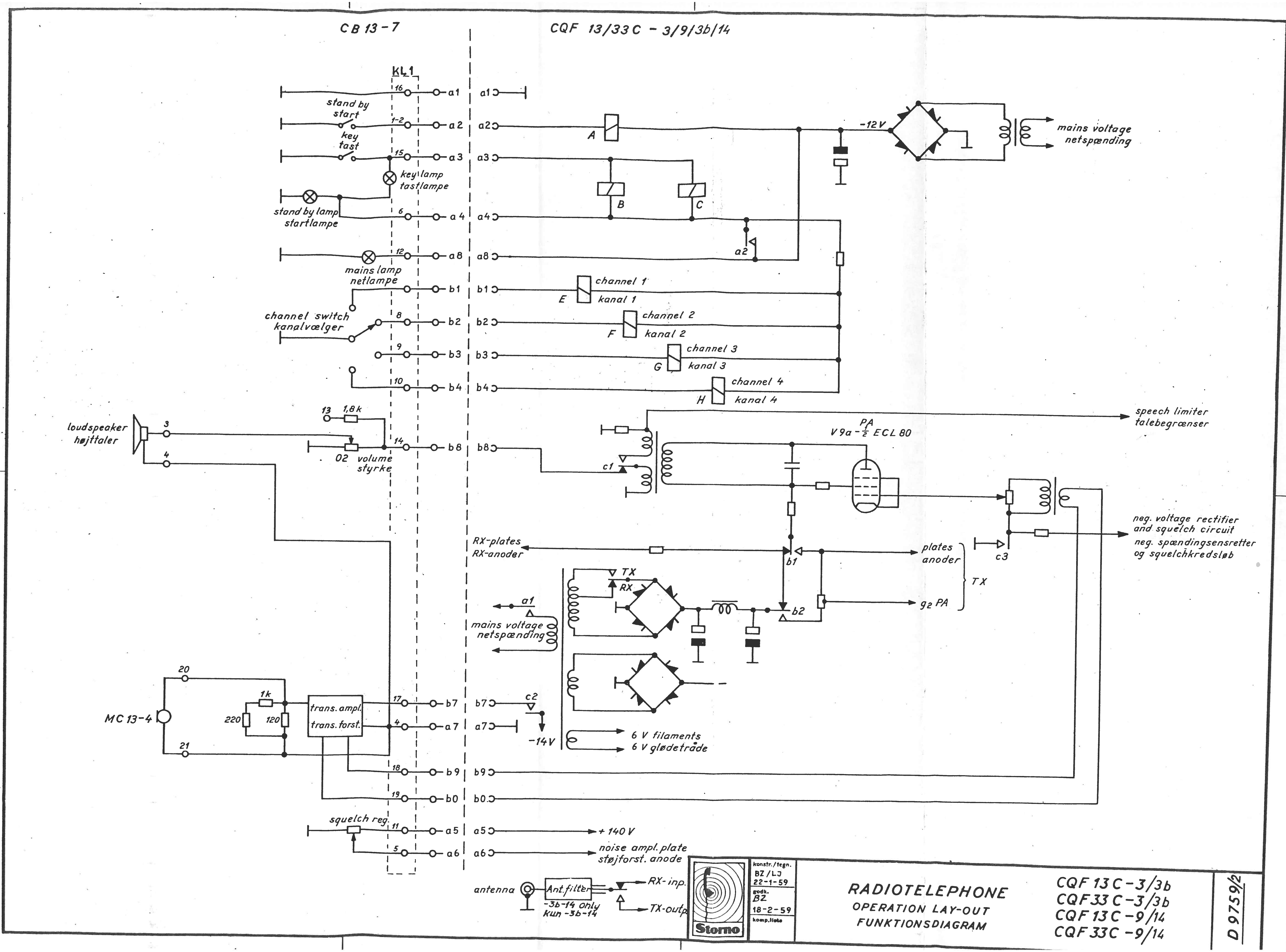
konstr./tegn. JH - GM. 11-2-60.
godk. 11-2-60
komp. liste

RADIOTELEPHONE

OPERATION LAY-OUT
FUNKTIONSDIAGRAM

CQF 13C-3b
CQF 33C-3b
CQF 13C-14
CQF 33C-14

D 10643


CB 13-7
CQF 13/33C - 3/9/3b/14
KL 1
a1
stand by
start
a2
key
tast
a3
key lamp
tastlampe
stand by lamp
startlampe
a4
a8
mains lamp
netlampe
b1
channel switch
kanalvælger
b2
b3
b4
loudspeaker
højttaler
13
1,8k
02 volume
styrke
b8
-12V
mains voltage
netspænding
A
B
C
a2
channel 1
kanal 1
E
channel 2
kanal 2
F
channel 3
kanal 3
G
channel 4
kanal 4
H
speech limiter
talebegrænser
PA
V9a - ½ ECL 80
c1
neg. voltage rectifier
and squelch circuit
neg. spændingsensretter
og squelchkredsløb
RX-plates
RX-anoder
b1
plates
anoder
TX
c3
TX
RX
b2
g2 PA
a1
mains voltage
netspænding
20
1k
220
120
trans. ampl.
trans. forst.
MC 13-4
21
b7
c2
a7
-14V
6 V filaments
6 V glødetråde
b9
b0
squelch reg.
a5
+140 V
a6
noise ampl. plate
støjforst. anode
antenna
Ant. filter
-3b-14 only
kun -3b-14
RX-inp.
TX-outp.
konstr./tegn.
BZ/LJ
22-1-59
godk.
BZ
18-2-59
komp. liste
Storno
RADIOTELEPHONE
OPERATION LAY-OUT
FUNKTIONSDIAGRAM
CQF 13C-3/3b
CQF 33C-3/3b
CQF 13C-9/14
CQF 33C-9/14
D 9759/2

Radiotelephone Model "Stornophone"

Alignment Procedure

1. General

The following steps are taken at the factory before shipping the equipment:

a. Quartz crystals are inserted in the equipment.
b. Receiver and transmitter are inspected and aligned carefully.
c. Potentiometers for adjustment of the receiver output power and the transmitter limiter level are adjusted and locked.
d. Receiver and transmitter frequencies are set with an accuracy better than 3×10^{-6}.

Alignment at initial start

a. Adjust the transmitter PA-plate circuit with the proper antenna connected to the antenna connector.
b. Adjust the transmitter modulation sensitivity.

These adjustments a, and b, should also be carried out, when the Stornophone is replaced in its normal location, i.e. in the car, van or ship etc. This is particularly necessary if the Stornophone is being transferred from one vehicle to another.

The above mentioned alignment procedures are described in detail in sections 2.1. and 2.3. in the chapter "Transmitter Alignment".

WARNING: When measuring voltages, currents etc. in connection with the transistorized power supply, particularly the primary of transformer T3, great care must be taken not to short any of these points to chassis with test prods or clips as the transistors may be destroyed. The supporting bar which runs by this section has been insulated with a P.V.C. sleeve to minimise the risk.

The Stornophone types are as follows:

25 kc/s	50 kc/s
CQMx3C-12 (12V DC) CQMx3C-13 (24V DC) CQMx3C-14 (6/12V DC) CQFx3C-14 (Mains)	CQMx3C-10 (12V DC) CQMx3C-11 (24V DC) CQMx3C-3b (6/12V DC) CQFx3C-3b (Mains)

The following procedure applies to all 50 kc/s and 25 kc/s channel separation model Stornophones in the 68-88 Mc/s and 146-174 Mc/s bands, and the test equipment used is designed by Storno for the various measurements.

The instructions in the following procedure refer to these instruments. General test equipment may also be used provided that it is equal or better than the Storno test equipment that it will substitute. The Storno equipment is given in the lists of equipment required. It is presumed that the usual workshop facilities are available in respect of battery power supplies, chargers, etc. for the supply of the primary power which must be as stated, i.e. 6.6, 13.2, and 26.4V DC ±10% to achieve the figures quoted in the specification. (See chapter on Fault Finding).

2. Transmitter Alignment

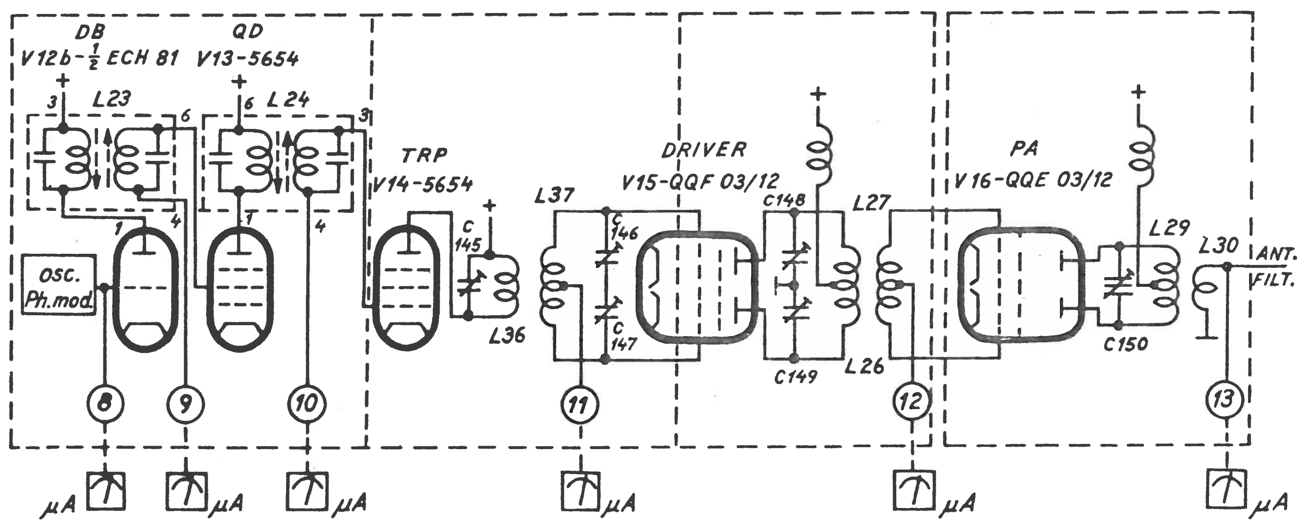
The alignment of the transmitter must be performed in the following order:

2.1. Alignment of multiplier and power amplifier.
2.2. Adjustment of speech limiter.
2.3. Adjustment of modulation sensitivity by R53.
2.4. Alignment of oscillator.

WARNING: Never key the transmitter without loading the output stage by the proper antenna or an artificial load.

NOTE: In equipment with more than one channel all relays must be inserted in the crystal shift panel before alignment is attempted as the capacitances of the relay contacts are part of the load capacity of the crystals.

2.1. Alignment of multipliers and power amplifier.



Meter connection.

Equipment required.

1. Test Meter (Storno SI05) 50-0-50 μA (R_i = 1 kΩ).
2. Dummy Load (50 Ω) dissipating 12-15 watts minimum. (Storno DL11-1).

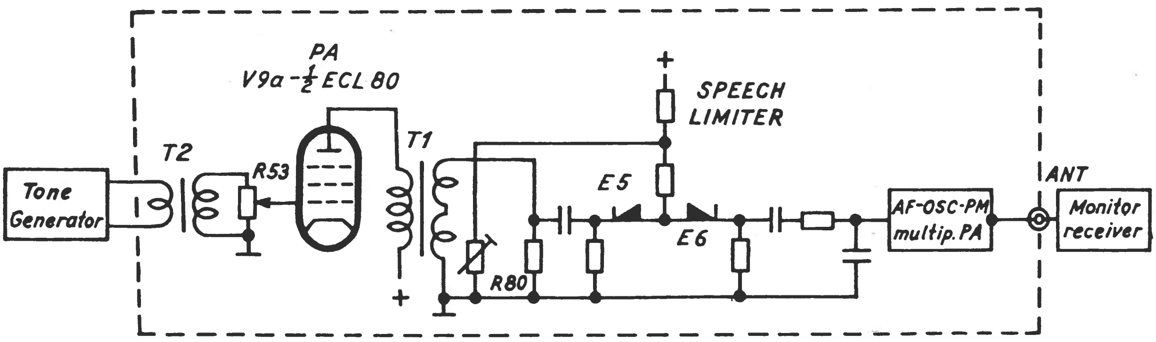
Procedure.

a) Attach antenna or dummy load and key the transmitter.
b) Connect the test meter to test point 8 and check the deflection (approx. 30 μA).
c) Connect the test meter to testpoint 9.
Adjust the primary and secondary of L23 for maximum deflection.
d) Connect the test meter to test point 10.
Adjust the primary and secondary of L24 for maximum deflection.
It may be necessary to repeat c) and d) several times.
e) Connect the test meter to test point 11.
Set C146, C147 so that they are approximately equal. Tune C145 for maximum indication. Then tune C146, C147 together, adjusting them by equal amounts for maximum deflection.
NB. The coupling between L36 and L37 is extremely critical and if this is disturbed for any reason, it must be carefully reset.
f) Connect test meter to test point 12.
Set C148, C149 so that they are approximately equal. Tune together in small steps for maximum indication in the meter.
g) Connect test meter to testpoint 13. Tune C150 for max. (It may be necessary to retune C148, C149 for max. power at this point.
Adjust the coupling between L29 and L30 for maximum indication on the meter.

Specification

If the dummy load has a meter indicating power output, this should read not less than 10 watts for all types of Stornophones. (The lower frequency equipments give readings in the region of 12 watts)

2.2. Adjustment of speech limiter.



Connection of test equipment

Equipment required

1) Audio Generator (600 Ω).
2) Dummy Load (50 Ω). Storno DL11-1.
3) Monitor Receiver, Storno Type L22, or other covering the range 146-174 or 68-88 Mc/s, with a deviation meter.

Procedure

a) Adjust R53 for max. sensitivity.
b) Key the transmitter.
c) Adjust the monitor to the transmitter frequency.
d) Adjust the audio tone generator to 1000 c/s and an output voltage (approx. 0.2V), which equals a frequency deviation on the monitor of 10 kc/s. (3 kc/s for 25 kc/s equipment).
e) Increase the voltage mentioned in d) by 20 dB.
f) Adjust R80 so that the frequency deviation does not exceed 15 kc/s. (5 kc/s for 25 kc/s equipment).

The microphone may be used instead of the tone generator, when adjusting R80. The potentiometer may be set in such a position that even excessive shouting does not cause the frequency deviation to exceed 15 kc/s (5 kc/s for 25 kc/s equipment).

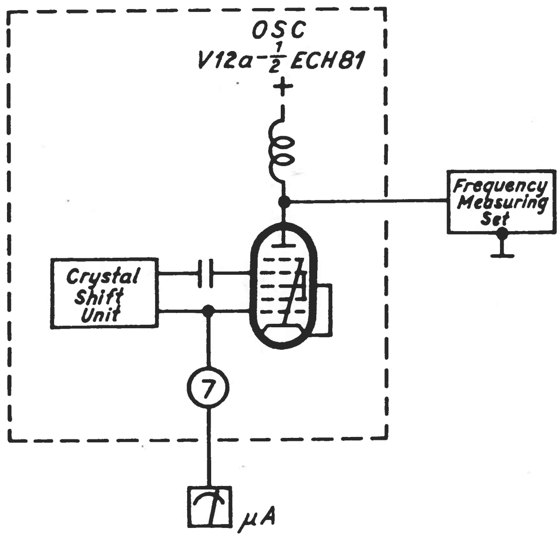
Specification

For 50 kc/s equipment, maximum deviation = ±15 kc/s.
For 25 kc/s equipment, maximum deviation = ±5 kc/s.

2.3. Adjustment of modulation sensitivity

The most suitable way to adjust R53 is by a speech test, using the main station receiver unit as a monitor. The final setting should be a compromise between clarity and modulation level. As soon as a gradual increase of the sensitivity potentiometer (R53) results in distortion in the main receiver output, the adjustment should be stopped and possibly be decreased slightly.

2.4. Alignment of oscillator



Connection of test equipment.

Equipment Required

1) Frequency measuring set covering the frequency bands below with an accuracy better than $1x10^{-6}$.
Crystal range: 6.05 - 7,25 Mc/s or 2.92 - 3.66 Mc/s.
2) 50 µA meter (R_i = 1 kΩ), Storno SI05.

Procedure

Before this test is carried out, the equipment should have been running for at least 10 minutes, immediately before the commencement of the alignment so that the various circuits are stabilized with regard to temperature, and (in the case of 25 kc/s equipment fitted with crystal ovens) the ovens are cycling.

a) Adjust the crystal trimmer to half capacitance.
b) Key the equipment and check the deflection (approx. 30 µA) with the service instrument connected to test point 7.
c) Connect the frequency measuring set between the plate of the oscillator valve and ground.
d) Tune in the frequency measuring set to the crystal frequency specified for each channel (see test report for actual figures).
e) Adjust the crystal trimmers (C116 - C121) to the exact crystal frequency for each channel.

In case a frequency measuring set is not available the main receiver unit may be utilized for the final setting of the crystal trimmers of the transmitter. The trimming condensers are adjusted for zero deflection on the 50 µA meter, which is connected to test point 3 in the discriminator of the main receiver unit.

It is emphasized that the above procedure is usable only in cases, where the main receiver frequencies are known to be adjusted correctly.

Specification

For 50 kc/s equipment.
The maximum deviation should not be more than $\pm 15 \times 10^{-6}$.
For 25 kc/s equipment with oven.
The maximum deviation should not be more than $\pm 5 \times 10^{-6}$. This should hold for an ambient temperature range of -10°C to $+40^{\circ}$C.

3. Receiver Alignment

The adjustments should be carried out in the following order:

3.1. Adjustments of the low (2nd) Intermediate Frequency (455 kc/s).
3.2. Adjustment of L15 and Discriminator.
3.3. Adjustment of the high (1st) Intermediate Frequency.
3.4. Adjustments of the Oscillator and Multipliers.
3.5. Adjustment of Local Oscillator, Final Multiplier and RF Amplifiers.
3.6. Setting the Antenna Link.
3.7. Setting the AF Output Power.
3.8. Setting the Squelch Potentiometer.

If however, the Storno Sweep Generator L20 is used for the alignment of the 2nd Intermediate Frequency, it will be more convenient if the AF Power Adjustment (Section 3.7) is carried out immediately after the Discriminator Alignment.

3.1. Adjustment of the Second Intermediate Frequency Amplifiers (455 kc/s)

Equipment required.

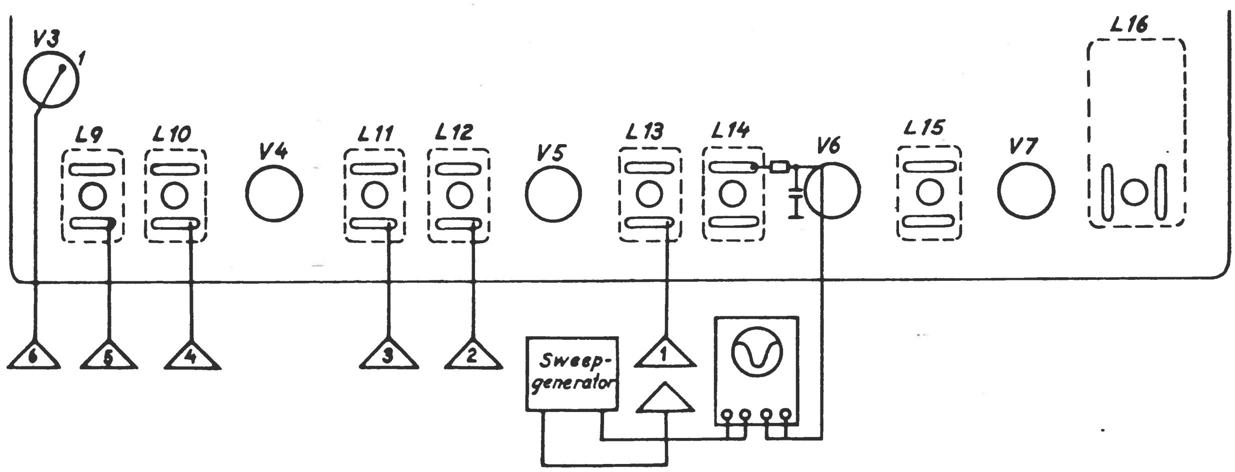
1) The adjustments are best carried out by means of a Storno Sweep Generator type L20, which is especially designed around 455 kc/s and is capable of delivering crystal controlled spot frequencies or frequency modulated signals up to approximately 10 volts.

NB: To enable the L20 to be used for alignment of 25 kc/s equipment, the deviations either side of the output frequency should be ±5 kc/s ±12 kc/s and ±35 kc/s. Later models of the L20 have been modified by substituting the crystals and screwing another plate with the new frequency points over the original markings.

The new L20 can be used for both 25 kc/s and 50 kc/s spacing equipments.

2) A test meter, preferably 50-0-50 µA with an internal resistance of 1000Ω (Storno SI05).
3) An oscilloscope, where the saw tooth voltage is brought out to terminals. (Philips GM5655).
4) A DC valve voltmeter with a range of 3 volts is preferred for the bandwidth measurements, but an oscilloscope with DC coupled Y-amplifiers to give a reference point may be used.
5) If the IF-amplifiers are to be tuned by the damping method, (Section 3.1.2), then a signal generator set to 455 ±0,2 kc/s (Storno L20) and an indicator will be required e.g. a 50-0-50 µA meter, a DC valve voltmeter or a DC oscilloscope.
6) Low-pass Filter (0.1MΩ and 2 nF).

3.1.1. Adjustment with Sweep Generator and Oscilloscope.



Connection of test equipment.

Procedure

a) Connect the Y-plate input of the oscilloscope via a low-pass filter (0.1 MΩ - 2 nF) to L14, tag 3.
b) Connect the test meter to test point 1.
c) Connect the sweep generator output to L13, tag 4. Set both attenuators to introduce the greatest possible signal and the frequency to 455 kc/s.
d) Adjust both primary and secondary of L14 to give maximum deflection on the meter. The iron core must not be screwed into the middle of the coil former.
e) Switch the sweep generator to "Δf Sweep" and the "455 kc/s" toggle switch downwards.

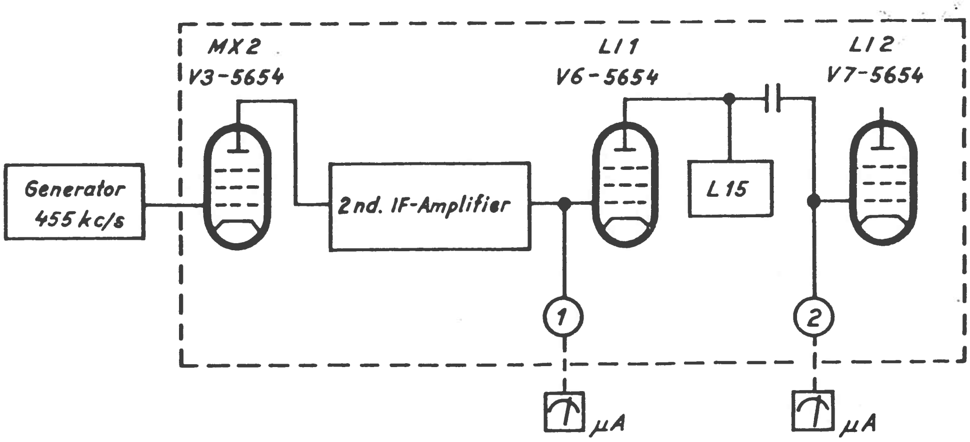
The display on the oscilloscope screen may be centred by "Freq. Adj", widened or closed up by "Sweep 0-100 kc", and the height may be controlled by the amplifier gain.

f) Adjust the primary and secondary of L14 for the best possible symmetry about the 455 kc/s marker, which is provided by the crystal oscillator.
g) Disconnect the sweep input from L13 and apply to L12, tag 4. Reduce the output, so that the display is at a convenient height and adjust both the primary and secondary of L13 as for point f) above.
h) Transfer the sweep output to L11, tag 4. Increase the output, and adjust the primary and secondary of L12.
i) Transfer the sweep output to L10, tag 4. Reduce the output and adjust the primary and secondary of L11.
j) Transfer the sweep output to L9, tag 4. Increase the output and adjust the primary and secondary of L10.
k) Transfer the sweep output to the grid of V3, pin 1 (Choose the earth connection with care. The screening plate just above the valve base or the chassis where the de-coupling capacitor is earthed is preferred). Reduce the generator output and adjust L9.
l) Check the symmetry of the curve with the crystal controlled markers ±5 and ±12 kc/s. (Use the graticules for reference, when the centre 455 kc/s marker is removed). Increase the generator output 6-10 dB and reduce the Y-plate amplifier gain by a corresponding amount. If the curve is distorted, check the earthing of the IF-cable. Small irregularities can be compensated for by re-adjustment of L14, while serious distortion indicates a faulty de-coupling or an IF-valve with a large inter-electrode capacitance. When the best possible symmetry and gain have been obtained, the bandwidth must be checked by the method outlined in 3.1.3. below.

3.1.2. Adjustment of the Low (2nd) Intermediate Frequency by the Damping Method.

Equipment required

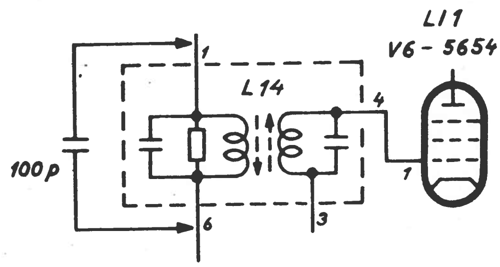
1. Signal Generator. (455 kc/s ±0.2 kc/s).
2. 50 μA meter. (R_i = 1000Ω) Storno SI05.
3. 100 pF Capacitors.



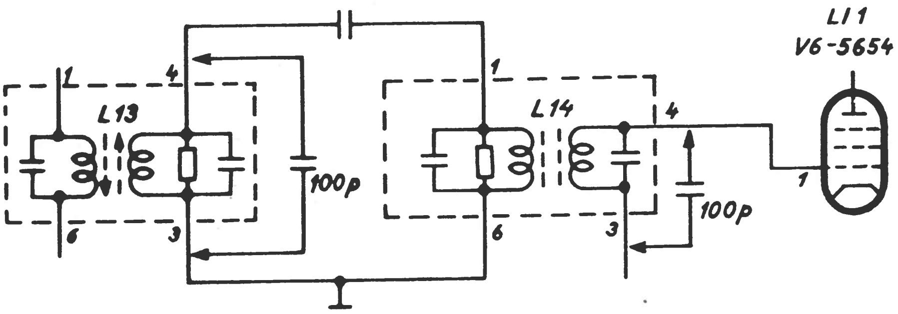
Connection of test equipment.

Procedure

The circuits are de-tuned by a 100 pF capacitor on each side during the adjustment of a particular circuit.



Attenuation of L14 primary.



Attenuation of L13 and L14 secondaries.

Procedure

a) Connect the microammeter to test point 2.
b) Set the generator to 455 kc/s. Inject this signal at pin 1 on V3 (MX2) at a suitable level to give a suitable deflection on the testmeter (5-20 µA).
c) With a 100 pF shunting capacitor, across the primary of L14, (fig.1) adjust the secondary for maximum indication.

d) Connect another capacitor across the secondary of L13 and place the capacitor used in (c) across the secondary of L14 (see Fig. 2). Adjust the primaries of these for maximum on the test meter.
e) Remove the meter and place it in testpoint 1.
f) Adjust L12, L11, L10, L9 in that order by the method outlined in (c) and (d) above, moving the damping capacitors as the adjustments are performed on each transformer.

3.1.3. Bandwidth Checking and Measurement.

Equipment Required

1) Signal Generator. (400-500 ±0.2 kc/s). (Storno L20).
2) Test Meter 50 μA. (Storno SI05).
3) D.C. Valve Voltmeter.

When the tuning process has been completed from the 2nd mixer to the 1st limiter, check that the generator is set to 455 kc/s. Set the two attenuators to obtain approximately -3V DC on the valve voltmeter or DC-oscilloscope, which is connected to L14 via a low pass filter as for 3.1.3. (Sweep Generator Method). Adjust the signal generator to plus and minus 5 kc/s, 12 kc/s and 35 kc/s and note at each setting the attenuation which has to be taken out to give the same limiter voltage.
If a signal generator and a 50-0-50 μA meter is used for checking, a reference level of 6-10 μA is to be preferred.

The series resistor at test point 1 is in the order of 1 MΩ, and a deflection of approx. 30 μA can only be obtained at the centre frequency, while on the edges of the band-pass curve where limiting will occur in the preceeding IF stages, the deflection will be below 30 μA irrespective of the signal strength which may be injected at the grid of V3.

Procedure

a) Connect the signal generator to the grid of MX2 and the test meter to test point 1.
b) Set the generator at 455 kc/s and a level to give a deflection of say 10 μA on the meter. Note setting of the attenuator.
c) Drift the signal generator to the limits as set out in (i) and (ii) below.
d) Increase the output to bring the deflection on the meter back to its original level. Note the attenuator setting.

The difference in attenuator settings in d) and b) will be the rejection at each point and should be within the values set out in (i) and (ii).

Specifications

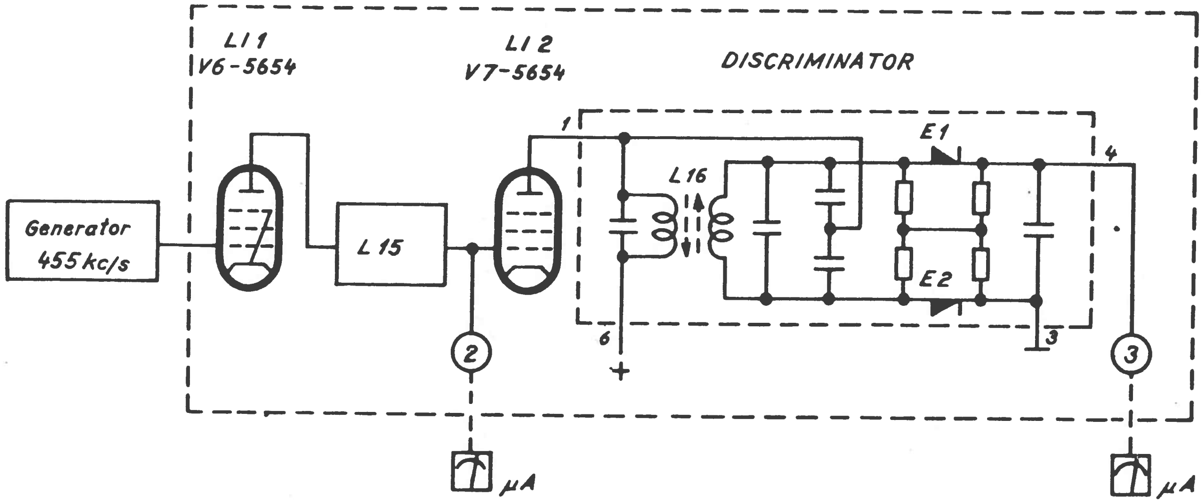
For 50 kc/s equipment:

(i) ±12 kc/s to be less than 4 dB.
(ii) ±35 kc/s to be not less than 70 dB.

For 25 kc/s equipment:

(i) ±5 kc/s to be less than 6 dB.
(ii) ±12 kc/s to be not less than 40 dB.

3.2. Adjustment of L15 and Discriminator



Connection of test equipment.

Equipment required

1) Signal Generator (455 kc/s ±0.2 kc/s) or Storno L20.
2) 50-0-50 μA Meter (R_i = 1kΩ), Storno SI05.

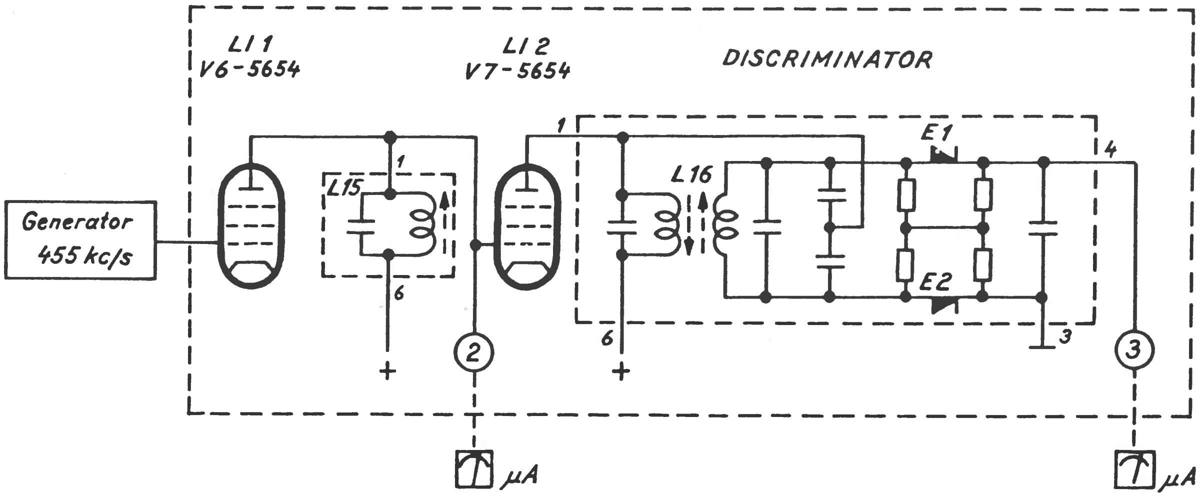
Procedure

a) Connect the meter to test point 2. Set the generator to 455 kc/s and inject a signal 60 dB down into the grid of V3. Adjust the core of L15 for the maximum deflection on the meter.
b) Remove the test-meter lead from test-point 2 and plug in to test-point 3.
Adjust L16 (top only) so that the meter indicates zero. Detune the generator +5 kc/s and adjust L16 (bottom only) for maximum deflection.
c) Return the signal generator to the centre frequency and re-adjust L16 top, if necessary, to zero.
d) Swing the generator frequency several times between ±5 and ±12 kc/s. Fine adjust the lower core so that the deflection equal in both directions when the generator is detuned both above and below the centre frequency.
e) When this is so, set the generator back to the centre frequency and check that the meter returns to zero. If this is not so, re-adjust the top core of L16.
f) Repeat steps d) and e).

3.3. Alignment of 1st Intermediate Frequency Amplifier

Equipment required:

1) Signal Generator covering the ranges: 9.1 - 10.7 Mc/s and 7.37 - 9.38 Mc/s.
2) 50-0-50 μA Meter. (R_i = 1000Ω), Storno SI05.

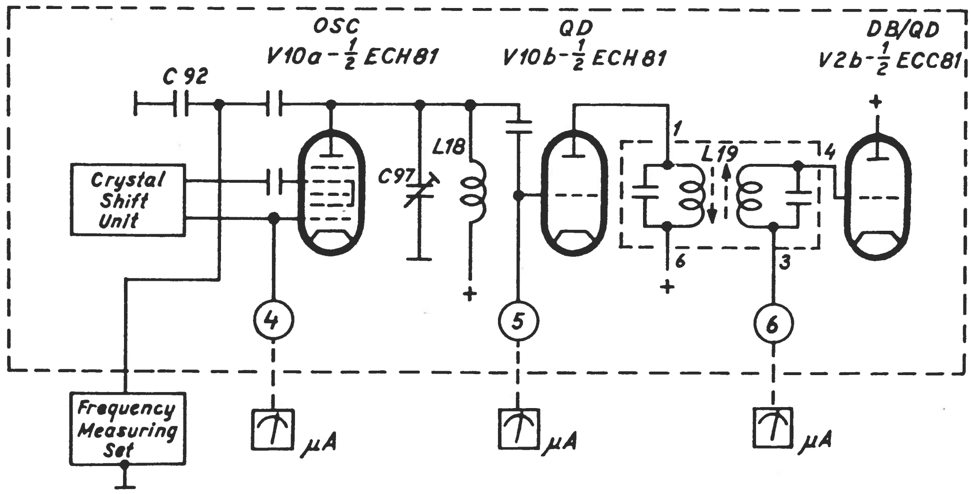


Connection of test equipment.

Procedure

a) Connect the μA-meter to test point 3.
b) Adjust the signal generator to obtain zero deflection on the μA-meter (1st intermediate frequency).
c) Connect the μA-meter to test point 1.
d) Adjust the signal generator for a deflection of approx. 20 μA on the μA-meter.
e) First adjust L8, then L7 for max. deflection on the meter.
f) Check the frequency setting of the generator by connecting the meter to point 3 and seeing that the reading is still zero. If not, re-adjust the generator and repeat step e).

3.4. Adjustment of oscillator and multipliers



Connection of test equipment.

Equipment Required

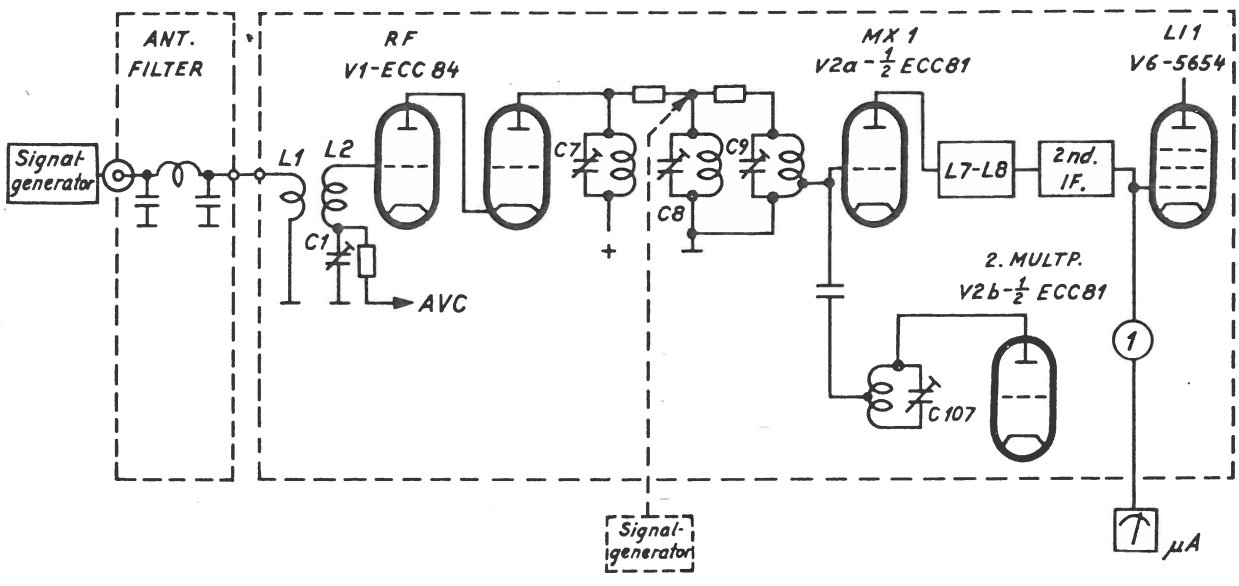
1. Frequency measuring set covering the ranges stated below by an accuracy better than $1x10^{-6}$: 9.1 - 10.2 Mc/s
   6.82 - 9,83 Mc/s
2. 50 µA-meter (R_i = 1 kΩ). Storno SI05.

Procedure

a) Connect the µA-meter to test point 4.
b) Check the deflection for each channel (min. deflection 12 µA).
c) Select the midmost channel for the following adjustment procedure.
d) Connect the µA-meter to test point 5.
e) Adjust C97 for max. deflection on the meter.
f) Connect the µA-meter to test point 6.
g) Adjust L19 for max. deflection on the meter.

Fine adjustment of the crystal frequency:
a) Connect the frequency measuring set across C92.
b) Adjust the frequency measuring set to the crystal frequency specified for each channel.
c) Adjust the crystal trimmers (C81 - C86) to the crystal frequencies specified. Precise setting is indicated by the frequency measuring set.

3.5. Adjustment of Local Oscillator Final Multiplier and RF-circuits



Connection of test equipment.

Equipment required:

1. Signal generator covering the ranges for the equipment being tested.
2. 50 µA-meter (R_i = 1 kΩ) Storno SI05.

Procedure

a) Use the midmost channel for the following procedure.
b) Connect the signal generator to the antenna connector and the 50 µA meter to test point 1.
c) Adjust the signal generator to the receiver frequency to give a deflection of 10-20 µA on the µA-meter.

If it is difficult to get the signal through, it may prove convenient to loosely couple the signal generator output across C8 and adjust C107 for maximum deflection on the µA-meter.

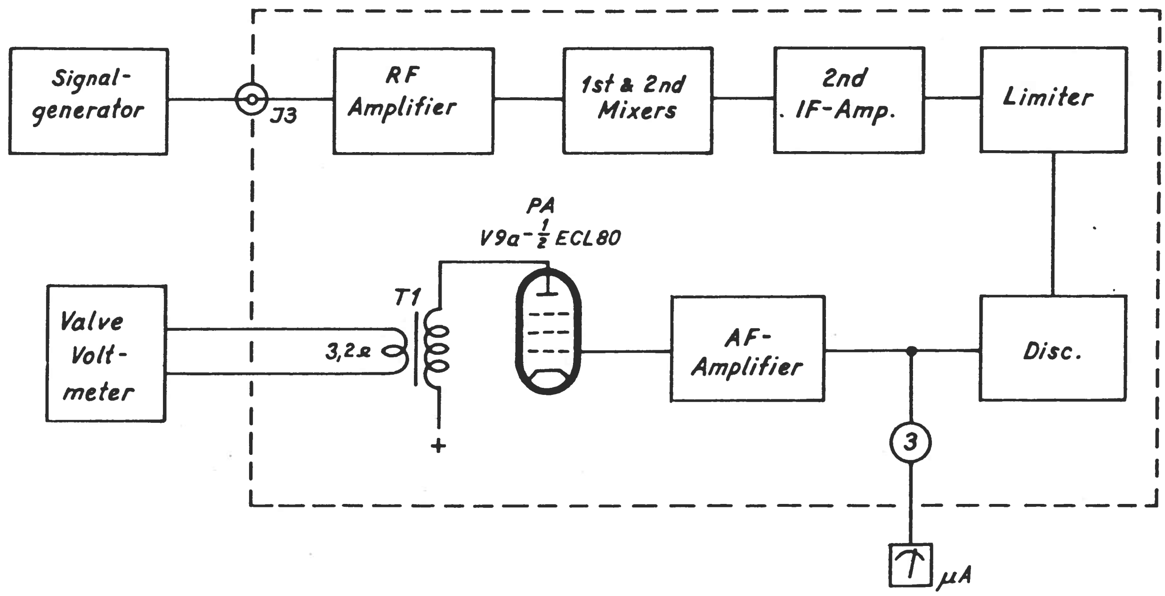
d) Adjust C107, C9, C8, C7 and C1 in that order for maximum deflection on the meter (During the adjustment the output from the signal generator must be reduced in order to keep the deflection between 10 and 20 µA).

e) Fine adjust all trimmers stated above, keeping the output from the signal generator as low as possible.
f) Check that the sensitivity is approximately the same for all channels. As the signal generator is adjusted to the receiver frequency for each channel, check the deflection of the µA-meter.

Stagger-tuning may be necessary at large channel spacing and thus the circuits are adjusted for equal sensitivity at the extreme channels.

WARNING: Do not key the transmitter with a signal generator connected to the antenna connector as the attenuator in the generator is easily damaged.

3.6. Adjustment of the antenna link (L1)



Connection of test equipment.

Equipment required:

1. Signal generator, covering the RF-ranges.
2. AF-valve voltmeter, Storno L22.
3. 50-0-50 µA-meter (R_i = 1kΩ), Storno SI05.

Procedure

a) Make a note of the noise level (in dB) measured by the AF-valve voltmeter without any signal applied to the receiver input.
b) Tune the signal generator to the receiver frequency and set the level to give a reading on the valve voltmeter which is 12 dB down in the reading obtained in a.
c) Check that the sensitivity is approximately the value stated in item (d) below.
d) Adjust the signal generator to an EMF, which corresponds to the following values: CQM/F13C-X: 0.8 µV.
   CQM/F33C-X: 0.7 µV.
e) Adjust the coupling between L1 and L2 in order to obtain a deflection on the valve voltmeter, which is 12-13 dB below the deflection measured under a.
f) Readjust C1, C7, C8 and C9.
g) Check if the level measured under a. has changed. It may be necessary to repeat e. and f.

NOTE: The voltage stated in d. is the generator voltage of the signal generator (voltage without load). Two methods are used for the calibration of attenuators in signal generators.

1. The output voltage engraved on the attenuator is the generator voltage.
2. The output voltage engraved on the attenuator is the voltage across an external load, which corresponds to the output impedance of the signal generator.

In case no. 1 use the voltage engraved on the attenuator.

In case no. 2 use twice the voltage value engraved on attenuator.

WARNING: Do not key the transmitter with a signal generator connected to the antenna connector as the attenuator in the generator is easily damaged.

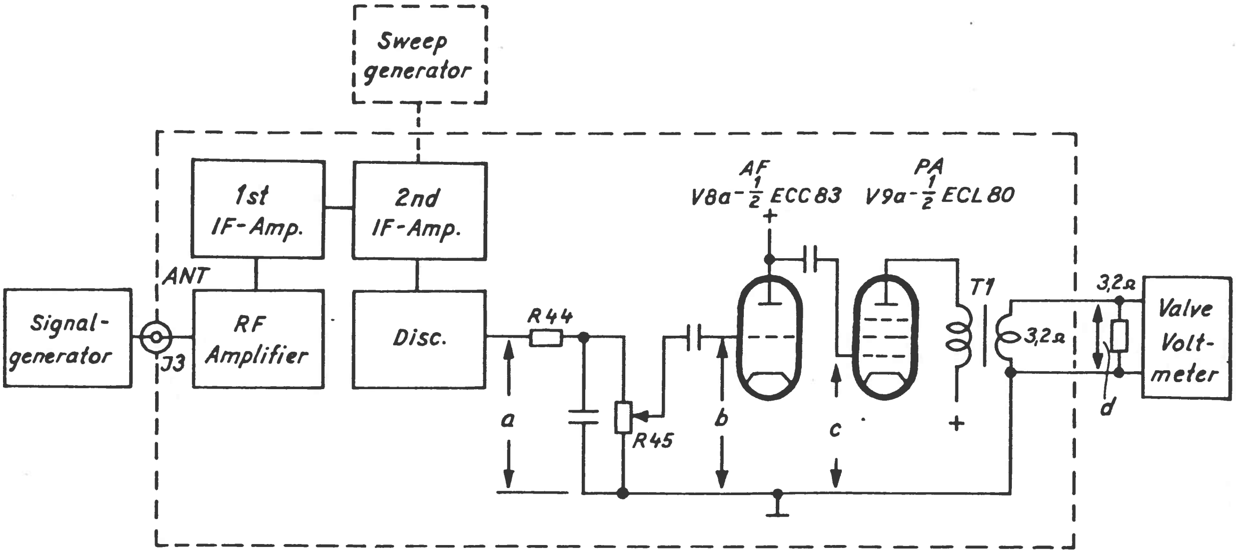
3.7. Adjustment of AF-output power

Equipment Required:

1. FM-signal generator covering the following ranges:

   CQM/F13C-X: 146-174 Mc/s.
   CQM/F33C-X: 68-88 Mc/s.
2. AF-valve voltmeter.
3. Sweep Generator, Storno L20.

NB: A sweep generator may be used if preferred.



Connection of test equipment.

Procedure

a) Connect the sweep generator to the grid of V3 or connect the signal generator set to the radiating frequency to the antenna connector.
b) The frequency deviation should be set to approx. 10 kc/s (3.3 kc/s for 25 kc/s equipment) with a modulation frequency of 1000 c/s.
c) Adjust R45 to 1.3 V at an output of 0.5 W or 1.8 V at an output at 1.0 W measured on the valve voltmeter.

The voltages given in specifications are measured with an audio valve voltmeter at ΔF = 10 kc/s (3.3 kc/s for the 25 kc/s equipment) at an modulation frequency of 1000 c/s.

WARNING: Do not key the transmitter with the signal generator connecte to the antenna connector as the generator attenuator is easily damaged.

Specification

For 50 kc/s equipment, the readings at the points a, b, c, and d on the diagram are as follows:

a. 5.6 V.
b. 0.1 V.
c. 2.2 V at 0.5 watts output.
   2.5 V at 1.0 watts output.
d. 1.3 V at 0.5 watts output.
   1.8 V at 1.0 watts output.

For 25 kc/s equipment, the valves are as follows:

a. 1.8 V.
b. 0.1 V.
c. 2.2 V at 0.5 watts output.
   2.5 V at 1.0 watts output.
d. 1.3 V at 0.5 watts output.
   1.8 V at 1.0 watts output.

3.7. Adjustment of squelch potentiometer in control box

The squelch potentiometer must be adjusted without any incoming signal to the receiver.

a. Turn knurled knob towards the right until a hissing sound is heard in the loudspeaker.
b. Turn the knob towards the left until the sound can hardly be heard.

This setting is the normal position of the squelch control.

type	* no.	* code	data		product
13	C1	78	5 pF trimmer		Philips 82081/5E
33	C1	78	10 pF trimmer		Philips 82081/10E
	C2	74	1.2 pF + 0,1 pF		TJ KCP
	C3	77	10 nF	150 V	Hunts W99 B800
	C4	74	2 nF	500 V	Stettner Dfk DM6 3x16D2500
	C5	74	2 nF	500 V	Stettner Dfk DM6 3x16D2500
	C6	74	100 pF ±10%	500 V	Stettner Rd 3x12N750/IB
13	C7	78	16 pF trimmer		Philips C005AA/16E
33	C7	78	25 pF trimmer		Philips C005AA/25E
13	C8	78	16 pF trimmer		Philips C005BA/16E
33	C8	78	25 pF trimmer		Philips C005BA/25E
13	C9	78	16 pF trimmer		Philips C005BA/16E
33	C9	78	25 pF trimmer		Philips C005BA/25E
	C10	74	1,5 pF ±20%		TJ KTP
	C11	74	1 nF	500 V	Stettner Sa Ku D4000
	C12	74	51 pF ±5%	500 V	Stettner Hd 3x12N075/IB
33	C13	77	500 pF	600 V	Hunts W99 B820
	C14		see L7		
	C15		see L7		
	C16	77	3 nF	400 V	Hunts W99 B817
13	C17	74	0,8 pF ±0,1 pF		TJ KCP
33	C17	74	3,3 pF ±20%		TJ KTP
	C18		see L8		
	C19		see L8		
	C20	77	1 nF	400 V	Hunts W99 B819
	C21	74	1,5 pF ±20%		TJ KTP
	C22	77	30 nF	200 V	Hunts W94 BT15
	C23		see L9		
	C24		see L9		
	C25	77	1 nF ±10%	400 V	Hunts W99 B819A
	C26	77	10 nF	400 V	Hunts W99 B810
	C27	74	1,8 pF ±0,1 pF		TJ KCP
	C28		see L10		
	C29		see L10		
	C30	77	1 nF	400 V	Hunts W99 B819
	C31	77	30 nF	200 V	Hunts W94 BT15
	C32	77	1 nF ±10%	400 V	Hunts W99 B819A
	C33		see L11		
	C34		see L11		
	C35	74	1,8 pF ±0,1 pF		TJ KCP
	C36		see L12		
	C37		see L12		
	C38	74	100 pF ±10%	500 V	Stettner Rd 3x12N750/IB
	C39	77	30 nF	200 V	Hunts W94 BT15
	C40	77	3 nF ±10%	400 V	Hunts W99 B817A
	C41		see L13		
	C42		see L13		
	C43	77	10 nF	400 V	Hunts W94 B810
	C44	74	1,8 pF ±0,1 pF		TJ KCP
	C45		see L14		
	C46		see L14		
	C47	74	100 pF ±10%	500 V	Stettner Rd 3x12N750/IB
	C48	77	500 pF	600 V	Hunts W99 B820
	C49	77	10 nF	400 V	Hunts W99 B810
	C50	77	10 nF	400 V	Hunts W99 B810
	C51		see L15		
	C52	74	51 pF ±5%	500 V	Stettner Hd 3x12N075/IB

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type	* no.	* code	data		product
	C53	77	10 nF	150V	Hunts W99 B800
	C54	77	10 nF	400V	Hunts W99 B810
	C55	77	10 nF	400V	Hunts W99 B810
	C56	77	10 nF	400V	Hunts W99 B810
	C57		see L16		
	C58		see L16		
	C59		see L16		
	C60		see L16		
	C61		see L16		
	C62	77	10 nF	400V	Hunts W99 B810
	C63	77	30 nF	200V	Hunts W94 BT15
	C64	77	30 nF	200V	Hunts W94 BT15
	C65	74	100 pF ±10%	500V	Stettner Rd 3x12N750/IB
	C66	73	8 µF	25V	TJ EAR 3535 eit
	C67	77	30 nF	200V	Hunts W94 BT15
	C68	73	4 µF	250V	TJ EAR 3438 eit
	C69	76	4,7 nF	400V	Erofol II nr. Hx247/4
	C70	73	8 µF	25V	TJ EAR 3535 eit
	C71	73	4 µF	250V	TJ EAR 3438 eit
	C72	77	1 nF	400V	Hunts W99 B819
	C73	74	68 pF ±10%		TJ KRN 750
	C74	73	4 µF	450/500V	TJ EAR 8828 eqit
	C75	77	0,1 µF	250V	Hunts W48 A306
	C76	72	1 nF	400V	Eroid nr. kc210/10(b)
	C77	76	0,1 µF	125V	Erofol II HX 410/1
	C78	72	10 nF	350V	TCC CP 113N
	C79	72	1 nF	400V	Eroid nr. kc210/10(b)
	C80	72	0,1 µF	250V	Eroid nr. kc410/2
	C81-		see special page for X-tal shift		
	C89		se specielt blad for X-tal skift		
	C91	74	10 pF ±0,5pF	500V	Stettner Rd2x12N075/IB
	C92	74	51 pF ±5%	500V	Stettner Hd3x12N075/IB
	C93	77	3 nF	400V	Hunts W99 B817
	C94	74	6 pF ±20%		TJ KTN 750
	C95	74	2,2 nF	350V	Keramikon 4133/1
	C96	77	10 nF	400V	Hunts W99 B810
13	C97	78	16 pF trimmer		Philips C005BA/16E
33	C97	78	25 pF trimmer		Philips C005BA/25E
	C98	77	10 nF	400V	Hunts W99 B810
	C99	74	51 pF ±5%	500V	Stettner Hd 3x12N075/IB
	C100	77	1 nF	400V	Hunts W99 B819
	C101		see L19		
	C102		see L19		
	C103	77	1 nF	400V	Hunts W99 B819
13	C104	74	13 pF ±5%	250V	Stettner Rd2x12N075/IB
33	C104	74	10 pF ±5%	500V	Stettner Rd2x12N075/IB
	C105	74	1 nF	500V	Stettner Sa Ku D4000
13	C107	78	16 pF trimmer		Philips C005AA/16E
33	C107	78	25 pF trimmer		Philips C005AA/25E
13	C108	74	51 pF	500V	Stettner Hd 3x12N075/IB
33	C108	74	110 pF	500V	Stettner Hd 3x20N075/IB
	C110	76	3 nF	400V	Erofol II Hx233/4 (3,3nF ±5% - 13% 400V)
	C111	77	10 nF	150V	Hunts W99 B810
	C112	76	10 nF ±5%	125V	Erofol II Hx310/1
	C113	74	51 pF ±5%	500V	Stettner Hd 3x12N075/IB
	C114	74	51 pF ±5%	500V	Stettner Hd 3x12N075/IB

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RADIO TELEPHONE CQF13C-14 CQF33C-14

* Se kodenumre og komponentbetegnelser * See code numbers and component designations

type	* no.	* code	data	product
	C115	73	8 µF 25V	TJ EAR 3535 eit
	C116-		see special page for X-tal shift	
	C124		se specielt blad for krystalskift	
	C126	74	6 pF ±20%	TJ KTN 750
	C127	77	3 nF 400V	Hunts W99 B817
	C128	77	10 nF 400V	Hunts W99 B810
	C129	77	500 pF 600V	Hunts W99 B820
13	C130	74	27 pF ±5% 500V	Stettner Hd 3x12N075/IB
33	C130	74	110 pF ±5% 500V	Stettner Hd 3x20N075/IB
13	C131	74	15 pF ±10% 500V	TJ KRP
33	C131	74	27 pF ±5% 500V	Stettner Hd 3x12N075/IB
	C132	74	2,2 nF 350V	Keramikon 4133/1
	C133	73	8 µF 25V	TJ EAR 3535 eit
	C134	74	51 pF ±5% 500V	Stettner Hd 3x12N075/IB
	C135		see L23	
	C136	74	2,2 nF 350V	Keramikon 4133/1
	C137	74	2,2 nF 350V	Keramikon 4133/1
	C139	74	2,2 nF 350V	Keramikon 4133/1
	C140		see L24	
	C141		see L24	
	C142	74	2,2 nF 350V	Keramikon 4133/1
	C143	74	2,2 nF 350V	Keramikon 4133/1
	C144	74	2,2 nF 350V	Keramikon 4133/1
13	C145	78	16 pF trimmer	Philips C005AA/16E
33	C145	78	25 pF trimmer	Philips C005AA/25E
13	C146	78	16 pF trimmer	Philips C005AA/16E
33	C146	78	25 pF trimmer	Philips C005AA/25E
13	C147	78	16 pF trimmer	Philips C005AA/16E
33	C147	78	25 pF trimmer	Philips C005AA/25E
13	C148	78	16 pF trimmer	Philips C005BA/16E
33	C148	78	25 pF trimmer	Philips C005BA/25E
13	C149	78	16 pF trimmer	Philips C005BA/16E
33	C149	78	25 pF trimmer	Philips C005BA/25E
13	C150	78	4 pF trimmer	Philips 82074B/4E
33	C150	78	10 pF trimmer	Philips 82074B/10E
	C151			
	C152	74	2,2 nF 350V	Keramikon 4133/1
	C164	73	20 µF+20 µF 450V	TJ EAL 6758 E
	C165	73	10 µF 50V	TJ EAR 2077 pit
	C166	73	10 µF 50V	TJ EAR 2077 pit
	C167	73	25 µF 50V	TJ EAR 3437 eit
	C169	74	1 nF 500V	Stettner Sa Ku D4000
	C172	74	1 nF 500V	Stettner Sa Ku D4000
13	C173	74	3,3 pF +20%	TJ KTP
13	C180	77	10 nF 400V	Hunts W99 B810
13	C181	74	2,2 nF 350V	Keramikon 4133/1
13	C182	74	2,2 nF 350V	Keramikon 4133/1
	C183	76	10 nF ±5% 125V	Erofol II Hx310/1
33	C184	74	0,8 pF ±0,1 pF	TJ KCP
"	C185	74	2,2 nF 350V	Keramikon 4133/1
"	C186	74	1 nF 500V	Stettner Sa Ku D4000
"	C187		see L7	
"	C188		see L7	
"	C189		see L8	
"	C190		see L8	

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type	* no.	* code	data	product
33	C191		see L19	
"	C192		see L19	
"	C193	74	10 pF ±0,5PF TC:-100	Stettner Rd 2x12N075/IB
"	C194		see L23	
"	C195		see L24	
"	C196		see L24	
"	C198	74	2,2 pF 350 V	Keramikon 4133/1
"	C200	74	4,7 pF	Keramikon 4110/2
"	C201	74	2,2 nF 350 V	Keramikon 4133/1
	C203	77	10 nF 150 V	Hunts W99 B800
	C204	73	4 µF 450-500 V	EAR 8828 eqit
	C205	73	10 µF 50 V	TJ EAR 2077e
	C206	73	2000 µF 25 V	TJ EAM 2374e
	C208	74	2 nF 500 V	Stettner Dfk DM63x16D2500
	C209	74	2 nF 500 V	Stettner Dfk DM63x16D2500
	C210		see L23	
	C211	74	2,2 nF 350 V	Keramikon 4133/1
	C212	74	2,2 nF 350 V	Keramikon 4133/1
	C213	77	10 nF 150 V	Hunts W99 B800
	C214	74	51 pF 500 V	Stettner Hd 3x12N075/IB
	C215	77	10 nF 400 V	Hunts W99 B810
	C216	74	1 nF 500 V	Stettner Sa Ku D4000
	C217	74	1 nF 500 V	Stettner Sa Ku D4000
	C218	74	2,2 nF 350 V	Keramikon 4133/1
	C219	74	2.nF 500 V	Stettner Dfk DM63x16D2500
	C220	74	1 nF 500 V	Stettner Sa Ku D4000
33	C223	74	5,6 pF ±5%	Keramikon 4116/SK
13	C224	74	25 pF ±5% TC: 0	TJ KRO Stand-off 5152
33	C224	74	51 pF ±5% TC: 0	TJ KRO Stand-off 5194
13	C225	74	25 pF ±5% TC: 0	TJ KRO Stand-off 5152
33	C225	74	51 pF ±5% TC: 0	TJ KRO Stand-off 5194
	C226	74	25 pF ±5% TC: 0	TJ KRO Stand-off 5152
33	C227		see L23	
	C228 -C234		see special page for X-tal shift / se specielt blad for krystalskift	
33	C242	74	25 pF ±5% TC: 0	TJ KRO Stand-off 5152
	C250	73	4 µF 450/500 V	TJ EAR 8828 eqi
	R1	81	0,1 MΩ ½ W	Vitrohm SBT
	R2	81	150 Ω ½ W	Vitrohm SBT
	R3	81	0,56 MΩ ½ W	Vitrohm SBT
	R4	81	0,1 MΩ ½ W	Vitrohm SBT
	R5	81	0,1 MΩ ½ W	Vitrohm SBT
	R6	81	1 kΩ ½ W	Vitrohm SBT
	R7	81	1 MΩ ½ W	Vitrohm SBT
	R8	81	1 MΩ ½ W	Vitrohm SBT
	R9	81	820 Ω ½ W	Vitrohm SBT
	R10	81	1 kΩ ½ W	Vitrohm SBT
	R11	81	0,47 MΩ ½ W	Vitrohm SBT
	R12	81	560 Ω ½ W	Vitrohm SBT
	R13	81	1 kΩ ½ W	Vitrohm SBT
	R14		see L9	
	R15		see L10	
	R16		see L10	
	R17	81	0,47 MΩ ½ W	Vitrohm SBT

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RADIO TELEPHONE CQF13C-14 CQF33C-14

Komp. liste X10978 Blad no 4

type	no.	code	data		product
	R18	81	820 Ω	½ W	Vitrohm SBT
	R19	81	3,9 kΩ	½ W	Vitrohm SBT
	R21	81	1 kΩ	½ W	Vitrohm SBT
	R23		see L12		
	R24	81	0,47 MΩ	½ W	Vitrohm SBT
	R25	81	820 Ω	½ W	Vitrohm SBT
	R26	81	3,9 kΩ	½ W	Vitrohm SBT
	R28	81	1 kΩ	½ W	Vitrohm SBT
	R30	81	0,15 MΩ	½ W	Vitrohm SBT
	R31	81	0,82 MΩ	½ W	Vitrohm SBT
	R32	82	18 kΩ	1 W	Vitrohm ABT
	R33	82	33 kΩ	1 W	Vitrohm ABT
	R34	81	0,56 MΩ	½ W	Vitrohm SBT
	R35	81	47 kΩ	½ W	Vitrohm SBT
	R36	81	1 kΩ	½ W	Vitrohm SBT
	R37	81	27 kΩ	½ W	Vitrohm SBT
	R38	81	1 kΩ	½ W	Vitrohm SBT
	R39		see L16		
	R40		see L16		
	R41		see L16		
	R42		see L16		
	R43	81	0,27 MΩ	½ W	Vitrohm SBT
	R44	81	47 kΩ	½ W	Vitrohm SBT
	R45	86	0,25 MΩ potent. (log)		Preh 4168
	R46	81	0,1 MΩ	½ W	Vitrohm SBT
	R47	81	3,3 kΩ	½ W	Vitrohm SBT
	R48	81	0,22 MΩ	½ W	Vitrohm SBT
	R49	81	10 kΩ	½ W	Vitrohm SBT
	R50	81	150 Ω	½ W	Vitrohm SBT
	R51	81	270 Ω	½ W	Vitrohm SBT
	R52	81	100 Ω	½ W	Vitrohm SBT
	R53	86	10 kΩ potent. (log)		Preh 4168
	R54	84	1,2 kΩ	6 W	Vitrohm H
	R55	81	0,1 MΩ	½ W	Vitrohm SBT
	R56	81	0,1 MΩ	½ W	Vitrohm SBT
	R57	81	0,1 MΩ	½ W	Vitrohm SBT
	R58	81	0,33 MΩ	½ W	Vitrohm SBT
	R59	81	0,47 MΩ	½ W	Vitrohm SBT
	R60	81	0,12 MΩ	½ W	Vitrohm SBT
	R61	81	1 MΩ	½ W	Vitrohm SBT
	R62	81	0,18 MΩ	½ W	Vitrohm SBT
	R63	81	0,47 MΩ	½ W	Vitrohm SBT
	R64	81	0,1 MΩ	½ W	Vitrohm SBT
	R65	81	82 kΩ	½ W	Vitrohm SBT
	R66	81	1 kΩ	½ W	Vitrohm SBT
	R67	81	0,33 MΩ	½ W	Vitrohm SBT
	R68	81	56 kΩ	½ W	Vitrohm SBT
	R69	81	100 Ω	½ W	Vitrohm SBT
13	R70	81	10 kΩ	½ W	Vitrohm SBT
33	R70	81	1 kΩ	½ W	Vitrohm SBT
	R71	81	1 kΩ	½ W	Vitrohm SBT
	R72	81	0,12 MΩ	½ W	Vitrohm SBT
	R73	81	2,7 MΩ	½ W	Vitrohm SBT
	R74	81	10 kΩ	½ W	Vitrohm SBT
	R75	81	0,12 MΩ	½ W	Vitrohm SBT

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RADIO TELEPHONE CQF13C-14 CQF33C-14

type	no.*	code*	data		product
	R76	81	0,82 MΩ	½ W	Vitrohm SBT
	R77	81	220 Ω	½ W	Vitrohm SBT
	R78	81	1 kΩ	½ W	Vitrohm SBT
	R80	86	0,1 MΩ	potent. (lin)	Preh 4168
	R81	82	1,5 kΩ	1 W	Vitrohm ABT
	R82	81	18 kΩ	½ W	Vitrohm SBT
	R83	81	0,68 MΩ	½ W	Vitrohm SBT
	R84	82	0,22 MΩ	1 W	Vitrohm ABT
	R85	81	18 kΩ	½ W	Vitrohm SBT
	R86	81	0,15 MΩ	½ W	Vitrohm SBT
	R87	81	0,18 MΩ	½ W	Vitrohm SBT
	R88	81	0,18 MΩ	½ W	Vitrohm SBT
	R89	81	0,18 MΩ	½ W	Vitrohm SBT
	R90	81	47 kΩ	½ W	Vitrohm SBT
	R91	81	390 Ω	½ W	Vitrohm SBT
13	R92	81	27 kΩ	½ W	Vitrohm SBT
33	R92	81	82 kΩ	½ W	Vitrohm SBT
13	R93	82	47 kΩ	1 W	Vitrohm ABT
33	R93	82	56 kΩ	1 W	Vitrohm ABT
13	R94	81	0,39 MΩ	½ W	Vitrohm SBT
33	R94	81	0,33 MΩ	½ W	Vitrohm SBT
	R95	81	56 kΩ	½ W	Vitrohm SBT
	R96	81	0,1 MΩ	½ W	Vitrohm SBT
	R97	81	0,47 MΩ	½ W	Vitrohm SBT
	R98	81	0,27 MΩ	½ W	Vitrohm SBT
	R99	81	1 kΩ	½ W	Vitrohm SBT
	R100	81	82 kΩ	½ W	Vitrohm SBT
13	R101	81	0,1 MΩ	½ W	Vitrohm SBT
33	R101	81	0,15 MΩ	½ W	Vitrohm SBT
	R102	81	220 Ω	½ W	Vitrohm SBT
	R103	82	56 kΩ	1 W	Vitrohm ABT
13	R104	81	0,56 MΩ	½ W	Vitrohm SBT
33	R104	81	0,56 MΩ	½ W	Vitrohm SBT
	R105	81	0,1 MΩ	½ W	Vitrohm SBT
13	R106	82	22 kΩ	1 W	Vitrohm ABT
33	R106	82	82 kΩ	1 W	Vitrohm ABT
13	R107	81	0,56 MΩ	½ W	Vitrohm SBT
33	R107	81	0,68 MΩ	½ W	Vitrohm SBT
	R108	81	47 kΩ	½ W	Vitrohm SBT
13	R109	82	82 kΩ	1 W	Vitrohm ABT
33	R109	82	0,22 MΩ	1 W	Vitrohm ABT
13	R110	82	22 kΩ	1 W	Vitrohm ABT
33	R110	82	56 kΩ	1 W	Vitrohm ABT
13	R111	81	1,2 kΩ	½ W	Vitrohm SBT
33	R111	81	1,8 kΩ	½ W	Vitrohm SBT
13	R112	81	120 kΩ	½ W	Vitrohm SBT
33	R112	81	0,15 MΩ	½ W	Vitrohm SBT
	R113	81	0,68 MΩ	½ W	Vitrohm SBT
	R114	81	82 kΩ	½ W	Vitrohm SBT
13	R115	81	0,68 MΩ	½ W	Vitrohm SBT
33	R115	81	1,2 MΩ	½ W	Vitrohm SBT
13	R116	81	0,68 MΩ	½ W	Vitrohm SBT
33	R116	81	1,2 MΩ	½ W	Vitrohm SBT
13	R117	81	3,9 kΩ	½ W	Vitrohm SBT
33	R117	81	6,8 kΩ	½ W	Vitrohm SBT

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RADIO TELEPHONE CQF13C-14
CQF33C-14

komp liste X10978

blad no 6

type	* no.	* code	data		product
13	R118	81	100 Ω	½ W	Vitrohm SBT
33	R118	81	3,9 kΩ	½ W	Vitrohm SBT
13	R119	83	5,5 kΩ+500Ω	3 W	Vitrohm GL
33	R119	83	2,5 + 3,5kΩ	3 W	Vitrohm GL
	R120	81	10 kΩ	½ W	Vitrohm SBT
	R122	83	470 Ω	2 W	Vitrohm BBT
	R123	82	330 Ω	1 W	Vitrohm ABT
	R124	81	5,6 kΩ	½ W	Vitrohm SBT
	R125	82	330 Ω	1 W	Vitrohm ABT
	R126	81	100 Ω	½ W	Vitrohm SBT
	R127	81	39 kΩ	½ W	Vitrohm SBT
33	R138	81	22 kΩ	½ W	Vitrohm SBT
33	R139	81	8,2 kΩ	½ W	Vitrohm SBT
	R141	81	2,7 kΩ	½ W	Vitrohm SBT
	R142	82	56 Ω	1 W	Vitrohm ABT
13	R145	82	82 kΩ	1 W	Vitrohm ABT
33	R145	82	0,27 MΩ	1 W	Vitrohm ABT
13	R146	82	27 kΩ	1 W	Vitrohm ABT
33	R146	82	47 kΩ	1 W	Vitrohm ABT
13	R147	84	3 kΩ	10 W	Vitrohm EKA
33	R147	84	5 kΩ	10 W	Vitrohm EKA
	R157	82	1 kΩ	1 W	Vitrohm ABT
	E1		see L16		
	E2		see L16		
	E3	99	Silicium diode		Philips OA200
	E4	99	Silicium diode		Philips OA200
	E5	99	Silicium diode		Philips OA200
	E6	99	Silicium diode		Philips OA200
	E7	99	Germanium diode		Philips OA81
	E8	94	300 V 0,2A		Siemens B300 C200
	E9	94	60 V 0,17A		Siemens B60 C170
	E10	94	30V 1,2A (2x30V 0,6A)		2xSiemens B30 C600
	Fc1-Fc18	65	ferroxcube beads perler		Philips 56-590-65/20
13		65	ferroxcube pipe 12x10 rør x6ø		Storno 65.017-00.0
	J1	41	20-poled		Tuchel T2661
	J2	41	16-poled		Tuchel T2020
	J3	41	coax connector		Amphenol SO 239
13	L1	62			Storno 62.446
33	L1	62			Storno 62.468
13	L2	62	156-174 Mc/s		Storno 62.447
33	L2	62	70-88 Mc/s		Storno 62.302
13	L3	62	156-174 Mc/s		Storno 62.236
13	L4	62	156-174 Mc/s		Storno 62.438
33	L4	62	70-88 Mc/s		Storno 62.459
13	L5	62	156-174 Mc/s		Storno 62.440
33	L5	62	70-88 Mc/s		Storno 62.460
13	L6	62	156-174 Mc/s		Storno 62.438
33	L6	62	70-88 Mc/s		Storno 62.461

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RADIO TELEPHONE CQF13C-14 CQF33C-14

komp. liste X10978

type	* no.	* code	data	product
13	L7	61	9,6 - 10,7 Mc/s	Storno 61.389
		74	C14:153pF(3x51pF) 500V	Stettner Hd 3x12N075/IB
		74	C15: 51pF ±5% 500V	Stettner Hd 3x12N075/IB
33	L7	61	7,37 - 9,38 Mc/s	Storno 61,404
		74	C14: 51pF +5% 500V	Stettner Hd 3x12N075/IB
		74	C15:102pF(2x51pF±5%) 500V	Stettner Hd 3x12N075/IB
		74	C187:27pF ±5% 500V	" Hd 3x12N075/IB
		74	C188:27pF ±5% 500V	" Hd 3x12N075/IB
13	L8	61	9,6 - 10,7 Mc/s	Storno 61,391
		74	C18: 51 pF ±5% 500V	Stettner Hd 3x12N075/IB
		74	C19: 51 pF ±5% 500V	Stettner Hd 3x12N075/IB
33	L8	61	7,37 - 9,37 Mc/s	Storno 61,406
		74	C18:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C19:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C189:27pF ±5% 500V	" Hd 3x12N075/IB
		74	C190:27pF ±5% 500V	" Hd 3x12N075/IB
	L9	61	0,455 Mc/s	Storno 61.451
		74	C23:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C24:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
	L10	61	0,455 Mc/s	Storno 61.450
		74	C28:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C29:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		89	R16: 0,39M ¼ W	Philips B830505B/390K
	L11	61	0,455 Mc/s	Storno 61.451
		74	C33:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C34:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
	L12	61	0,455 Mc/s	Storno 61.450
		74	C36:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C37:102pF(2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		89	R23: 0,39M ¼ W	Philips B830505B/390K
	L13	61	0,455 Mc/s	Storno 61.451
		74	C41:102pF (2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C42:102pF (2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB

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type	* no.	* code	data	product
	L14	61	0,455 Mc/s	Storno 61.451
		74	C45:102pF (2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
		74	C46:102pF (2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
	L15	61	0.455 Mc/s	Storno 61.395
		74	C51:102pF (2x51pF ±5%) 500V	Stettner Hd 3x12N075/IB
	L16	61	0.455 Mc/s	Storno 61.396
		74	C57:340 (2x170pF ±5%) 500V	Stettner Rd 3x30N220/IB
		74	C58: 40pF ±5%	TJ KTN 750
		74	C59:340pF (2x170 ±5%) 500V	Stettner Rd 3x30N220/IB
		74	C60:340pF (2x170pF ±5%) 500V	Stettner Rd 3x30N220/IB
		77	C61: 500 pF 600V	Hunts W99 B820
		99	E1: Silicium diode	Philips OA200
		99	E2: Silicium diode	Philips OA200
		81	R39: 12 kΩ ½ W	Vitrohm SBT
		81	R40: 12 kΩ ½ W	Vitrohm SBT
		81	R41: 56 kΩ ½ W	Vitrohm SBT
		81	R42: 56 kΩ ½ W	Vitrohm SBT
13	L17	62	170 µH	Storno 62.121
13	L18	62	8 µH	Storno 62.448
33	L18	62	8,5 µH	Storno 62.456
13	L19	61	37-41 Mc/s	Storno 61,390
			C101: 27pF ±5% 500V	Stettner Hd 3x12N075/IB
			C102: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
33	L19	61	31,3 - 39,3 Mc/s	Storno 61.405
		74	C101: 27pF ±5% 500V	Stettner Hd 3x12N075/IB
		74	C102: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
		74	C191: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
		74	C192: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
13	L20	62	147-164 Mc/s	Storno 62.439
33	L20	62	62.6 - 78.6 Mc/s	Storno 62.462
13	L21	63	100 µH	Storno 63.007
33	L21	63	0,9 mH	Storno 63.006
13	L22	62	100 µH	Storno 62.099
33	L22	62	0,9 mH	Storno 62.455
13	L23	61	12,6 14,5 Mc/s	Storno 61,419
		74	C135:27pF ±5% 500V	Stettner Hd 3x12N075/IB
		74	C210:27pF ±5% 500V	Stettner Hd 3x12N075/IB

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RADIO TELEPHONE CQF13C-14 CQF33C-14

type	no.	code	data	product
33	L23	61	5,8 - 7,3 Mc/s	Storno 61,430
		74	C135: 27pF ±5% 500V	Stettner Hd 3x12N075/IB
		74	C194:5.6pF ±5% 500V	Keramikon 4116/2
		74	C210: 27pF ±5% 500V	Stettner Hd 3x12N075/IB
		74	C226:5.6pF ±5%	Keramikon 4116/2
13	L24	61	50,6-58 Mc/s	Storno 61.420
		74	C140: 10pF ±5% 500V	Stettner Hd 2x12N075/IB
		74	C141: 10pF ±5% 500V	Stettner Hd 2x12N075/IB
33	L24	61	23,2-29,2 Mc/s	Storno 61,431
		74	C140: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
		74	C141: 10pF ±5% 500V	Stettner Rd 2x12N075/IB
		74	C195:5.6 pF ±5%	Keramikon 4116/2
		74	C196:5.6 pF ±5%	Keramikon 4116/2
	L26	62	0,56 µH	Vitrohm ADS 0,56 uH
13	L27	62	156-174 Mc/s	Storno 62.491
33	L27	62	70-88 Mc/s	Storno 62.492
	L28	62	0,56 µH	Vitrohm ADS 0,56 µH
13	L29	62	156-174 Mc/s	Storno 62.442
33	L29	62	70-88 Mc/s	Storno 62.463
13	L30	62		Storno 62.441
33	L30	62		Storno 62.496
13	L36	62	156-174 Mc/s	Storno 62.494
33	L36	62	70-88 Mc/s	Storno 62.500
13	L37	62	156-174 Mc/s	Storno 62.493
33	L37	62	70-88 Mc/s	Storno 62.495
13	L38	62	ant. coil	Storno 62.513
33	L38	62	ant. coil	Storno 62.521
13	L39	62	ant. coil	Storno 62.524
33	L39	62	ant. coil	Storno 62.522
13	L40	62	ant. coil	Storno 62.510
33	L40	62	ant. coil	Storno 62.514
13	L41	62	ant. coil	Storno 62.509
	Re1	58	A start relay	Siemens Trls 6a TBv 62057/20a/20a
	Re2	58	B key relay tastrelæ	Storno 58007-59
	Re3	58	C key relay tastrelæ (ANT.mike)	Siemens Trls 154d TBv 65418/93e

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RADIO TELEPHONE CQF13C-14 CQF33C-14

komp liste X10978

blad no 10

type	* no.	* code	data	product
	Re5-Re10		see special page for X-tal shift se specielt blad for krystalskift	
220V	S1	92	0,1 Amp.	ETA 500 0,1/H
110V	S1	92	0,2 Amp.	ETA 500 0,2/H
220V	S2	92	0,1 Amp.	ETA 500 0,1/H
110V	S2	92	0,2 Amp.	ETA 500 0,2/H
	T1	60	1-2:10kΩ 25mA 3-4:1,5kΩ 5-6: 3,2 Ω 1 W	JS 5H-7361
	T2	60	600Ω/10kΩ	JS 0,16K-7173
	T4	60	1,5H 0,17A 120Ω	JS 3,15-7254/2
	T5	60	primary: 1/5-2/6:101V 50 c/s 1/5-3/7:110V 50 c/s 1/5-4/8:119V 50 c/s 1-2/5-6: 202V 50 c/s 1-2/5-7: 211V 50 c/s 1-3/5-7: 220V 50 c/s 1-3/5-8: 228V 50 c/s 1-4/5-8: 238V 50 c/s secondary: 9-10-11-12-13:0-166-196-275-310V 0,2A RMS BR 14-15-16:0-45-50V 80mA RMS BR 17-18: 6,3V 5A	JS 80-7843/3
	T6	60	primary: 1/5-2/6:101V 50 c/s 1/5-3/7:110V 50 c/s 1/5-4/8:119V 50 c/s 1-2/5-6: 202V 50 c/s 1-3/5-7: 220V 50 c/s 1-4/5-8: 238V 50 c/s secondary: 9-10: 0-12V 1,2A RMS.Int. 11-12-13: 0-12-13V 1A. RMS. BR.	JS 16 H 9837/2
	V1	99	duotriode	Philips ECC84
	V2	99	duotriode	Philips ECC81
	V3	99	pentode	Philips 5654/M8100
	V4	99	pentode	Philips 5654/M8100
	V5	99	pentode	Philips 5654/M8100
	V6	99	pentode	Philips 5654/M8100
	V7	99	pentode	Philips 5654/M8100
	V8	99	duotriode	Philips ECC83
	V9	99	triode/pentode	Philips ECL80
	V10	99	triode/hexode	Philips ECH81
	V11	99	duotriode	Philips ECC81
	V12	99	triode/hexode	Philips ECH81
	V13	99	pentode	Philips 5654/M8100

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RADIO TELEPHONE CQF13C-14
CQF33C-14

X10978
blad no. 11 af 12

type	* no.	* code	data	product
	V14	99	pentode	Philips 5654/M8100
	V15	99	duotetrode	Philips QQE 03/12
	V16	99	duotetrode	Philips QQE 03/12
	X1-X12		see special pages for X-tal shift se specielle blade for krystalskift	

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RADIO TELEPHONE CQF13C-14
CQF33C-14

komp liste X10978

blad nr 12 af

"See "code numbers and component designations"

type	* no.	* code	data	product
			<u>1 channel/1 kanal</u>	
	C81	78	25 pF trimmer	Philips C005BA/25E
	C88	74	10 pF ±5% TC:-100	Stettner Rd 2x12N075/IB
	C89	74	15 pF ±10% TC:+100	TJ KRP
	C116	78	25 pF trimmer	Philips C005BA/25E
	C123	74	6 pF ±20% TC:-750	TJ KTN 750
	C124	74	27 pF ±5% 500 V	Stettner Hd 3x12N075/IB
	X1R	98	crystal	
	X1T	98	crystal	
			<u>2 channels/2 kanaler</u>	
	C81 C82	78	2 trimmers trimmere 25 pF	Philips C005BA/25E
	C88	74	6 pF ±20% TC:-750	TJ KTN 750
	C89	74	15 pF ±10% TC:+100	TJ KRP
	C116 C117	78	2 trimmers trimmere 25 pF	Philips C005BA/25E
	C123	74	3,3 pF ±20% TC:+100	TJ KTP
	C124	74	20 pF ±5% 500V	Stettner Rd 2x12N0750/IB
	C228 C230	74	3 1 nF 500V	Stettner Sa Ku D4000
	Re5- Re6	58	2 relays relæer	Siemens Trls 154d TBv 65412/93e
33C-13	Re5- Re6	58	2 relays relæer	Siemens Trls 154d TBv 65421/93e
	X1R-X2R	98	2 crystals krystaller	
	X1T-X2T	98	2 crystals krystaller	
			<u>4 channels/4 kanaler</u>	
	C81 C84	78	4 trimmers trimmere 25 pF	Philips C005BA/25E
	C89	74	15 pF ±10% TC:+100	TJ KRP
	C116 C119	78	4 trimmers trimmere 25 pF	Philips C005BA/25E
	C124	74	15 pF ±10% TC:+100	TJ KRP
	C228 -C232	74	5 1 nF 500 V	Stettner Sa Ku D4000
	Re5- Re8	58	4 relays relæer	Siemens Trls 154d TBv 65412/93e
33C-13	Re5- Re8	58	4 relays relæer	Siemens Trls 154d TBv 65421/93e
	X1R- X4R	98	4 crystals krystaller	
	X1T- X4T	98	4 crystals krystaller	

Formular 9100

Storno

udarb af CJ 15.6.60
kontrol af
tilh diagr

X-TAL SHIFT UNIT
for
RADIO TELEPHONE

CQM33C-12
CQM33C-13
CQM33C-14
CQF33C-14

tegning nr. X400.073
blad nr 1 af 2

type	* no.	* code	data	product
			6 channels/6 kanaler	
	C81-C86	78	6 trimmers trimmere 25 pF	Philips C005BA/25E
	C116-C121	78	6 trimmers trimmere 25 pF	Philips C005BA/25E
	C228-C234		7 1 nF 500 V	Stettner Sa Ku D4000
	Re5-Re10	58	6 relays relæer 52 Ω	Siemens Trls 154d TBv 65412/93e
33C-13	Re5-Re10	58	6 relays relæer 700 Ω	Siemens Trls 154d TBv 65421/93e
	X1R-X6R	98	6 crystals krystaller	
	X1T-X6T	98	6 crystals krystaller	

Formular 9100

Storno

udarb af CJ 15.6.60

kontrol af

tilh diagr

X-TAL SHIFT UNIT
for
RADIO TELEPHONE

CQM33C-12
CQM33C-13
CQM33C-14
CQF33C-14

tilhør. bilag X400.073

blad nr 2 af 2

CODE	DESCRIPTION	DATA	PRODUCT	NUMBER	TOTAL PRICE
			brought forward		
58	Relay		Siemens Trls 6a TBv 62057/20a/20a	1	58.00
58	"		Storno 58.007-59	1	51.00
58	"		Siemens Trls 154d TBv 65412/93e	2	44.00
61	Transformer	7,37-9,38 Mc/s	Storno 61.404	1	15.80
61	"	7,37-9,37 Mc/s	Storno 61.406	1	16.55
61	"	0.455 Mc/s	Storno 61.451	1	18.50
61	"	0.455 Mc/s	Storno 61.450	1	18.30
61	"	0.455 Mc/s	Storno 61.395	1	12.20
61	"	0.455 Mc/s	Storno 61.396	1	31.00
61	"	31.3-39.3 Mc/s	Storno 61.405	1	14.20
61	"	5.8-7.3 Mc/s	Storno 61.430	1	14.00
61	"	23.2-29.2 Mc/s	Storno 61.431	1	13.10
72	Condenser, paper	1 nF 400V	Eroid no. Kc210/10(b)	2	1.60
72	" "	10 nF 350V	TCC CP 113N	1	2.40
72	" "	0.1 µF 250V	Eroid no. Kc410/2	1	0.85
73	" electr.	8 µF 25V	TJ EAR 3535 eit	6	8.70
73	" "	4 µF 250V	TJ EAR 3438 eit	2	3.00
73	" "	4 µF 450/500V	TJ EAR 8828 eqit	4	11.20
73	" "	20+20 µF 450V	TJ EAL 6758 E	2	21.20
73	" "	10 µF 50V	TJ EAR 2077 pit	6	10.80
73	" "	25 µF 50V	TJ EAR 3437 eit	2	4,00
73	" "	2000 µF 25V	TJ EAM 2374 e	2	44.00
74	" ceramic	1.2pF ±0.1pF	TJ KCP	2	1.60
74	" "	2 nF 500V	Stettner Dfk DM3 3x16D2500	3	3.30
74	" "	100 pF 500V	Stettner Rd 3x12N750/IB	2	0.70
74	" "	1.5 pF ±20%	TJ KTP	2	0.90
74	" "	1 nF 500V	Stettner Sa Ku D4000	5	2.00
74	" "	51 pF ±5%	Stettner Hd 3x12N075/IB	4	1.60
74	" "	3.3 pF ±20%	TJ KTP	2	1.00
74	" "	68 pF ±10%	TJ KRN 750	2	1.00
74	" "	10 pF ±0.5pF	Stettner Rd 2x12N075/IB	2	0.70
74	" "	6 pF ±20%	TJ KTN 750	2	0.80
74	" "	2.2 nF 350V	Keramikon 4133/1	8	4.00
74	" "	110 pF 500V	Stettner Hd 3x20N075/IB	2	1.00
74	" "	1,8pF ±0.1 pF	TJ KCP	2	1.30
			Carried forward		434.30

REMARKS: Recommended spare parts for 5 units, excluding quartz crystals and control equipment. Prices apply to complete list only and are subject to change without notice.

Storno

Fixed Radiotelephone Equipment CQF33C-14

Non-consumable spare parts 68-88 Mc/s

CODE	DESCRIPTION	DATA	PRODUCT	NUMBER	TOTAL PRICE
			brought forward		
74	Condenser, ceramic	27 pF ±5%	Stettner Hd 3x12N075/IB	2	1.10
74	" "	0.8 pF ±0.1pF	TJ KCP	2	1.60
74	" "	4.7 pF	Keramikon 4110/2	2	1.00
74	" "	5.6 pF ±5%	Keramikon 4116/SK	2	1.00
74	" "	51 pF ±5%	TJ KRO Stand-off 5194	2	12.60
74	" "	25 pF ±5%	TJ KRO Stand-off 5152	2	11.40
76	" polyest.	4.7 nF 400V	Erofol II no. HX247/4	2	1.20
76	" "	0.1 µF 125V	Erofol II HX410/1	2	1.70
76	" "	3 nF 400V	Erofol II HX233/4	2	1.90
76	" "	10 nF 125V	Erofol II HX310/1	2	1.50
77	" metal.	10 nF 150V	Hunts W99 B800	5	2.75
77	" "	3 nF 400V	Hunts W99 B817	4	2.20
77	" "	1 nF 400V	Hunts W99 B819	7	3.50
77	" "	30 nF 200V	Hunts W94 BT15	6	3.90
77	" "	10 nF 400V	Hunts W99 B810	12	7.20
77	" "	500pF 600V	Hunts W99 B820	2	1.00
77	" "	0.1 µF 250V	Hunts W48 A306	2	2.20
78	" variabl.	10 pF	Philips 82081/10E	1	1.50
78	" "	25 pF	Philips 82755/25E	1	2.90
78	" "	10 pF	Philips 82074B/10E	1	10.40
83	Resistors, fixed	2,5+3,5 kΩ 3W	Vitrohm GL	1	0.95
83	" "	470 Ω 2W	Vitrohm BBT	1	0.30
84	" "	5 kΩ 10W	Vitrohm EKA	1	2.20
84	" "	1.2 kΩ 6W	Vitrohm H	1	0.80
86	Potentiometer	0.25 MΩ log.	Preh. 4168	1	3.20
86	"	10 kΩ log.	Preh. 4168	1	3.20
86	"	0.1 MΩ lin.	Preh. 4168	1	3.20
94	Rectifiers	300V 0.2A	Siemens B300 C200	2	68.00
94	"	60V 0.17A	Siemens B60 C160	2	15.50
94	"	30V 0.6A	Siemens B30 C600	2	23.20
					627.40

REMARKS: Recommended spare parts sufficient for up to 5 units, excluding quartz crystals and control equipment. Prices apply to complete list only and are subject to change without notice.

Storno

Fixed Radiotelephone Equipment CQF33C-14

Non-consumable spare parts 68-88 Mc/s

Blanket

CODE	DESCRIPTION	DATA	PRODUCT	NUMBER	TOTAL PRICE
				brought forward	
99	Diodes	Silicium	Philips OA200	4	51.00
99	"	"	Philips OA81	6	31.50
99	Valves	Duotriode	Philips ECC84	3	36.00
99	"	"	Philips ECC81	5	60.00
99	"	"	Philips ECC83	3	36.00
99	"	Pentode	Philips EF95	18	324.00
99	"	Triode/pentode	Philips ECL80	3	36.00
99	"	Triode/hexode	Philips ECH81	5	50.00
99	"	Duotetrode	Philips QQE 03/12	10	300.00
					924.50
		Non-consumable	spare parts (p.1-2)		627.40
			Total kr.		1.551.90

REMARKS: Recommended spare parts sufficient for up to 5 units for a period of 2 years excluding quartz crystals and control equipment.
Prices are subject to change without notice.

Storno

Fixed Radiotelephone Equipment CQF33C-14
Consumable spare parts 68-88 Mc/s