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NOKIA MOBILE PHONES

INTRODUCTION

TMF-1XS

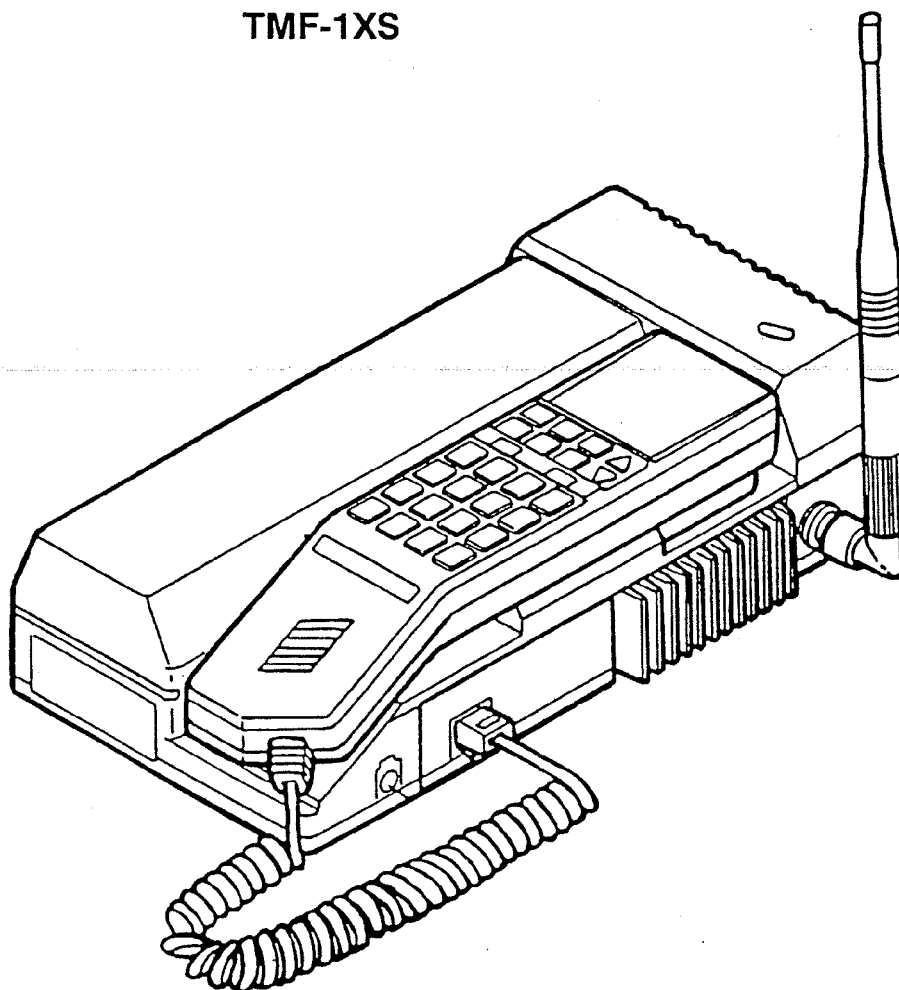
SERVICE

9224ARo

1-1

SERVICE MANUAL

TMF-1XS



NOKIA MOBILE PHONES

INTRODUCTION

TMF-1XS

SERVICE

9224ARo

1-3

CONTENTS

-
1. Introductions
 2. Technical abstract
 3. User's manual
 4. Installation instructions
 5. Local mode
 6. Service instructions
 7. Audio module
 8. Processor module
 9. Synthesizer module
 10. Receiver module
 11. Transmitter module
 12. Duplex filter
 14. Chassis
 15. Handset
 16. Battery pack
 17. Accessories
 18. Spare parts list
 19. Bulletins
 20. Block and circuit diagrams

NOKIA MOBILE PHONES

TECHNICAL ABSTRACT

TMF-1XS

SERVICE

9224ARo

2-5

TECHNICAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Temperature range	-25 °C...+55 °C
-------------------	-----------------

Current consumption	
---------------------	--

- at stand-by	80 mA
- transmitting at maximum power	2.5 A

Number of channels	180 [200]
--------------------	-----------

Duplex separation	10 MHz
-------------------	--------

Channel spacing	25 kHz
-----------------	--------

Frequency stability	
---------------------	--

- AFC off	± 2.5 kHz
- AFC on	± 0.5 kHz

Frequency control	AFC
-------------------	-----

Voice modulation	FM with 6dB/oct pre-emph.
------------------	---------------------------

Comander	2:1
----------	-----

Data modulation	1200 baud FFSK
-----------------	----------------

RECEIVER

Frequency band	463.000...467.475 MHz [462.500...466.975 MHz]
----------------	--

Injection	484.400...488.875 MHz [483.900...488.375 MHz]
-----------	--

Supply voltage	8 V
----------------	-----

Current consumption	Less than 20 mA
---------------------	-----------------

Sensitivity (20dB SINAD)	
--------------------------	--

- normal conditions	-113 dBm
- extreme conditions	-110 dBm

Audio harmonic distortion	< 5 %
---------------------------	-------

RSSI measurement	
------------------	--

- starting point	-115 dBm
- dynamic range	> 60 dB
- resolution	< 2 dB

Adjacent-channel selectivity	> 70 dB
------------------------------	---------

Intermodulation spurious response attenuation	> 67 dB
--	---------

NOKIA MOBILE PHONES

TECHNICAL ABSTRACT

TMF-1XS

SERVICE

9224ARo

2-6

Protection against spurious
response interference > 70 dB

Spurious signals at
antenna connector < -57 dBm,
f = 100 kHz...2000 MHz

TRANSMITTER

Frequency band 453.00...457.475 MHz
[452.500...456.975 MHz]

Supply voltage 10.8...15.6 V

Current consumption at
maximum power level about 2.5 A

Input level 8 dBm ± 2dB

RF output power
- low power 0.125 W (20.9 dBm)
- medium power 1.25 W (30.9 dBm)
- high power 7.0 W (38.4 dBm)

Spurious signals at
antenna connector
f = 100 kHz...2000 MHz < -36 dBm TX-operating,

Modulation distortion at
1 kHz audio, dev = ± 3.0 kHz < 5 %

Maximum deviation < ± 4.7 kHz

Values in [] brackets are used in Polish mode

NOKIA MOBILE PHONES

TECHNICAL ABSTRACT

TMF-1XS

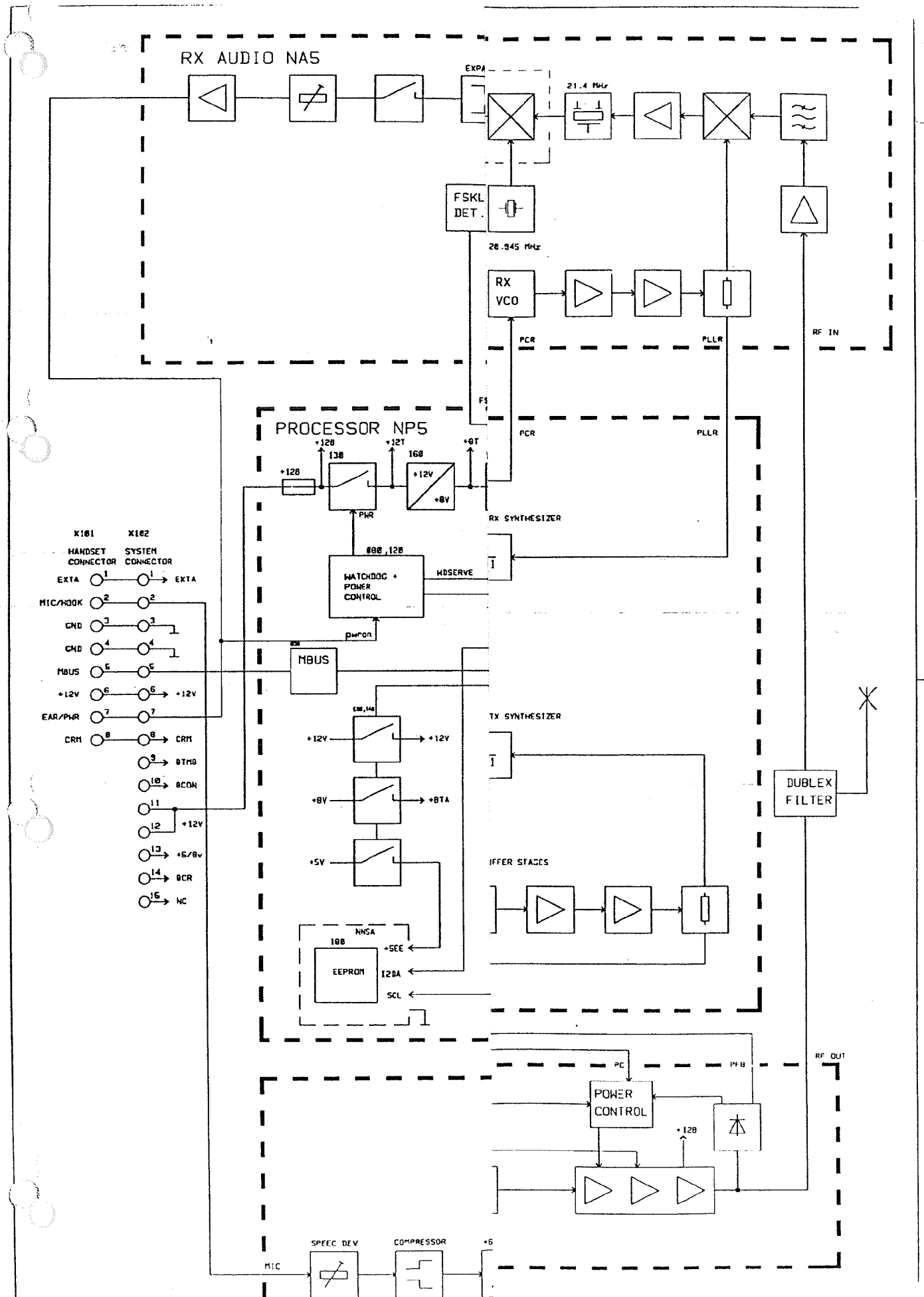
SERVICE

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2-7

MECHANICAL DIMENSIONS

Unit	Dimensions H x W x D (mm)	Weight (g)	Length (m)
Transceiver TMF-1XS	029x115x190	720	
Handset HSF-2	195x50x20	250	
Mounting base MBT-1K	15(41)x121x264	160	
Battery base BBM-2	61x115x232	850	
Spare battery SBM-1	24x47x217	550	
Hands-free cradle	38(57)x60x111	220	
Extension cable XCM-7		270	7
Extension cable XCM-2		90	2
Power cable PCM-66		480	6
Lighter cable LCP-1		95	1.5
Portable antenna	370x16x27		
Data adapter DAM-1		63	0.40
AC-charger ACS-2	95x60x57(85) (socket incl.)	540	2





QUICK GUIDE OF TMF-1XS/HSF-2

Making a Call

1. Switch on with the PWR (on/off) switch.
2. Key in the desired telephone number including the area code
- 3a. Lift the handset and await the answer, or
- 3b. Press the HF key and pick up the handset when the answer is heard in the loudspeaker, or
- 3c. If the handset is off the holder, press the (handset) key.
4. After the call, put the handset back in the holder or press the (handset) key.



Answering a Call

When you hear the ringing tone and see the text CALL flashing on the display; pick up the handset (within 1 minute from the start of ringing).

Storing a Number

1. Key in the desired telephone number including the area code.
2. Key in FCN + STO; the display will show the text STORE*.
3. Key in the number of the desired memory location (1-98) and press OK. The number is now stored in the desired memory location. (The memory location number is shown in the top right-hand corner of the display.)



If you want to store the number in the first available memory location, accept the STORE* display with the OK key.

The memory can be scanned with the NEXT key.



Speed Dialling (Recall from Memory)

Key the number of the memory location and press # or RCL; the number stored at that memory location will be displayed.

Last Number Redial

Key in 0 + # or 0 + RCL

Scratch Pad Memory

To dial a number keyed in during the call key in 0 + 0 + # .

Clearing the Display

Key in # + # or FCN + CLA.

Secondary Key Functions

FCN + 1	Field strength
FCN + 2	Lighting ON/OFF
FCN + 3	Call timers
FCN + 4	Automatic power off
FCN + 5	Key tone volume
FCN + 6	Key tone ON/OFF
FCN + 7	Battery capacity
FCN + 8	Transmitter power in portable use
FCN + 9	Country selection
FCN + *	Locking level setting
FCN + MUTE	Pause character (/)
FCN + #	Transfer call
FCN + STO	Storing in the memory
FCN + PREV	Scanning backward
FCN + LOCK	Locking
FCN + CLA	Clearing the display
FCN + ALPHA	Letter selection

MOBIRA TALKMAN®520 tekniset tiedot

Tuotetyyppi * NMT450-järjestelmän matkapuhelin

Mitat ja paino

	Leveys	Korkeus	Syvyys	Paino
	mm	mm	mm	g
kannettavana	125	70	240	2000

Akku * 1700 mAh NiCd

Käyttöjännite

* 9...30 V (vakiovarusteilla)

Teho * lähetysteho 7,0 W/1,5 W (valittavissa kannettavana)
* autokäytössä tukiaseman ohjaamana

Käyttöaika

- * yhtäjaksoinen puheaika
 - 7 W teholla 35 min
 - 1,5 W teholla 1 h 10 min
- * valmiusaika 14 h
- * 10/90 puhe/valmius (1,5 W) 7 h
- * 10/90 puhe/valmius (7 W) 4 h 20 min

Näyttö

- * 16 merkin aakkosnumeerinen nestekidenäyttö
- * näytön valaistus päälle/pois
- * katselukulman säätö

Näppäimistö

- * 26 näppäintä
- * näppäimistön valaistus päälle/pois
- * näppäinäännet päälle (4 tasoa)/pois

Muisti, pikavalinnat ja lukitus

- * 98 + 2 muistipaikkaa
- * muistin selailu nimen ja muistipaikkanumeron mukaan
- * muistipaikkaryhmien luonti
- * STO/RCL-näppäin muistiin tallentamista ja muistista hakua varten
- * viimeksi valitun numeron toisto
- * numeron muistiinnäppäily puhelun aikana
- * sähköinen lukitus ja soitonrajoitus

Hälytys- ja äänitoiminnot

- * voimistuva soittoääni (6 aloitustasoa), kiinteä taso, äänetön hälytys näytön/näppäimistön valoilla
- * kaksi soittoäänen tyyppiä
- * kuusitasoinen kuulokkeen/kaiuttimen äänenvoimakkuuden säätö
- * mikrofonin mykistys
- * alhaisen akkujännitteen varoitusääni
- * DTMF/MFT-lähetys
- * palvelualueelta poistumisen merkkiääni päälle/pois
- * varoitusäänet päälle/pois

Muita toimintoja

- * puheluajan mittaustoiminnot
- * nollattava puheaikalaskuri
- * eri toimintojen käyttöä opastava palveluvalikko
- * oman numeron näyttö
- * ulkoisen hälyttimen ohjausliitäntä
- * autoradion vaimennus liitäntä
- * suoraan kytkettävissä myös 24 V:n järjestelmiin
- * data-liitäntä
- * puhelinvastaaja liitäntä

Latausvaihtoehdot ja -ajat (20 °C)

- | | |
|----------------------|--------|
| * verkkolaturi ACS-2 | 5 h |
| * verkkolaturi ACL-2 | 90 min |
| * autolaturi LCP-1 | 90 min |
| * autoasennussarja | 90 min |

NOKIA MOBILE PHONES

INSTALLATION INSTRUCTIONS 9224ARo

TMF-1XS

SERVICE

4-1

Introduction

This installation guide has been prepared to give you the basic information necessary to install the TMF-1XS cellular mobile telephone in a vehicle. Read this guide carefully and you will be able to minimize any problems and make the job as easy as possible.

The information in this guide is in no way definitive as different types and models of vehicle will influence exactly how the installation work should be carried out. The information serves only as a guide and is not meant to replace the skill and common sense of an experienced fitter.

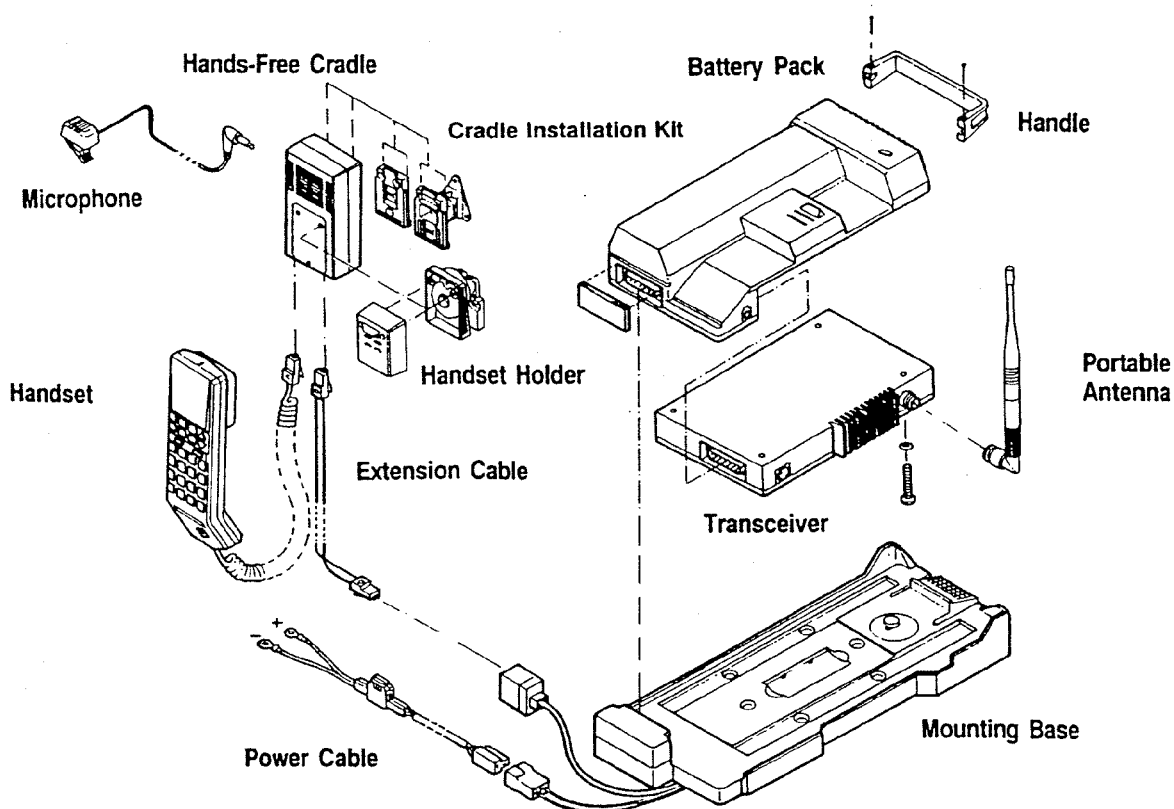
Installation for transportable use

The installation with a MBT-1 mounting bracket makes it possible to use the telephone both in transportable use and in mobile use. The battery pack will be attached the transceiver part with screws and after that it is unnecessary to detach the battery pack from the transceiver part. The transceiver part and the battery pack together makes the telephone transportable radio telephone when an antenna and a handset are added to.

Charging

The battery pack can be charged with a separate charger, recharging cable from cigarette lighter (12 V) or when the battery pack and the transceiver are in a mounting bracket.

TMF-1 transportable/mobile installation



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SERVICE**

**INSTALLATION
INSTRUCTIONS
9224ARo**

**TMF-1XS
4-2**

Preliminary work

Unpack the installation kit and check that all parts and installation fittings are included. Installation screws and fittings are supplied and they are listed later.

Tools

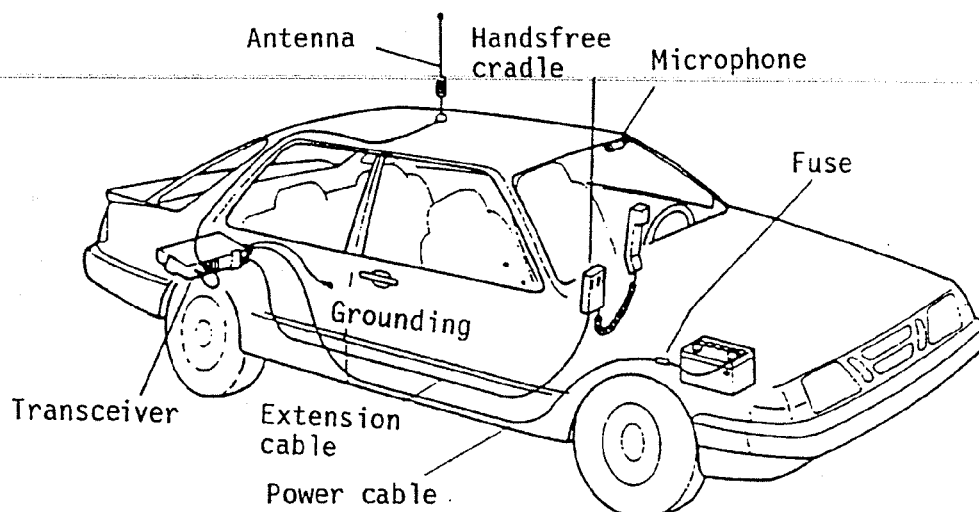
To make the installation easier and to ensure the best possible results, it is important that the right tool is used for the right job. Below is a suggested list of tools that you will require:

- Phillips, posidrive and blade-type screwdrivers
- Electric drill
- Adjustable wrench
- Drills according to the sizes listed later
- Sheet metal punch or hole cutter (for mounting the antenna and enlarging holes)

Work routine

The first step is to select suitable mounting positions for the different units and the antenna and convenient routes for the cables. The customer may have particular wishes as to the positions of the handset and antenna and these should be taken into account. If, however suggested, the disadvantages of such possibilities should be pointed out to the customer and alternative positions suggested.

Units installed in a vehicle



Before starting the actual installation work, we advise you to place protective covers on the seats, and on the floor if the vehicle is new, so that the interior of the vehicle does not become soiled when you are working in the vehicle.

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INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-3

Drilling holes

Here are a few suggestions on how to drill and enlarge holes:

- Make sure you know what you are drilling into and that the intended place can support the unit
- When you drill a hole make sure that you don't inadvertently drill into something else such as electric cables, hydraulic hoses or fuel tanks. Always check before drilling. Remember even cars of the same type and make, may have cables and hoses in slightly different positions. Just because you have drilled a hole there once before does not mean that it can always be drilled there.
- Remove the swarf when you have drilled a hole, particularly if it is metal, as it can cause rusting
- If you drill the hole in the roof for the antenna you may have to use different conical drills to enlarge the hole. It is important to remove swarf, as rusting swarf can discolor the roof lining. If it is difficult to remove swarf, try placing a ring-shaped magnet round the hole when drilling. This will stop the swarf from dropping into the vehicle.
- If you are worried that the drill might "skid" when drilling into curved body surfaces, place a couple of pieces of masking tape over the drilling position. These will help to hold the drill in position until it bites into the metal.
- Always seal holes with a rust-proofing compound after they have been drilled or enlarged and before the component is fitted.
- When drilling, particularly with large drills, be careful not to drill too quickly or push too hard and overheat metal. Overheating can cause the paint to "bubble", which may subsequently lead to rusting.

NOKIA MOBILE PHONES

INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-4

Mounting base

Positioning

The mounting base MBT-1 can be installed in any suitable position.
Different makes of car require different installation locations.

Wherever you install the mounting base make sure that there is enough room to place the transceiver without hindrance. Never install the transceiver in a engine compartment or in any place that is excessively dusty or damp. Also do not install it where it is likely to be kicked or trodden on, or where it will interfere with the operation of the vehicle.

If it is inconvenient to install the transceiver in the boot or if the vehicle doesn't have one, such as with estate cars, other possible locations are:

- under one of the seats
- behind the rear seat
- in the spare-wheel compartment or any other storage space

The transceiver when installed in the mounting base should be in such a position that the cables and connectors cannot be damaged by luggage or other objects carried or placed in a vehicle.

Further make sure that there are suitable routes for the antenna cable, power cable and the extension cable and that the connectors and plugs can be attached and removed easily. Also avoid running these next to other cables in the vehicle, particularly those of anti-skid braking systems.

Do not install the transceiver near to the vehicle's radio or any other such equipment, because transmitting signals from the mobile phone may cause interference.

NOKIA MOBILE PHONES

INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-5

Installation

Use the mounting base as a template to mark positions of the fixing holes. Spacers are supplied to enable the mounting base to be levelled if attached on an uneven surface. The large washers are used if there are existing holes which are too large.

When you have drilled the holes position the mounting base, insert the screws and securely tighten them.

Installation for transportable use

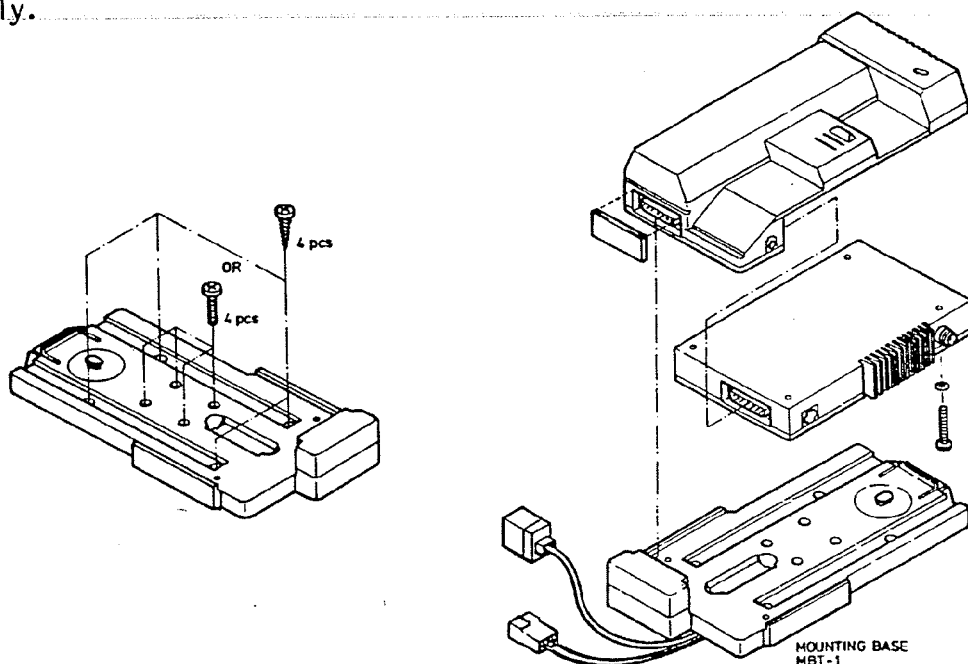
Installation with the MBT-1 mounting bracket makes it possible to use the telephone both as a transportable and as a mobile. The battery pack will be attached to the transceiver part with screws. After this it is unnecessary to detach the battery pack from the transceiver part. The transceiver part and the battery pack together make the telephone into a transportable radio telephone when an antenna and handset are added.

Charging

The battery pack can be charged with a separate charger, using the recharging cable from the cigarette lighter (12 V/24 V) socket or with the battery pack and the transceiver on the mounting bracket.

Inserting the transceiver and the battery pack into the mounting base

Make sure that the battery pack is connected to the transceiver. Engage the small stud on the mounting base into the key slot in the base of the transceiver. Slide the transceiver and battery pack until the connector on the transceiver engages with the connector on the battery pack. A click will indicate that transceiver has been inserted correctly.



Installation of the MBT-1 mounting base

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INSTALLATION INSTRUCTIONS 9224ARo

TMF-1XS

SERVICE

4-6

Hands-free cradle and handset holder

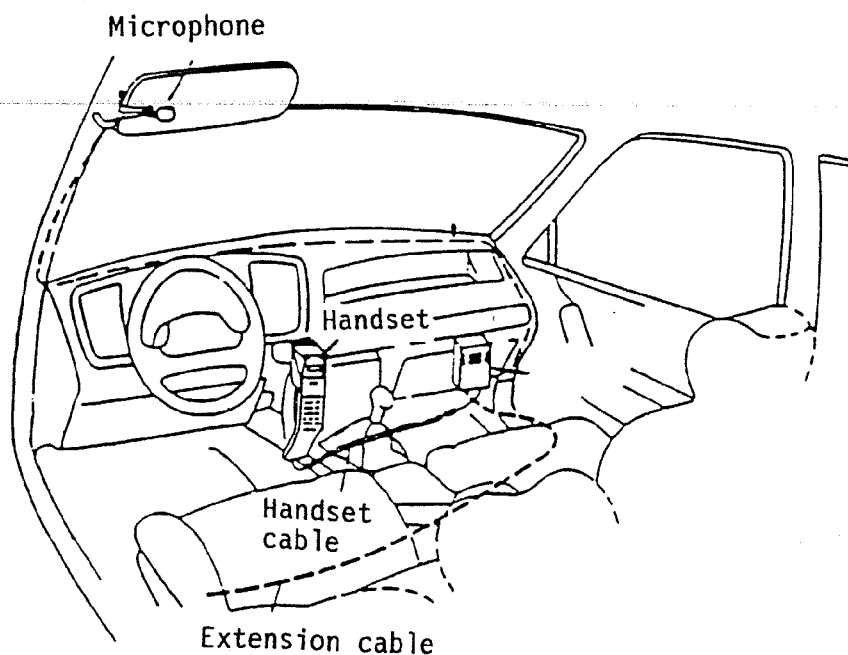
Positioning

The microphone should be positioned not more than 40 cm from the user's mouth and more than 1 meter from the speaker located in the hands-free cradle HFN-1. The microphone can be clipped on to the sunvisor. The hands-free cradle can probably be installed under the dashboard. See next figure.

The handset holder should be positioned so that the handset can be easily reached by the person who is going to use it, usually the driver. The dash is probably the most convenient position, but the vehicle transmission hump is also a good place, particularly if rear-seat passengers need to use the phone. Don't install the handset near the outlet of the heater. Neither the handset nor its spiral cord should be allowed to obscure or obstruct the vehicle's controls nor interface with the safe driving of the vehicle. It should be installed in a fairly prominent position so that the driver's attention is not diverted from the road when using it and so that the display and controls are visible in different light conditions.

It may be difficult to satisfy all the above criteria but above all, common sense should prevail. Select the best position to obtain the optimum viewing angle so that the display digits can be clearly seen from where the user is seated.

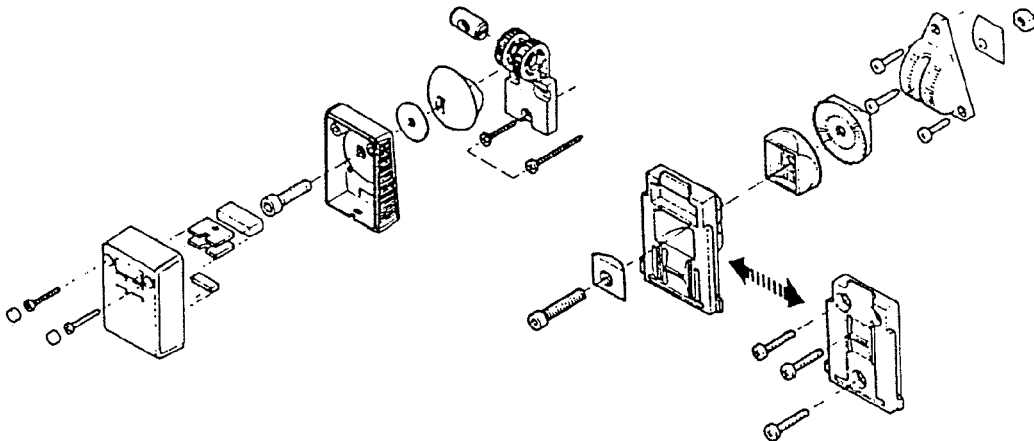
Example of equipment positioning



Installation

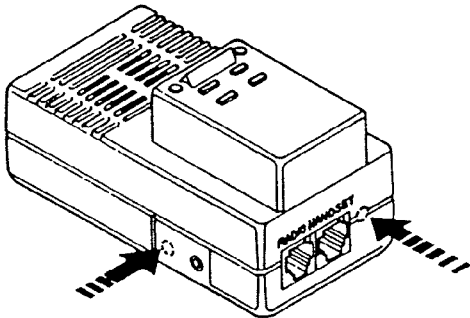
Every HFN-1 package includes both swivel and hinge joints with all installation parts. Selection between two assemblies is done according to the vehicle.

Installation alternatives for the handset holder

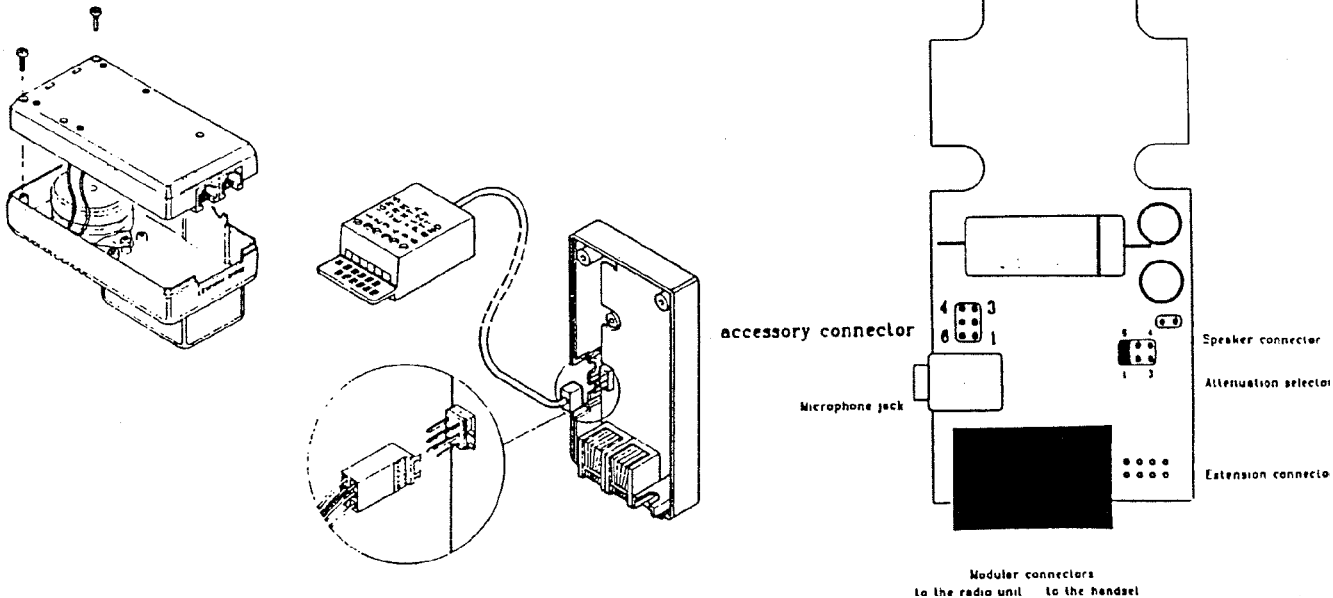


Routing the accessory cable

Inserting alternatives for the AXM-3



Disassembling the HFN-1 and routing the AXM-3



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INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

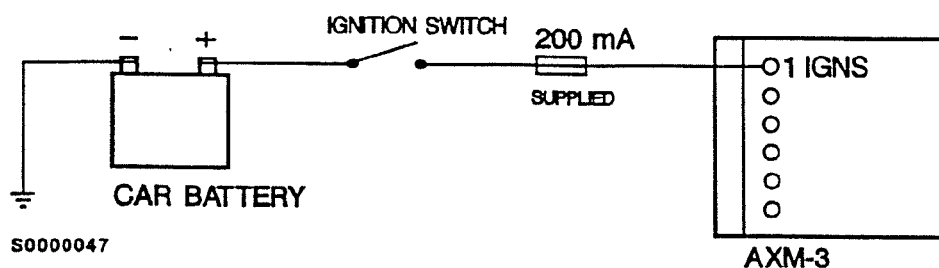
4-8

Installing the accessories

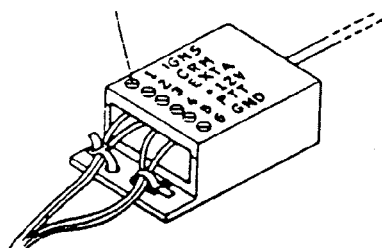
Ignition sense

A fused cable from the car ignition switch is connected to pin 1 of the connector on AXM-3.

Wiring of ignition sense



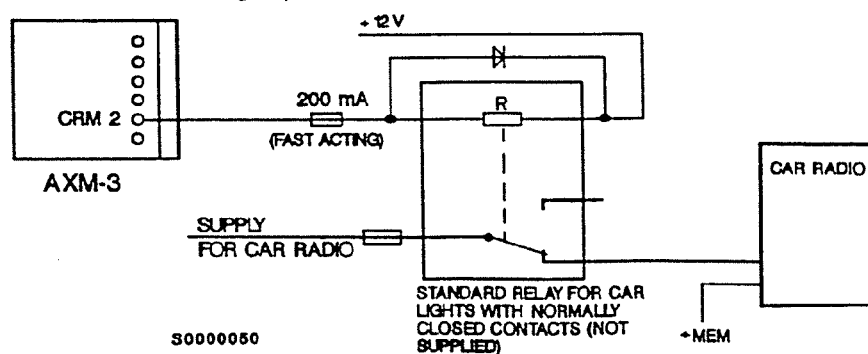
Run cable ties through the holes (see the next figure) and tighten the cable for proper fixing.



Car radio muting

The CRM control signal is taken from pin 2 of the AXM-3 connector. Supply voltage for the muting relay is obtained either from the ignition current wire or from pin 4 of the AXM-3 connector.

Wiring of CRM muting option



Note!

Failure to use the correct fuse can result in damage to the radio unit if the relay is accidentally by-passed.

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INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

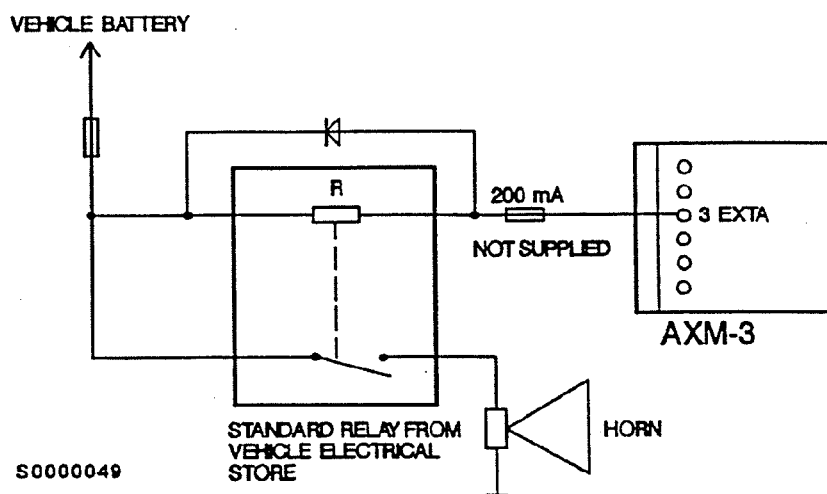
4-9

External alert

The EXTA control signal is taken from pin 3 of the AXM-3 connector. Supply voltage for the relay should be taken from the ignition current wire.

Note! Failure to use the correct fuse can result in damage to the radio unit if the relay is accidentally by-passed.

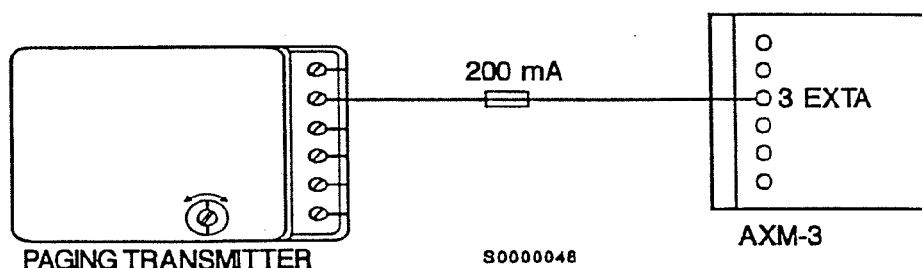
Alert coupling



Note! It is illegal to use an external alert in a vehicle whilst on a public road.

The EXTA-line could also be used to drive a pocket pager. In this case pin 3 of the AXM-3 is connected to the triggering input of the paging transmitter.

Pocket pager coupling



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INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

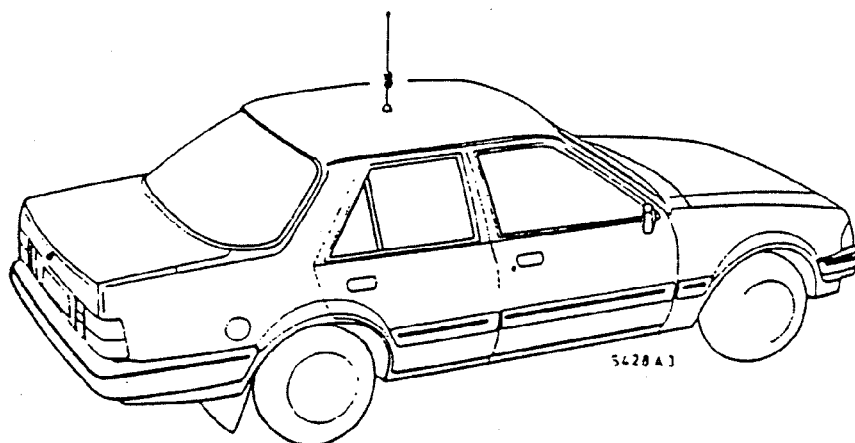
4-10

Antenna

Positioning

The correct installation of the antenna is very important. The antenna should be at least one meter away from other antennas mounted on the vehicle. The best position to mount the antenna is in the center of the roof. This position gives the highest transmitting power, reception sensitivity and the most even radiation pattern.

Antenna in the center of the roof.



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INSTALLATION
INSTRUCTIONS
9224ARo

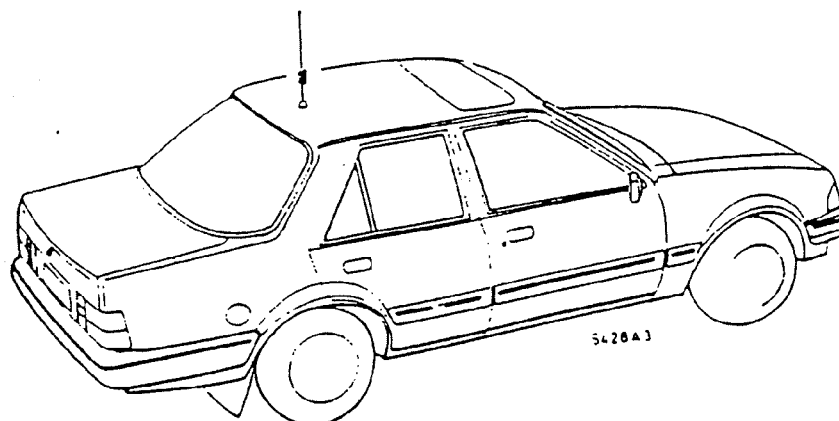
TMF-1XS

SERVICE

4-11

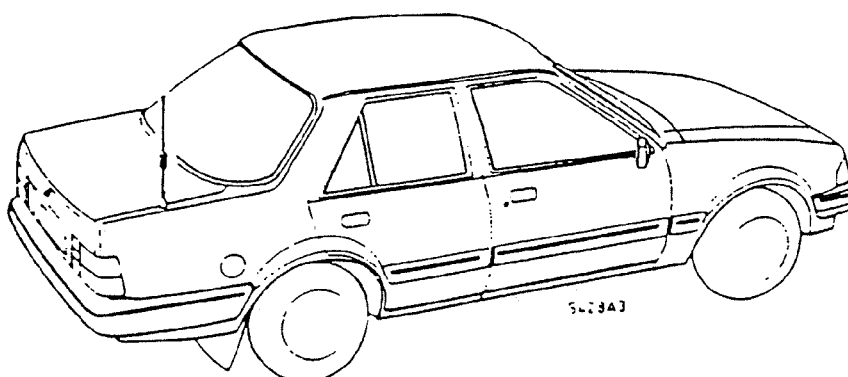
Although roof space on vehicles with sunroofs may be limited, it is still worth installing the antenna on the roof, as long as the radius of the ground plane is not less than 10 cm.

Antenna in the rear of the proof



Mounting the antenna on one of the car's rear wing gives a less effective radiation pattern but is still a very common location. The radiation pattern will be uneven and the communication quality of the mobile telephone will be more dependent on the orientation of the vehicle with respect to the base station. When the antenna is installed on one of the rear wings, it should not be mounted in the corner between the boot lid and the rear window. For best results, it should be located halfway along the wing.

Antenna installed on the rear wing



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INSTALLATION INSTRUCTIONS 9224ARo

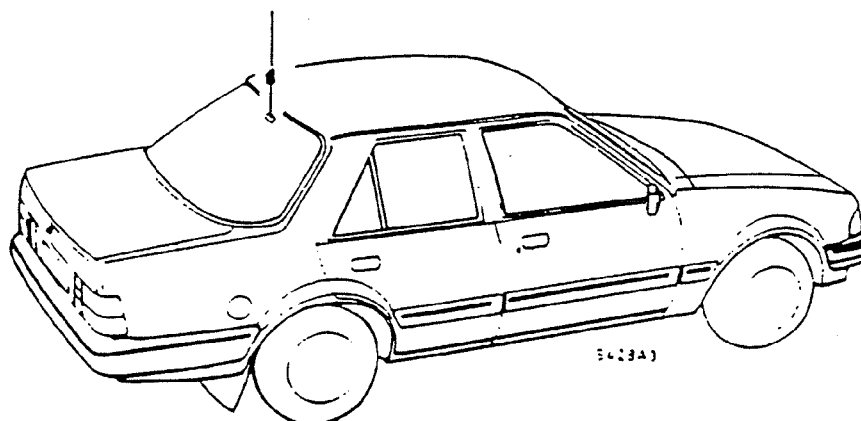
TMF-1XS

SERVICE

4-12

If drilling a hole is not desired for the antenna, a glass-mounted antenna can be used. Recommended position of the antenna is shown in the next figure. On deciding the exact position, make sure that the opening of the boot lid can be done without hindrance. The antenna is fixed to the glass with adhesive. Fixing should be done in a warm and dry place. For more information, refer to the service leaflet included in the antenna package.

Antenna installed on the rear-window



Installing

a) The radio equipment should be connected to the antenna via non-radiating cable (e.g. coax).

b) The antenna should be mounted in such a position that no part of the human body will normally rest within 20 cm of any part of the antenna for more than a few minutes while the equipment is switched on, unless there is an intervening metallic screen at least 0.3 m² in area (e.g. a metallic roof).

There are several types of antenna available:

- * Glass mount - Attached to the window using special adhesive. Be careful not to mount it over defroster wires.
- * Permanent mount - Mounted permanently to the vehicle, normally on the roof or one of the rear wings
- * Magnet mount - Mounted on the roof

To install the antenna the separate instruction supplied with particular antenna should be followed. The information given in "Cable Routing" also applies to the routing of the antenna cable. It is also particularly important that the antenna cable is not allowed to become kinked; if it does, the performance may suffer.

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INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-13

Cable routing

The following cables must be installed; extension cable, power cable and antenna cable.

Power cable

The red power cable is connected to the positive terminal on the vehicle battery and the other one is connected to the negative terminal. Don't connect any other equipment to the power cable. Remove the fuse from the holder on the red wire before you start the installation work and do not replace it until the job is finished.

24 V system

In some countries there must be a master switch in certain types of vehicles. Never pass the switch.

Grounding

The short black wire must be grounded to the frame of the car. This wire must be connected directly to the metal frame.

If the grounding place is one of the screws in the car, make sure that it is connected to the metal frame of the car nor to the plastic or fiberglass parts. Remove the paint or other cover from the grounding point to guarantee as good contact as possible and make sure that the screw is well tightened. Protect the area after connecting to prevent rusting.

Extension cable

The extension cable is routed to the front of the vehicle, figure 3. The actual cable routes depend very much on the vehicle in which the equipment is being installed and where the existing wiring channels are. It is also easy to route cables under carpets or behind panels. There are usually holes in the firewall and other dividing panels so it should not be difficult to route the cables through the vehicle. If there are no holes you may have to drill some or if the holes are too small enlarge them.

Additional routing tips:

- Route the cable away from other electronic equipment in the vehicle, e.g. anti-skid braking, electronic fuel injection etc.
- Avoid running the cable next to other cables in the vehicle. This will minimize any induced interference
- Do not run the cables over sharp metal edges or along the edges of doors where they may be cut or pinched
- Do not run cables over engine parts that become hot and may cause the cable insulation to melt

NOKIA MOBILE PHONES

INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-14

-
- Avoid running cables under the center of carpets where people place their feet. Constant foot pressure and scuffing will eventually damage the cable
 - If the cables are routed under the carpets make sure that the carpets are correctly put back and fixed in place so that they cannot be accidentally kicked up
 - When routing cables through holes with sharp edges use grommets or plastic sleeves to protect the cable from damage

Warning!

Do not use a fuse with a rating other than that of the supplied fuse. Any damage caused by using improvised power cables or fuses will not be covered by the warranty.

Testing

It is important to make sure that the cellular phone operates satisfactorily. Make sure that the handset holder is adjusted correctly so that the display digits can be clearly seen when the user is seated in the vehicle.

Test calls should be made when the vehicle is stationary with the engine running and then switched off.

Customer instruction

When the above has been completed, the most important task remains; instructing the customer in the proper use of equipment. This will save the customer and you from many needless problems. Simple demonstrations are enough; how to insert and remove the telephone, how to use the unit in the hands-free mode, how to make a call, and how to use the short code memory.

NOKIA MOBILE PHONES

INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-15

Fault finding

Symptom	Check list
Power can not be switched on	Power cables and fuses
The fuse blows after the power has been switched on. Power will be turned off immediately.	Is the polarity of the power cables correct? Has the subscriber number been programmed?
SERV indicator is all the time off	Is the antenna OK? Is antenna cable OK?
SERV and ROAM indicators are on simultaneously	Has the number been updated to MTX in case of the new number? Is transmitter power OK?
Power will be switched off during a call	Are the power cable connectors in good condition?
Alternator noise can be heard during a call	Install the supply voltage filter
Cracking sound is heard during a call when the car is moving	Are all the groundings in good condition?
Reflected power is too high (> 5 W)	Is the type of the antenna correct?
Text HIGH POWER or LOW POWER is displayed after turning the device on	Has the power cables and the fuse been connected?

NOKIA MOBILE PHONES

INSTALLATION
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

4-16

INSTALLATION KIT KTM-1, PARTS LIST

ITEM	Q'TY	CODE	DESCRIPTION	TYPE, DATA
8		6150725	Ch.hd.screw	M4x16 PZ 5.8
4		6151084	Ch.hd.screw	M4x25 PZ 5.8
4		6270331	Tapping screw	BZ 3.5x9.5 DIN 7981 PZ
4		6270395	Tapping screw	BZ 3.5x19 DIN 7981 PZ
4		6291860	Screw	M4x8 PZ bright
4		6310489	Nut	M4
4		6340412	Washer	5.1/16.2x1.5
4		6350241	Locking washer	A 4.3/8 S=0.5
5		6400929	Cable tie	28mmx2.4 mm blk
1		2643038	Washer	4.3/9
8		9137176	Packing piece	
4		9302976	Installation foot	

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-1

GENERAL INSTRUCTIONS

The LOCAL mode commands can be given only by means of special service handset SHN-2T. Limited set of commands like programming the subscriber identification data can be executed with installation handset SHN-2N.

The local mode operation is activated when command 99# has been given from the service or the installation handset.

The commands can be interrupted entering <FCN><CLR> or giving command 99#.

The command <FCN><CLR> will switch

- TX- power off
- RX- and TX- audio off
- handset audio gates to last used values

CHANNEL SETTINGS

Free choice

The used channel can be selected freely in the local mode. The number of the desired channel is given using four digits and pressing <*> button. The selected channel will be shown on the display together with RX-frequency of the transceiver.

Preset channels

0 # lowest channel

1 # middle channel

2 # highest channel

TEST COMMANDS

With these commands (two digits and # or *) the output signals can be set to modes needed in test and adjusting procedures.

All compensations are activated.

10 # transmitter low power

-transmitter on, level 0

11 # transmitter medium power

-transmitter on, level 1

12 # transmitter high power

-transmitter on, level 2

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-2

13 # sensitivity measurement transmitter on

- transmitter on
- receiver on
- RX- and TX-audio on
- last used power level
- last used channel

14 # receiver path on, transmitter off

- receiver on
- RX-audio on
- transmitter off

15 # audio deviation measurement

- transmitter on
- TX-audio on
- RX-audio off
- last used channel

16 # SAT-deviation adjustment

- receiver on
- transmitter on
- SAT-signal path on
- RX-audio on
- TX-audio on

17 # duplex mode

- receiver and transmitter on
- RX-and TX-audio on
- SAT-signal path on

18 # AFC off

- sets VCTCX0 to the middle of its range
- disables the AFC function

SWITCH CONTROLS

- (#) will activate the function
- (*) will deactivate the function

20 # switches AFC on

21 # enables external HF-speaker

22 # enables external HF-microphone

23 # enables handset HF-speaker

24 # enables handset HF-microphone

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-3

25 # enables handset earphone

26 # enables handset microphone

27 # enables service handset earphone

28 # enables service handset microphone

29 # enables service handset speaker

30 # enables RSSI temperature compensation

31 # enables deviation correction

32 # enables SAT-signal temperature compensation

33 # enables transmitter power level correction

34 # switches compander on

35 # enables car radio muting

36 # enables external alarm

37 # all corrections on

38 # key click of the service handset on

Audio output selection table

DEVICE	MIC	LSP	ERP
HANDSET	26	--	25
HS-HF	24	23	--
SERVICE	28	29	27
EXTR-HF	22	21	--

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-4

FAULT FINDING

40 # reading the state of digital input

The bit can be read as follows:

UUAACC<OK> where UU=unit number, AA=port, CC=bit number

Unit number of the transceiver is 00. Unit number of the connected device can be read with command 43#.

Port number is given according to the following table:

AA	TMF-1	HSF-2
00	-	PA
01	PA	PB
02	PC	HSIC R0
04	LFU reg 0	HSIC R1
05	LFU reg 1	HSIC R2
06	LFU reg 2	HSIC R3
07	LFU reg 3	
08	MODEM	

41 # setting the digital output

UUAACCB<OK> , where B is state of bit
Value of AA is read from the table above.

43 # displays the unit number of a device connected to radio unit

Only one device can be connected to the radio unit while reading.

47 # displays A/D-converter values (scale 0 - 4095)

- enter 47#
- enter UUCC<OK>, where UU=unit number and CC=channel

Channnel	Name	Function
00	FSKL	FFSK level
01	BCR	Charging current
02	BTMB	Battery temperature
03	RSSI	Received signal strength
04	PFB	TX power level
05	BATC	Supply voltage
06	TEMP	Temperature control
07	NC	NC
08		Charging capacity of the battery
09		Average capacity of the battery
10		Reference current

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-5

48 # displays D/A converter values (0 - 4095)

- enter 48#
- enter UUC<OK>

Channel	Name	Function
00	PC	TX power control
01	BCON	Charging control
02	AFC	AFC control

In addition it is possible to read the following parameters:

09 Default battery capacity (mAh), reading and changing

DATA TRANSMISSION

50 # continuous transmission of "1" frequency (1200 Hz)

51 # continuous transmission of "0" frequency (1800 Hz)

52 # continuous transmission of the frame 13a (L = 14)

53 # continuous idle frame transmission (data = 0000 ...)

54 # continuous transmission of the desired frame

Key in the frame as follows:

N ₁ N ₂ N ₃	P(x)	Z	X ₁ X ₂ X ₃ X ₄ X ₅ X ₆	J ₁ J ₂ J ₃ J ₄ J ₅
--	------	---	---	--

The meaning of the symbols is explained in part: Data reception

- <OK>activates transmission
- Alphanumeric symbols can be used in alpha mode

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-6

TESTS

60 # data reception

- 60 # activates signalling frame receiving
- Received data will be displayed
- If the modem has not received data for 2 seconds,
"-----" will be displayed
- The frame includes the following information:
 - N_1 channel number including power level information
 - N_2 channel number
 - N_3 channel number
 - $P(x)$ prefix (C=calling channel, 3=traffic channel,
4=combined channel)
 - Z country code of the subscriber
 - $X_1 - X_6$ subscriber number
 - $J_1 - J_3$ information field

62 # DTMF-tone test

- entering 62# clears the display and you can test the DTMF-signals
- pressing buttons (0-9,*,#) generates corresponding DTMF-tone to the speaker

	1209	1336	1477
679	1	2	3
770	4	5	6
852	7	8	9
941	*	0	#

- <FCN><CLR> disables DTMF testing and returns the control to command level

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-7

63 # display self test

parameter	function
1	show all segments
2	show even segments
0	clears display

64 # handset LIVE test on

64 * handset LIVE test off

65 # handset SW-version number

66 # radio unit SW-version number

70 # EEPROM clear

- the subscriber data of the EEPROM will be erased.
- tuning values will stay.

71 # delivery date

- also the code number of the programmer will be automatically stored.

DDMMYY

DD = date

MM = month

YY = year

<OK>

72 # subscriber number

- also the code number of the programmer will be automatically stored.

ZX₁X₂X₃X₄X₅X₆K₁K₂K₃

<OK>

Z = country code

X₁-X₆ = subscriber numberK₁-K₃ = password

73 # personal locking code

L₄L₃L₂L₁

<OK>

74 # channel area

lowest channel XXXX*1 (=0001)

<NEXT>

highest channel XXXX*2 (=0384)

<OK>

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-8

71 * checking of the delivery date + dealer code

72 * checking of the subscriber number

73 * checking of the locking code

74 * checking of the channel area

TUNING COMMANDS

75 # RSSI levels

76 # limits of the battery pack voltages

78 # FFSK level detector

79 # tuning of the transmitter output power

80 # channel relating deviation adjustment

81 # temperature limits

83 # temperature compensation of SAT signal

90 # NMT mode

-after the command telephone goes to NMT mode
-see command 99#

95 # Serial number programming

97 # BURN-IN on

-after burn in command has been given and phone is switched
off and on again the phone will have following status:
-channel 90
-high power transmission
-receiver on
-audio paths open

97 * BURN-IN off

-deactivates the BURN-IN mode

98 # RAM clear

-the command will clear RAM.
-power will be switched off after the command has been
executed.

99 # init for test

-the phone goes to LOCAL mode if the service handset has
been connected.
-Only command that can be used after 90#.

NOKIA MOBILE PHONES

LOCAL MODE

TMF-1XS

SERVICE

9224ARo

5-9

SIS LOCALS

48 # READ/SET D/A CONVERTER

- key in 48 # -> the display is cleared

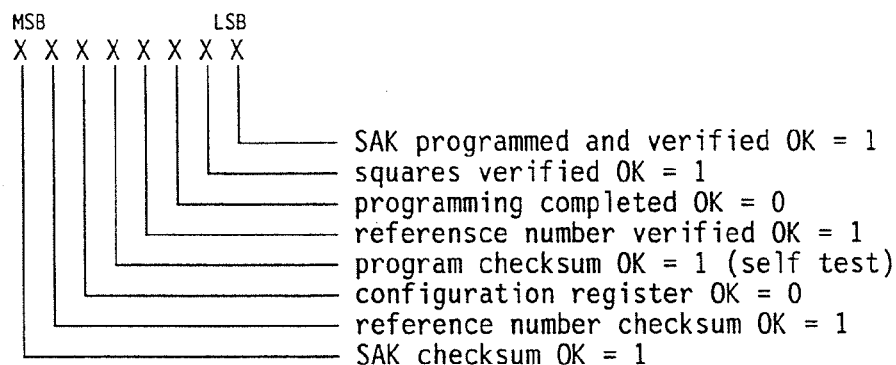
- enter:

UUCC <OK> where UU = unit number (= 00)
CC = converter channel

1. Channel 11, SIS circuit self test

The display will show the status data of the SIS circuit in hex format

(1 byte = 2 digits):



Correct status of the programmed circuit is DB.

2. Channel 12, setting test SAK

- the display shows 'TEST'; to go to NMT mode, enter command 90 # or switch off power
- the mobile now calculates SRES value by means of test SAK
- the test SAK is reset by executing command 99 #

3. Channel 13, recalculation of squares

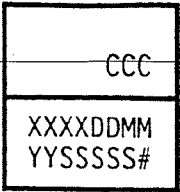
- 'OK' displayed if the calculation was successful, otherwise 00000

Key in FCN CLR to escape from command.

Reading the reference number with normal handset

NOKIA MOBILE PHONES	LOCAL MODE	TMF-1XS
SERVICE	9224ARo	5-10

After start, the reference number resides in memory location 00 as follows:



- CCC = checksum in decimal mode
- XXXX = manufacturer code
- DD = programming day
- MM = programming month
- YY = programming year
- SSSSS = serial number

The lower display will stay on view; the upper can be viewed by keeping key FCN depressed.

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-1

TUNING INSTRUCTIONS OF TMF-1

Measuring equipment list

- Adjustable power supply 0-20 V; 10 A
- Service handset SNH-2T
- DVM
- Radio telephone test set
 - Frequency counter (± 1 ppm accuracy)
 - RF-generator
 - Modulation analyzer
 - RF-attenuator
 - AF-generator
 - Power meter
 - Combiner
 - SINAD-meter

Preliminary steps

Connect the service handset and power supply (13.2V) to the radio unit. If the maximum input power to the measuring equipment is less than 20W use a suitable attenuator.

After switching power to the service handset display shows INIT FOR TEST. Press <OK> to enter the local mode. Local mode is activated also by command 99#.

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-2

TUNING INSTRUCTIONS

1. SYNTHESIZER

VCTCX0 frequency

- Connect frequency counter to the radio unit
- Select channel 0080 by keying (1#) (frx = 464.975 MHz)
- Switch the AFC off (20#)
- Set AFC to the middle of its range (18#)
- Switch the transmitter on (10#)
- Tune TX- frequency to 454.9750 Hz with G500

AFC limits

- Feed the following signal to the antenna connector of the radio unit
 - frx = 464.975 MHz, 2.5 kHz increment
 - level = -53 dBm
- Switch on the AFC tuning (77#)
- Lock the counter reading with <OK>
- Store it by pressing <OK> again (index 000)
- Decrease the frequency of the RF-generator by 2.5 kHz
- Lock the counter reading with <OK>
- Store it by pressing <OK> again (index 001)
- Increase the frequency of the RF-generator by 5.0 kHz
- Lock the counter reading with <OK>
- Store it by pressing <OK> again (index 002)
- Turn the AFC on (20#) and check the operation of the AFC (± 2.5 kHz)

Table 1: Nominal values for AFC tuning

Index	Frequency	Parameter
000	464.975 MHz	from measuring device
001	-2.5 kHz	017
002	+2.5 kHz	049

Synthesizer deviation

- Connect deviation meter to the antenna connector and feed 1 kHz signal 100 mVrms to MIC-line (X101/2)
- Open the audio path and switch the transmitter on, (15#)
- Adjust the level of the AF input signal so that voltage at SMOD-line (X501/41) is 415 mVrms
- Tune deviation to ± 2.4 kHz with potentiometer R601 on the synthesizer module
- <FNC> <CLR>

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-3

2. TRANSMITTER

Transmitter power levels (79#)

After the command 79# has been executed the display of the service handset will show index number, old value from EEPROM and new value used by D/A converter. The output power of the transmitter is read from the power meter. The D/A value can be changed keying new value by means of the keypad. The D/A value can be increased or decreased with <+> or <-> buttons respectively. <OK> button is pressed once to store the adjustment result to EEPROM.

Table 2: Transmitter power levels.

Index	Channel TMF-1XS	Power	Parameter
000		125 mW	0050
001		1.25 W	0450
002		7 W	1560
003		7 W	1550
004		7 W	1540
005		7 W	1540
006		7 W	1512

- Switch the transmitter on, (10#)
- Go to the programming mode, (79#)
- Feed the first parameter, e.g. 0050
- Adjust the power to 100 mW with +/- buttons
- Press <OK> to store the DAC-reading to the EEPROM
- If the parameter needs not to be changed press <NEXT> to skip to the next index.
- <FNC> <CLR>

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-4

3. RECEIVER

Checking

- Connect a SINAD-meter to the EAR-line (X101/7) of system connector.
- Set the RF-generator as follows:
 - Frx = 464.975 MHz
 - level = -53 dBm
 - fm = 1 kHz
 - dev = ± 3.0 kHz
- Open the audio path, (14#)
- Set the AFC in the middle position, (18#)
- Check that the SINAD-reading is at least 30 dB (without a psfometric filter)
- Tune the EAR- line level to 160 mVrms with potentiometer R724
- The SINAD value should stay over 20 dB when RF signal level is decreased to -113 dBm. Psfometric filter is used.
- Set the transceiver to the lowest channel, (0181*)
Frx = 462.500 MHz
- Check the distortion and the sensitivity
- Set the transceiver to the highest channel, (0180*)
Frx = 466.975 MHz
- Check the distortion and the sensitivity

Tunings

If the sensitivity is too low the tuning is performed according following instructions:

Connect a RF-signal to the antenna connector.

- Frx = 464.975 MHz
- level = -53 dBm
- fm = 1 kHz
- dev = ± 3.0 kHz

Connect SINAD-meter to the DAF-line (X705/2) and the digital volt meter to the RSSI-line (X705/3).

Set the AFC in middle position, 18# and select channel 0080, 1#

Tune the SINAD to maximum value at first by L707 and then by C716 and L706.

Tune the RSSI-level to maximum value by L701.

Repeat the tunings so that maximum performance will be obtained.

Adjust the DAF-level to 120 mVrms with trimmer R724.

Check that RSSI-level doesn't change more than 0.1 VDC in the following channels:

- (channel 0181*, 462.500 MHz)
- channel 0180#, 466.975 MHz.

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-5

DAC level of the RSSI-signal, (75#)

- Set the radio unit to the channel 0080, (1#)
- Set the RF-generator as follows:
 - frx = 464.975 MHz
 - level= variable

- Switch the AFC on, (20#)
- Go to the RSSI programming mode, (75#)

Table 3: RSSI level tuning

Index	RF-level dBm	Level number	Notes °C
000	-115	0-1	
001	-103	1-2	
002	- 63	3-4	
003	- 53	4-5	
004	- 93	2-3	+55
005	- 93	2-3	+25
006	- 93	2-3	-25

- Command <OK> stops reading of the ADC and the second press of the <OK> stores the value to the EEPROM. With command <NEXT> it is possible to jump to the next point without any changes.

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-6

4. AUDIO

Speech Deviation

- Turn on the transmitter and tx audio, (15#)

Maximum deviation

- Switch off the deviation correction, (31*)
- Supply 2.7 kHz 1 Vrms to the MIC-line
- Adjust maximum deviation to ± 4.5 kHz ± 100 Hz with potentiometer R400 on the audio module

Nominal deviation

- Set the 1 kHz signal level to 100 mVrms and adjust the MIC-sensitivity to ± 3.0 kHz with potentiometer R500

Channel relating deviation

- Switch on the channel relating deviation adjustment, (80#)
- Adjust the deviation to ± 3.0 kHz with +/- buttons (MIC=100 mVrms)
- Store the reading to the EEPROM with <OK>
- If the deviation is correct, go to the next index with <NEXT>
- Exit with <FNC> <CLR>

Table 4: Deviation tuning table

Index	Channel TMF-1XS	Parameter
000		003
001		003
002		003
003		003
004		003
005		003
006		003
007		003
008		003
009		003
010		003

FFSK data deviation

- Set the radio unit to the channel 0080, (1#)
- Set data transmission on, (51#)
- Adjust the FFSK-deviation to ± 4.2 kHz with potentiometer R362
- Turn TX off <FNC> <CLR>

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-7

FFSK level detector

- Feed the following signal to the antenna connector of the radio unit:

- frx = 464.975 MHz
- level = -53 dBm
- fm = 1200 Hz
- dev = ± 350 Hz

- Switch FFSK programming mode, (78#)
- Lock the ADC-reading with <OK>, write the parameter and store it to EEPROM with <OK> (parameter value about 74)
- <FNC> <CLR>

SAT deviation

- Switch on the tuning of SAT temperature compensation, (83#)
- Set the parameter of room temperature to 003 (index is 001)
- <FNC> <CLR>
- Set the radio unit to the channel 0080, (1#)
- Set RF-generator as follows:
 - frx = 464.975 MHz
 - level = -53 dBm
 - fm = 4 kHz
 - dev = ± 1 kHz
- Turn transmitter on, (10#)
- Set the AFC on, (20#)
- Set the SAT-signal deviation compensation on, (32#)
- Set SAT measurement on, (16#)
- Adjust deviation to ± 1 kHz with R381
- <FNC> <CLR>

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-8

5. OTHERS

Voltage limits (76#)

- Switch on the tuning of voltage limits, (76#)
- ~~Set supply voltage to 12.0 V (X102/11,12)~~
- Lock the reading with <OK>
- Store it to EEPROM with <OK>
- Set supply voltage to 11.2 V
- Lock the reading with <OK>
- Store it to EEPROM with <OK>
- Set supply voltage to 10.0 V
- Lock the reading with <OK>
- Store it to EEPROM with <OK>
- <FNC> <CLR>

Table 5: Voltage limits

Index	Parameter	Note
000	171	12.0 V
001	159	11.2 V
002	143	10.0 V

Temperature compensations

There are three temperature tunings:

- Temperature meter, (81#)
 - RSSI-level tuning, (75#)
 - SAT temperature compensation, (83#)
- The tunings are done in three temperatures +55°C, +25°C and -25°C.
 - After changing the temperature wait until the phone has reached the desired temperature

Table 6: Temperature meter

Index	Parameter	Note
000	123	+55°C
001	146	+25°C
002	176	-25°C

NOKIA MOBILE PHONES

SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-9

Table 7: SAT temperature compensation

Index	Parameter	Note
000	001	+55°C
001	003	+25°C
002	005	-25°C

- Set the cabinet to +25°C
- Temperature meter, (81#)
- Program the parameter of index number 001 according to the table 6
- Lock the ADC-reading with <OK>
- Store it to EEPROM with <OK>
- RSSI-level temperature compensation, (75#)
- Program the parameter of the index number 005 from the table 3 in the chapter (RSSI-level tuning).
- Select index number 005 by means of <NEXT> button
- Lock the ADC-reading with <OK>
- Store it to EEPROM with <OK>
- SAT temperature compensation, (83#)
- Program the index number 001 from the table 7
- Lock the ADC-reading with <OK>
- Store it to EEPROM with <OK>
- Repeat the described tuning procedure in +55°C and -25°C temperatures using proper index numbers from the tables 3, 6 and 7.

FREQUENCY LIST

Channel	TX freq. (MHz)	RX freq. (MHz)	RX inj. (MHz)
001	453.000	463.000	484.400
045	454.100	464.100	485.500
090	455.225	465.225	486.625
135	456.350	466.350	487.750
180	457.475	467.475	488.875

NOKIA MOBILE PHONES

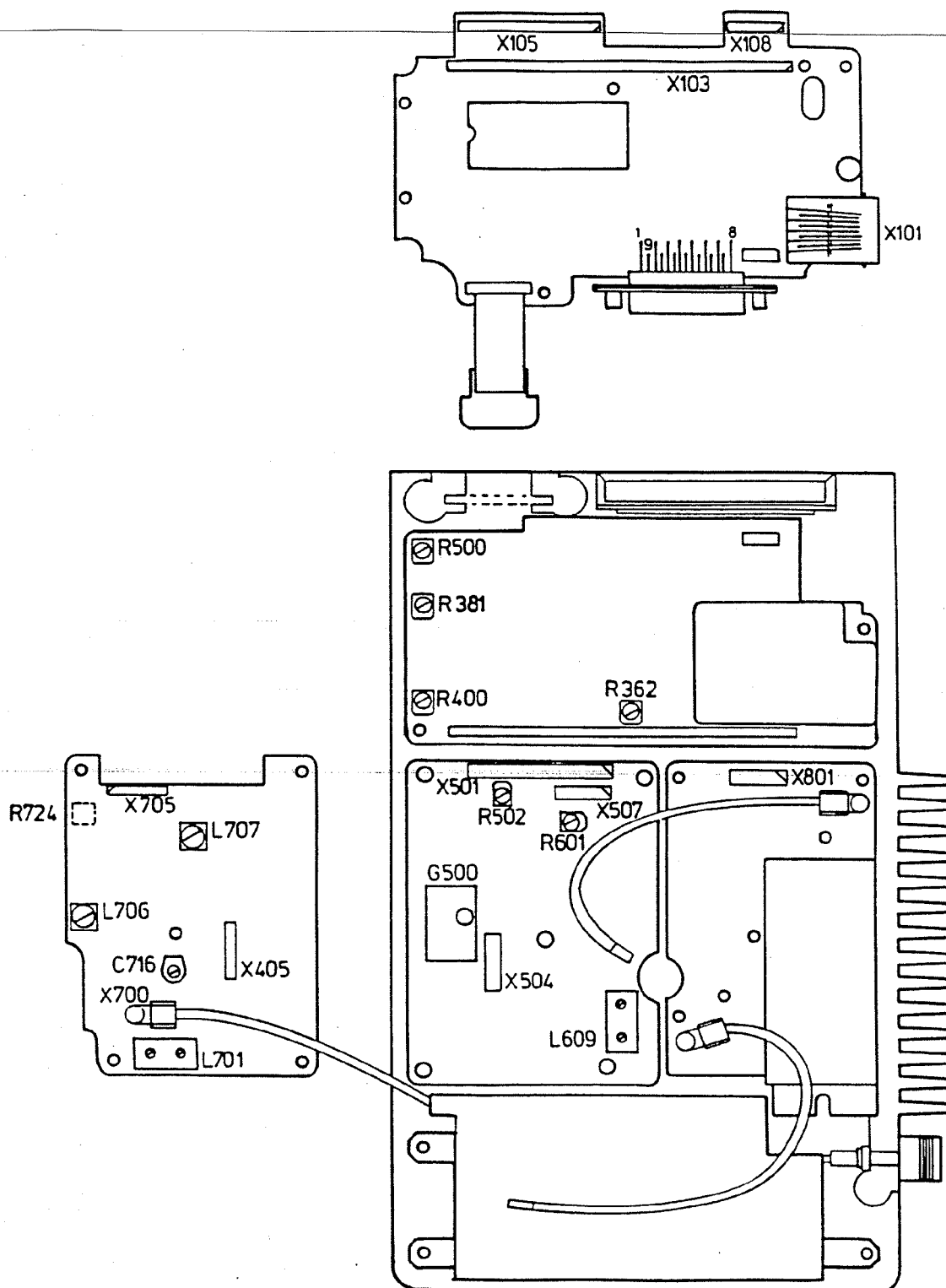
SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-10

TUNING CHART



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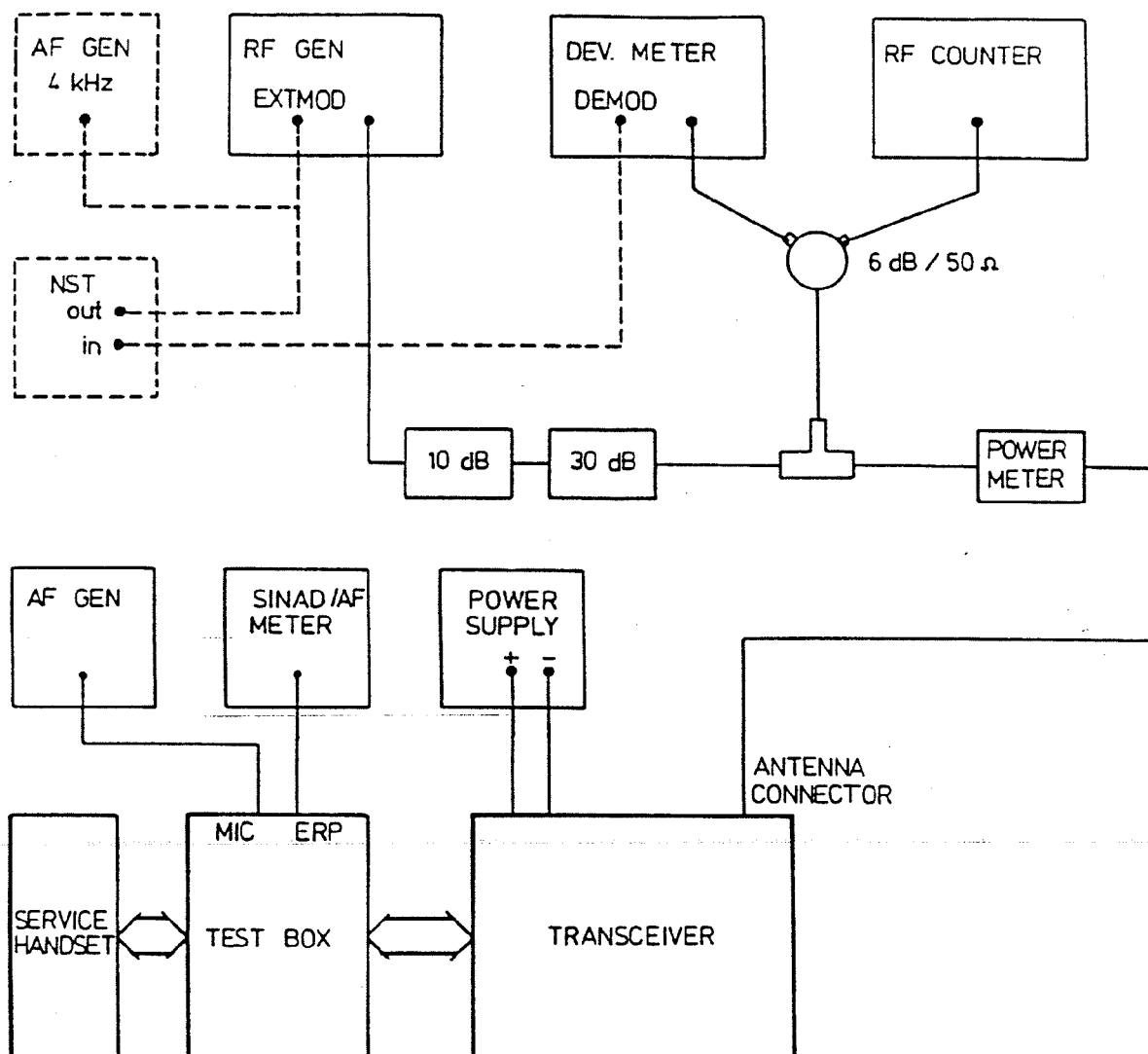
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INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-11

MEASUREMENT CONNECTION



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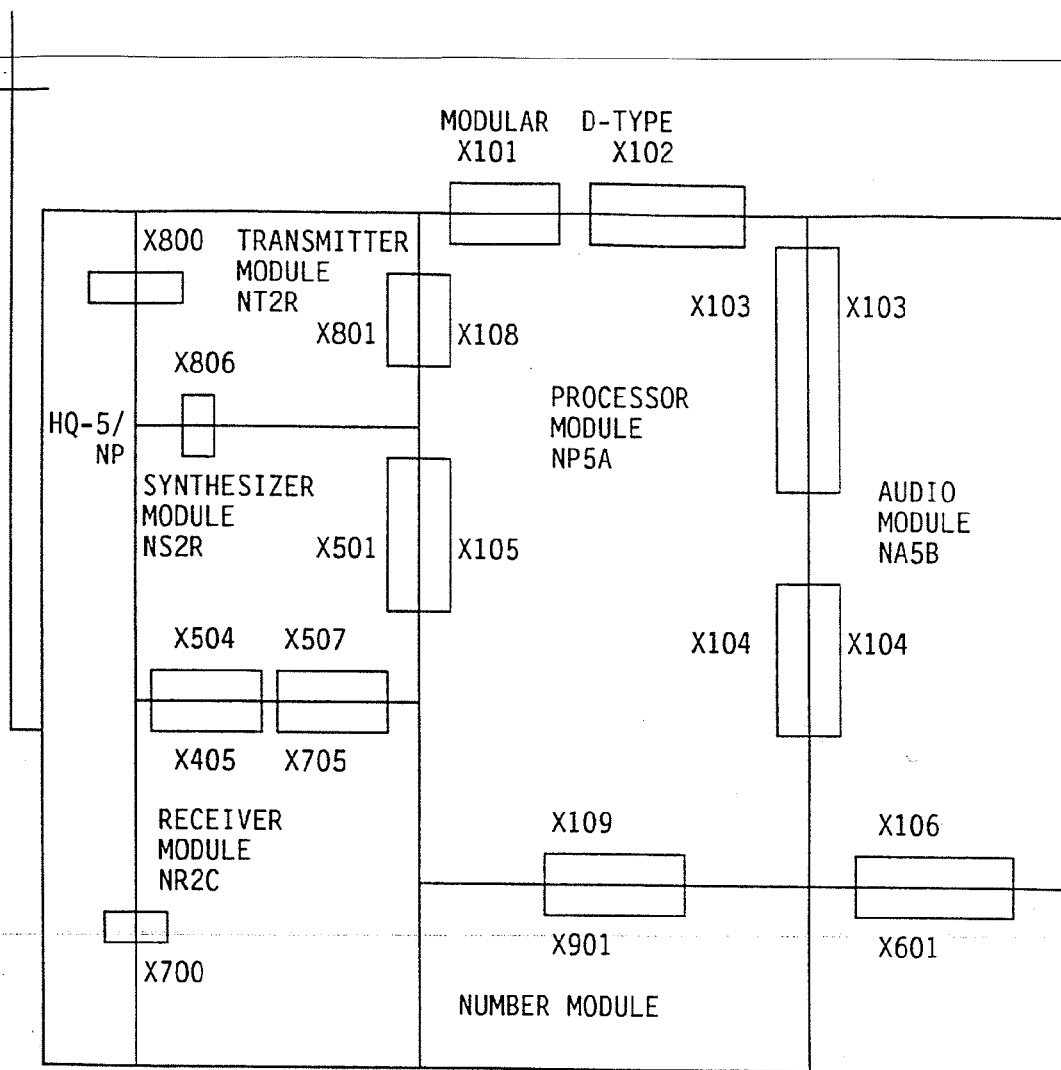
SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-12

CONNECTOR DIAGRAM



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SERVICE
INSTRUCTIONS
9224ARo

TMF-1XS

SERVICE

6-13

DECIBEL-VOLTS-WATTS CONVERSION TABLE OF TERMINATED 50Ω SYSTEM

The voltage is expressed in EMF values. The corresponding PD values can be obtained by dividing the EMF value by two. The PD (potential difference) value gives the voltage in the 50-ohm line, e.g. at the input impedance of a receiver. For example, in a 50-ohm system -113 dBm corresponds to 1 uV EMF and 0.5 uV PD.

dBm	U (EMF)	P	dBm	U (EMF)	P	dBm	U (EMF)	P
+60	450 V	1000 W	0	450 mV	1000 uW	-60	450 uV	1000 pW
+59	400 V	794 W	-1	400 mV	794 uW	-61	400 uV	794 pW
+58	350 V	631 W	-2	350 mV	631 uW	-62	350 uV	631 pW
+57	316 V	500 W	-3	316 mV	500 uW	-63	316 uV	500 pW
+56	282 V	400 W	-4	282 mV	400 uW	-64	282 uV	400 pW
+55	251 V	316 W	-5	251 mV	316 uW	-65	251 uV	316 pW
+54	224 V	250 W	-6	224 mV	250 uW	-66	225 uV	250 pW
+53	200 V	200 W	-7	200 mV	200 uW	-67	200 uV	200 pW
+52	178 V	158 W	-8	178 mV	158 uW	-68	178 uV	158 pW
+51	158 V	125 W	-9	158 mV	125 uW	-69	158 uV	125 pW
+50	141 V	100 W	-10	141 mV	100 uW	-70	141 uV	100 pW
+49	126 V	79 W	-11	126 mV	79 uW	-71	126 uV	79 pW
+48	112 V	63 W	-12	112 mV	63 uW	-72	112 uV	63 pW
+47	100 V	50 W	-13	100 mV	50 uW	-73	100 uV	50 pW
+46	89 V	40 W	-14	89 mV	40 uW	-74	89 uV	40 pW
+45	79 V	32 W	-15	79 mV	32 uW	-75	79 uV	32 pW
+44	71 V	25 W	-16	71 mV	25 uW	-76	71 uV	25 pW
+43	63 V	20 W	-17	63 mV	20 uW	-77	63 uV	20 pW
+42	56 V	16 W	-18	56 mV	16 uW	-78	56 uV	16 pW
+41	50 V	12.5 W	-19	50 mV	12.5 uW	-79	50 uV	12.5 pW
+40	45 V	10.0 W	-20	45 mV	10 uW	-80	45 uV	10 pW
+39	40 V	7.9 W	-21	40 mV	7.9 uW	-81	40 uV	7.9 pW
+38	35 V	6.3 W	-22	35 mV	6.3 uW	-82	35 uV	6.3 pW
+37	31.6 V	5.0 W	-23	31.6 mV	5.0 uW	-83	31.6 uV	5.0 pW
+36	28.2 V	4.0 W	-24	28.2 mV	4.0 uW	-84	28.2 uV	4.0 pW
+35	25.1 V	3.2 W	-25	25.1 mV	3.2 uW	-85	25.1 uV	3.2 pW
+34	22.4 V	2.5 W	-26	22.4 mV	2.5 uW	-86	22.4 uV	2.5 pW
+33	20.0 V	2.0 W	-27	20.0 mV	2.0 uW	-87	20.0 uV	2.0 pW
+32	17.8 V	1.6 W	-28	17.8 mV	1.6 uW	-88	17.8 uV	1.6 pW
+31	15.8 V	1.25 W	-29	15.8 mV	1.25 uW	-89	15.8 uV	1.25 pW
+30	14.1 V	1000 mW	-30	14.1 mV	1000 nW	-90	14.1 uV	1000 fW
+29	12.6 V	794 mW	-31	12.6 mV	794 nW	-91	12.6 uV	794 fW
+28	11.2 V	631 mW	-32	11.2 mV	631 nW	-92	11.2 uV	631 fW
+27	10.0 V	500 mW	-33	10.0 mV	500 nW	-93	10.0 uV	500 fW
+26	8.9 V	400 mW	-34	8.9 mV	400 nW	-94	8.9 uV	400 fW
+25	7.9 V	316 mW	-35	7.9 mV	316 nW	-95	7.9 uV	316 fW
+24	7.1 V	250 mW	-36	7.1 mV	250 nW	-96	7.1 uV	250 fW
+23	6.3 V	200 mW	-37	6.3 mV	200 nW	-97	6.3 uV	200 fW
+22	5.6 V	158 mW	-38	5.6 mV	158 nW	-98	5.6 uV	158 fW
+21	5.0 V	125 mW	-39	5.0 mV	125 nW	-99	5.0 uV	125 fW
+20	4.5 V	100 mW	-40	4.5 mV	100 nW	-100	4.5 uV	100 fW
+19	4.0 V	79 mW	-41	4.0 mV	79 nW	-101	4.0 uV	79 fW
+18	3.5 V	63 mW	-42	3.5 mV	63 nW	-102	3.5 uV	63 fW
+17	3.16 V	50 mW	-43	3.16 mV	50 nW	-103	3.16 uV	50 fW
+16	2.82 V	40 mW	-44	2.82 mV	40 nW	-104	2.82 uV	40 fW
+15	2.51 V	32 mW	-45	2.51 mV	32 nW	-105	2.51 uV	32 fW
+14	2.24 V	25 mW	-46	2.24 mV	25 nW	-106	2.24 uV	25 fW
+13	2.00 V	20 mW	-47	2.00 mV	20 nW	-107	2.00 uV	20 fW
+12	1.78 V	16 mW	-48	1.78 mV	16 nW	-108	1.78 uV	16 fW
+11	1.58 V	12.5 mW	-49	1.58 mV	12.5 nW	-109	1.58 uV	12.5 fW
+10	1.41 V	10.0 mW	-50	1.41 mV	10.0 nW	-110	1.41 uV	10.0 fW
+9	1.26 V	7.9 mW	-51	1.26 mV	7.9 nW	-111	1.26 uV	7.9 fW
+8	1.12 V	6.3 mW	-52	1.12 mV	6.3 nW	-112	1.12 uV	6.3 fW
+7	1.00 V	5.0 mW	-53	1.00 mV	5.0 nW	-113	1.00 uV	5.0 fW
+6	0.89 V	4.0 mW	-54	0.89 mV	4.0 nW	-114	0.89 uV	4.0 fW
+5	0.79 V	3.2 mW	-55	0.79 mV	3.2 nW	-115	0.79 uV	3.2 fW
+4	0.71 V	2.5 mW	-56	0.71 mV	2.5 nW	-116	0.71 uV	2.5 fW
+3	0.63 V	2.0 mW	-57	0.63 mV	2.0 nW	-117	0.63 uV	2.0 fW
+2	0.56 V	1.6 mW	-58	0.56 mV	1.6 nW	-118	0.56 uV	1.6 fW
+1	0.50 V	1.25 mW	-59	0.50 mV	1.25 nW	-119	0.50 uV	1.25 fW

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SERVICE
INSTRUCTIONS
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TMF-1XS

SERVICE

6-14

SERVICE ACCESSORIES

Service handset SHN-2T	4626089
Installation handset SHN-2N	4626123
Modular branching adapter 1:2	4626134
Modular branching adapter 1:4	4626142
Service cable set	4626128
Audio and power supply	4626125
Modular/modular cable	4626131

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AUDIO MODULE NA5B

TMF-1XS

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9224ARo

7-1

ASSOCIATED DOCUMENTATION

0176910 block diagram
2B 0176910 circuit diagram NA5B
0176886 circuit diagram NAS5B
4F 9853356 layout and foil diagrams NA5B
4F 9853268 layout and foil diagrams NAS5B
6E 0176910 parts list NA5B
6E 0176886 parts list NAS5B

Functional description

Audio module NA5B comprises audio circuits for receiver, transmitter, supervisory signal and modem and additionally logical circuits for modem, timer and frequency divider.

Circuit description

Receiver audio circuits

Received signal from the receiver is applied to the connector X103 pin DAF. Audio signal is fed to LFU circuit (low frequency unit) pin LF1. In LFU the signal is filtered. Expander N320/A is between LFU output pin LFR1 and input pin LFR2. In LFU the signal is amplified and from output pin SP the signal is fed to buffer amplifier N480. Amplified signal is then fed to the connector X104 pin EAR.

Transmitter audio circuits

Microphone signal is applied from the connector X104 to the LFU input MIC. The signal is amplified and fed from output LF1 to the compressor N320/B. After compressing the signal is fed to LFT2. From output there can be obtained a filtered signal. The signal is fed pass the 4 kHz band rejection filter N400 and the deviations adjustment R400 to the input (TXD) of the LFU.

The inputs TXD and SVS are summed up. After that they are fed to the output (SMOD) from pin (ZFD) of the LFU. The deviation adjustment according to the channel is done by software.

Supervisory signal Ø

The supervisory signal Ø branches from after the input (DAF) to the input (LF1) of the circuit N380. In circuit N380 there is a 4 kHz band pass filter. From output (SVS) of the N380 the Ø signal is fed pass the deviations adjustment to the input (SVS) of the circuit N310. The Ø signal is summed up to the audio signal and then it is fed to the connector X103 (pin SMOD). The temperature compensation of the supervisory signal is programmable.

Timer

The timer circuit N450 performs the AFC operation. It performs also the interruptions between received and transmitted frames. The timer is controlled by the processor.

Modem

N440 is the digital part of the modem. N380 is the modem filter.

NOKIA MOBILE PHONES

AUDIO MODULE NA5B

TMF-1XS

SERVICE

9224ARo

7-2

SIS circuit

The SIS circuit XXX performs the subscriber authentication procedure according to the NMT-900 SIS specifications. The Subscriber Authentication Key (SAK) is stored together with the algorithm in the SIS circuit. The SAK is programmed at the factory and can not be changed. The authentication takes places at the call set up by a special request from the MTX. The MTX transmits a random number to the mobile. Upon detection of the request the received and decoded random number is transmitted from the mobile cpu to the SIS circuit. The SIS circuit XXX is activated by the clock in the serial transmission. The I²C bus is used for the serial transmission. The SIS circuit calculates a result (signed response) based on the received random number the SAK and the computing algorithm. The computing time with 3.6864 MHz clock is about 400 ms. The circuit returns to standby after the calculation. The mobile cpu reads the result from the SIS-circuit and transmits it back to the MTX for verification. If the verification is performed successfully the call is set up. The clock needed is generated from the NMT modem crystal oscillator. The reset line is connected to the mobile cpu. The reset is active during power up and power down to prohibit corruption of the stored SAK.

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AUDIO MODULE NA5B

TMF-1XS

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7-3

LFU registers

N	5	6	7	8
	R0	R1	R2	R3
0	DSB 0 -	VOL 0 1	GEN 1 -	S 0
1	DSB 1 -	VOL 1 1	GEN 2 -	XS 0
2	DSB 2 -	VOL 2 1	H 1	MLD 0
3	FFSKT 0	VOL 3 0	RXP 1	AGCE 1
4	FSKE 1	SPK 1	COME 1	SVE 0
5	TXP 1	XSPK 0	MICO 0	TEST 0
6	0	1	0	1
7	0	0	1	1

DSB 0	
DSB 1	Not in use
DSB 2	
FFSKT	TX data switch
FSKE	RX data switch
TXP	Power supply to transmitter and to 4 kHz filter
VOL 0	
VOL 1	ERP line volume control
VOL 2	
VOL 3	
SPK	ERP line switch
XSPK	Not in use
GEN 0	Not in use
GEN 1	Not in use
H	ERP line switch
RXP	ERP line power supply
COME	Compander switch
MICO	Speech path switch in data transmission
S	Microphone switch
XS	Not in use
MLD	Not in use
AGCE	Automatic gain control
SVE	Supervisory signal path switch
TEST	Not in use

Supply voltages

Supply voltages +5 VDC and +8 VDC are fed to the connector X103 (pins 86 and 87).

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AUDIO MODULE NA5B

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7-4

Connections

Connector X103 (NA5B/NP5A)

59	TENA	Timer enable
60	NC	NC
61	455 kHz	2.intermediate frequency signal for AFC operation (to circuit N450)
62	FSKL	The detection of the data level. DC voltage level 0...2.5 VDC to the processor.
63	MENA	Modem enable
64,65	MEMCONT <1:2>	Read/write control
66	MINT	Modem INT, also timer output to the processor (pin INT2)
67	RESET	The audio reset input, which resets switches.
68-75	PORT D <0:7>	Data bus from the processor to the modem and to the timer.
76,77	ADRBUS <0:1>	Address bus
78	ADRBUS <2>	Address bus
79	SRES	SIS reset
80	LE	Latch enable
81	SCL	Serial clock
82	I2DA	I ² C bus
83,84	SERBUS <0:1>	SI and CLS inputs for LFU
85	STROBE	STROBE input for LFU
86	+5 V	Supply voltage
87	+8 V	Supply voltage
88	SMOD	TX audio and data signal for TX synthesizer
89	DAF	RX audio and data signal from RX synthesizer

Connector X104 (NA5B/NP5A)

90	MIC	Microphone signal
91	EAR	Earphone signal
92	GND	Ground

Connector X106 (NA5B/NAS5B)

93,94	+5 V	Supply voltage to SIS processor
95	I2DA	I ² C bus to SIS processor
96	SCL	Serial clock to SIS
97	RESET	SRES
98	CL	3.6864 MHz to SIS
99,100	GND	Ground

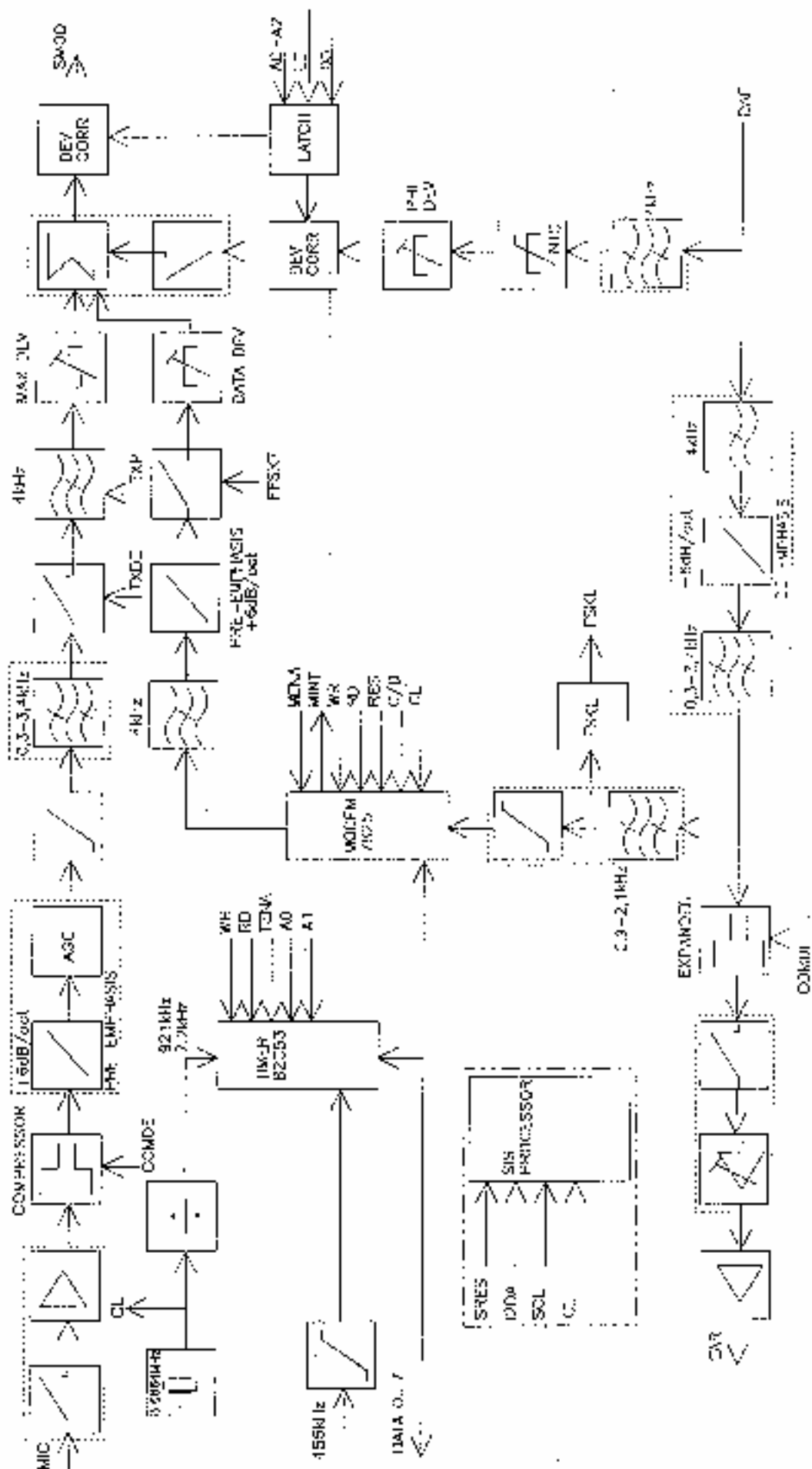
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NOKIA HMD-115
927445c
7-5

Block Diagram of N160



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AUDIO MODULE NA5B

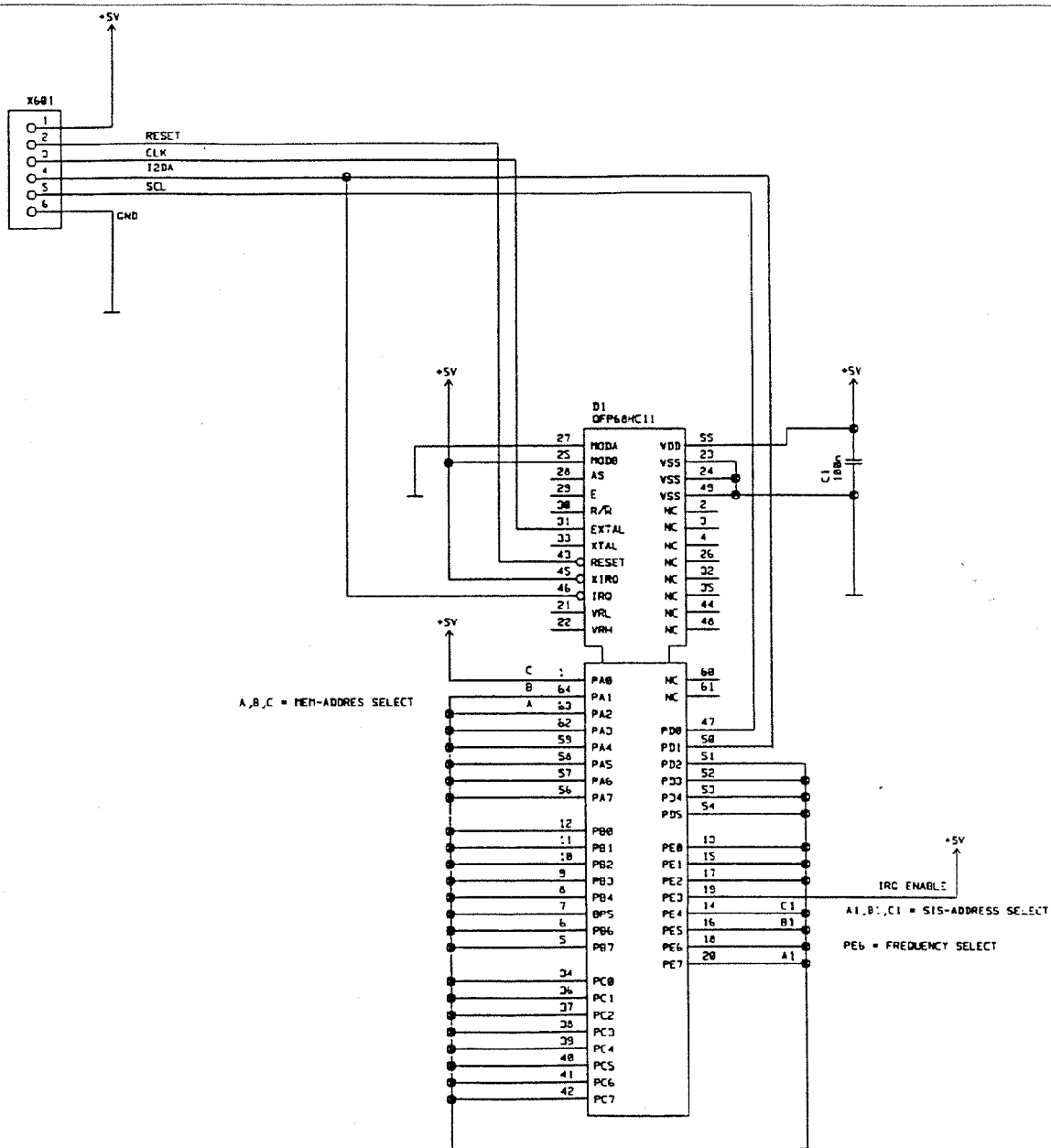
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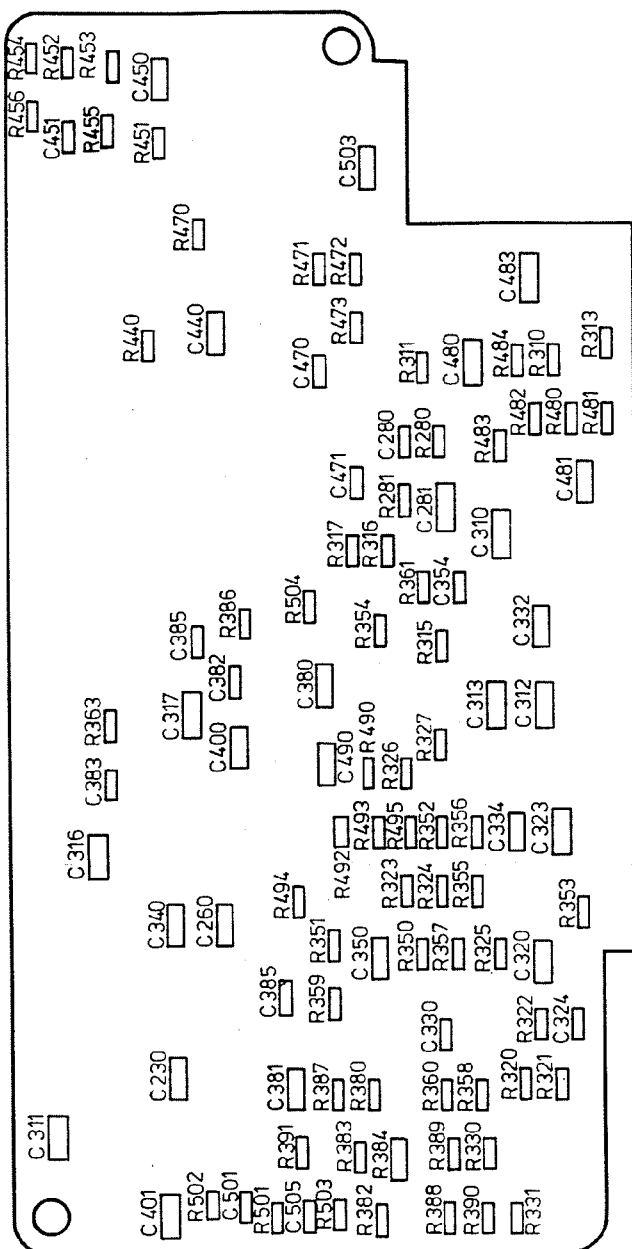
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7-7

CIRCUIT DIAGRAM OF NAS5B 0176886





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AUDIO MODULE NA5B

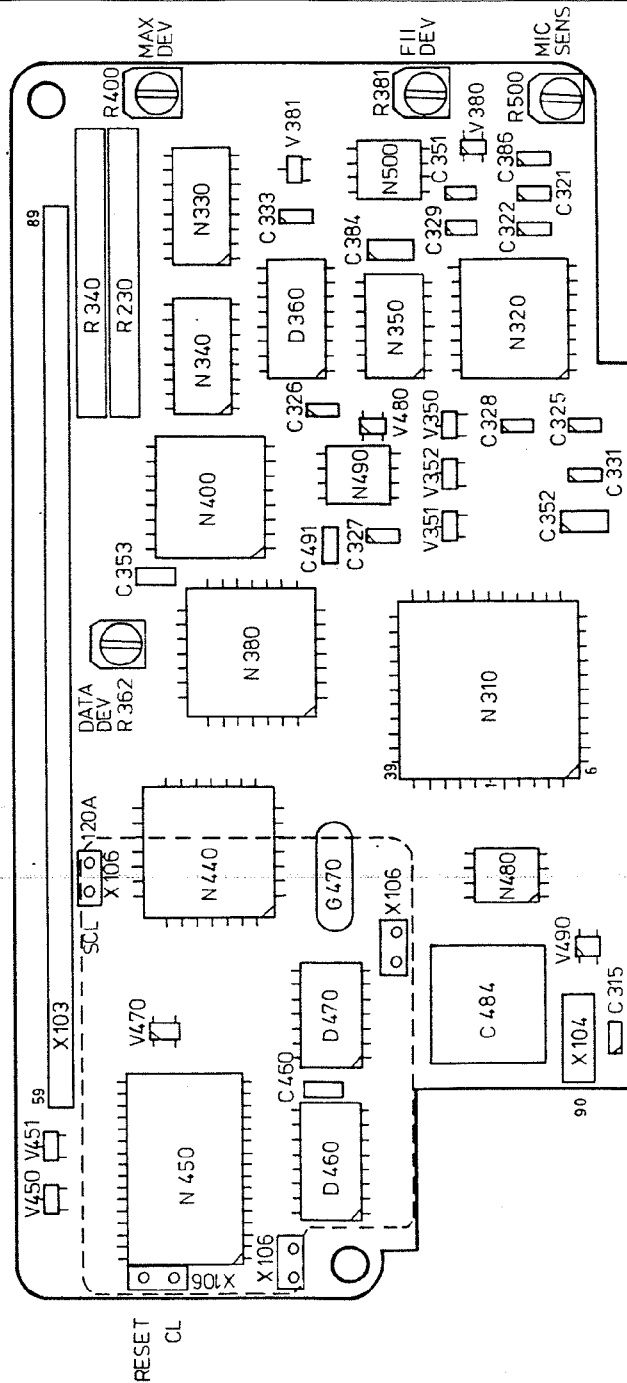
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7-9

LAYOUT AND FOIL DIAGRAMS OF NA5B



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AUDIO MODULE NA5B

TMF-1XS

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7-11

PARTS LIST OF NA5B

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R282	1412239	Chip resistor	120	5 % 0.063 W 0805
R456	1412310	Chip resistor	470	5 % 0.063 W 0805
R311	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R327	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R383	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R385	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R386	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R452	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R313	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R353	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R388	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R454	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R473	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R490	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R281	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R320	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R321	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R322	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R323	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R324	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R382	1412729	Chip resistor	33 k	5 % 0.063 W 0805
R391	1412729	Chip resistor	33 k	5 % 0.063 W 0805
R455	1412729	Chip resistor	33 k	5 % 0.063 W 0805
R326	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R331	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R387	1413603	Chip resistor	47 k	5 % 0.063 W 0805
R325	1413610	Chip resistor	68 k	5 % 0.063 W 0805
R363	1413628	Chip resistor	82 k	5 % 0.063 W 0805
R310	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R315	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R316	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R317	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R330	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R350	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R351	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R352	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R354	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R355	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R356	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R357	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R358	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R359	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R360	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R389	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R390	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R440	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R451	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R470	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R484	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R494	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R495	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R501	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R504	1413635	Chip resistor	100 k	5 % 0.063 W 0805

NOKIA MOBILE PHONES

AUDIO MODULE NA5B

TMF-1XS

SERVICE

9224ARo

7-12

R491	1413642	Chip resistor	56 k	5 % 0.063 W 0805
R493	1413642	Chip resistor	56 k	5 % 0.063 W 0805
R503	1413642	Chip resistor	56 k	5 % 0.063 W 0805
R482	1413804	Chip resistor	1.0 M	5 % 0.063 W 0805
R481	1414029	Chip resistor	3.3 k	5 % 0.063 W 0805
R453	1414036	Chip resistor	8.2 k	5 % 0.063 W 0805
R280	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R480	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R492	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R496	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R483	1414131	Chip resistor	180 k	5 % 0.063 W 0805
R361	1414205	Chip resistor	270 k	5 % 0.063 W 0805
R502	1414205	Chip resistor	270 k	5 % 0.063 W 0805
R471	1414244	Chip resistor	2.2 M	5 % 0.063 W 0805
R472	1414244	Chip resistor	2.2 M	5 % 0.063 W 0805
R380	1414420	Chip resistor	680 k	5 % 0.063 W 0805
R230	1601798	Chip resistor	27 k	0805
R340	1601798	Chip resistor	27 k	0805
R362	1706920	Trimmer resistor	50 k	25 % EVM-07S X00 B54
R381	1706920	Trimmer resistor	50 k	25 % EVM-07S X00 B54
R400	1706920	Trimmer resistor	50 k	25 % EVM-07S X00 B54
R500	1706920	Trimmer resistor	50 k	25 % EVM-07S X00 B54
R384	1800619	NTC thermistor	15 k	10 % 1206
C230	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C260	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C310	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C320	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C340	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C350	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C380	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C381	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C400	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C440	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C450	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C460	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C481	2309475	Ceramic cap.	47 n	10 % X7R 1206 chip
C281	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C311	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C312	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C313	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C316	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C317	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C323	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C332	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C334	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C353	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C385	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C401	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C480	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C483	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C490	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C491	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C503	2309517	Ceramic cap.	100 n	20 % 50 V 1206 chip
C470	2310375	Ceramic cap.	39 p	5 % 50 V 0805 chip
C471	2310375	Ceramic cap.	39 p	5 % 50 V 0805 chip
C280	2310424	Ceramic cap.	100 p	5 % 50 V 0805 chip
C354	2310424	Ceramic cap.	100 p	5 % 50 V 0805 chip

NOKIA MOBILE PHONES

AUDIO MODULE NAS5B

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7-14

PARTS LIST OF NAS5B

ITEM	CODE	DESCRIPTION	TYPE	DATA
C410	2309475	Ceramic cap.	47 n	10 % 50 V 1206 chip
D410	4370001	ASIC	MC68HC11A8	QFP64
X601	5413918	Pin strip		
	9853268	PC board NAS5B		

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-1

ASSOCIATED DOCUMENTATION

0176438 block diagram NP5A
2B 0176438 circuit diagram NP5A
4F 9852962 layout and foil diagrams NP5A
6E 0176438 parts list

Master control unit

The heart of processor module is MCU, which controls the functions of the cellular mobile telephone. It communicates with the base station via modem unit (MU) and then controls the other blocks by means of instructions from the base station. For example, it ensures that the phone is on the right channel, that transmission is at the right power level and so on. Also it controls the audio module, power consumption, handset or external devices and all internal functions.

Master control unit includes the following operational blocks:

* Microprocessor uPD78C10 and following peripherals:

- crystal oscillator 11.0592 MHz
- identification/status memory 128x8 bits EEPROM
- D/A converter and amplifier
- temperature control
- battery voltage measurement
- battery current measurement
- battery temperature measurement
- battery charging control
- receiver signal strength indication (RSSI)
- FSKL measurement
- I/O ports
- A/D converter
- M-bus hardware logic

* Memory block which includes:

- program memory 64 k x 8 bits EPROM
- read/write memory 8 k x 8 bits SRAM
- address latch

* Watchdog and power on/off logic

* Address decoder, RAM write protection, addressable output latch and reset generator.

Microprocessor, general

Microprocessor D10 controls the functions of the mobile telephone. An NEC uPD78C10 microprocessor is used. It is a single-chip, 8-bit CMOS microprocessor, with fully integrated 16-bit ALU (arithmetic logical unit), RAM (256x8), A/D converter, multifunction timer/ event counter, and a serial interface.

The pins MODE0 and MODE1 are pulled up to select processor's mode so that it is using an external memory up to 64 kilobytes.

NOKIA MOBILE PHONES	PROCESSOR MODULE NP5A	TMF-1XS
SERVICE	9224ARo	8-2

Identification memory

EEPROM D180 is used to store permanent data, for example:

- serial number of the phone
- own telephone number
- information for cellular system
- tuning tables

EEPROM is active when data is written or read from it. Writing or reading can be made via I2DA line. I2DA line is connected to PC2 in D10 and the serial clock line SDL is connected to PA0 in D10. The EEPROM receives its operating voltage via transistor switch V140 which is controlled by the signal EEON.

The memory circuit is permanently fixed to the chassis.

M-BUS hardware logic

This block changes separate receive and transmitter data lines to one common bidirectional line.

M-BUS operation

Tx data closes and opens transistor V30. MBUS data signal is available from V30 emitter. An output voltage of the transistor is limited to 0.5-4.5 V.

Net free -state is detected by internal counter in the microcomputer. Therefore RXDATA is also connected to PC5 (Counter interrupt) pin in the microprocessor D10.

Temperature control

Temperature measurement is done by reading forward voltage across six diodes (V13, V14, V15 three pairs). Forward voltage is around $6 \times 0.5 \text{ V} = 3.0 \text{ V}$ ($I=600 \text{ uA}$) at +20C. This is around 153 from 8 bit A/D converter. Voltage changes $5 \text{ mV} \times 6 = 30 \text{ mV}$ per one degree in reverse. So when temperature is +50C, voltage is 2.1 V (107 from A/D converter). The A/D converter detects a 0.67C change in temperature.

Battery voltage measurement

Voltage level of battery is accomplished by dividing +12V with $(R20+R40)/R21$ (253 k Ω /100 k Ω):

15 V corresponds to 4.25 V to the A/D converter (218 from A/D converter)

10 V corresponds to 3.08 V to the A/D converter (157 from A/D converter)

The A/D converter detects a 70 mV change in voltage level.

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-3

Transmitter power control

D/A converter MC144111 (N20) controls the output power of the transmitter. MC144111 includes four (4) 6-bit D/A converters, therefore, a 12-bit D/A conversion is got by summing two analog outputs in the ratio 1/64. The accuracy of the conversion can be determined as follows:

$$\frac{\text{reference voltage}}{64 \times 64}$$

where reference voltage = 5 V (operating voltage)
 64 = 2 power 6
 64 = summing ratio

Actually, the summing ratio is not exactly 1/64, but slightly smaller in order to prevent high jumps in voltage when the settings of the most significant D/A converter (i.e. six MSBs of the conversion) change. For example variations in component tolerances can bring about those voltage jumps.

If summing ratio 1/44 is used it is obtained as follows:

$$\frac{1}{44} = \frac{\text{network resistance}}{R31 + \text{network resistance}}$$

where network resistance is 10 kΩ (7...15 kΩ),
 R31 = 432 kΩ (1%)

After replacing the original summing ratio 1/64 with 1/44 we get the D/A conversion accuracy of 1.8 mV.

Control voltage from the d/a converter is doubled in op amp N30-A. The converter is connected to the microprocessor via SERBUS and enabled by PC4.

Power Feedback (PFB) voltage is proportional to real output power level of transmitter. It is used to monitor the state of the transmitter. Feedback voltage might be more than 5 V, so, voltage dropping is performed with two resistors, which constitute a voltage division. One is on the transmitter board (NT5A) and the other is R22 on the NP5A board.

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-4

Input/Output lines from microprocessor

Gate	Pin	I/O	Name	Function
PA0	59	0	SCL	serial clock
PA1	60	0	SDA	data to synthesizer, EEPROM and DAC
PA2	61	0	TSLG	transmitter synthesizer loop gain
PA3	62	I/O	DATA	data I/O
PA4	63	0	STROBE	latch for LFU
PA5	64	0	CRM	car radio mute control
PA6	1	0	EXTA	external alarm control
PA7	2	0	DTC	datakit enable
PB0	3	0	SD	6/8V portable/mobile select
PB1	4	0	TSEN	transmitter synthesizer enable
PB2	5	0	RSEN	receiver synthesizer enable
PB3	6		NC	-
PB4	7	0	TXON	transmitter supply power on "1"
PB5	8	0	TSON	Tx synthesizer supply power on "0"
PB6	9	0	TAON	audio supply power on "1"
PB7	10	0	EEON	EEPROM supply power on "0"
PC0	11	0	TXD	MBUS data output
PC1	12	I	RXD	MBUS data input
PC2	13	I/O	I2DA	I2C bus data line
PC3	14	0	PAGE	memory page control
PC4	15	0	DAEN	D/A enable
PC5	16	I	FREE	MBUS free detection
PC6	17	0	WDC	watchdog clear: 2us pulse every 100 ms
PC7	18	0	PWROFF	power off control to the power switch
AN0	28	A	FSKL	received data level
AN1	29	A	BCR	battery current measurement
AN2	30	A	BTMB	battery temperature measurement
AN3	31	A	RSSI	receiver signal strength
AN4	32	A	PFB	transmitter power feedback
AN5	33	A	BATC	battery voltage measurement
AN6	34	A	TEMP	voltage level depending on temperature
AN7	35	A	TIMEOUT	power off timeout measurement
RESET	22	I	RESET	from the reset generator
NMI	19	I	NMI	interrupt from watchdog
INT1	20	I	INT1	interrupt from modem
ALE	40	0	ALE	address latch enable
WR	39	0	WR	memory write enable
RD	38	0	RD	memory read enable
PD0	49	I/O		multiplexed address (LSB) and data bus 8 bits
.	.			
PD7	56			
PF0	41	0		MSB of the address
.	.			
PF7	48			

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PROCESSOR MODULE NP5A

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SERVICE

9224ARo

8-5

Memory block

Memory block includes:

D60	- program memory	64 k x 8 bits	EEPROM
D70	- read/write memory	8 k x 8 bits	SRAM
D50	- address latch		

Program memory

Program memory space is 64 k x 8. Base memory is 32 k x 8 0000H-8000H and the rest 32 k is divided to two pages by using a page control line (PAGE) from MCU PC3.

page 0 PC3 = "0" program memory 8000H-BFFFH

page 1 PC3 = "1" program memory area C000H-FFFFH paged in 8000H-BFFFH

Read/Write memory

Read/write memory area is 8 k x 8 and addressed so that the 255 highest bytes are in same addresses as internal RAM of the 78C10 microprocessor. Therefore those highest bytes are selected by program either from the internal or external RAM area.

Address latch

Address latch separates 8 lowest address bits from multiplexed address/databus.

Address decoder, RAM write protection, and RESET generator

Address space is divided into following blocks:

			control signal
Program memory	D60	0000H-BFFFH	EPROMEN
Modem unit	N440	C000H-C3FFH	MENA
Timer unit	N450	C400H-C7FFH	TENA
		C800H-CBFFH	SISE
Audio latch	D340	D400H-D7FFH	AMU/LE
RAM	D70	E000H-FFFFH	RAMEN

Addresses D000H-DFFFH are also gated by WR with D90-C.

The RAM is protected against power failure. When power has not been connected, RAM and protection circuits get their operating voltages from battery. This voltage is decreased from 12 V to 4.5 V by R105 and V104.

If battery does not exist or is discharged, back up voltage is available from back-up battery G100. In normal operation +5BB voltage is available via transistor V103 from normal operating voltage +5 V. If +12 V (voltage after power switch) drops below 7.8 V, then V102 and V103 close down and +5BB is received from +12BT. At the same time RESET is generated if the RAM is not enabled. If the RAM is enabled, RESET is generated after RAM addressing.

The RAM cannot be addressed during RESET. When +12 V rises, it causes power on RESET, the length of which is determined by the time constant R103xC101 (30 ms).

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PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-6

Watchdog and power on/off logic

Watchdog logical operation

Operation of the microprocessor is protected by watchdog circuit. The watchdog receives a pulse ($> 2 \mu s$) every 100 ms. If it does not receive a pulse, it generates NMI interruption to the microprocessor 400 ms after the last pulse. If the microprocessor does not get control back after 12 s from NMI, the watchdog generates a power off signal to switch the radio unit off via power off logic.

Logical operation of power on/off logic

Power on/off logic gets power state information from handset. When power is switched on in the handset, the power logic connects supply to the microprocessor in the radio unit. The powers are kept on until the microcomputer of the handset detects PWROFF signal and reports it to the MCU, which sets PWROFF signal up.

Watchdog electrical operation

After power-on C82 starts to charge via R83 and C83 via R82. After the first time constant ($C82 \times R83$) D80-A detects input high, NMI is generated. After second time constant ($C83 \times R82$) D80-B detects input high, D80-D output goes up forcing V86 to conduct and power off is generated. The both capacitors are discharged via R84/V83 and R85/V84 by watchdog reset pulse, which makes the transistors to conduct. C81 prevents that steady high level does not keep the transistors open more than the period determined by the time constant $C81 \times R80/R81$. Because of the diode V80 there is not any negative pulse on the transistors V81 and V82.

Electrical operation of power on/off logic

When power has not been connected, D120 still gets operating voltage from the batter. The both inputs of D120-B are pulled up, the inputs of D120-A are down and PWR is down. If PWR button is pressed, the output of D120-B goes up, output of D120-A goes down and PWR up causing power connection.

Power supply

All supply voltages of the telephone are controlled by the microprocessor D10.

The NP5A board gets its supply voltages +12 V, +8 V, +5 V from power supply (N150, N160) on the same board and distributes them via FET or transistor switches to other parts of the telephone.

Also +12BT to the transmitter NT2R is fed through the NP5A board

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PROCESSOR MODULE NP5A

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8-7

Supply voltages

SOURCE	TARGET	OBJECT	MAX LOAD	SWITCH Udrop<200 mV
+12B	+12BT	NT2R transmitter	4500 mA	
+12V	+12T	first stages of NT2R	200 mA	V130
+8V	+8TA	NA5 audio module	100 mA	V133
+5V	+5EE	identification memory	20 mA	V140
+12B/ G100	+5BB	RAM, write protection power on/of Udrop=1.0 V	100 uA	V100
+5	+5BB	RAM, write protection power on/off logic	20 mA	V103
+12 V		battery control R20, R21, R40.		
+8 V		regulated from +12 V		N160
+5 V		regulated from +8 V (car use) N150 or from 6/8 V (portable use) selected by signal SD		V150

Connector X109: between processor and NN module

21	SCL	serial clock
22	I2DA	serial i/o data
23	GND	ground
24	+5EE	supply voltage

Connector X108: between processor and transmitter

31	+12BT	battery voltage
32	+12BT	battery voltage
33	+12T	supply during transmission
34	PC	power control 0.2-7.0 VDC ---> 6.8-38.5 dBm
35	PFB	power feedback 6.8-34.8 dBm ---> 0.2-7.0 VDC

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

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9224ARo

8-8

Connector X105 between processor and synthesizer		
41	455kHz	IF from receiver
42	DAF	demod audio frequency 1 kHz/3.0 kHz dev 125 mVrms
43	RSSI	received signal strength indication 0.5-3.5VDC
44	+8R	continuous +8 VDC
45	AFC	AFC control signal from A/D converter D20
46	TSLG	tx-synthesizer loop gain
47	+6/8V	+6 VDC from switching regulator(portable use) or +8 VDC from N160 (mobile use)
48	TSON	logic "1" during transmission
49	SCL	serial clock
50	RSEN	rx-synthesizer enable
51	SDA	serial data
52	TSEN	tx-synthesizer enable
53	SMOD	synthesizer modulation input

Connector X103: Between audio and processor		
59	TENA	Timer enable
60	NC	NC
61	455 kHz	AFC counter input to circuit N450
62	FSKL	FFSK signal level detector output to the processor 0...2.5 VDC
63	MENA	Modem enable
64 and 65	MEMCONT	Read/write control
66	MINT	Modem interrupt
67	RESET	Reset signal to audio gates
68 to 75	PORT D	Data bus from the processor to the modem and to the processor
76 and 77	ADRBUS 1	Address bus
78	ADRBUS 2	Address bus
79	SRES	SIS-reset
80	LE	Latch enable
81	SCL	Serial clock
82	I2DA	I2C bus
83 and 84	SERBUS	SI and CLS inputs for LFU
85	STROBE	STROBE input for LFU
86	+5 V	Supply voltage
87	+8 V	Supply voltage
88	SMOD	TX audio signal TX synthesizer
89	DAF	Received audio signal

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-9

Connector X104: Between audio and processor		
90	MIC	Microphone signal
91	EAR	Earphone signal
92	GND	Ground

Connectors X102 and X101: to battery pack or system cable		
1	EXTA/EXTM	EXTA: Open collector output. Sink current max 200 mA. EXTM: Nom. level 50 mVrms ± 10 mV. $Z_{in} > 10$ k Ω DC: 0-5 V Line is connected to +5 V by 470 k Ω resistor in control units.
2	MIC/HOOK	MIC: $Z_{out} < 1$ k Ω , $Z_{in} > 100$ k Ω . Nominal level: 50 mVrms ± 10 mV HOOK: On-hook DC < 1.0 V Off-hook DC > 4.0 V
3	GND	GND: Ground for all signals and supply currents
5	MBUS	MBUS: Bidirectional serial data bus out: "0": < 0.5 V "1": > 4.5 V in: "0": < 0.8 V "1": > 2.2 V
6	+12V	+12V: Voltage during "on"
7	EAR/POWER	EAR: $Z_{out} < 100$ Ω , $Z_{in} > 10$ k Ω . Level 50 mVrms ± 10 mV POWER: Grounding over 0.2 s turns power on.
8	CRM/EXTS	CRM: Car Radio Mute. Open collector output. Sink current max 200mA EXTS: Level 50 mVrms ± 10 mV. $Z_{out} < 1$ k Ω . $Z_{in} > 100$ k Ω Controlled range ± 10 dB by (+) and (-) buttons. Handset HF is muted by DC load (10 k Ω) of external HF.
9	BTMB	BTMB: Battery temperature. Thermistor between BTMB and GND
10	BCON	BCON: Battery charging control line 6 bit DAC, 0-5 VDC.
11 12	+VB/12B	+VB: Input to battery pack U_i 9-32 VDC (5 A max) 12B: Input to radio unit U_i 10.8-15.6 VDC (3.7 A max)
13	+6/8V	+6/8V: +6 V input from transportable switching regulator In car use +8 V output
14	BCR	BCR: Battery current indication line -3A...+3A/0-5 VDC.
15	DATA	DATA: Data from datakit. (in TACS)

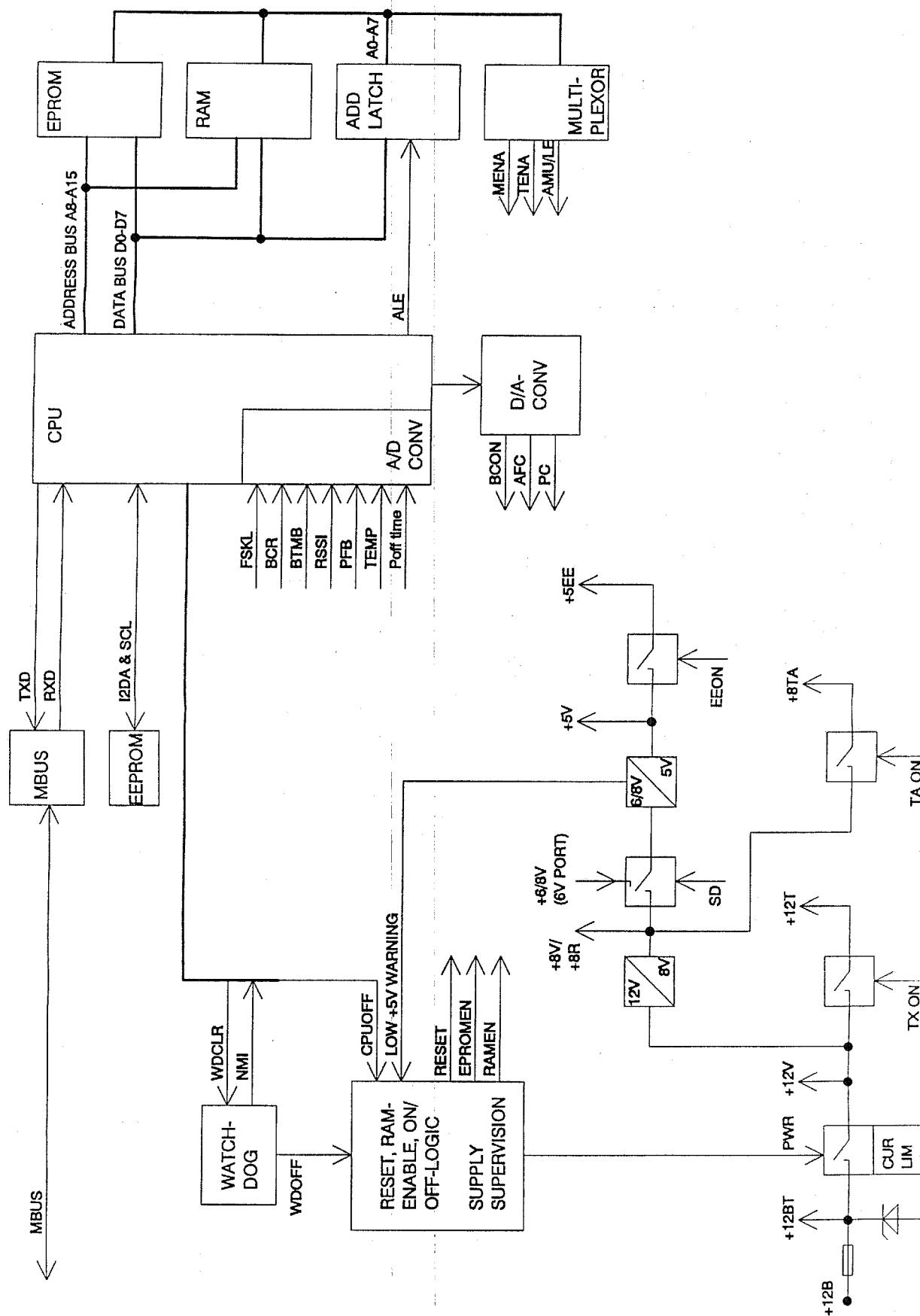
NOTE! Both connectors have same signals at their pins 1 to 8

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BLOCK DIAGRAM OF NP5A

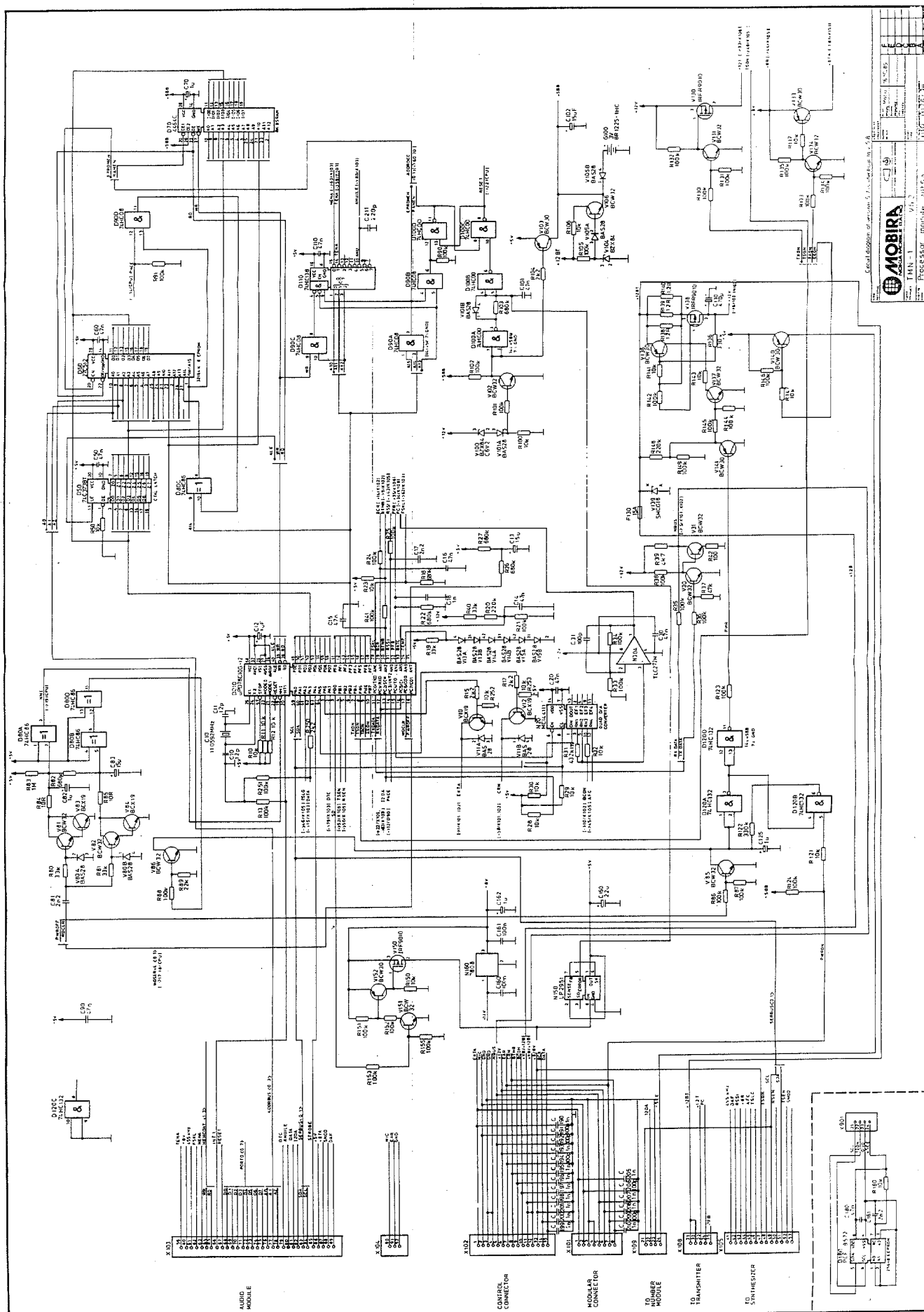


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CIRCUIT DIAGRAM OF NP5A



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PROCESSOR MODULE NP5A

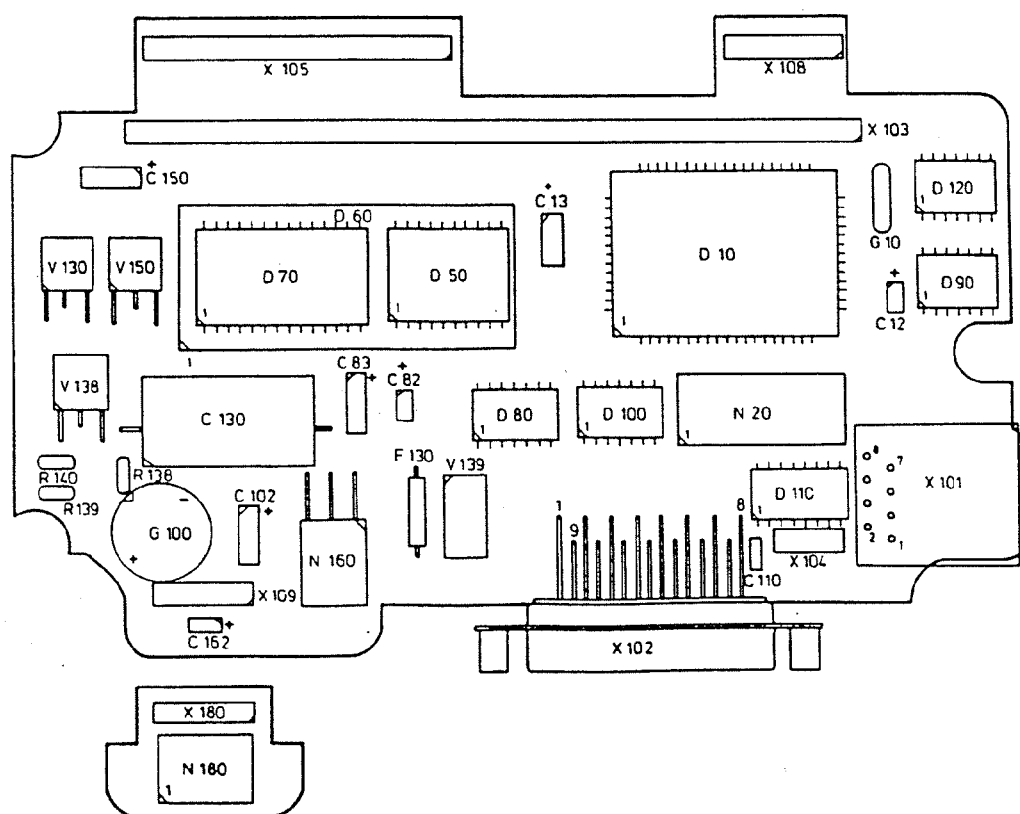
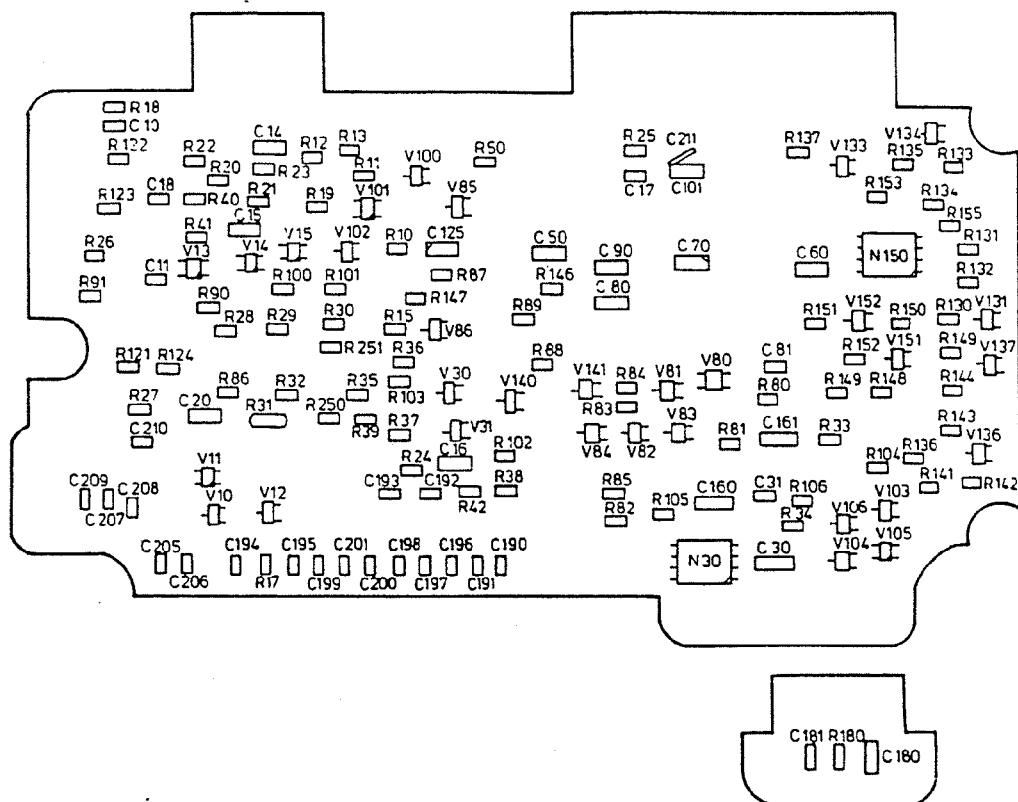
TMF-1XS

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9224ARo

8-12

LAYOUT AND FOIL DIAGRAMS OF NP5A,



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PROCESSOR MODULE NP5A

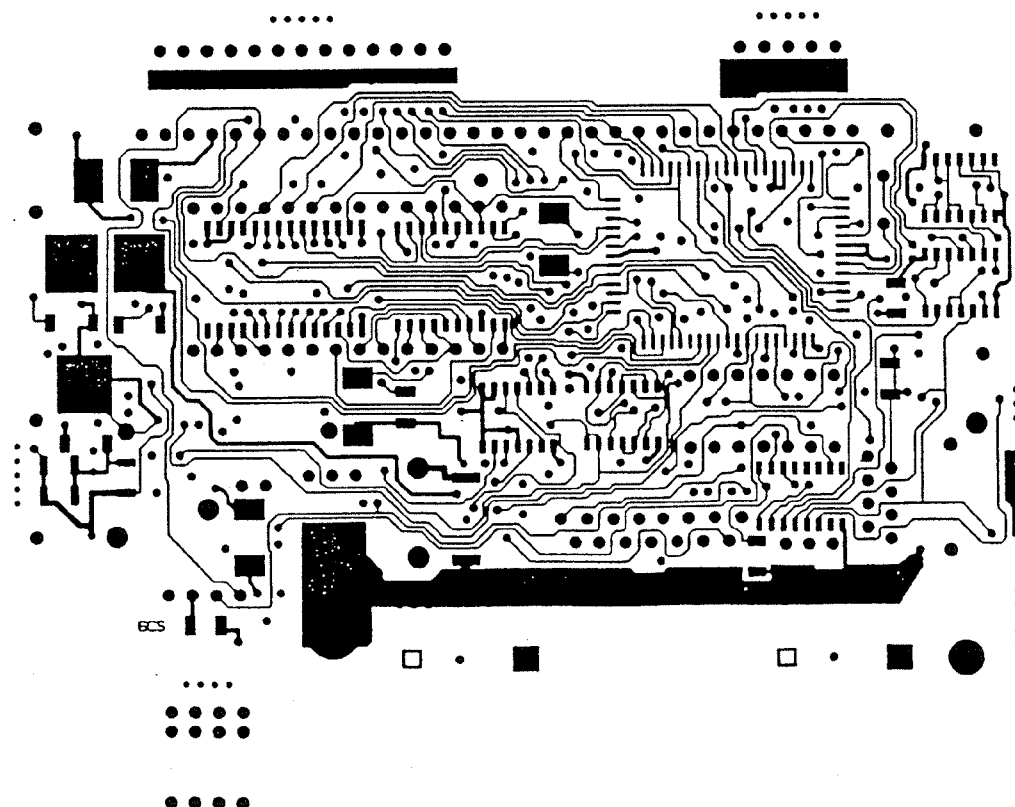
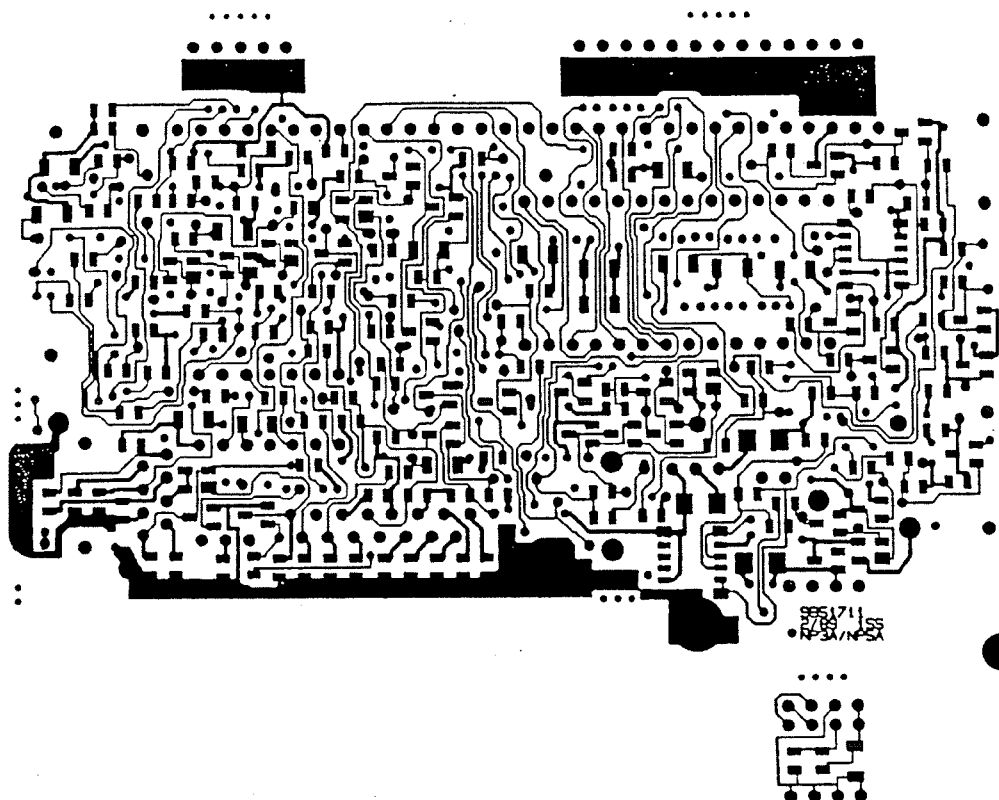
TMF-1XS

SERVICE

9224ARo

8-13

LAYOUT AND FOIL DIAGRAMS OF NP5A



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PROCESSOR MODULE NP5A

TMF-1XS

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9224ARo

8-14

PARTS LIST

ITEM	CODE	DESCRIPTION	VALUE	TYPE
	0240057	Programmed EPROM	TMF-1XS	
R138	1411151	Resistor	1.2	MELF 0.25 W 1206
R139	1411151	Resistor	1.2	MELF 0.25 W 1206
R140	1411151	Resistor	1.2	MELF 0.25 W 1206
R42	1412261	Chip resistor	100	0.06 W 0805
R15	1412416	Chip resistor	2.2 k	0.06 W 0805
R17	1412416	Chip resistor	2.2 k	0.06 W 0805
R104	1412416	Chip resistor	2.2 k	0.06 W 0805
R250	1412416	Chip resistor	2.2 k	0.06 W 0805
R39	1412423	Chip resistor	4.7 k	0.06 W 0805
R10	1412430	Chip resistor	10 k	0.06 W 0805
R11	1412430	Chip resistor	10 k	0.06 W 0805
R12	1412430	Chip resistor	10 k	0.06 W 0805
R23	1412430	Chip resistor	10 k	0.06 W 0805
R28	1412430	Chip resistor	10 k	0.06 W 0805
R29	1412430	Chip resistor	10 k	0.06 W 0805
R30	1412430	Chip resistor	10 k	0.06 W 0805
R32	1412430	Chip resistor	10 k	0.06 W 0805
R50	1412430	Chip resistor	10 k	0.06 W 0805
R100	1412430	Chip resistor	10 k	0.06 W 0805
R106	1412430	Chip resistor	10 k	0.06 W 0805
R121	1412430	Chip resistor	10 k	0.06 W 0805
R137	1412430	Chip resistor	10 k	0.06 W 0805
R141	1412430	Chip resistor	10 k	0.06 W 0805
R143	1412430	Chip resistor	10 k	0.06 W 0805
R147	1412430	Chip resistor	10 k	0.06 W 0805
R150	1412430	Chip resistor	10 k	0.06 W 0805
R252	1412430	Chip resistor	10 k	0.06 W 0805
R253	1412430	Chip resistor	10 k	0.06 W 0805
R89	1412536	Chip resistor	22 k	0.06 W 0805
R19	1412729	Chip resistor	33 k	0.06 W 0805
R40	1412729	Chip resistor	33 k	0.06 W 0805
R80	1412729	Chip resistor	33 k	0.06 W 0805
R81	1412729	Chip resistor	33 k	0.06 W 0805
R37	1413603	Chip resistor	47 k	0.06 W 0805
R13	1413635	Chip resistor	100 k	0.06 W 0805
R21	1413635	Chip resistor	100 k	0.06 W 0805
R24	1413635	Chip resistor	100 k	0.06 W 0805
R25	1413635	Chip resistor	100 k	0.06 W 0805
R33	1413635	Chip resistor	100 k	0.06 W 0805
R34	1413635	Chip resistor	100 k	0.06 W 0805
R35	1413635	Chip resistor	100 k	0.06 W 0805
R36	1413635	Chip resistor	100 k	0.06 W 0805
R38	1413635	Chip resistor	100 k	0.06 W 0805
R41	1413635	Chip resistor	100 k	0.06 W 0805
R86	1413635	Chip resistor	100 k	0.06 W 0805
R87	1413635	Chip resistor	100 k	0.06 W 0805
R88	1413635	Chip resistor	100 k	0.06 W 0805
R90	1413635	Chip resistor	100 k	0.06 W 0805
R91	1413635	Chip resistor	100 k	0.06 W 0805
R101	1413635	Chip resistor	100 k	0.06 W 0805
R102	1413635	Chip resistor	100 k	0.06 W 0805
R105	1413635	Chip resistor	100 k	0.06 W 0805
R123	1413635	Chip resistor	100 k	0.06 W 0805
R124	1413635	Chip resistor	100 k	0.06 W 0805

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PROCESSOR MODULE NP5A

TMF-1XS

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8-15

R130	1413635	Chip resistor	100 k	0.06 W 0805
R131	1413635	Chip resistor	100 k	0.06 W 0805
R132	1413635	Chip resistor	100 k	0.06 W 0805
R133	1413635	Chip resistor	100 k	0.06 W 0805
R134	1413635	Chip resistor	100 k	0.06 W 0805
R135	1413635	Chip resistor	100 k	0.06 W 0805
R142	1413635	Chip resistor	100 k	0.06 W 0805
R144	1413635	Chip resistor	100 k	0.06 W 0805
R145	1413635	Chip resistor	100 k	0.06 W 0805
R146	1413635	Chip resistor	100 k	0.06 W 0805
R149	1413635	Chip resistor	100 k	0.06 W 0805
R151	1413635	Chip resistor	100 k	0.06 W 0805
R152	1413635	Chip resistor	100 k	0.06 W 0805
R153	1413635	Chip resistor	100 k	0.06 W 0805
R155	1413635	Chip resistor	100 k	0.06 W 0805
R251	1413635	Chip resistor	100 k	0.06 W 0805
R20	1413716	Chip resistor	220 k	0.06 W 0805
R148	1413716	Chip resistor	220 k	0.06 W 0805
R83	1413804	Chip resistor	1.0 M	0.06 W 0805
R84	1413829	Chip resistor	10	0.06 W 0805
R85	1413829	Chip resistor	10	0.06 W 0805
R122	1414212	Chip resistor	330 k	0.06 W 0805
R136	1414212	Chip resistor	330 k	0.06 W 0805
R18	1414420	Chip resistor	680 k	0.06 W 0805
R22	1414420	Chip resistor	680 k	0.06 W 0805
R26	1414420	Chip resistor	680 k	0.06 W 0805
R27	1414420	Chip resistor	680 k	0.06 W 0805
R82	1414420	Chip resistor	680 k	0.06 W 0805
R103	1414420	Chip resistor	680 k	0.06 W 0805
R31	1416516	Resistor	432 k	MELF 0.25 W 1206
C14	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C15	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C16	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C20	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C30	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C50	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C60	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C80	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C90	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C101	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C110	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C160	2309563	Ceramic cap.	100 n	50 V X7R 1210 chip
C161	2309563	Ceramic cap.	100 n	50 V X7R 1210 chip
C10	2310311	Ceramic cap.	12 p	50 V NPO 0805 chip
C11	2310311	Ceramic cap.	12 p	50 V NPO 0805 chip
C31	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C191	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C192	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C194	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C206	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C209	2310424	Ceramic cap.	100 p	50 V NPO 0805 chip
C211	2310463	Ceramic cap.	220 p	50 V NPO 0805 chip
C18	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C190	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C193	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C195	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C196	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C197	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C198	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-16

C199	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C200	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C201	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C205	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C207	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C208	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C210	2310544	Ceramic cap.	1.0 n	50 V NPO 0805 chip
C17	2310713	Ceramic cap.	2.2 n	50 V X7R 0805 chip
C81	2310713	Ceramic cap.	2.2 n	50 V X7R 0805 chip
C130	2504282	Electrol. cap.	470 μ	25 V
C12	2604209	Tantalum cap.	1.0 μ	16 V chip
C70	2604209	Tantalum cap.	1.0 μ	16 V chip
C82	2604209	Tantalum cap.	1.0 μ	16 V chip
C125	2604209	Tantalum cap.	1.0 μ	16 V chip
C162	2604209	Tantalum cap.	1.0 μ	16 V chip
C13	2604341	Tantalum cap.	15 μ	10 V chip
C83	2604341	Tantalum cap.	15 μ	10 V chip
C102	2604341	Tantalum cap.	15 μ	10 V chip
C150	2604495	Tantalum cap.	22 μ	16 V chip
V139	4103543	Trans.supressor		15 V 1500 W
V100	4107040	Zener diode		5 % 6.2 V 300 mW SOT-23
V104	4107040	Zener diode		5 % 6.2 V 300 mW SOT-23
V11	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V13	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V14	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V15	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V80	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V101	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V105	4108639	Diode	BAS28	75 V 250 mA dual SOT-143
V130	4200610	Transistor	IRFR9010	50 V FET TO-252
V138	4200610	Transistor	IRFR9010	50 V FET TO-252
V150	4200610	Transistor	IRFR9010	50 V FET TO-252
V10	4200836	Transistor	BCX19	45 V 500 mA 100 MHz SOT-23
V12	4200836	Transistor	BCX19	45 V 500 mA 100 MHz SOT-23
V83	4200836	Transistor	BCX19	45 V 500 mA 100 MHz SOT-23
V84	4200836	Transistor	BCX19	45 V 500 mA 100 MHz SOT-23
V103	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V133	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V136	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V140	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V141	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V152	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V30	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V31	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V81	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V82	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V85	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V86	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V102	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V106	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V131	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V134	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V137	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V151	4200917	Transistor	BCW32	30 V 100 mA SOT-23
N150	4301062	Regulator	LP2951ACM	+2-29 V SO-8
D80	4301217	Quad 2-input	EX/OR	74HC86T SO-14
D10	4301986	Microprocessor		μ PD78C10G-12 MCU 8-bit
D70	4303158	SRAM 8kx8		μ PD4464G-15 L
D50	4303567	8xD type latch		74HC373 SO-20

NOKIA MOBILE PHONES

PROCESSOR MODULE NP5A

TMF-1XS

SERVICE

9224ARo

8-17

D100	4303679	4x2 NAND	74HC00	SO-14
N160	4304426	Regulator	8 V 1 A 7808CP	T0-220
N20	4305652	D/A converter	MC144111	DIL-14
N30	4309576	Op. amplifier	4...16 V TLC27M21D	SO-8
D110	4309590	3 to 8 decoder	74HC4020N	SO-16
D90	4309632	Quad 2-in NAND	74HC08T	SO-14
D120	4309907	2 input Schm.trig.NAND	74HC132	SO-14
G10	4500822	Crystal	11.0592 MHz ± 30 ppm	
G100	4700236	Backup battery	BR 1225-1HC	
F130	5111307	Fuse	15 A 125 VDC	
	5400475	Socket strip	14 pole	
	5400509	Socket strip	4 pin	
X108	5414069	Pin strip	5 pole	
X105	5415689	Pin strip	13 pole	
X103	5416267	Pin strip	31 pole	
X104	5416274	Pin strip	3 pole	
X101	5416517	Modular jack	8 pole	
X102	5430399	D15 conn. angle	male	
	6500056	Comp. base	PKR40	
	7313027	Double sided tape	19 mm	
	9145258	Insulation		
	9851711	PC board NP5A		

PARTS LIST OF NN5A

R180	1412430	Chip resistor	10 k	5% 0.06 W
C180	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C181	2310713	Ceramic cap.	2.2 nF	20% chip
N180	4303077	EEPROM		128x8 bit 2us
	7133112	Flat cable		

NOKIA MOBILE PHONES

SYNTHESIZER MODULE NS2R

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9-1

ASSOCIATED DOCUMENTATION

3B 0176861 circuit diag. synthesizer
3B 0176861 circuit diag. Transmitter VCO
4F 9853211 layout diagrams

INTRODUCTION OF THE NS2R MODULE

Brief Introduction of the NS2R Module

The NS2R is the synthesizer module including TX-VCO for the NMT 450 -system. NS2R generates, with VCO - circuits on the NR2R board, the injection frequency for the receiver and with its inboard VCO the modulated frequency for the transmitter.

TECHNICAL SPECIFICATION OF THE NS2R MODULE

Modes of Operation of the NS2R Module

Supply voltage for the TX-branch synthesizer is switchable via TSON - control line, refer to 3.1

Supply Voltages and Power Consumption of the NS2R Module

Line	Voltage VDC	Current Nominal	Note
+8R	8 $\pm$ 0.25 VDC	3 mA	
+6/8	6 $\pm$ 0.30 VDC 8 $\pm$ 0.25 VDC	3 mA (9 mA TX on)	in portable use. in mobile use

Mechanical Characteristics of the NS2R Module

The NS2R synthesizer module is mounted together with the NR2R receiver module to chassis by five phillips-type screws.

Extreme Conditions of the NS2R Module

Temperature range: -25 - +80 C

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SYNTHESIZER MODULE NS2R

TMF-1XS

SERVICE

9224ARo

9-2

External Signals and Connections of the NS2R Module

Connector X501: to the processor module		
41	SMOD	Modulating audio signal input 415 mV(rms) generates ± 3.0 kHz deviation $Z_o < 5 \text{ k}\Omega$
42	TSEN	TX-synthesizer latch enable (*)
43	RSEN	RX-synthesizer latch enable (*)
44	SDA	Serial data (*)
45	SCL	Serial clock (*)
46	TSO	Transmitter synthesizer on/off Logic "1" during transmission
47	+6/8	+6 VDC (portable use) +8 VDC (mobile use)
48	TSLC	Loop speed control line, not used
49	AFC	Control voltage input for AFC function VCTCXO 0.1 - 5 VDC, $Z_o < 5 \text{ k}\Omega$, $Z_L > 22 \text{ k}\Omega$
50	+8R	Supply for synthesizer and receiver
51	RSSI	Receiver signal strength indication
52	DAF	Audio output 120 mVrms (± 3.0 kHz deviation)
53	455k	455 kHz frequency to the AFC counter

Connector X507: to the receiver module		
1	455k	455 kHz frequency to the AFC counter
2	DAF	Audio output 120 mVrms (± 3.0 kHz deviation)
3	RSSI	Receiver signal strength indication
4	+8R	Supply for synthesizer and receiver
5	GND	Ground

NOKIA MOBILE PHONES

SYNTHESIZER MODULE NS2R

TMF-1XS

SERVICE

9224ARo

9-3

Connector X504: to the VCO of the receiver module		
1	PLLR	RF feedback from RX-VCO -2 dBm (± 3 dBm) $Z = 50 \Omega$, SWR < 2
2	GND	Ground
3	+8R	8 VDC power supply for RX-VCO
4	GND	Ground
5	PCR	Control voltage to RX-VCO range 2.5 - 6.5 VDC nominal 3.5 VDC at channel 500

FUNCTIONAL DESCRIPTION OF THE NS2R MODULE

Circuit Description

The circuits can be divided into functional stages in the following way, which relates to the part numbering system used:

	Component numbers
- Voltage regulators, power supply, etc.	500-509
- RX-synthesizer	510-519
- RX-loop filter	520-529
- TX-synthesizer	530-539
- TX-loop filter	540-549
- Audio filter	550-559
- TX-VCO and buffer states	600-630

VOLTAGE REGULATORS, POWER SUPPLY

Supply voltages for synthesizer circuits, VCTCX0 and TX-VCO are regulated by two independent circuits V500, V501, V502 and V503, V504, V505.

+6/8 supply voltage from processor unit - 6 VDC from switching regulator in portable and 8 VDC in mobile use - is stabilized using the voltage at +8R line as reference. Output voltages of regulators should be adjusted to 5.0 VDC (R502).

TSON -line controls the TX-branch supply voltage regulator by switching transistor V506 off when transmitter is not in use. Active loop filter is connected direct to +8R. When N530 is turned off V541 doesn't conduct and current through the whole loop filter is zero.

NOKIA MOBILE PHONES

SYNTHESIZER MODULE NS2R

TMF-1XS

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9224ARo

9-4

REFERENCE OSCILLATOR

The reference frequency for the PLL circuit is obtained from a 12.800 MHz temperature compensated voltage controlled crystal oscillator G500 (VCTCXO).

VCTXO has control voltage input for AFC function. When control voltage has value 3 VDC oscillator frequency should be correct. Frequency of the output signal can be changed ± 6 ppm with adjusting control voltage AFC ± 2 V.

RECEIVER BRANCH

The injection frequency is 21.4 MHz above the RX frequency of the corresponding channel.

The injection frequency is generated by a digital phase-locked loop, which is composed of VCO - on receiver board NR2C - synthesizer (N510) and loop filter (V521).

The frequency is determined with the resonant circuit on NR2C. The feedback frequency from VCO (PLL) is fed to synthesizer N510 via connector X504.

The internal dividers in synthesizer chip N510 constitute a divider chain. The overall divisor of it is selected according to the desired channel.

The internal dividers of N510 after its prescaler circuit are programmed with 19 bits (18 bits are used) which are transferred serially on the SDA-line from the processor module into a shift register in N510 (N 11 bit and A 7 bit). The last one is a control bit. N and A latches are activated, if the control bit is at a logic low state. The data transfer is timed with SCL clock pulses. After the transfer the RSEN line goes high and the data is latched into N510.

The internal reference frequency of the synthesizer is 12.5 kHz. It is obtained from a 12.8 MHz reference frequency of VCTCXO dividing it by 1024. This value is written to the reference divider latches, which are activated, if the control bit of the word is at a logical high state.

The outputs of the phase detector (R) are the pin 15 and 16. The detector gives out 5 V or 0 V pulses, the duration of which depends on the phase difference between the input frequencies.

The charge supplied to active integrator V520 for both pulses is balanced to be equal by resistors R520, R521 and a diode V520. After the integrator there is a low pass filter - R524-526, C524-526. The control voltage is supplied to VCO in line PCR of connector X504.

NOKIA MOBILE PHONES

SYNTHESIZER MODULE NS2R

TMF-1XS

SERVICE

9224ARo

9-5

TRANSMITTER BRANCH

The transmission frequency is generated by a phase-locked loop similar to the one in receiver branch - except that TX-VCO is on synthesizer board NS2R.

The VCO voltage is between 2.5 and 6.5 volts. The nominal level of the VCO voltage at the channel 500 is about 4.5 V. Hole range of the control voltage is typically 2.0 ± 0.5 V.

The output frequency of the loop - which is the same as the channel frequency to be sent - is determined with the resonant circuit, which comprises coaxial resonator L601, capacitance diodes V601, V602 and capacitors C603, C604, C606, C607, C611

From the VCO the signal is fed to the buffer amplifiers V605-V607, which provide the 6 ± 2 dBm level required by the transmitter. After the buffer stages there is a helix-type band pass filter, which improves the noise figure of the output signal.

The modulation is performed by connecting the audio signal to the anodes of the capacitance diodes V602 and V603.

TSLG (transmitter synthesizer loop gain) -line is not used, instead of it a very light (1 dB at 340 Hz) high pass filter - a 100 nF capacitor on the audio board and resistors R550 - R552. C550, C551 with mentioned resistors constitutes a low pass filter witch reduces noise on the SMOD-line. The deviation is adjusted with trimmer R601.

TEST POINTS

Supply voltages at collectors of V500 and V503 (test point T500) should be same (5.0 VDC).

Supply voltage of the synthesizers (pin 4) should be about 0.2 VDC lower than at test point T500.

DC-level at test point T520 should be about 7.8 VDC when receiver board not connected.

AFC drive voltage at pin 4 of VCTX0 should be 3.0 ± 0.2 VDC.

Following checking with an oscilloscope is recommended to make: A signal of 2.7 VDC and at least 1.0 VAC (peak to peak) should exist at the pins 1 of the synthesizers. ($f = 12.8$ MHz).

At pins 13 and 14 a narrow square pulse at frequency of 12.5 kHz should be observed.

If the receiver board NR2C is not connected, the pin 14 of RX-synthesizer (N510) can't be measured.

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9-6

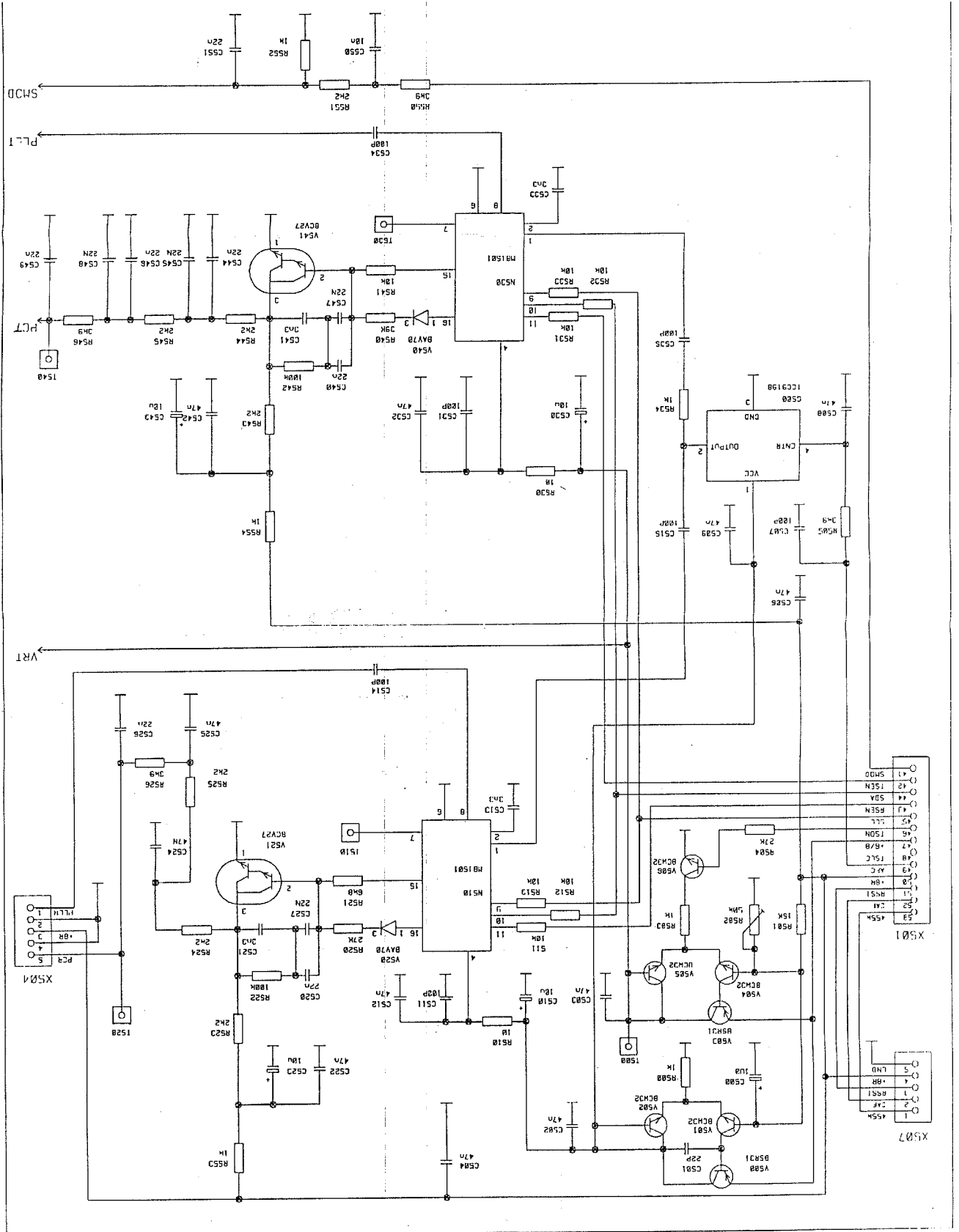
SYNTHESIZER MODULE NS2R

9224AR0

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CIRCUIT DIAGRAMS OF THE SYNTHESIZER NS2R



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9-7

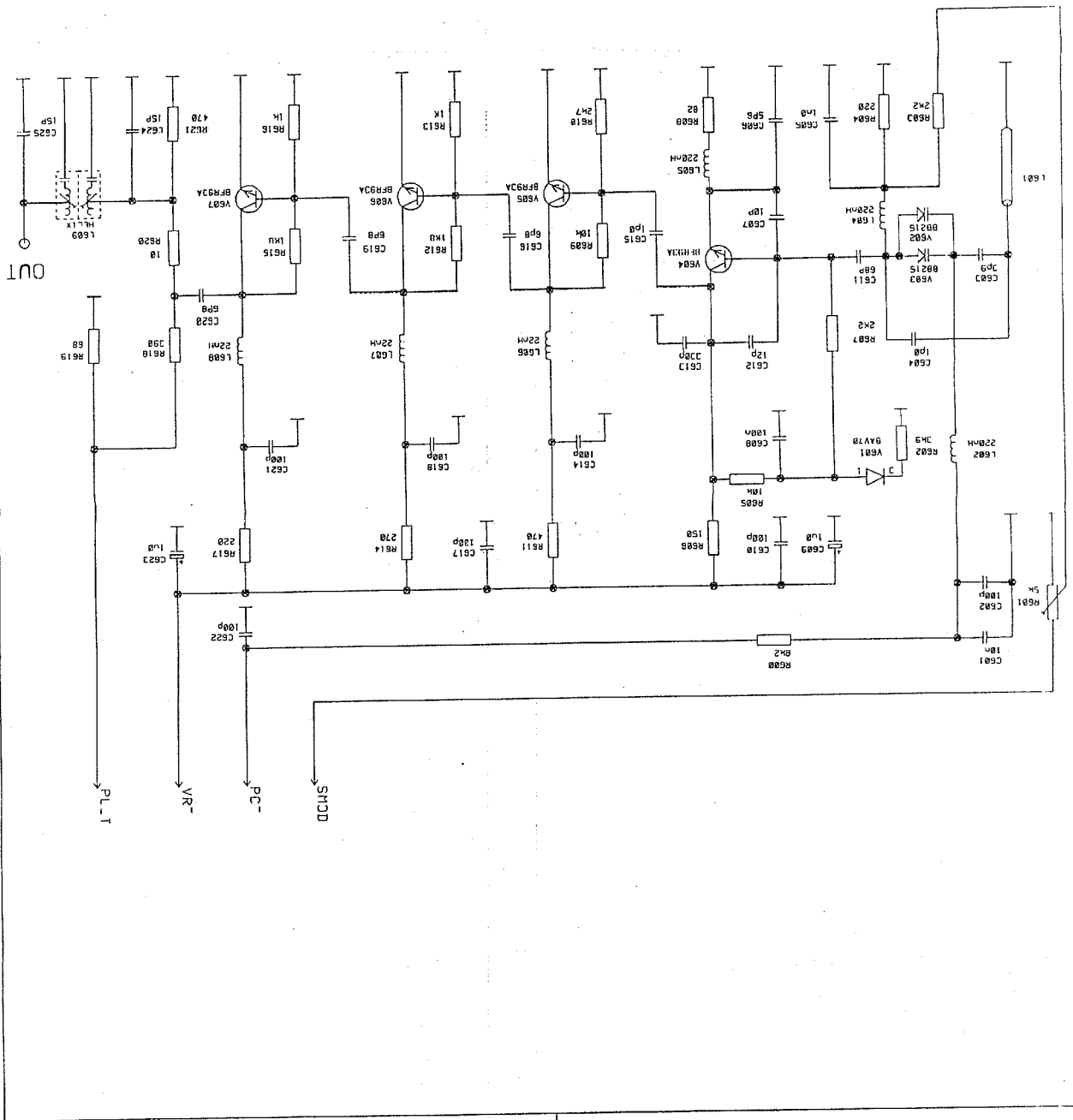
SYNTHESIZER MODULE NS2R

9224AR0

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CIRCUIT DIAGRAMS OF TRANSMITTER VCO OF NS2R

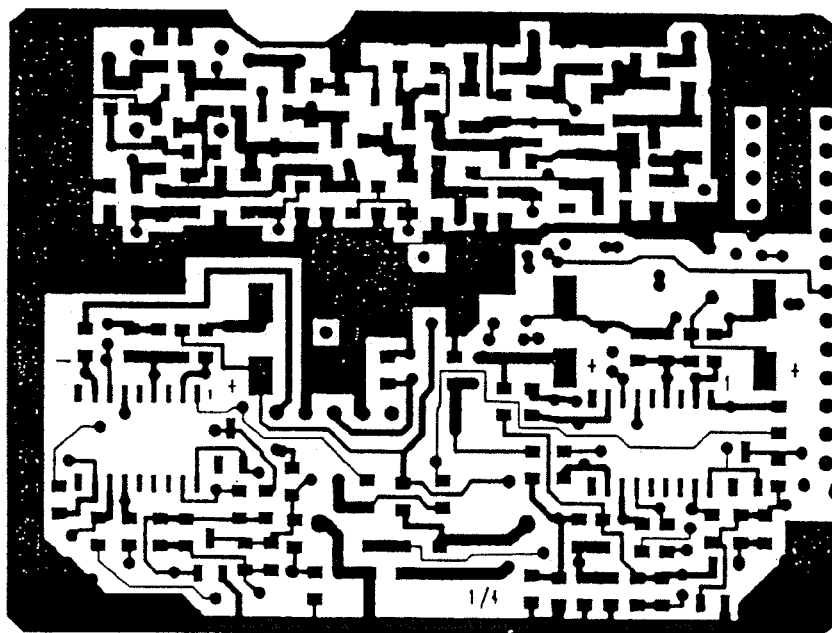


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9-8



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SYNTHESIZER MODULE NS2R

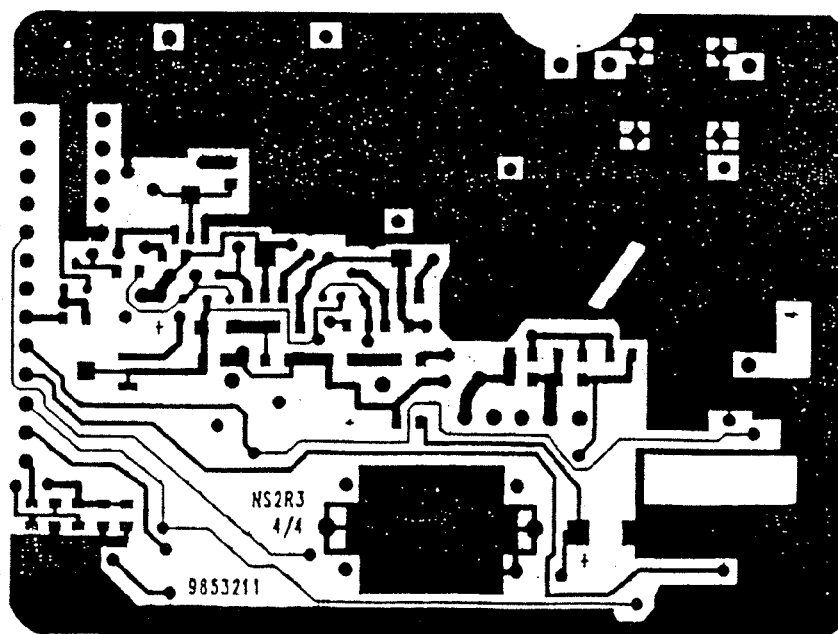
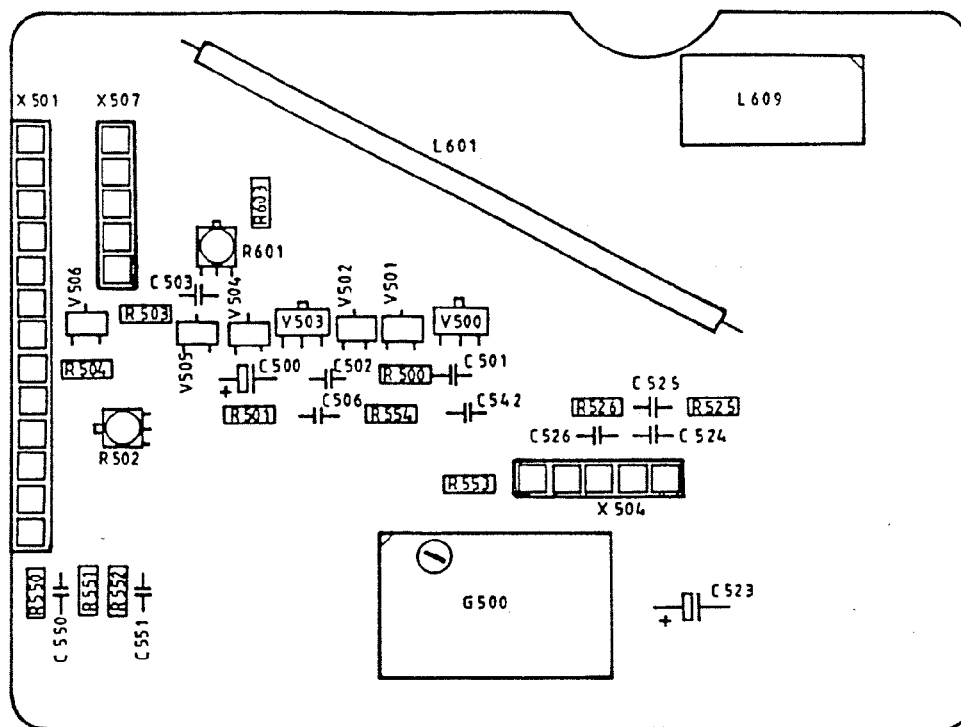
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9-9

LAYOUT DIAGRAMS OF NS2R



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SYNTHESIZER MODULE NS2R

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9-10

PARTS LIST OF NS2R

ITEM	CODE	DESCRIPTION	VALUE	DATA
R608	1412222	Chip resistor	82	5 % 0.063 W 0805
R614	1412254	Chip resistor	270	5 % 0.063 W 0805
R611	1412310	Chip resistor	470	5 % 0.063 W 0805
R621	1412310	Chip resistor	470	5 % 0.063 W 0805
R500	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R503	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R534	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R552	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R553	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R554	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R613	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R616	1412335	Chip resistor	1 k	5 % 0.063 W 0805
R523	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R524	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R525	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R543	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R544	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R545	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R551	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R603	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R607	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R511	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R512	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R513	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R531	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R532	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R533	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R541	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R605	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R609	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R610	1412448	Chip resistor	2.7 k	5 % 0.063 W 0805
R505	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R526	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R546	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R550	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R602	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R504	1412609	Chip resistor	27 k	5 % 0.063 W 0805
R520	1412609	Chip resistor	27 k	5 % 0.063 W 0805
R522	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R542	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R510	1413829	Chip resistor	10	5 % 0.063 W 0805
R530	1413829	Chip resistor	10	5 % 0.063 W 0805
R620	1413829	Chip resistor	10	5 % 0.063 W 0805
R619	1413909	Chip resistor	68	5 % 0.063 W 0805
R606	1413917	Chip resistor	150	5 % 0.063 W 0805
R604	1413924	Chip resistor	22	5 % 0.063 W 0805
R617	1413924	Chip resistor	220	5 % 0.063 W 0805
R600	1414036	Chip resistor	8.2 k	5 % 0.063 W 0805
R612	1414043	Chip resistor	1.8 k	5 % 0.063 W 0805
R615	1414043	Chip resistor	1.8 k	5 % 0.063 W 0805
R501	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R540	1414117	Chip resistor	39 k	5 % 0.063 W 0805

NOKIA MOBILE PHONES

SYNTHESIZER MODULE NS2R

TMF-1XS

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9-11

R618	1414332	Chip resistor	390	5 % 0.063 W	0805
R521	1414413	Chip resistor	6.8 k	5 % 0.063 W	0805
R601	1706906	Trimm. resistor	5 k	EVM 07S X00	B53
R502	1706920	Trimm. resistor	50 k	EVM 07S X00	B54
C502	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C503	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C504	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C506	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C508	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C509	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C512	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C522	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C524	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C525	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C532	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C542	2307816	Chip cer. cap	47 n	X7R 25V 20%	0805
C604	2309806	Chip cer. cap	1.0 p	NP0 5%	0805
C615	2309806	Chip cer. cap	1.0 p	NP0 5%	0805
C603	2309877	Chip cer. cap	3.9 p	NP0 5%	0805
C606	2309891	Chip cer. cap	5.6 p	NP0 5%	0805
C616	2309901	Chip cer. cap	6.8 p	NP0 5%	0805
C619	2309901	Chip cer. cap	6.8 p	NP0 5%	0805
C620	2309901	Chip cer. cap	6.8 p	NP0 5%	0805
C607	2310304	Chip cer. cap	10 p	NP0 5%	0805
C612	2310311	Chip cer. cap	12 p	NP0 5%	0805
C624	2310329	Chip cer. cap	15 p	NP0 5%	0805
C625	2310329	Chip cer. cap	15 p	NP0 5%	0805
C501	2310343	Chip cer. cap	22 p	NP0 5%	0805
C611	2310409	Chip cer. cap	68 p	NP0 5%	0805
C507	2310424	Chip cer. cap	100 p	NP0 5%	0805
C511	2310424	Chip cer. cap	100 p	NP0 5%	0805
C514	2310424	Chip cer. cap	100 p	NP0 5%	0805
C515	2310424	Chip cer. cap	100 p	NP0 5%	0805
C531	2310424	Chip cer. cap	100 p	NP0 5%	0805
C534	2310424	Chip cer. cap	100 p	NP0 5%	0805
C535	2310424	Chip cer. cap	100 p	NP0 5%	0805
C602	2310424	Chip cer. cap	100 p	NP0 5%	0805
C610	2310424	Chip cer. cap	100 p	NP0 5%	0805
C614	2310424	Chip cer. cap	100 p	NP0 5%	0805
C617	2310424	Chip cer. cap	100 p	NP0 5%	0805
C618	2310424	Chip cer. cap	100 p	NP0 5%	0805
C621	2310424	Chip cer. cap	100 p	NP0 5%	0805
C622	2310424	Chip cer. cap	100 p	NP0 5%	0805
C613	2310488	Chip cer. cap	330 p	NP0 5%	0805
C605	2310544	Chip cer. cap	1.0 p	NP0 5%	0805
C513	2310720	Chip cer. cap	3.3 n	X7R 25V 20%	0805
C521	2310720	Chip cer. cap	3.3 n	X7R 25V 20%	0805
C533	2310720	Chip cer. cap	3.3 n	X7R 25V 20%	0805
C541	2310720	Chip cer. cap	3.3 n	X7R 25V 20%	0805
C550	2310752	Chip cer. cap	10 n	X7R 25V 20%	0805
C601	2310752	Chip cer. cap	10 n	X7R 25V 20%	0805
C520	2310777	Chip cer. cap	22 n	X7R 25V 20%	0805
C526	2310777	Chip cer. cap	22 n	X7R 25V 20%	0805
C527	2310777	Chip cer. cap	22 n	X7R 25V 20%	0805
C540	2310777	Chip cer. cap	22 n	X7R 25V 20%	0805
C544	2310777	Chip cer. cap	22 n	X7R 25V 20%	0805

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SYNTHESIZER MODULE NS2R

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9-12

C545	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C546	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C547	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C548	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C549	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C551	2310777	Chip cer. cap	22 n	X7R 25V 20% 0805
C608	2310784	Chip cer. cap	100 n	X7R 25V 20% 0805
C500	2604209	Chip tant. cap	1 u	20 % 16 V
C609	2604209	Chip tant. cap	1 u	20 % 16 V
C623	2604209	Chip tant. cap	1 u	20 % 16 V
C510	2604431	Chip tant. cap	10 u	20 % 16 V
C523	2604431	Chip tant. cap	10 u	20 % 16 V
C530	2604431	Chip tant. cap	10 u	20 % 16 V
C543	2604431	Chip tant. cap	10 u	20 % 16 V
L609	3600253	Helix		NEOSID
L606	3608029	Chip coil	22 nH	10%
L607	3608029	Chip coil	22 nH	10%
L608	3608029	Chip coil	22 nH	10%
L602	3608301	Chip coil	220 nH	10%
L604	3608301	Chip coil	220 nH	10%
L605	3608301	Chip coil	220 nH	10%
V520	4100278	Chip diode	BAV70	SOT-23
V540	4100278	Chip diode	BAV70	SOT-23
V601	4100278	Chip diode	BAV70	SOT-23
V602	4108389	Cap diode	BB215	SOD-80
V603	4108389	Cap diode	BB215	SOD-80
V521	4200226	Transistor	BCV27	SOT-23
V541	4200226	Transistor	BCV27	SOT-23
V604	4200709	Transistor	BFR93A	SOT-23
V605	4200709	Transistor	BFR93A	SOT-23
V606	4200709	Transistor	BFR93A	SOT-23
V607	4200709	Transistor	BFR93A	SOT-23
V500	4200804	Transistor	BSR31	SOT-89
V503	4200804	Transistor	BSR31	SOT-89
V501	4200917	Transistor	BCW32	SOT-23
V502	4200917	Transistor	BCW32	SOT-23
V504	4200917	Transistor	BCW32	SOT-23
V505	4200917	Transistor	BCW32	SOT-23
V506	4200917	Transistor	BCW32	SOT-23
N510	4305145	IC	MB1501	SO-16
N530	4305145	IC	MB1501	SO-16
G500	4505757	VCTCX0	TCO-919B	
X501	5413900	Connector		Connector body 13 pin
X504	5413932	Connector		Connector body 5 pin
X506	5413932	Connector		Connector body 5 pin
	5422635	RF connector		50 mangl+inj cable TX
L601	7130637	Resonator		l =55mm imp =75 OHM
	9143740	Lock plate		
	9853211	PC board NS2R		

NOKIA MOBILE PHONES

RECEIVER MODULE NR2C

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10-1

ASSOCIATED DOCUMENTATION

3B 0200103 circuit diagram receiver
 3B 0200103 circuit diagram RX-VCO
 4F 9853854 layout diagrams

INTRODUCTION OF THE NR2C MODULE

Brief Introduction of the NR2C Module

The NR2C is a 450 MHz receiver including RX-VCO for the NMT 450-system.

TECHNICAL SPECIFICATIONS OF THE NR2C MODULE

Supply Voltages and Power Consumption of the NR2C Module

Connector X705/4 (+8R) supply for receiver circuits

- Voltage 8 VDC ± 0.25 VDC
- Current consumption
 - * normal 23 mA
 - * extreme 30 mA

Connector X405/3 (+8V) supply for RX-VCO circuit

- Voltage 8 VDC ± 0.25 VDC
- Current consumption
 - * normal 20 mA
 - * extreme 25 mA

Mechanical Characteristics of the NR2C Module

The NR2C receiver module is mounted together with the NS2R synthesizer module to chassis by five phillips-type screws.

Extreme Conditions of the NR2C Module

Temperature range: $-25...+80^{\circ}\text{C}$

External Signals and Connections of the NR2C Module

Connector X700 from duplex filter 462.500 - 466.975 MHz		
+8 dBm	Injection frequency from RX-VCO 483.900 - 488.375 MHz	

Connector X705: from the processor module (via NS2R module)		
5	GND	Ground
4	+8R	+8 V supply
3	RSSI	Receiver signal strength 1.0 - 4.5 V (-120 ... -45 dBm)
2	DAF	Audio output 120 mVrms (± 3.0 kHz deviation)
1	455k	455 kHz output 675 mVpp ± 25 mV

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RECEIVER MODULE NR2C

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10-2

Connector X405: from the synthesizer module		
5	PCR	Control voltage from synthesizer normal 2.5 - 6.5 VDC
4	GND	Ground
3	+8R	8 VDC power supply for RX-VCO,
2	GND	Ground
1	PLL	RF feedback to synthesizer -2 dBm $\pm$ 3 dB Z = 50 Ω , SWR < 2

FUNCTION DESCRIPTION OF THE NR2C MODULE

Circuit Description of the NR2C Module

The circuitry can be divided into functional stages in the following way, which relates to the used numbering system :

- | | |
|----------------------------|-----------|
| - RF stage | Component |
| - First IF stage | 700 - |
| - Second IF | |
| - Detector | |
| - Level detector | |
| - 455 kHz reference signal | |
| - RX-VCO and buffer stages | 500 - |

RF STAGE

RF signal comes through the duplex filter to the front end amplifier V701. After the amplifier there is the helix type band-pass filter (L701).

FIRST IF STAGE

The first IF 21.4 MHz is produced by mixing to the received frequency and the injection frequency coming from the RX-VCO, in the mixer N700.

The first intermediate frequency is amplified by transistor V703.

The selectivity of the receiver is determined by crystal filter Z701. Its impedance is matched by the R713, C714, L705, C715 and C716. From the crystal filter the signal is fed to the second mixer N701. The matching circuits of the crystal filter have two tunable elements (C716 and L706) in order to allow tuning for minimum audio distortion.

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RECEIVER MODULE NR2C

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10-3

SECOND IF

N701 is a double balanced mixer which gets the injection frequency (20.945 MHz) from the G700. The frequency of the second IF is 445 kHz

DETECTOR

Second IF, 455 kHz, is fed through ceramic filter Z702 to detector circuits N702. Resonance circuits needed in quadrature detector is provided by L707.

The audio output is obtained at pin 6 and applied via transistor V706 to connector X705 pin DAF. The level of audio signal can be tuned with resistor R724.

LEVEL DETECTOR (RSSI)

FM detector circuits N702 contains an amplifier which gives the voltage proportional to the received signal strength. The DC signal is applied to connector X705 pin RSSI.

455 KHZ REFERENCE SIGNAL

The second intermediate frequency 455 kHz used by AFC function is taken from the detector N702. Signal is applied via an amplifier V707 to connector X705 pin 455. The AFC will lock the transmitter frequency of the mobile to the frequency received from the base station. Due to this high TX frequency stability is obtained during a call.

RX-VCO AND BUFFER STAGES

RF injection frequency is generated by a phase-locked loop similar to the one in transmission branch, which lays on the synthesizer module.

The injection frequency of the loop - which is the 21.4 MHz upper than the received frequency - is determined with resonant circuit, which comprises coaxial resonator L400, capacitance diodes V401, V402 and capacitors C402, C403, C407, C408, C409.

From the VCO the signal is fed to the buffer amplifiers V406 and V407, which provide the $+8 \text{ dBm} \pm 2 \text{ dB}$ level required by the receive.

VCO voltage range is between 4V and 5V. At channel 0181 (462.500 MHz) the control voltage is more than 2.5 V, at channel 0180 (464.975 MHz) it is less than 6.5 V. The difference between the lowest and highest voltage is nominally $2 \text{ V} \pm 0.5 \text{ V}$.

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RECEIVER MODULE NR2C

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10-4

TESTING INSTRUCTIONS OF THE NR2C MODULE

Supply voltages of X405/3 and X705/4 should be $8 \text{ VDC} \pm 0.25 \text{ VDC}$.

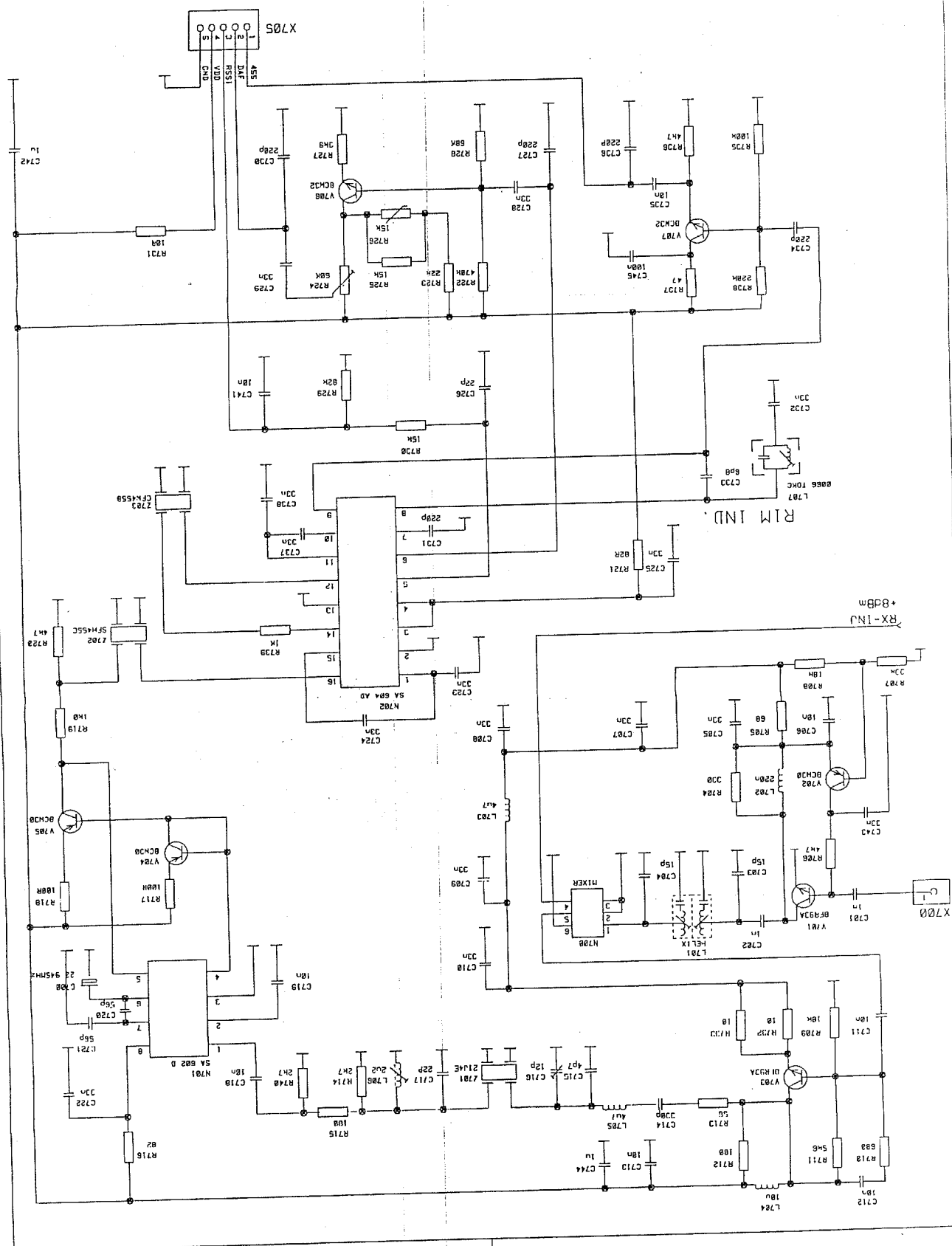
Voltage in PCR-line, X405/5, should be 4 - 5 VDC when middle channel selected.

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CIRCUIT DIAGRAMS OF NR2C



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10-6

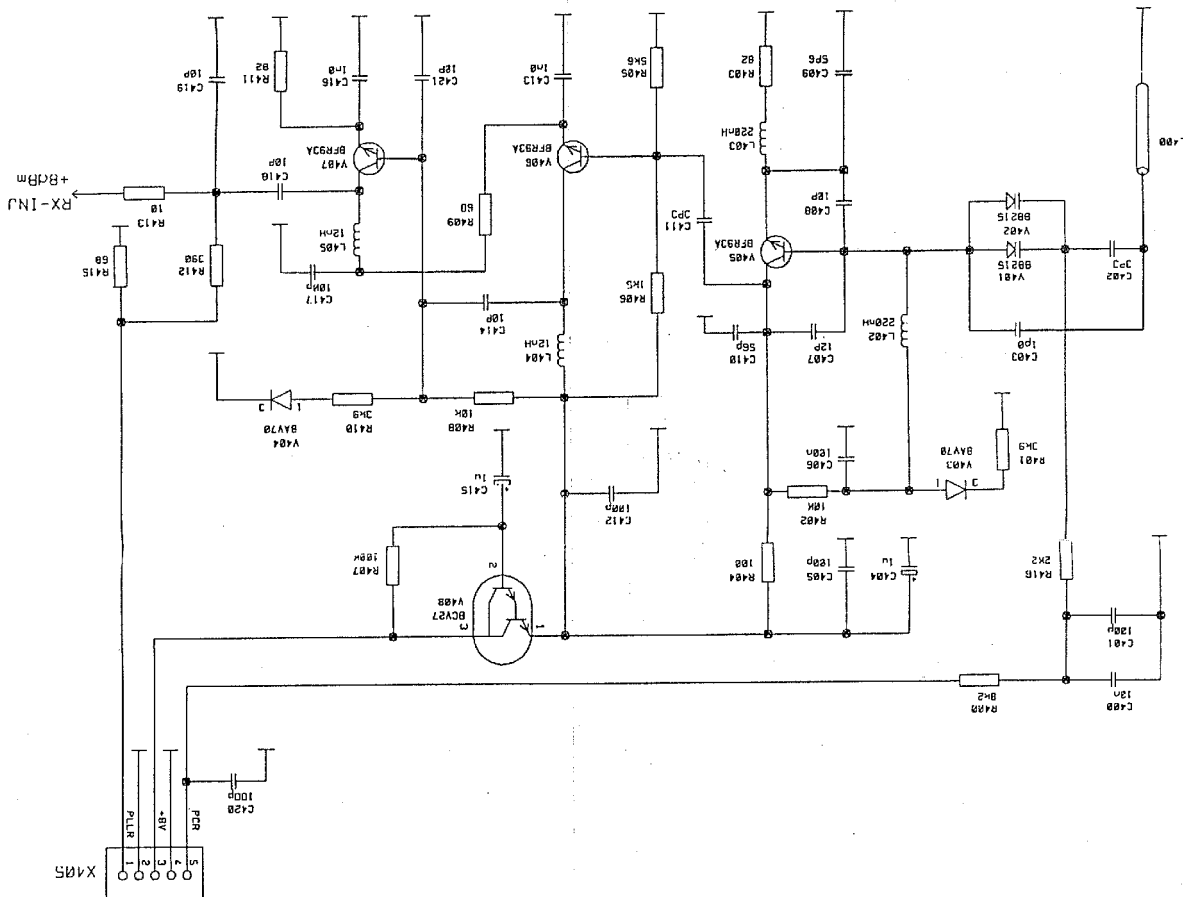
RECEIVER MODULE NR2C

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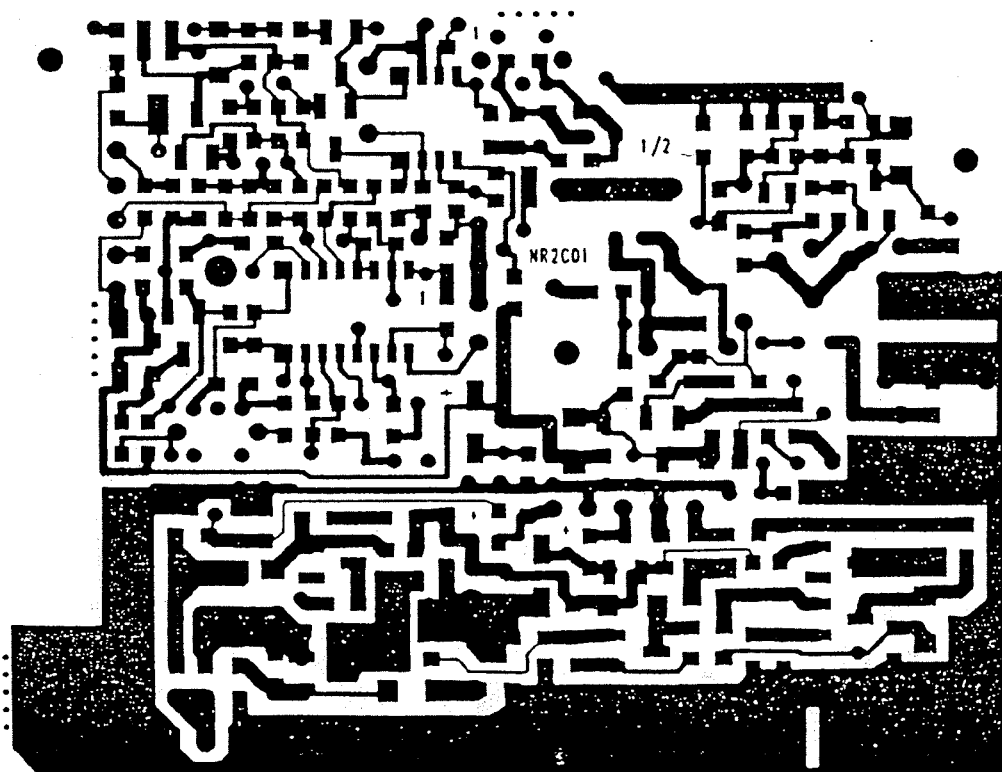
CIRCUIT DIAGRAMS OF RX-VCO



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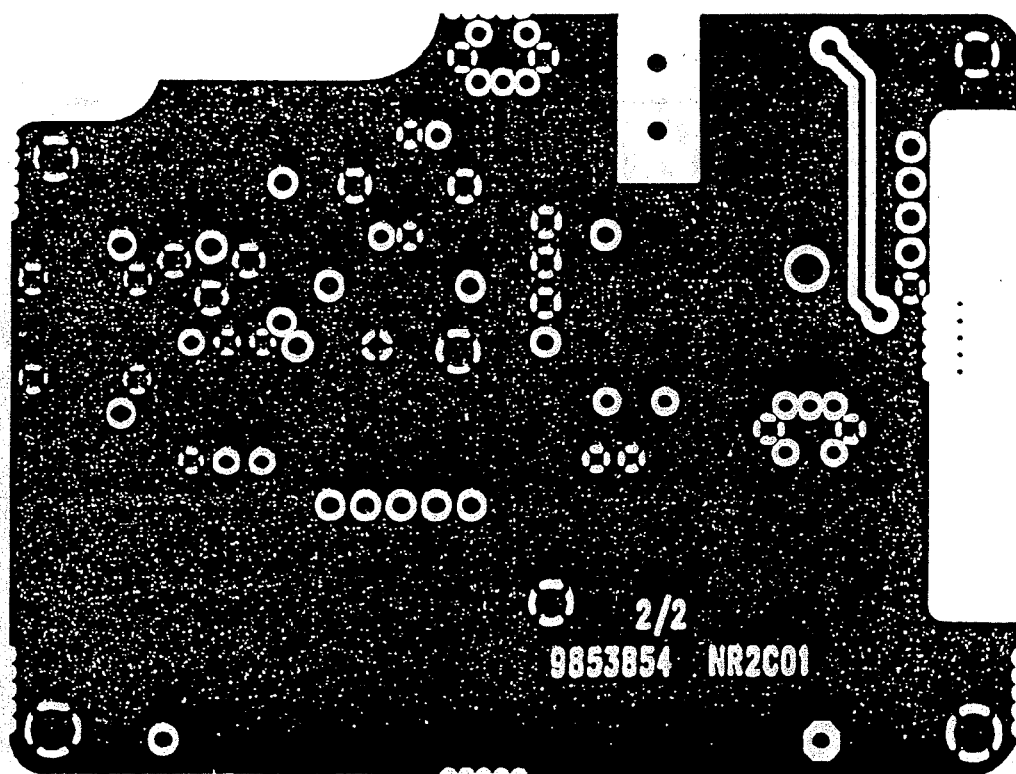
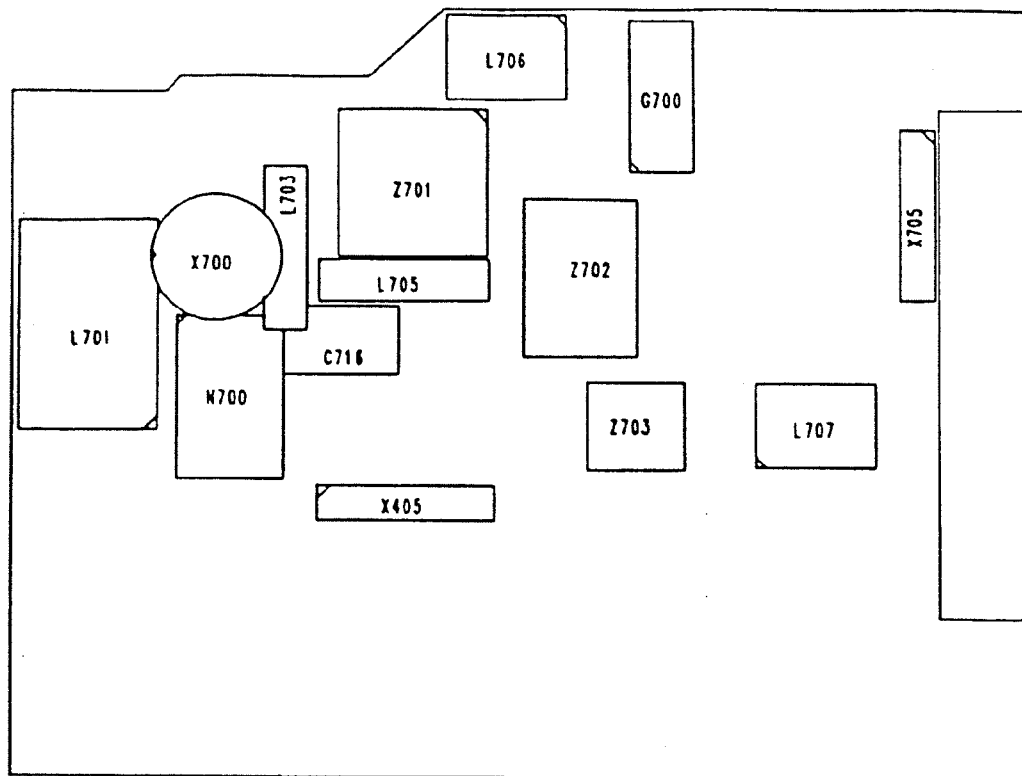
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10-8

LAYOUT DIAGRAMS OF NR2C



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RECEIVER MODULE NR2C

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10-9

PARTS LIST OF NR2C

ITEM	CODE	DESCRIPTION	VALUE	DATA
R713	1412198	Chip resistor	56	5 % 0.063 W 0805
R403	1412222	Chip resistor	82	5 % 0.063 W 0805
R411	1412222	Chip resistor	82	5 % 0.063 W 0805
R716	1412222	Chip resistor	82	5 % 0.063 W 0805
R721	1412222	Chip resistor	82	5 % 0.063 W 0805
R712	1412247	Chip resistor	180	5 % 0.063 W 0805
R715	1412247	Chip resistor	180	5 % 0.063 W 0805
R404	1412261	Chip resistor	100	5 % 0.063 W 0805
R717	1412261	Chip resistor	100	5 % 0.063 W 0805
R718	1412261	Chip resistor	100	5 % 0.063 W 0805
R704	1412303	Chip resistor	330	5 % 0.063 W 0805
R719	1412335	Chip resistor	1 k	5 % 0.065 W 0805
R739	1412335	Chip resistor	1 k	5 % 0.065 W 0805
R406	1412409	Chip resistor	1.5 k	5 % 0.063 W 0805
R416	1412416	Chip resistor	2.2 k	5 % 0.063 W 0805
R706	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R720	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R736	1412423	Chip resistor	4.7 k	5 % 0.063 W 0805
R402	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R408	1412430	Chip resistor	10 k	5 % 0.063 W 0805
R714	1412448	Chip resistor	2.7 k	5 % 0.063 W 0805
R740	1412448	Chip resistor	2.7 k	5 % 0.063 W 0805
R401	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R410	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R727	1412455	Chip resistor	3.9 k	5 % 0.063 W 0805
R708	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R709	1412511	Chip resistor	18 k	5 % 0.063 W 0805
R723	1412536	Chip resistor	22 k	5 % 0.063 W 0805
R707	1412729	Chip resistor	33 k	5 % 0.063 W 0805
R734	1412729	Chip resistor	33 k	5 % 0.063 W 0805
R728	1413610	Chip resistor	68 k	5 % 0.063 W 0805
R729	1413628	Chip resistor	82 k	5 % 0.063 W 0805
R407	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R735	1413635	Chip resistor	100 k	5 % 0.063 W 0805
R738	1413716	Chip resistor	220 k	5 % 0.063 W 0805
R722	1413723	Chip resistor	470 k	5 % 0.063 W 0805
R413	1413829	Chip resistor	10	5 % 0.063 W 0805
R731	1413829	Chip resistor	10	5 % 0.063 W 0805
R732	1413829	Chip resistor	10	5 % 0.063 W 0805
R733	1413829	Chip resistor	10	5 % 0.063 W 0805
R737	1413836	Chip resistor	47	5 % 0.063 W 0805
R409	1413909	Chip resistor	68	5 % 0.063 W 0805
R415	1413909	Chip resistor	68	5 % 0.063 W 0805
R705	1413909	Chip resistor	68	5 % 0.063 W 0805
R710	1414004	Chip resistor	680	5 % 0.063 W 0805
R400	1414036	Chip resistor	8.2 k	5 % 0.063 W 0805
R725	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R730	1414109	Chip resistor	15 k	5 % 0.063 W 0805
R412	1414332	Chip resistor	390	5 % 0.063 W 0805
R405	1414406	Chip resistor	5.6 k	5 % 0.063 W 0805
R711	1414406	Chip resistor	5.6 k	5 % 0.063 W 0805
R724	1706864	Trimmer resistor	50 k	25 %

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RECEIVER MODULE NR2C

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10-10

R726	1800619	NTC-resistor	15 k	CIAN37 FSH11206
C403	2309806	Ceramic cap.	1.0 p	NPO 5 % 0805
C411	2309869	Ceramic cap.	3.3 p	NPO 5 % 0805
C402	2309869	Ceramic cap.	3.3 p	NPO 5 % 0805
C715	2309884	Ceramic cap.	4.7 p	X7R 20 % 0805
C409	2309891	Ceramic cap.	5.6 p	NPO 5 % 0805
C733	2309901	Ceramic cap.	6.8 p	NPO 5 % 0805
C409	2309919	Ceramic cap.	8.2 p	NPO 5 % 0805
C408	2310304	Ceramic cap.	10 p	NPO 5 % 0805
C414	2310304	Ceramic cap.	10 p	NPO 5 % 0805
C418	2310304	Ceramic cap.	10 p	NPO 5 % 0805
C419	2310304	Ceramic cap.	10 p	NPO 5 % 0805
C421	2310304	Ceramic cap.	10 p	NPO 5 % 0805
C407	2310311	Ceramic cap.	12 p	NPO 5 % 0805
C703	2310329	Ceramic cap.	15 p	NPO 5 % 0805
C704	2310329	Ceramic cap.	15 p	NPO 5 % 0805
C421	2310343	Ceramic cap.	22 p	NPO 5 % 0805
C726	2310343	Ceramic cap.	22 p	NPO 5 % 0805
C717	2310343	Ceramic cap.	22 p	NPO 5 % 0805
C410	2310399	Ceramic cap.	56 p	NPO 5 % 0805
C720	2310399	Ceramic cap.	56 p	NPO 5 % 0805
C721	2310399	Ceramic cap.	56 p	NPO 5 % 0805
C401	2310424	Ceramic cap.	100 p	NPO 5 % 0805
C405	2310424	Ceramic cap.	100 p	NPO 5 % 0805
C412	2310424	Ceramic cap.	100 p	NPO 5 % 0805
C417	2310424	Ceramic cap.	100 p	NPO 5 % 0805
C420	2310424	Ceramic cap.	100 p	NPO 5 % 0805
C727	2310463	Ceramic cap.	220 p	NPO 5 % 0805
C730	2310463	Ceramic cap.	220 p	NPO 5 % 0805
C731	2310463	Ceramic cap.	220 p	NPO 5 % 0805
C734	2310463	Ceramic cap.	220 p	NPO 5 % 0805
C736	2310463	Ceramic cap.	220 p	NPO 5 % 0805
C714	2310488	Ceramic cap.	330 p	X7R 20 % 0805
C413	2310544	Ceramic cap.	1.0 n	NPO 5 % 0805
C416	2310544	Ceramic cap.	1.0 n	NPO 5 % 0805
C701	2310544	Ceramic cap.	1.0 n	NPO 5 % 0805
C702	2310544	Ceramic cap.	1.0 n	NPO 5 % 0805
C400	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C706	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C711	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C712	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C713	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C718	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C719	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C735	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C741	2310752	Ceramic cap.	10 n	X7R 20 % 0805
C406	2310784	Ceramic cap.	100 n	X7R 20 % 0805
C745	2310784	Ceramic cap.	100 n	X7R 20 % 0805
C705	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C707	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C708	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C709	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C710	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C722	2310791	Ceramic cap.	33 n	NPO 5 % 0805
C723	2310791	Ceramic cap.	33 n	X7R 20 % 0805
C724	2310791	Ceramic cap.	33 n	X7R 20 % 0805

NOKIA MOBILE PHONES

RECEIVER MODULE NR2C

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10-11

C725	2310791	Ceramic cap.	33 n	X7R 20 %0805	
C728	2310791	Ceramic cap.	33 n	X7R 20 %0805	
C729	2310791	Ceramic cap.	33 n	X7R 20 %0805	
C732	2310791	Ceramic cap.	33 n	X7R 20 % 0805	
C737	2310791	Ceramic cap.	33 n	X7R 20 %0805	
C738	2310791	Ceramic cap.	33 n	X7R 20 %0805	
C743	2310791	Ceramic cap.	33 n	X7R 20 % 0805	
C404	2604209	Tantalum cap.	1 u	20 % 16 V0805	
C415	2604209	Tantalum cap.	1 u	20 % 16 V0805	
C742	2604209	Tantalum cap.	1 u	CASEA	
C744	2604209	Tantalum cap.	1 u	CASEA	
C716	2700417	Trimmer capacit.		2.8-12.5 pF 100 V	
L701	3600253	Helix filter		NEOSID	
L703	3607114	Coil		4.7 uH 10 % 1.2 R	
L705	3607114	Coil		4.7 uH 10 % 1.2 R	
L707	3607509	Trimmer Coil	5MMC	0066 661UH 455kHz Q=100	TOKO
L706	3607643	Trimmer Coil		2.215 uH	
L404	3608012	Coil		12 nH 10 %	
L405	3608012	Coil		12 nH 10 %	
L402	3608301	Coil		220 nH 10 %	
L403	3608301	Coil		220 nH 10 %	
L702	3608301	Coil		220n	
L704	3608559	Coil		1206	
V403	4100278	Diode	BAV70	SOT-23	
V404	4100278	Diode	BAV70	SOT-23	
V401	4108389	Varactor diode		BB215 SOD-89	
V402	4108389	Varactor diode		BB215 SOD-89	
V408	4200226	Darlington trans		BCV27N 30 V, 0.3 A	
V405	4200709	Transistor	BFR93A	SOT-23	
V406	4200709	Transistor	BFR93A	SOT-23	
V407	4200709	Transistor	BFR93A	SOT-23	
V701	4200709	Transistor	BFR93A	SOT-23	
V703	4200709	Transistor	BFR93A	SOT-23	
V702	4200909	Transistor	BCW30	SOT-23	
V704	4200909	Transistor	BCW30	SOT-23	
V705	4200909	Transistor	BCW30	SOT-23	
V706	4200917	Transistor	BCW32	SOT-23	
V707	4200917	Transistor	BCW32	SOT-23	
N702	4306342	IF-circuit	SA604AD	SIGNETICS	
N701	4306367	IF-circuit	SA602D	SIGNETICS	
N700	4351313	Mixer	MCL ASK-1	MINI-CIRCUITS	
Z702	4500124	Ceramic filter	SFH455C	MURATA	
G700	4502217	Crystal		SAL8 20.945 MHz	
Z703	4505796	Ceramic filter	CFW455C	MURATA	
Z701	4505852	Crystal filter	21J4E	TOYOCOM	
X700	5407142	RF-connector		HIROSE	
X405	5413890	Connector		1 x 5 POLE	
X705	5413890	Connector		1 x 5 POLE	
L400	9780015	Resonator		1 = 67 mm imp = 75 ohm	
	9143740	Lock plate			
	9853854	PC board NR2C			

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TRANSMITTER MODULE NT2R

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11-1

ASSOCIATED DOCUMENTATION

3B 0176847 circuit diagram of NT2R
4F 9853194 layout diagrams of NT2R

INTRODUCTION OF THE NT2R MODULE

Brief Introduction of the NT2R Module

The NT2R is a 450 MHz power amplifier of the transmitter.

Functional blocks

The NT2R consists of a pc-board containing driver and power control circuitry and an RF-power hybrid.

TECHNICAL SPECIFICATIONS OF THE NT2R MODULE

Supply Voltages and Power Consumption

Connector X801/1,2 (+12 BT) supply for the transmitter

- * Voltage 13.2 VDC $\pm$ 2.4 VDC
- * Current consumption:

	normal	extreme
TX on		
TX off		

Power output

Limits with duplex-filter:

Normal conditions	Extreme conditions
7.0 W $\pm$ 1.0 dB	7.0 W +1.5/-2.5 dB
1.25 W $\pm$ 1.0 dB	1.25 W +1.5/-2.5 dB
0.125 W $\pm$ 1.0 dB	0.125 W +1.5/-2.5 dB

Mechanical Characteristics of the NT2R Module

The NT2R transmitter module pc-board is mounted to the chassis by five phillips-type M3-screws, one of which is common with the power hybrid. The power hybrid is fastened to the chassis at both ends.

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TRANSMITTER MODULE NT2R

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11-2

Extreme Conditions of the NT2R Module

Temperature range: $-25^{\circ}\text{C} \dots +80^{\circ}\text{C}$ (operating)
 Supply voltage range: 10.8...15.6 V

External Signals and Connections of the NT2R Module

Connector X806 RF-input from the synthesizer (50 Ω)
level +8 dBm ± 2 dB

Connector X800 RF-output to the duplex filter (50 Ω)
High level
Medium level
Low level

Connector X801 from the processor module		
1	12BT	supply voltage 10.8...15.6 V
2	12BT	supply voltage 10.8...15.6 V
3	12T	supply voltage, when TX on ; 0 V, TX off
4	PC	power control, 0.1...6.3 V
5	PFB	power feed back, 0...5 V

FUNCTION DESCRIPTION OF THE NT2R MODULE

Circuit Description of the NT2R Module

The circuitry can be divided into functional stages in the following way, which relates to the part numbering system used:

Stage	Component numbers
DC-voltage regulator	811...820
1'st RF-stage, BFR 93 A	821...830
2'nd RF-stage, BFQ 18 A	831...840
RF-power hybrid and the related components	841...850
RF-power sampling circuitry	851...860
Power control circuitry	861...870
Common parts	801...810

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TRANSMITTER MODULE NT2R

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11-3

THE FIRST RF-STAGE

The first RF-stage, V821, BRF 93 A, is a grounded base circuit for a good load isolation and a small reflection at the input. The stage is operating in class A.

THE SECOND RF-STAGE

The second stage, V831, BFQ 18 A, is a common emitter circuit biased to class B for a reasonable efficiency and a power control by changing the collector supply voltage.

POWER AMPLIFIER

For power stages a hybrid module, N841, is used. There is about 2.1 dB attenuation from the collector of V831 to the input of the power hybrid to ensure a decent input match for the hybrid in all conditions.

The total gain of the two front stages is about 16 dB. Both of the stages are biased from a common voltage divider. To some extent base-emitter junction voltage variations at variant temperatures are compensated by a silicon diode V822 in the bias circuit. Power level at the input of the hybrid is up to 200 mW.

The power module consists of three stages, the first in class B, the rest in class C. The collector voltage for the first stage is fed from the power control circuit in parallel with V831 (pin 2).

Inductors and capacitors around N841 are for suppressing RF-voltages from entering the DC-supplies and for ensuring low frequency stability.

OUTPUT POWER LEVEL CONTROL

The output power level is monitored by a power sampling circuitry, which consists of a directional coupler, Z851, Z852, on the pc-board and the rectifier circuit following.

The basic rectifier is a peak to peak type circuit, V851, but an other pair of similar schottky diodes, V852, is added for compensating the small signal voltage unlinearity as well as for temperature compensation. To increasing the rectifier sensitivity at low voltage levels a combination of a fixed (R855) and a linearly controlled bias current via R856 from N851 is provided for more a linear response.

To control the RF output power voltage of the RF-rectifier is compared to an adjustable DC-voltage (PC, X801, pin 4) from the processor board by the operational amplifier N861. The output of the operational amplifier drives a DC-power amplifier circuit consisting of V861 and V862 supplying current to the two RF amplifier stages.

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TRANSMITTER MODULE NT2R

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11-4

The first RF-stage and the operational amplifier are supplied from a regulated 7.5 V rail. For this voltage regulation a simple zener-diode voltage follower combination is used (V811,V812). TX-on/off-keying is done in this stage. When TX is on, the voltage in pin 3/X801 (12T) is near the supply voltage. In the off-stage this voltage is near zero.

TEST POINTS

For service and fault locating purposes there are some test points on the upper side of the PC-board. In the following list the nominal DC-voltage values are given, Ucc 14.2 V.

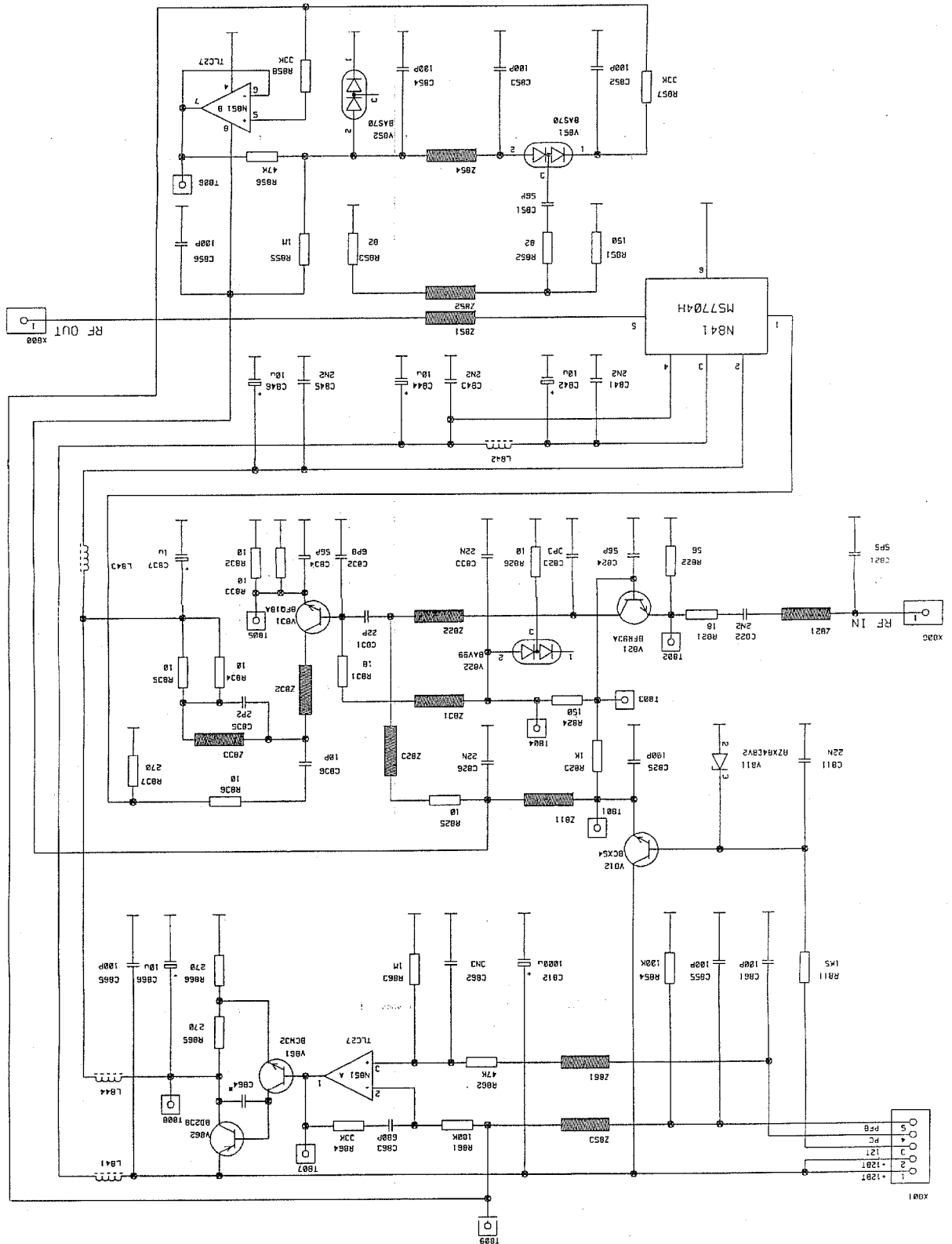
Test point	Description	Nominal value, hi/lo power
1	Regulated DC-voltage	7.5 V
2	Emitter voltage of V821	1.0 V
3	Base voltage of V821	1.6 V
4	Bias voltage for V831	0.8 V
5	Emitter voltage of V831	0.27 V
6	Output voltage of N851, rectifier bias	3.6/0.4 V
7	Output voltage of N861, DC-power stage drive	3.2/2.3 V
8	Output voltage of the DC-power amplifier	4.8/3.2 V
9	Output voltage of the RF-rectifier	3.6/0.4 V

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CIRCUIT DIAGRAM OF NT2R



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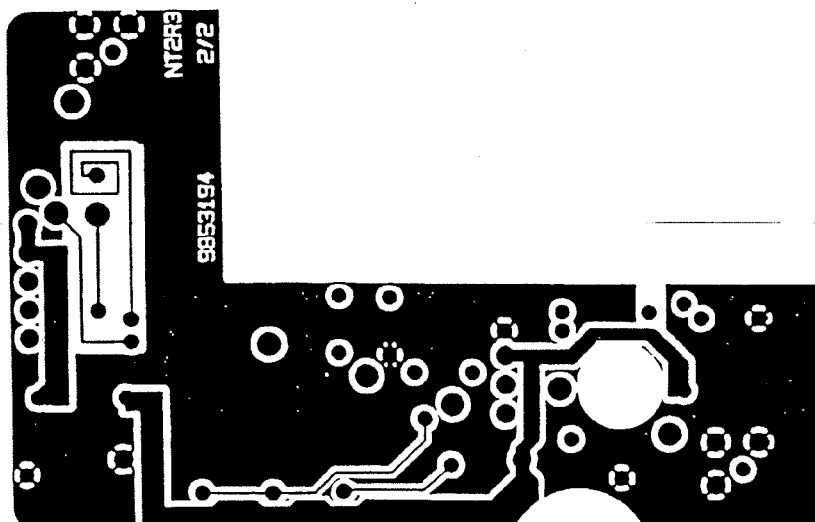
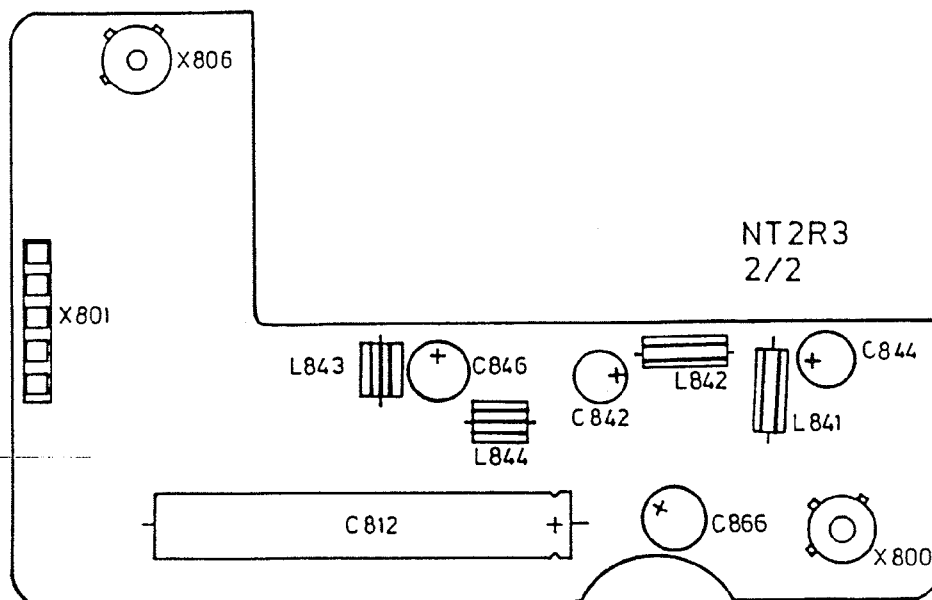
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11-6

LAYOUT DIAGRAMS OF NT2R



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TRANSMITTER MODULE NT2R

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11-8

PARTS LIST OF NT2R

ITEM	CODE	DESCRIPTION	VALUE	DATA
L843	0164030	Ferr.Choke		3.5*3.5, N4
L844	0164030	Ferr.Choke		3.5*3.5, N4
L841	0164062	Ferr.Choke		4*5, N3
L842	0164062	Ferr.Choke		4*5, N3
R821	1411589	Chip resistor	18	5 % 63 mW 0805
R831	1411589	Chip resistor	18	5 % 63 mW 0805
R822	1412198	Chip resistor	56	5 % 63 mW 0805
R852	1412222	Chip resistor	82	5 % 63 mW 0805
R853	1412222	Chip resistor	82	5 % 63 mW 0805
R837	1412254	Chip resistor	270	5 % 63 mW 0805
R823	1412335	Chip resistor	1 k	5 % 63 mW 0805
R811	1412409	Chip resistor	1.5 k	5 % 63 mW 0805
R857	1412729	Chip resistor	33 k	5 % 63 mW 0805
R858	1412729	Chip resistor	33 k	5 % 63 mW 0805
R864	1412729	Chip resistor	33 k	5 % 63 mW 0805
R856	1413603	Chip resistor	47 k	5 % 63 mW 0805
R862	1413603	Chip resistor	47 k	5 % 63 mW 0805
R854	1413635	Chip resistor	100 k	5 % 63 mW 0805
R855	1413804	Chip resistor	1 M	5 % 63 mW 0805
R863	1413804	Chip resistor	1 M	5 % 63 mW 0805
R825	1413829	Chip resistor	10	5 % 63 mW 0805
R826	1413829	Chip resistor	10	5 % 63 mW 0805
R832	1413829	Chip resistor	10	5 % 63 mW 0805
R833	1413829	Chip resistor	10	5 % 63 mW 0805
R834	1413829	Chip resistor	10	5 % 63 mW 0805
R835	1413829	Chip resistor	10	5 % 63 mW 0805
R836	1413829	Chip resistor	10	5 % 63 mW 0805
R824	1413917	Chip resistor	150	5 % 63 mW 0805
R851	1413917	Chip resistor	150	5 % 63 mW 0805
R861	1414131	Chip resistor	180 k	5 % 63 mW 0805
R865	1420271	MELF resistor	270	2 % 250 mW MMA 0204
R866	1420271	MELF resistor	270	2 % 250 mW MMA 0204
C835	2309845	Chip cer. cap		2.2p/0.25p NPO 0805
C823	2309869	Chip cer. cap		3.3p/0.25p NPO 0805
C821	2309891	Chip cer. cap	5.6 p	5 % NPO 0805
C832	2309901	Chip cer. cap	6.8 p	5 % NPO 0805
C836	2310304	Chip cer. cap	10 p	5 % NPO 0805
C831	2310343	Chip cer. cap	22 p	5 % NPO 0804
C824	2310399	Chip cer. cap	56 p	5 % NPO 0805
C834	2310399	Chip cer. cap	56 p	5 % NPO 0805
C851	2310399	Chip cer. cap	56 p	5 % NPO 0805
C825	2310424	Chip cer. cap	100 p	5 % NPO 0805
C852	2310424	Chip cer. cap	100 p	5 % NPO 0805
C853	2310424	Chip cer. cap	100 p	5 % NPO 0805
C854	2310424	Chip cer. cap	100 p	5 % NPO 0805
C855	2310424	Chip cer. cap	100 p	5 % NPO 0805
C856	2310424	Chip cer. cap	100 p	5 % NPO 0805
C861	2310424	Chip cer. cap	100 p	5 % NPO 0805
C865	2310424	Chip cer. cap	100 p	5 % NPO 0805
C863	2310529	Chip cer. cap	680 p	5 % NPO 0805
C822	2310713	Chip cer. cap	2.2 n	20 % X7R 0805
C841	2310713	Chip cer. cap	2.2 n	20 % X7R 0805

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TRANSMITTER MODULE NT2R

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11-9

C843	2310713	Chip cer. cap	2.2 n	20 % X7R	0805
C845	2310713	Chip cer. cap	2.2 n	20 % X7R	0805
C862	2310720	Chip cer. cap	3.3 n	20 % X7R	0805
C811	2310777	Chip cer. cap	22 n	20 % X7R	0805
C826	2310777	Chip cer. cap	22 n	20 % X7R	0805
C833	2310777	Chip cer. cap	22 n	20 % X7R	0805
C812	2503803	Elektrol. cap	1000 u	20 % 25 V	
C842	2505239	Elektrol. cap	10 u	20 % 35 V	
C844	2505239	Elektrol. cap	10 u	20 % 35 V	
C846	2505239	Elektrol. cap	10 u	20 % 35 V	
C866	2505239	Elektrol. cap	10 u	20 % 35 V	
C837	2604209	Chip tant. cap	1 u	20 %	
V822	4100285	Si-diode	BAV 99		
V851A,B	4100567	Sch-diode	BAS 70-04		
V852A,B	4100567	Sch-diode	BAS 70-04		
V811	4106992	Zenerdiode	BZX 84	C8V2	
V831	4200115	Transistor	BFQ 18 A		
V821	4200709	Transistor	BFR 93 A		
V812	4200875	Transistor	BCX 54		
V861	4200917	Transistor	BCW 32		
V862	4204742	Transistor	BD 238		
N851A,B	4309576	Op. amp. (dual)		TLC 27 M 2 ID	
N841	4352537	Hybrid amp.	M 57704		
X800	5407142	Coax. conn.		HRS FL-R-PC(2), no 331-0052-7	
X806	5407142	Coax. conn.		HRS FL-R-PC(2), no 331-0052-7	
X801	5413932	Terminal conn.		5 pole R=2.5 PCB female	
C864		place on the PC board, if needed			
Z800	3606336	Filter		2x1.5 nF 0.3 uH 5 ADC	
	7313201	Doubleside tape		1x12x25 mm wht	
	9853194	PC-board NT2R			

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DUPLEX FILTER HQ-5/NP

TMF-1XS

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12-1

GENERAL FEATURES

Input/output impedances 50 ohm

ELECTRICAL SPECIFICATIONS

RX BRANCH WITH CABLES

Pass band frequency 462.5 ... 467.0 MHz

Pass band attenuation < 4.5 dB

Pass band ripple < 1.2 dB

Pass band return loss > 14 dB

Attenuations in stop band

452.5 ... 457.0 MHz > 50 dB

TX BRANCH WITH CABLES

Pass band frequency 452.5 ... 457.0 MHz

Pass band power handling capacity 25 W

Pass band attenuation < 2.1 dB

Pass band ripple < 0.8 dB

Pass band return loss > 14 dB

Attenuations in stop band

462.5 ... 467.0 MHz > 61 dB

2nd, 3rd and 4th harmonics > 40 dB

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DUPLEX FILTER HQ-5/NP

TMF-1XS

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12-2

ENVIRONMENTAL CONDITIONS

Operating temperature range -25°C...+85°C

Storage temperature range -40°C...+85°C

Relative humidity 20 %... 75 %

Vibration 10- 55 Hz ± 0.3mm displacement
55-150 Hz 5g acceleration

Sweep rate: 1 octave per minute

Duration : 2 hours in each 3 directions

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CHASSIS

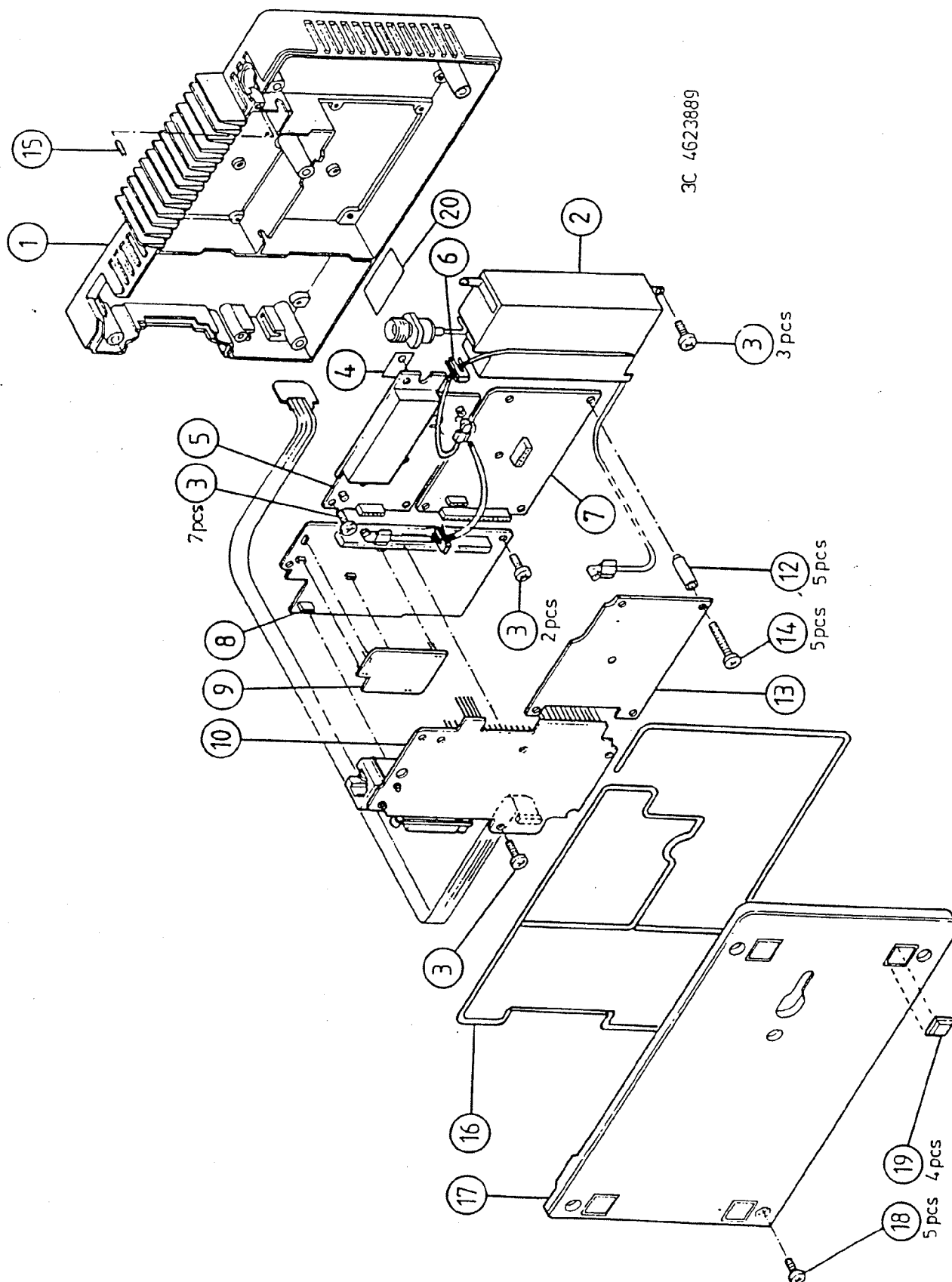
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14-1

EXPLODED VIEW OF TMF-1



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CHASSIS

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14-2

ASSEMBLY PARTS OF TMF-1XS

ITEM	Q'TY	CODE	DESCRIPTION	DATA
1		9308583	Chassis	N2D20452
2		4508218	Duplex filter HQ-5/NP	
3	12	6150281	Cross rec.Screw	M3X6 SFS2976 PZ5.8 FEZN YEL
4		6500200	Isolator	CHO-TERM 60-11-8302-1674
5		0176847	Transmitter module NT2R	
6	6	9302905	Shield plate	A4D40105
7		0176861	Synthesizer module NS2R	
8		0176910	Audio module NA5B	
10		0176438	Processor module NP5A	
12		9310416	Bushing	4D20623
13		0200103	Receiver module NR2C	
14	5	6150499	Cross rec.Screw	M3X22 SFS2976 PZ5.8 FEZN YEL
15		6100481	Set screw	M3X8 DIN914 FEZN BLC
16		6502247	RF-strip	10-04-2865-1350 l=0.84m
17		9308590	Cover	N2D20453
18	5	6150563	Cross rec.Screw	M4X8 SF6S2976 PZ5.8 FEZN BRT
19	4	6502215	Foot	10.5X10.5MM BUMPON SJ 5007
20			Type label	TMF-1XS
		5422635	Injection cable	4D20577-A
	2	6150316	Screw	M3x8 DIN 7985

NOKIA MOBILE PHONES

HANDSET HSF-2

TMF-1XS

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15-1

ASSOCIATED DOCUMENTS

INTRODUCTION OF THE HSF-2 UNIT

Brief Introduction of the HSF-2

HSF-2 is a microprocessor controlled combined handset and control unit. It can be used in a vehicle installation as well as in the portable use. Alphabetical characters can be used and display is dot matrix type. Handset contains also an office hands free function.

List of modules of the HSF-2 unit

The handset consist of two modules:

Control module (keyboard, display) NL3C 0200092

Handset module (processor, audio) NK3K 0177745

Mechanics (HSF-2) 0260154

TECHNICAL SPECIFICATIONS OF THE HSF-2

Supply Voltages and Power Consumption

Supply voltage +12 V DC:

* 10 V ... 16 V

Current consumption:

* typical 40 mA

* max. 1 A (peak of power amplifier)

* min 30 mA (in standby mode)

Mechanical Characteristics

Chassis of the handset consists of three parts: cover A, cover B, frame C and RF cover. The PC boards are fixed in the frame C which is not visible outside. The RF cover makes a RF protection for the handset.

Handset is connected to the transceiver with a modular connector. Detachment of the handset from the radio unit is done by pressing the lever below the modular connector and pulling out the connector.

Extreme conditions

- storage temperature range
- operating temperature range

-40 ... +85 °C
-30 ... +70 °C

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HANDSET HSF-2

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15-2

External signals and connections

Connector X01B between NL3C and NK3K modules		
1	CLOCK	Clock signal for the display driver. 0V - 5V square wave 250 kHz.
2-8	TOKEYBOARD	Keyboard write pulses to keyboard rows. 7 pcs. 20 ms +5V; 50 us 0V
9-11	LCDCONT	3-bit control signal from the processor to display drivers.
12	C_D	Control/Data signal to LCD drivers.
13	LCDEN	Enable signal for the LCD drivers.
14	PWR	Power button signal to processor. (power off) +5V normal; 0V active.
15	+12V	Power supply for illumination.

Connector X020B between NL3C and NK3K modules		
1-4	FROMKEYBOARD	Keyboard read signals from keyboard columns. 0V normal.
5	WIEVCONT	Controls the wieving angle of the display. 0V high angle; +1.2V low angle.
6	XRESET	Reset signal to LCD drivers. 0V normal; +5V active.
7	POWER	Power and ignition sense signal. (power on) +5V normal; 0 active.
8-14	LEDS	LED control signals from HSIC. (Handset IC) +8V LED on; 0V LED off.
15	+5V	Power supply for indicators and LCD drivers.

FUNCTIONAL DESCRIPTION OF NK3K MODULE

Circuit Description

The module NK3K consists of three main parts: illumination, keyboard and display.

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HANDSET HSF-2

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15-3

Illumination

Illumination and indicators are accomplished by LEDs. LEDs are driven by the HSIC and controlled by the processor. Transistors V776 and V779 makes a constant current source for the illumination LEDs.

Keyboard

The keyboard has been constructed by making contact patterns of the switches on the circuit board. Above the board there is a rubber switching mat which contacts are made of conductive material.

The switches are organized to lines and columns. When pressing a key, the contact plates will short. This causes an interrupt (INT 1) to the processor. The processor monitors the state of the keyboard sending a pulses sequentially to every row of the keyboard matrix.

Columns are connected to the A/D inputs of the processor. Now the pulse that the CPU sent to certain line appears in the column that informs the processor which key has been pressed.

Display

The NK3K module has a LCD-display which allows to perform max. 18 alphanumeric characters. In addition also some indicators appear on the display.

The display is driven by two NEC uPD7228AG display drivers. The multiplex ratio is 1/8. The serial control data is transferred along 3-bit bus LCDCONT. CLOCK signal is used to get the 250 kHz clock for the LCD drivers. The signal WIEWCONT is used to control the viewing angle of the display. The status of the WIEWCONT is OV (high angle) and HIGH impedance for the low angle.

Resistors R432 to R436 controls the LCD driving voltage levels. The NTC resistor R454 is for the temperature compensation.

FUNCTIONAL DESCRIPTION OF THE NL3C MODULE

Brief introduction

The processor module consists of two main blocks: CPU and AUDIO. The block CPU includes the processor, memory and logic parts of the module. The block AUDIO includes analog parts and the connection to the radio unit.

To the module NL3C module includes NEC's microprocessor (uPD78C10), audio-IC (HSIC NMOY 4462), memory 8k RAM, 64k ROM, audio power amplifier (TDA 7233) for hands free functions, MBUS driver and separate logic for STOP feature.

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HANDSET HSF-2

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15-4

Supply Voltages and current consumption

+12V	10.8 ... 15.6 V DC	max. 1A (peak of power amplifier). typ. 23 mA.
+5V	4.5 ... 5.5 V DC	typ. 15 mA. max. 25 mA.
+8V	7.5 ... 8.5 V DC	typ. 5 mA. max. 20 mA

Processor and memories

The processor (D250) controls peripherals along two serial buses. LCDCONT-bus is used to control the display controllers on NK3K module. Other serial bus MBUS is used to communicate with the radio unit along the system cable.

The HSIC (N610) is controlled with 8-bit parallel bus by the processor. The processor also monitors keyboards status (signals TOKEYBOARD and FROMKEYBOARD) and DC-levels of MIC, EXTM- and EAR/POWER-lines. Furthermore the processor controls the volume level of the HF-microphone with the 3-bit signal INPCONT. This is needed for VOX features during office hands free call.

The memory circuits used in the handset are D270 (64k ROM 27C512G), D280 (8k RAM 4464G) and a 8-bit latch circuit D200 (74HC373). The memory is addressed as follows:

```
0000 ... DFFF (0..56k) EPROM/LATCH(WR)
E000 ... FFFF (56k..64k) RAM
00 ... 03     HSIC's control registers
```

MBUS controller

The processor communicates with the radio unit along the MBUS. The processor has separate I/O port for transmission and reception. However, the system cable has only one data wire in the spiral cord. Because of that, there is a open collector connected to MBUS controller (V244 and D220) which allows transmitting and receiving data along same wire.

Separate logic

Separate logic is needed for the STOP feature. The processor goes to STOP mode always when there is no work to do. The processor stops completely including the crystal oscillator. This is used to lower the current consumption and electromagnetic interferences.

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HANDSET HSF-2

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15-5

The processor gets a NMI interrupt if a key is pressed, HOOK position is changed or it receives a MBUS message (circuits V236, V237, D240, D220 and D230). NMI input is masked during the operation with the NMIMASK signal (R233 and C233).

Clock generator

The clock generator (D230, R234, R230 and C231) is used to give 250kHz clock signal to the LCD-drivers on the NK3K board.

Audio IC

NL3C has most of it's audio amplifiers and DTMF-generator in same custom chip - HSIC. There are also watchdog for the processor and LED drivers. The processor controls the HSIC by 8-bit data bus. Also two address signals, chip enable and write signal are needed. HSIC has four 8-bit registers that controls it's functions.

Power amplifier

Power amplifier N640 drives office HF loudspeaker B640. Transistors V642, V641 and resistors R640 - R642 connect supply power to the power amplifier when needed. Transistor V646 and resistors R645, R646 compensate the DC-level differences of analog ground and digital ground.

EAR-level detector

Components N630, R630 - R637 and C630 - C637 compose a level detector. This is needed for the office hands free call. The processor controls the volume levels of the HF-mic and HF-loudspeaker depending of the AC-signal level of EAR-line.

EAR-line	EARLEVEL	A/D-result
0 mV	1.8 V	92
10 mV	2 V	100
50 mV	3 V	150
200 mV	5 V	255

The rising time of the detector is 2 ms and the lap time is 1 s. The program of the handset reads the EARLEVEL signal in 10 ms periods during the hands free call.

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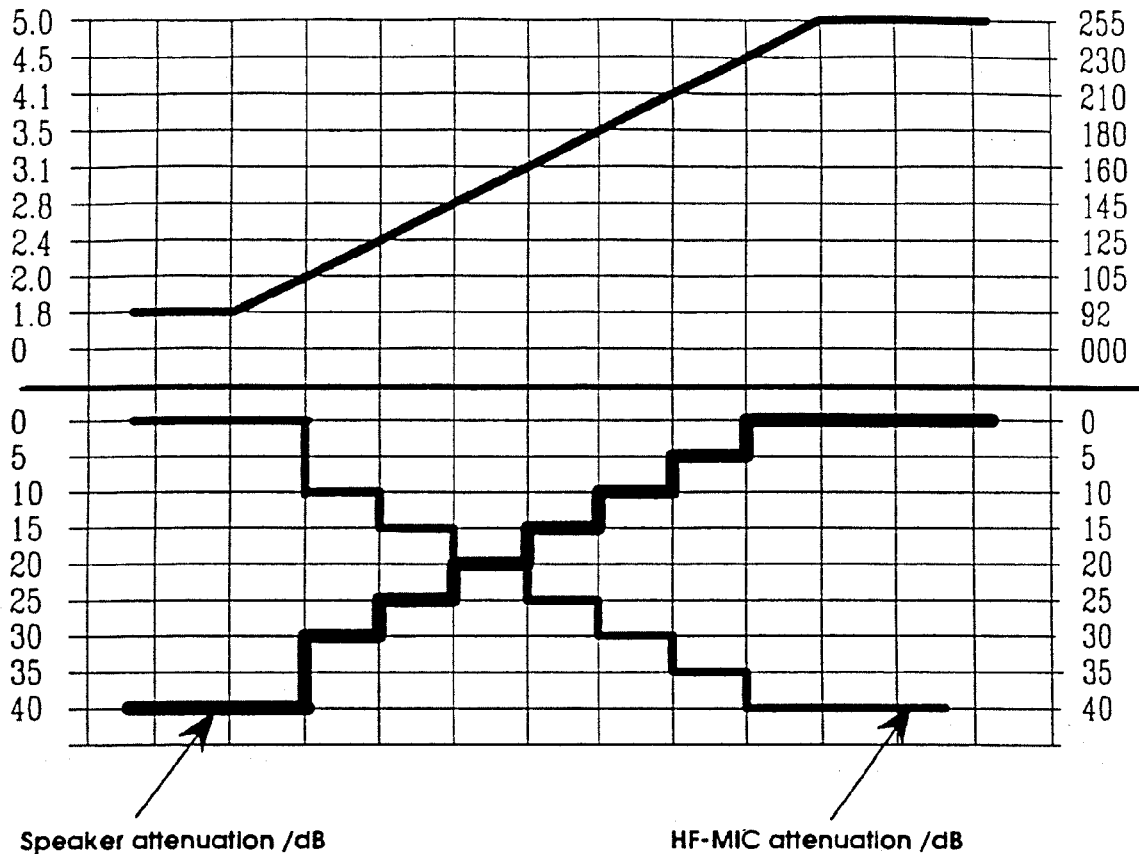
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15-6

DC level of ear level detector output
EARLEVEL /V

A/D result



Volume control of the microphone and earphone signals during a hands-free operation

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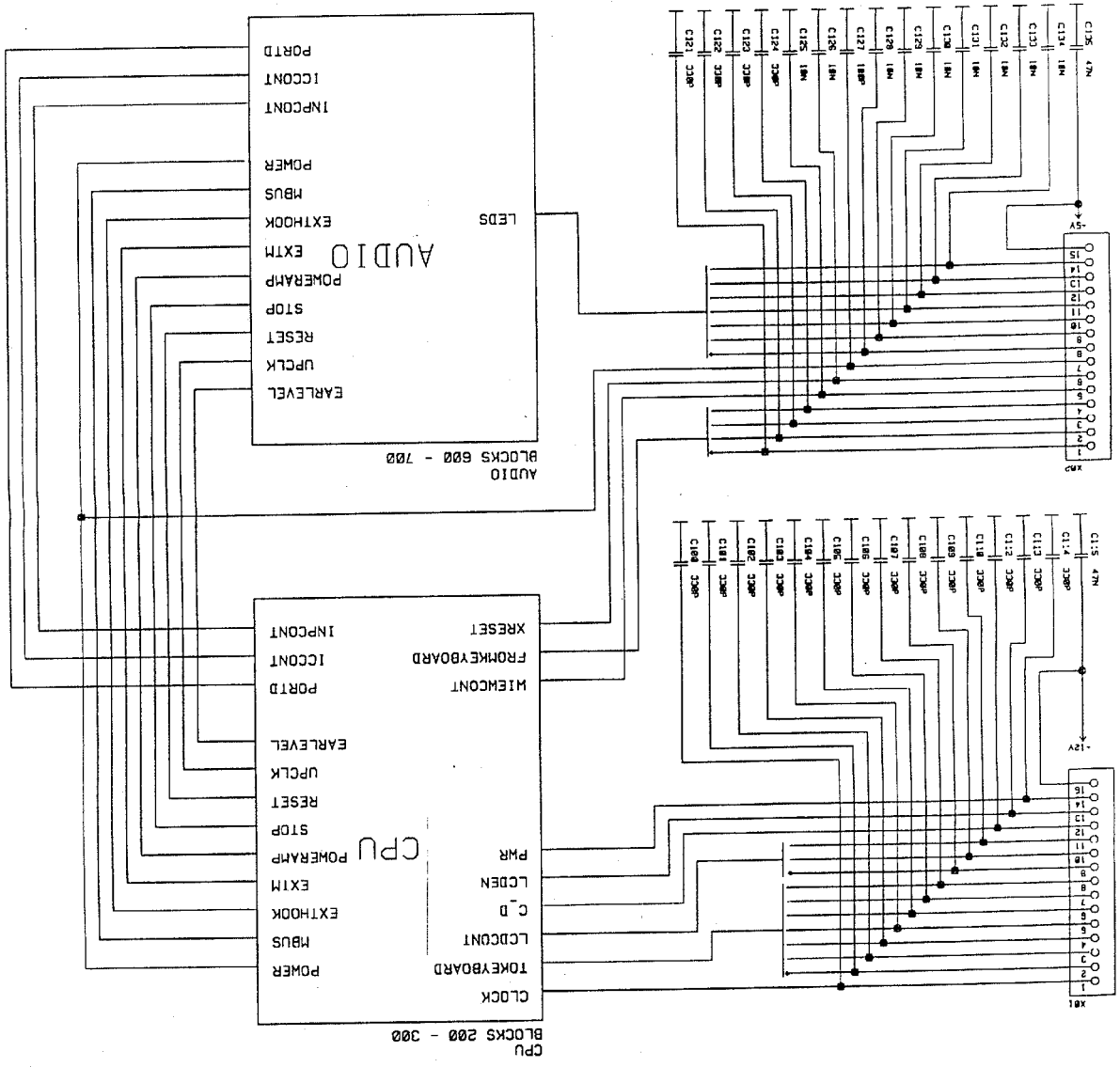
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 15-7

BLOCK DIAGRAM OF NL3C MODULE



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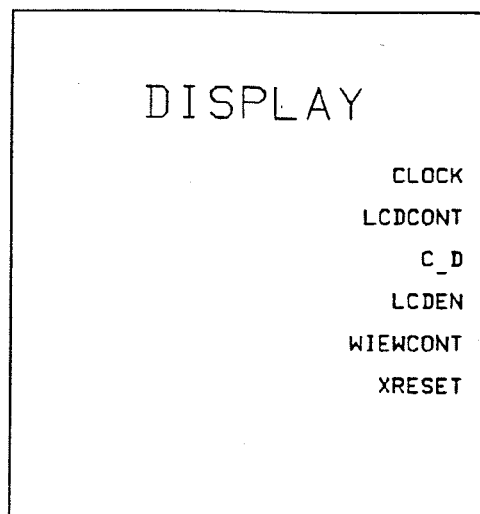
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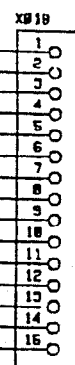
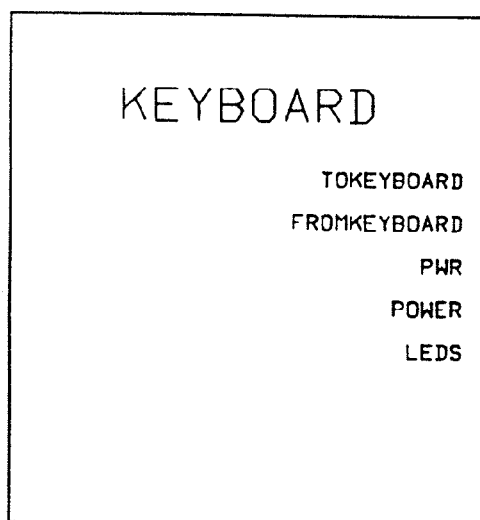
15-8

BLOCK DIAGRAM OF NK3K MODULE

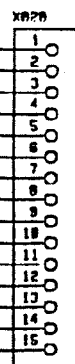
DISPLAY
BLOCKS 700 - 800



KEYBOARD
BLOCKS 100 - 500



-12V

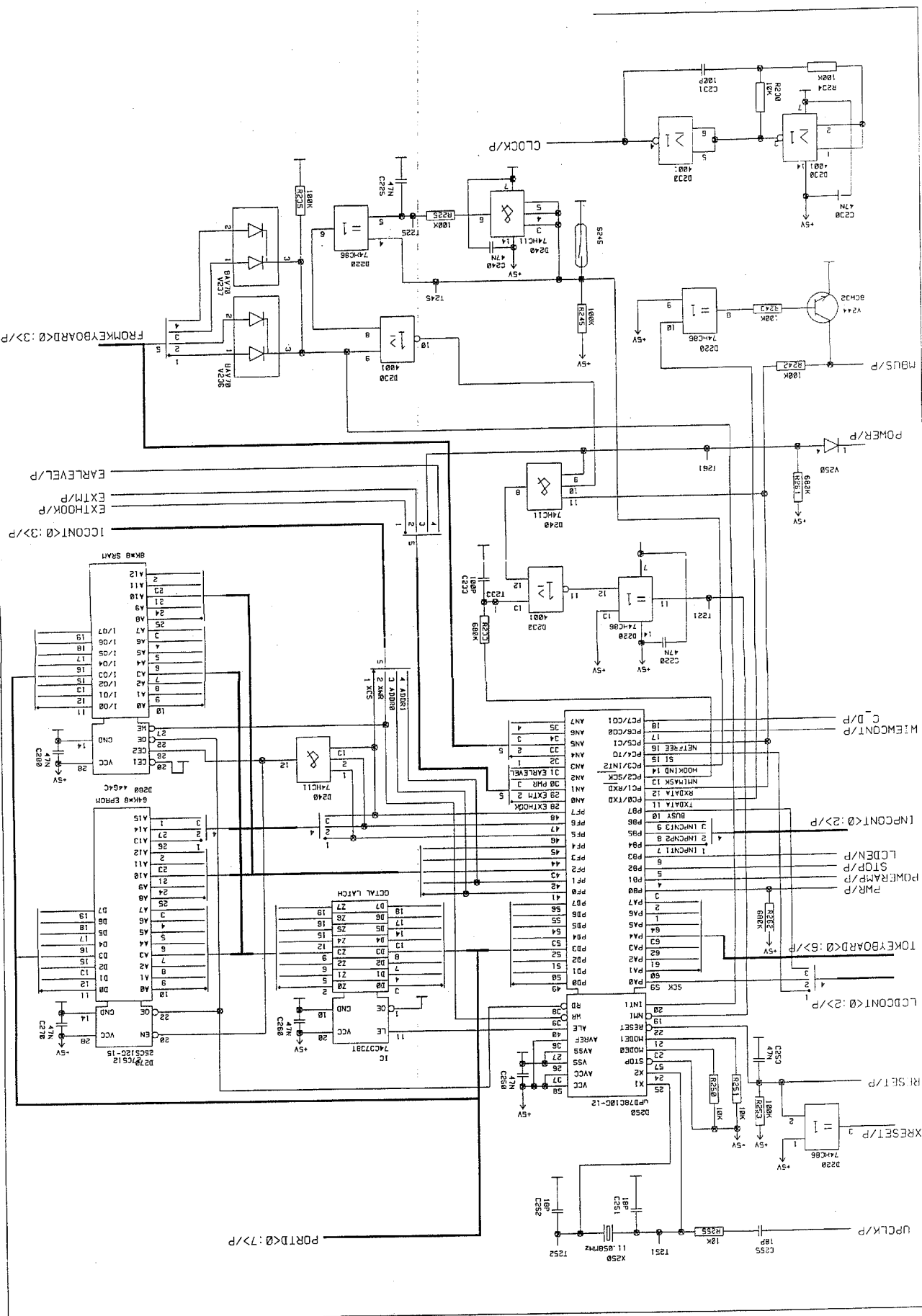


+5V

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IMT-LT

15-10

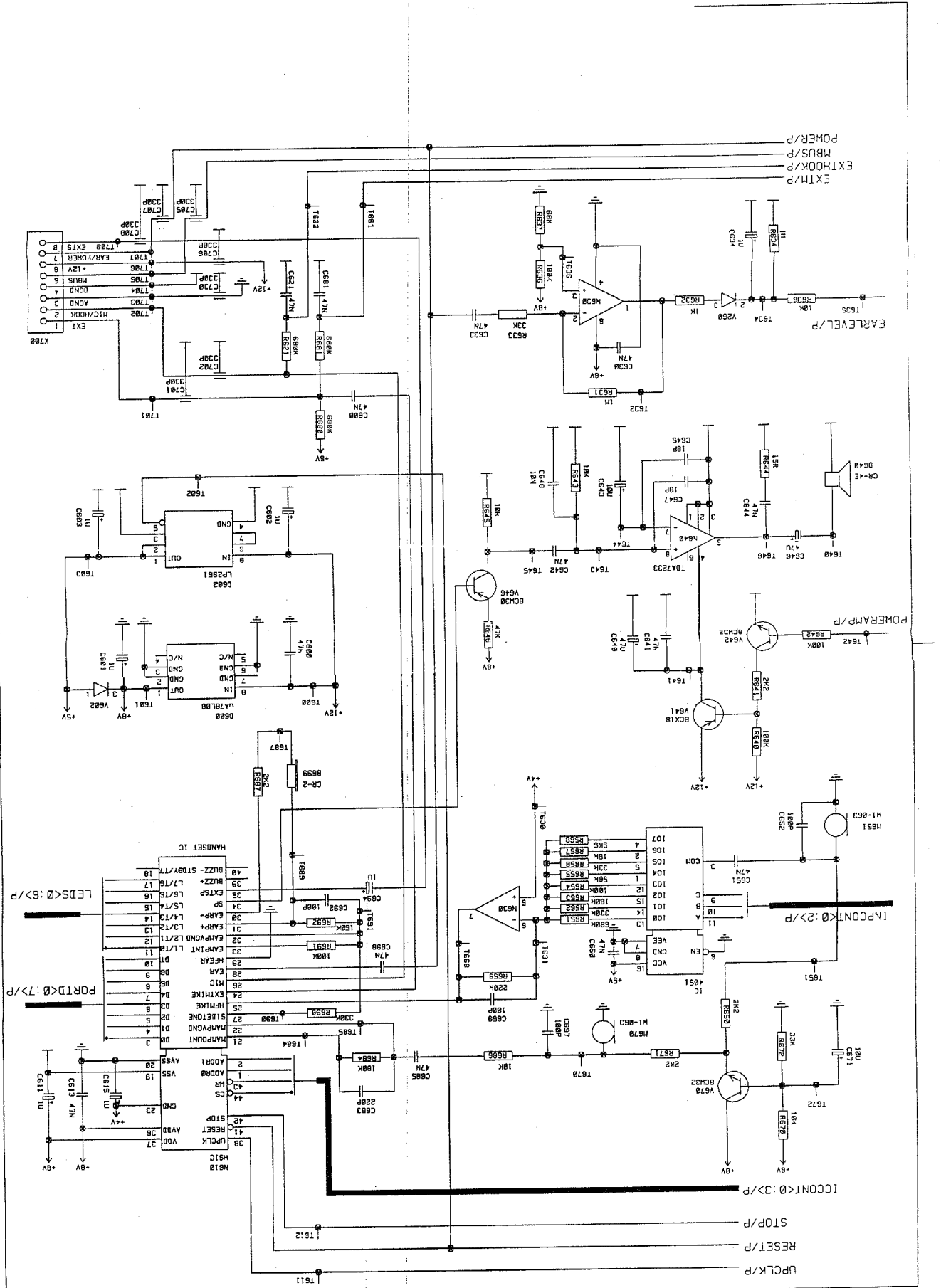
HANDSET HSF-2

9224AR0

NOKIA MOBILE PHONES

SERVICE

AUDIO CIRCUITS OF NL3C MODULE



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TMF-1XS

15-11

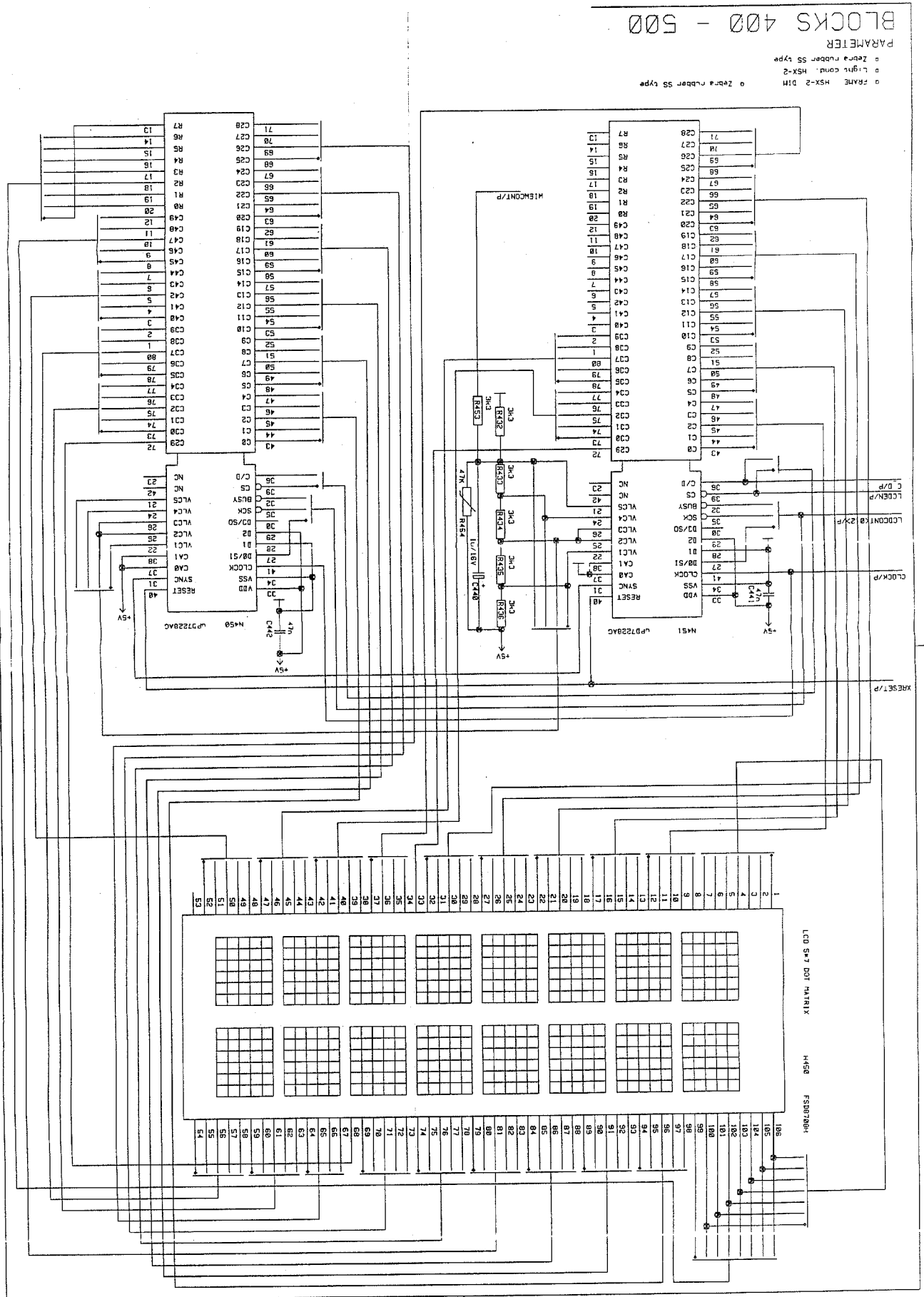
HANDSET HSF-2

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NUKLA MOBILE PHONES

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DISPLAY OF NK3K MODULE



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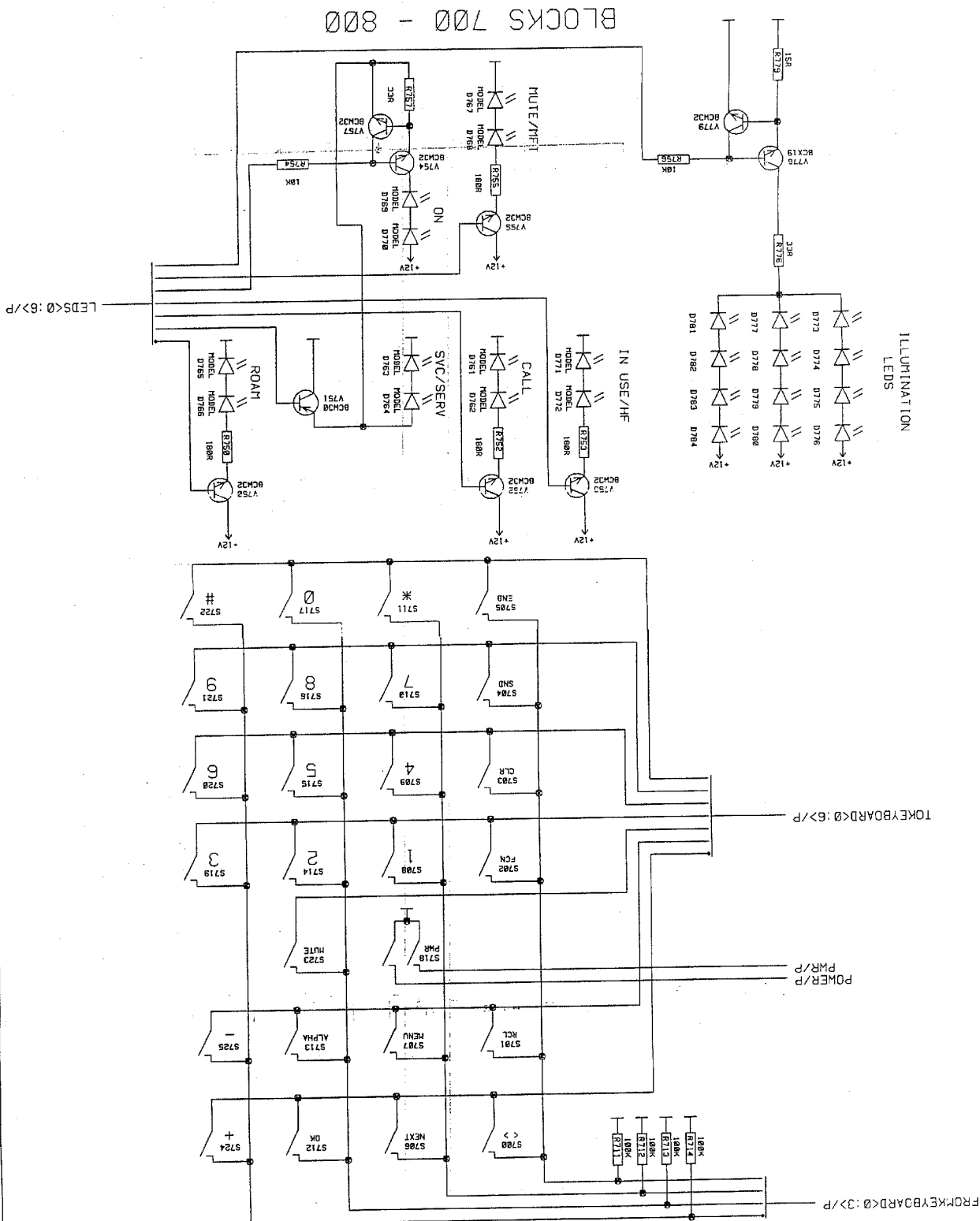
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HANDSET HSF-2
9224Ro

TMF-1XS
15-12

KEYBOARD OF NK3K MODULE



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HANDSET HSF-2

TMF-1XS

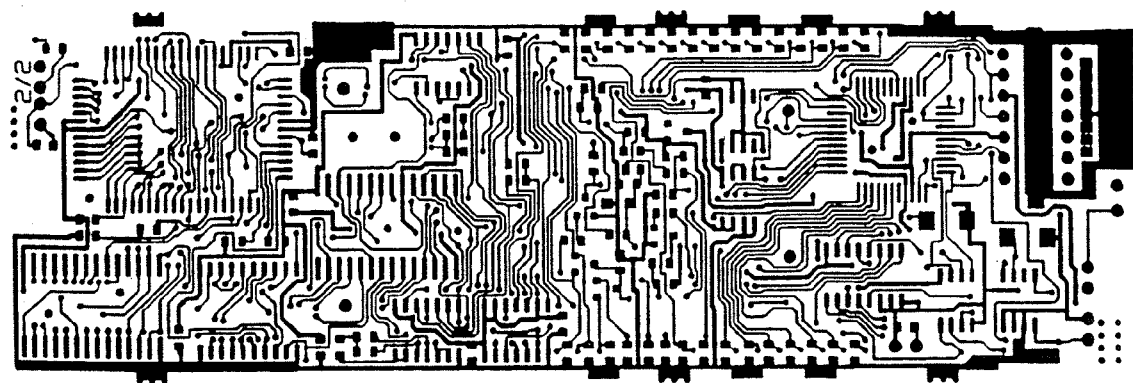
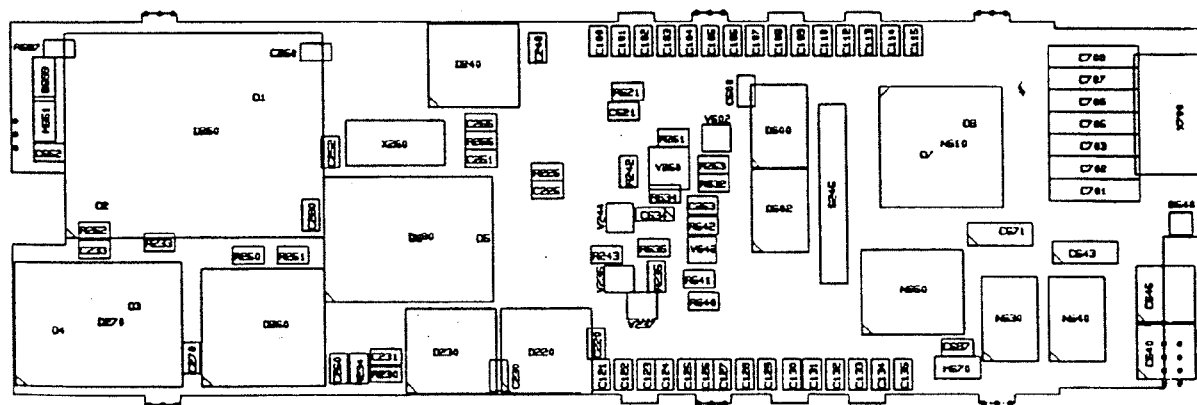
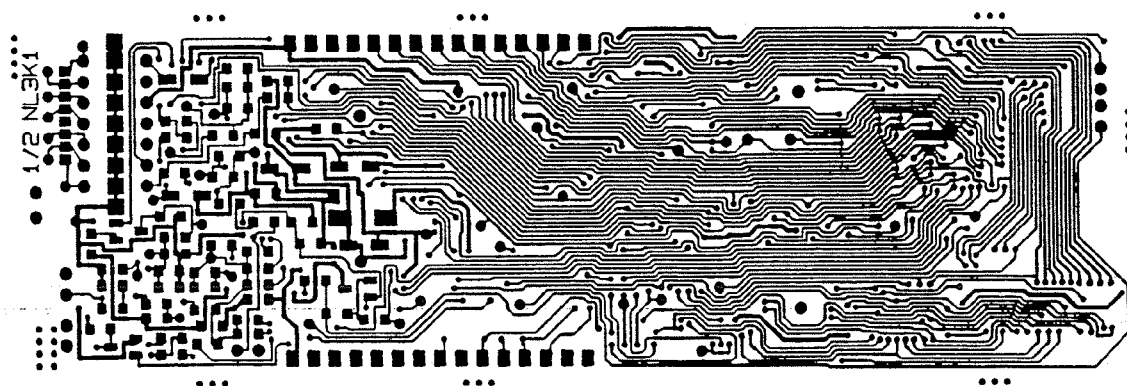
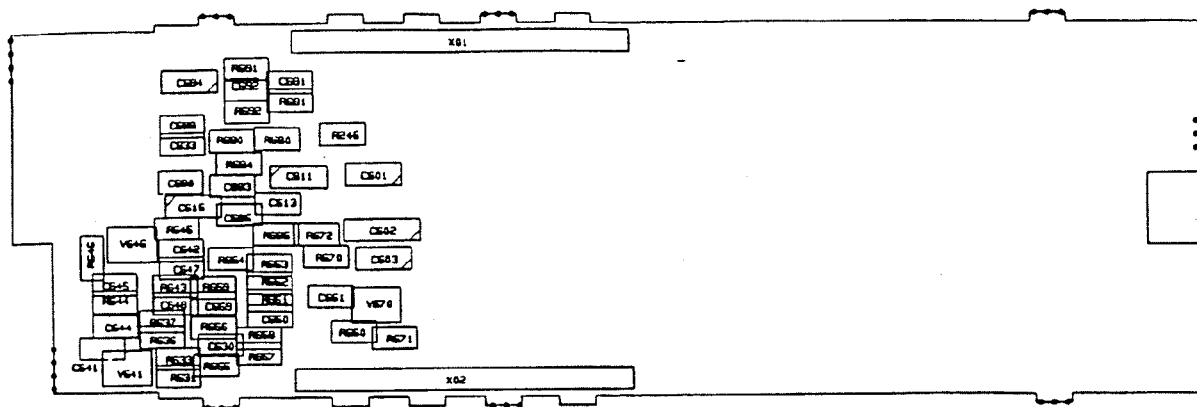
SERVICE

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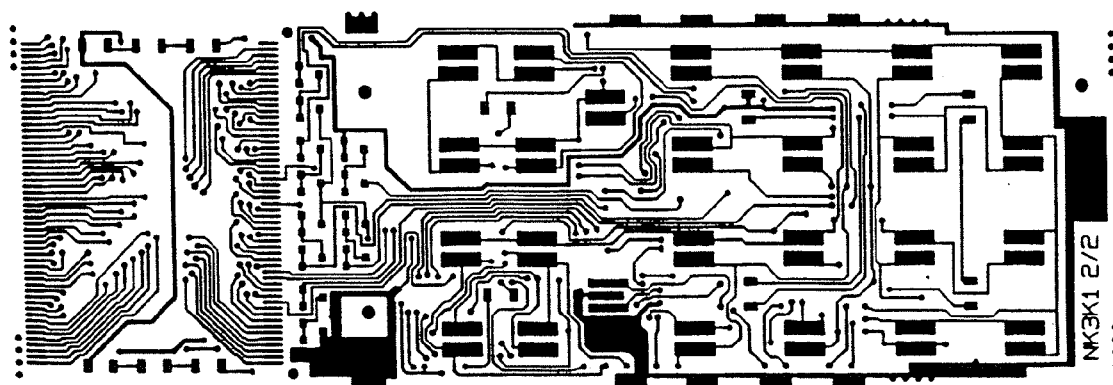
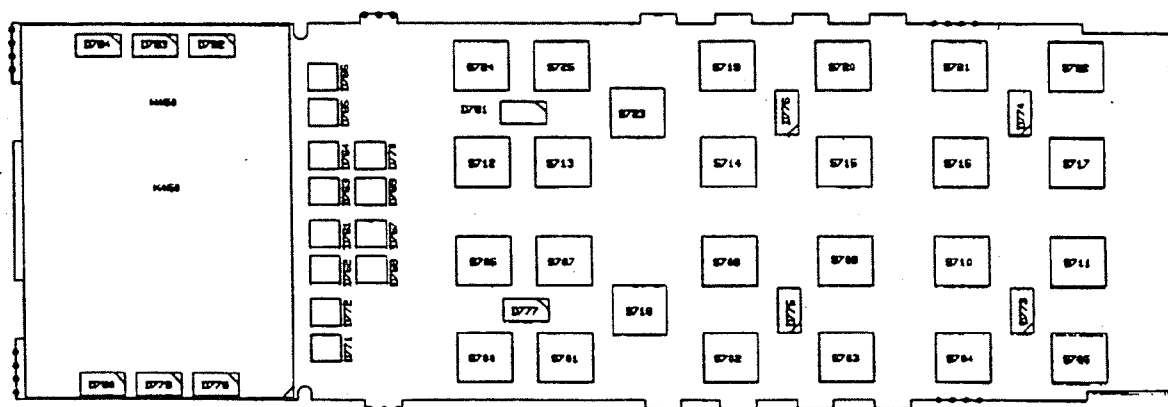
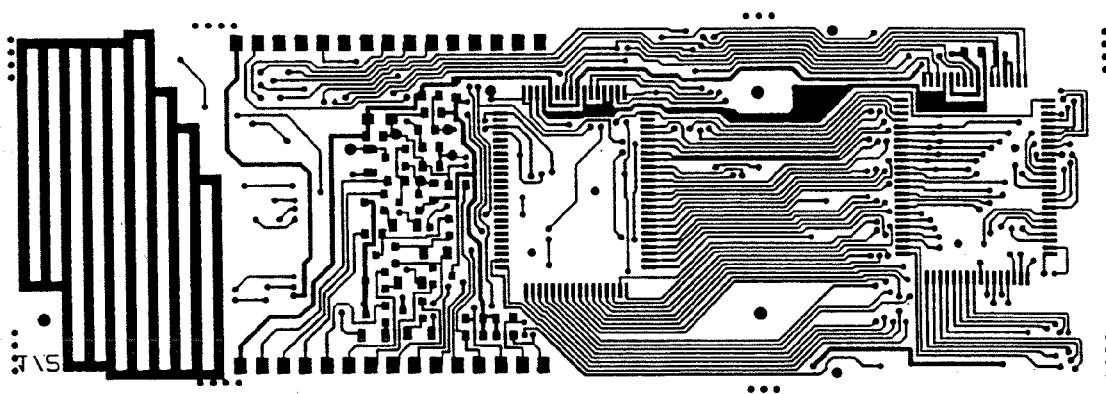
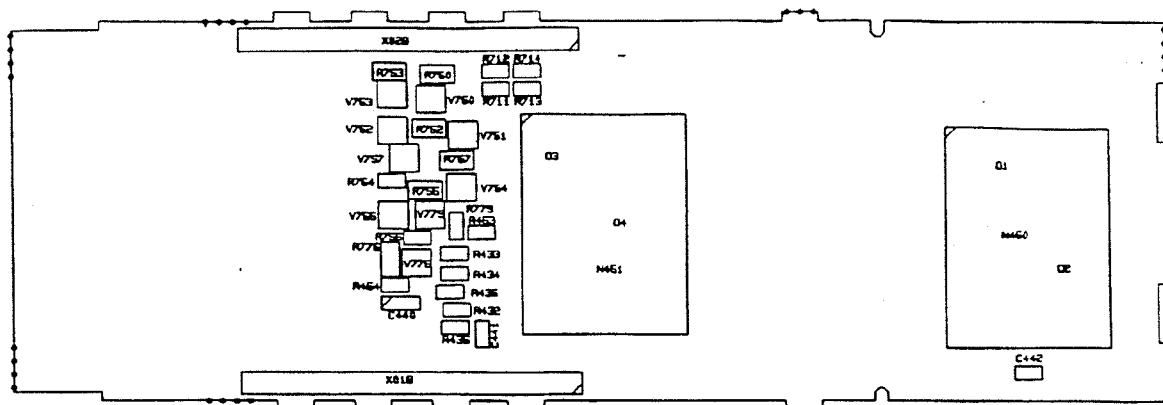
15-13

LAYOUT DIAGRAMS OF NL3C

9853596



9853606



NOKIA MOBILE PHONES

HANDSET HSF-2

TMF-1XS

SERVICE

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15-15

PARTS LIST OF NK3K

ITEM	CODE	DESCRIPTION	VALUE	DATA
R757	1411388	Chip resistor	33	1206
R776	1411388	Chip resistor	33	1206
R750	1411564	Chip resistor	180	1206
R752	1411564	Chip resistor	180	1206
R753	1411564	Chip resistor	180	1206
R755	1411564	Chip resistor	180	1206
R779	1412215	Chip resistor	15	
R754	1412430	Chip resistor	10 k	
R756	1412430	Chip resistor	10 k	
R711	1413635	Chip resistor	100 k	
R712	1413635	Chip resistor	100 k	
R713	1413635	Chip resistor	100 k	
R714	1413635	Chip resistor	100 k	
R432	1414029	Chip resistor	3.3 k	
R433	1414029	Chip resistor	3.3 k	
R434	1414029	Chip resistor	3.3 k	
R435	1414029	Chip resistor	3.3 k	
R436	1414029	Chip resistor	3.3 k	
R453	1414029	Chip resistor	3.3 k	
R454	1800659	NTC	47 k	
C441	2307816	Cer. cap.	47 n	
C442	2307816	Cer. cap.	47 n	
C440	2604209	Tantalum cap.	1u/16V	
D773	4102998	LED	CL-50 G-CD	
D774	4102998	LED	CL-50 G-CD	
D775	4102998	LED	CL-50 G-CD	
D776	4102998	LED	CL-50 G-CD	
D777	4102998	LED	CL-50 G-CD	
D778	4102998	LED	CL-50 G-CD	
D779	4102998	LED	CL-50 G-CD	
D780	4102998	LED	CL-50 G-CD	
D781	4102998	LED	CL-50 G-CD	
D782	4102998	LED	CL-50 G-CD	
D783	4102998	LED	CL-50 G-CD	
D784	4102998	LED	CL-50 G-CD	
D763	4103014	LED	LG 260	
D764	4103014	LED	LG 260	
D765	4103021	LED	LS 260	
D766	4103021	LED	LS 260	
D761	4103039	LED	LY 260	
D762	4103039	LED	LY 260	
D767	4103039	LED	LY 260	
D768	4103039	LED	LY 260	
D769	4103039	LED	LY 260	
D770	4103039	LED	LY 260	
D771	4103039	LED	LY 260	
D772	4103039	LED	LY 260	
V776	4200836	Transistor	BCX19	
V751	4200909	Transistor	BCW30	
V750	4200917	Transistor	BCW32	
V752	4200917	Transistor	BCW32	
V753	4200917	Transistor	BCW32	

NOKIA MOBILE PHONES

HANDSET HSF-2

TMF-1XS

SERVICE

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15-16

V754	4200917	Transistor	BCW32	
V755	4200917	Transistor	BCW32	
V757	4200917	Transistor	BCW32	
V779	4200917	Transistor	BCW32	
Z1	4306222	Elastomer. conn.		SS typ
Z2	4306222	Elastomer. conn.		SS typ
H450	4306310	Display		FSD8708H
N450	4309047	Displ. driver		uPD7228AG
N451	4309047	Displ. driver		uPD7228AG
	7310959	Tape		19x55mm l=0.025 m
FR1	9304564	Displ. frame		HSX-2
LC1	9304571	Light cond		HSX-2
	9853608	PCB board NK3K		

NOKIA MOBILE PHONES

HANDSET HSF-2

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15-17

PARTS LIST OF NL3C

ITEM	CODE	DESCRIPTION	VALUE	DATA
	0240030	Programmed OTPROM		
R644	1412215	Chip resistor	15	
R632	1412335	Chip resistor	1 k	
R641	1412416	Chip resistor	2.2 k	
R650	1412416	Chip resistor	2.2 k	
R671	1412416	Chip resistor	2.2 k	
R687	1412416	Chip resistor	2.2 k	
R230	1412430	Chip resistor	10 k	
R250	1412430	Chip resistor	10 k	
R251	1412430	Chip resistor	10 k	
R255	1412430	Chip resistor	10 k	
R635	1412430	Chip resistor	10 k	
R643	1412430	Chip resistor	10 k	
R657	1412430	Chip resistor	10 k	
R670	1412430	Chip resistor	10 k	
R685	1412430	Chip resistor	10 k	
R645	1412511	Chip resistor	18 k	
R656	1412511	Chip resistor	18 k	
R633	1412729	Chip resistor	33 k	
R655	1412729	Chip resistor	33 k	
R672	1412729	Chip resistor	33 k	
R637	1413610	Chip resistor	68 k	
R225	1413635	Chip resistor	100 k	
R234	1413635	Chip resistor	100 k	
R235	1413635	Chip resistor	100 k	
R242	1413635	Chip resistor	100 k	
R243	1413635	Chip resistor	100 k	
R245	1413635	Chip resistor	100 k	
R253	1413635	Chip resistor	100 k	
R640	1413635	Chip resistor	100 k	
R642	1413635	Chip resistor	100 k	
R653	1413635	Chip resistor	100 k	
R691	1413635	Chip resistor	100 k	
R646	1413642	Chip resistor	56 k	
R654	1413642	Chip resistor	56 k	
R692	1413709	Chip resistor	150 k	
R631	1413804	Chip resistor	1 M	
R634	1413804	Chip resistor	1 M	
R636	1414131	Chip resistor	180 k	
R652	1414131	Chip resistor	180 k	
R684	1414131	Chip resistor	180 k	
R651	1414212	Chip resistor	330 k	
R659	1414212	Chip resistor	330 k	
R690	1414212	Chip resistor	330 k	
R658	1414406	Chip resistor	5.6 k	
R233	1414420	Chip resistor	680 k	
R261	1414420	Chip resistor	680 k	
R262	1414420	Chip resistor	680 k	
R621	1414420	Chip resistor	680 k	
R680	1414420	Chip resistor	680 k	
R681	1414420	Chip resistor	680 k	
C701	2307085	Feed through cap.	330 p	
C702	2307085	Feed through cap.	330 p	
C703	2307085	Feed through cap.	330 p	
C705	2307085	Feed through cap.	330 p	

NOKIA MOBILE PHONES

HANDSET HSF-2

TMF-1XS

SERVICE

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15-18

C706	2307085	Feed through cap.	330 p
C707	2307085	Feed through cap.	330 p
C708	2307085	Feed through cap.	330 p
C115	2307816	Ceramic cap.	47 n
C135	2307816	Ceramic cap.	47 n
C220	2307816	Ceramic cap.	47 n
C225	2307816	Ceramic cap.	47 n
C230	2307816	Ceramic cap.	47 n
C240	2307816	Ceramic cap.	47 n
C250	2307816	Ceramic cap.	47 n
C253	2307816	Ceramic cap.	47 n
C260	2307816	Ceramic cap.	47 n
C270	2307816	Ceramic cap.	47 n
C280	2307816	Ceramic cap.	47 n
C600	2307816	Ceramic cap.	47 n
C613	2307816	Ceramic cap.	47 n
C621	2307816	Ceramic cap.	47 n
C630	2307816	Ceramic cap.	47 n
C633	2307816	Ceramic cap.	47 n
C641	2307816	Ceramic cap.	47 n
C642	2307816	Ceramic cap.	47 n
C644	2307816	Ceramic cap.	47 n
C650	2307816	Ceramic cap.	47 n
C651	2307816	Ceramic cap.	47 n
C680	2307816	Ceramic cap.	47 n
C681	2307816	Ceramic cap.	47 n
C685	2307816	Ceramic cap.	47 n
C698	2307816	Ceramic cap.	47 n
C251	2310336	Ceramic cap.	18 p
C252	2310336	Ceramic cap.	18 p
C255	2310336	Ceramic cap.	18 p
C645	2310336	Ceramic cap.	18 p
C647	2310336	Ceramic cap.	18 p
C127	2310424	Ceramic cap.	100 p
C231	2310424	Ceramic cap.	100 p
C233	2310424	Ceramic cap.	100 p
C652	2310424	Ceramic cap.	100 p
C659	2310424	Ceramic cap.	100 p
C692	2310424	Ceramic cap.	100 p
C697	2310424	Ceramic cap.	100 p
C683	2310463	Ceramic cap.	220 p
C100	2310488	Ceramic cap.	330 p
C101	2310488	Ceramic cap.	330 p
C102	2310488	Ceramic cap.	330 p
C103	2310488	Ceramic cap.	330 p
C104	2310488	Ceramic cap.	330 p
C105	2310488	Ceramic cap.	330 p
C106	2310488	Ceramic cap.	330 p
C107	2310488	Ceramic cap.	330 p
C108	2310488	Ceramic cap.	330 p
C109	2310488	Ceramic cap.	330 p
C110	2310488	Ceramic cap.	330 p
C112	2310488	Ceramic cap.	330 p
C113	2310488	Ceramic cap.	330 p
C114	2310488	Ceramic cap.	330 p
C121	2310488	Ceramic cap.	330 p
C122	2310488	Ceramic cap.	330 p
C123	2310488	Ceramic cap.	330 p
C124	2310488	Ceramic cap.	330 p

NOKIA MOBILE PHONES

HANDSET HSF-2

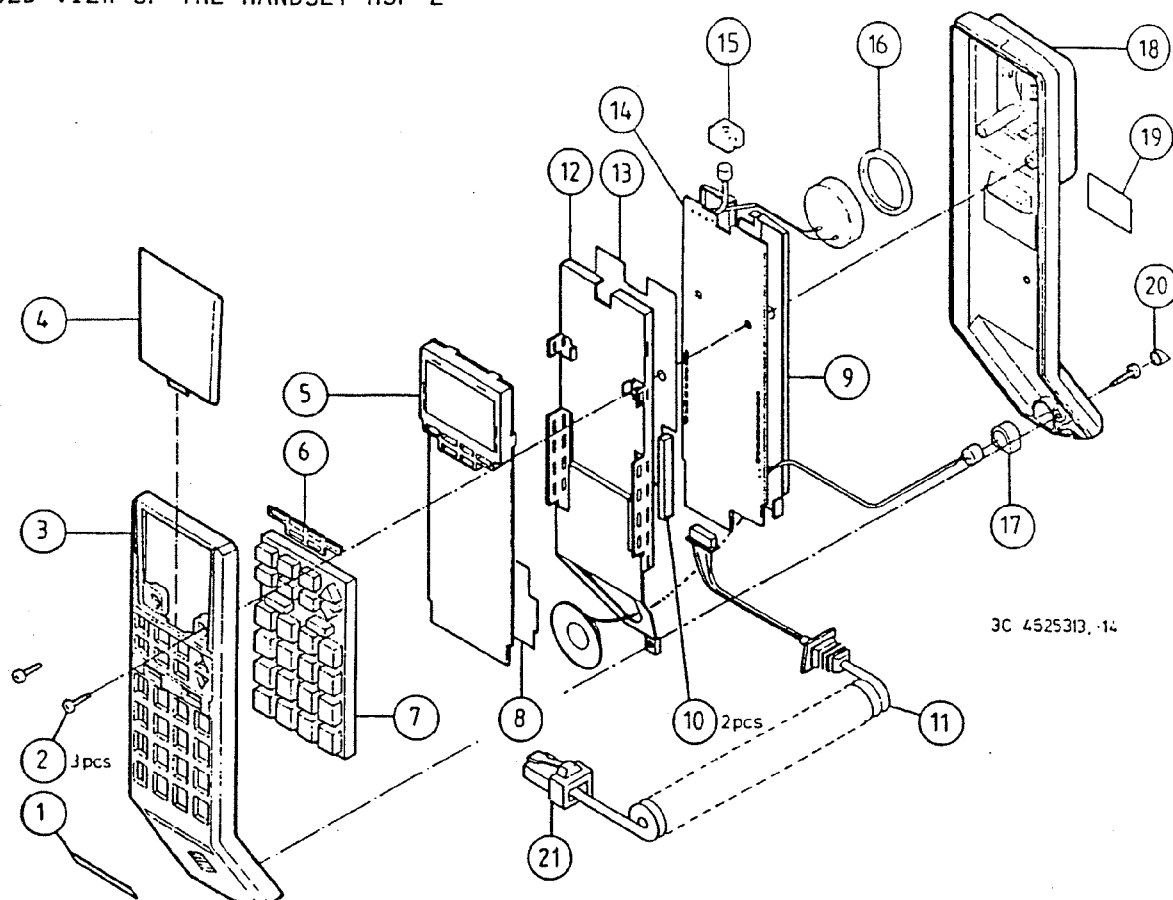
TMF-1XS

SERVICE

9224ARo

15-20

EXPLODED VIEW OF THE HANDSET HSF-2



ASSEMBLY PARTS HSF-2

ITEM	Q'TY	CODE	DESCRIPTION	DATA
1		9122807	Logo plate "Mobira"	
2	3	6293003	Screw	KB-30X12
3		9310818	A-cover	A1D40151
4		9304589	Display lens	N4D20268
5		0177745	Control module NK3K	
6		9307043	Ind. light cond.	HSX-2 A4D40261
7		5207866	Keyboard	HSN-2F
8		9310180	Insulator	HSX-2K N4D20591
9		9310198	RF-cover	HSX-2K N2D20592
10	2	5407777	Elastomeric connector	
11		7100913	Spiral cord (shielded)	
12		9310208	Secondary chassis	HSX-2K N2D20593
13		9310173	Insulator	HSX-2K N4D20590
14		0200092	Handset module NL3C	
15		9304549	HF-mic. soft	HSX-2 A4D40157
17		9304532	Microphone soft	HSX-2 A4D40156
18		9310790	B-cover	HSF-2 4C20718
19		9370118	Type label	HSF-2AC
20		9302711	Rubber plug	E4D10018
21		9309298	Socket	HSX-2 A3D40276
		7313122	Double sided tape	0.8x19x66 mm blk l=0.003 m
		9305119	Seal ring	

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1
16-1-1

RELATED DOCUMENTATION

4624585 battery pack BBM-1
 4625286 battery pack BBM-1N
 4625366 battery pack BBM-1LS
 4625352 battery pack BBM-1VP
 4625287 battery pack BBM-1T
 4625330 battery pack BBM-1V
 4625369 battery pack BBM-1R
 4624585 block diagram BBM-1
 0176692 block diagram NB3A
 4624585 connectors BBM-1
 0176692 circuit diagram NB3A
 0176702 circuit diagram NY3A
 4F 9852169 layout and foil diagrams NB3A
 4F 9852070 layout and foil diagrams NY3A
 6E 0176692 parts list NB3A
 6E 0176702 parts list NY3A
 2C 4624585 exploded view
 6E 4624585 assembly parts

Functional description

The battery pack consist of a NiCd cell and its charging electronics. Battery charging is possible only when the radio unit is connected, because its processor controls the operation of the charge converter module NB3A. The module provides the following:

- Charge converter for charging the NiCd battery; with an input voltage of 9 to 32 V d.c. the output voltage is controllable within 13 to 16 V.
- 6 V converter operating with the radio unit in the portable mode
- Battery charge/discharge current measurement circuit
- LED indicators for battery charging
- The start pulse is generated, when the charger is connected.
- An empty battery is pre-charged.

Connections

X101 (flat cable)

1,2	GND	Ground
3,4	+12B	Output of the charge converter and the positive pole of the NiCd battery
5,6	+VB	Supply voltage from car battery or network charger
7	BTMP	Connection of battery-internal NTC resistor
8	BCR	DC voltage output of battery current measurement
9	+12 V	Operating voltage input
10	PWR/EAR	Start pulse output for radio unit
11	BCON	Control input of charge converter
12	+6/8 V	6 V converter output

X102 (NiCd battery)

1	-B	Negative pole of battery
2	+12B	Positive pole of battery and charge converter output
3	BTMP	Connection of battery-internal NTC resistor
4	GND	Ground

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-2

Circuit description of the charge converter

Control circuit with BCON input

The voltage regulator N190 has an internal reference voltage of 1.23 V and the output voltage can be set by two external resistors according to this. The output voltage in this case is set to 7.1 V by R194 and R196. This voltage is then divided with R191 and R192 and applied to the non-inverting input of the operational amplifier N200B, which acts as a PI controller. This is the reference voltage for the charge converter and is controllable from about 4 to 5.6 V by the BCON input, where transistor V190 operates as a voltage follower.

The charger output voltage is divided by resistors R157 and R160 and applied to the non-inverting input of the amplifier, but only when the switch transistor V151 is on.

This switch disables charger operation if the supply voltage on line +VB is lower than 9 V. This is because the converter input current rises when the voltage goes down and there must be a limit. This also makes it possible to use a low-power, 9 V charger; the converter acts as a 9 V constant voltage load.

Oscillator

Comparator N160A generates the square/triangular wave of about 330 kHz frequency for converter control. The switching level of the comparator is set by resistors R173 and R174 connected to the non-inverting input of the comparator.

If the voltage at the comparator inverting input is lower than at pin 3 the open-controller output is off, and capacitor C165 is charged via R170...R172. When the voltage at pin 2 reaches the switching level, the comparator output goes low and capacitor C165 is discharged via R170.

The oscillator output is buffered by transistors V160 and V166 and the signal is returned to resistors R171 and R172 by capacitor C164. Because of the connection, the AC signal at both ends of resistor R171 is the same and only direct current is flowing through. Therefore R171 acts as a constant current device. Because capacitor C165 is charged with a constant current, a linear voltage ramp is obtained on it and also on the oscillator output, the output waveform being the sum of the sawtooth and square waves.

The pulse width of the oscillator signal is set by resistors R173 and R174 because when in operation, the average voltage at pins 2 and 3 as well as at the output, is the same. At the ratio of 100 k to 18 k, the output is about six times longer in the positive state than in zero state.

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-3

Pulse-width modulation

The AC signal from the oscillator and the control voltage from the controller are added together at the input pin 1 of the Schmitt trigger inverter V150A. Because the inverter has a fixed switching level and the DC level of the input signal is controllable, the duty cycle at the inverter output can be controlled.

The maximum duty cycle is set by V163 to equal that of the oscillator; when the oscillator output is in the low state also the voltage at V150A input goes low.

Chopper

The pulse-width modulated square wave is used to control FET switches V100 and V110. The gates of these parallel connected FETs are controlled via buffer transistor pair V101, V102. In operation, the energy is transferred to the output via capacitors C104 and C105.

As can be seen in the figure, coil L100 is connected to the input voltage line +VB and the coil L120 on the other side of the capacitance to ground. In operation, the average voltage on drain of the FETs must be equal to +VB and must be zero on the anode of diode V103.

When the control voltage is in the high state and the FETs are conducting, coils L100 and L120 are charged by current to ground and when the control voltage is low and the FETs in off state, the charges are transferred to the output via Schottky diode V103.

Capacitors C104 and C105 maintain their charge at quite the same level as the input voltage. This is because when the switches are on, the current in the capacitors flows in the opposite direction compared to that with the switches off, and the output is supplied.

The output energy is stored by capacitors C102 and C103 and filtered with L110 and C112 because of the pulsating current waveform. The input current is a triangular wave, smoothed with capacitor C101.

Current limiting

Current limiting is based on measuring the ripple voltage on output capacitors C102, C103. The ripple voltage is proportional to output current and is isolated from the DC by capacitor C121, rectified by diode V121 and filtered by C120. Transistor V120 is controlled with this DC voltage and the oscillator pulses are grounded when the transistor is conducting.

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-4

Circuit description of the 6 V converter

Control circuit

The 6 V converter reference voltage 3.6 V is produced by voltage divider R190, R191 from the voltage regulator N190 output. This reference is compared by the operational amplifier N200 to the output voltage value measured by resistors R132 and R161.

The operational amplifier produces a DC control voltage, which is applied to the pulse-width modulator N150B input via R168. To this voltage an oscillator signal is summed and the resulting PWM control signal is applied to the gate of the FET V132 via a pair of buffer transistors (V130 and V131).

Chopper

The 6 V chopper is of the step-down type and consists of FET switch V132, Schottky diode V135, coil L130 and output capacitor C130. Note that the control signal is active low; the FET V132 is conducting when the signal is in the low state.

Current limiting

The output current is measured by resistors R131 and R130. When the output current causes a voltage drop of 0.7 V and transistor V133 starts conducting, transistor V136 connects the oscillator pulses to ground.

Other functions

Battery current measurement

The negative pole of the NiCd battery is connected to the ground via low-resistance resistors R182...R185. The charging or discharging current of the battery causes a positive or negative voltage drop over the resistance, and this small voltage is amplified by N160B. The reference voltage is set by resistors R177 and R178 and the gain by the ratio of R180 and R178. In normal operation the FET V182 is conducting, and the measuring resistors are connected to the amplifier.

However when the +12 V supply first appears, FET V182 is turned to the off state and the V183 on state for a period of 500 ms. During this period the processor of the radio unit can read the reference for the zero battery current.

Start pulse generation

When a voltage of more than 9 V is applied to line +VB so that transistor V151 is turned on, the output of inverter N150E, pin 10, goes high and makes transistor V152 the conductive. In addition line PWR/EAR is grounded via R154. When capacitor C151 is charged the transistor turns off. This start pulse causes the radio unit to be turned on when a charger is connected, so that the radio unit can start controlling the charging process.

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-5

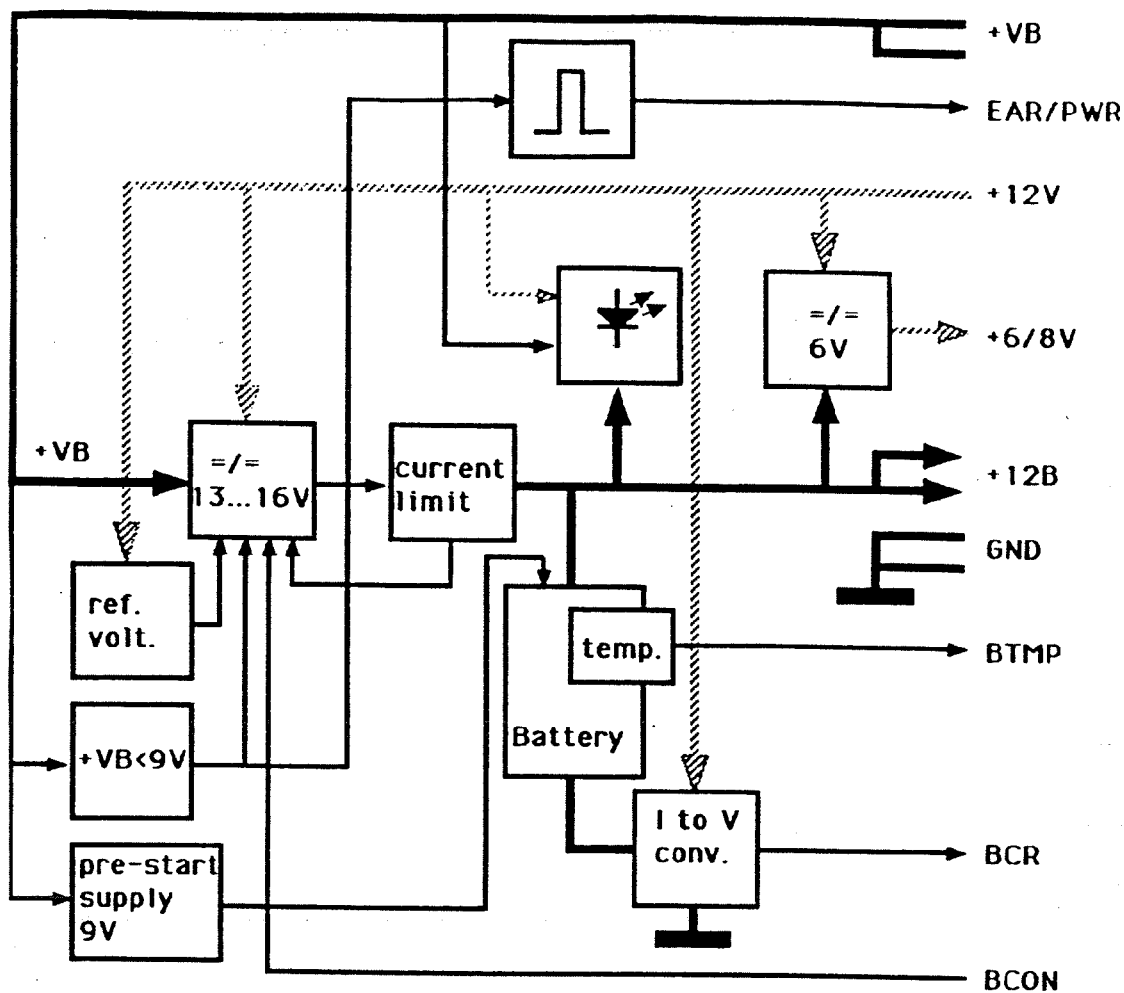
Pre-charging an empty battery

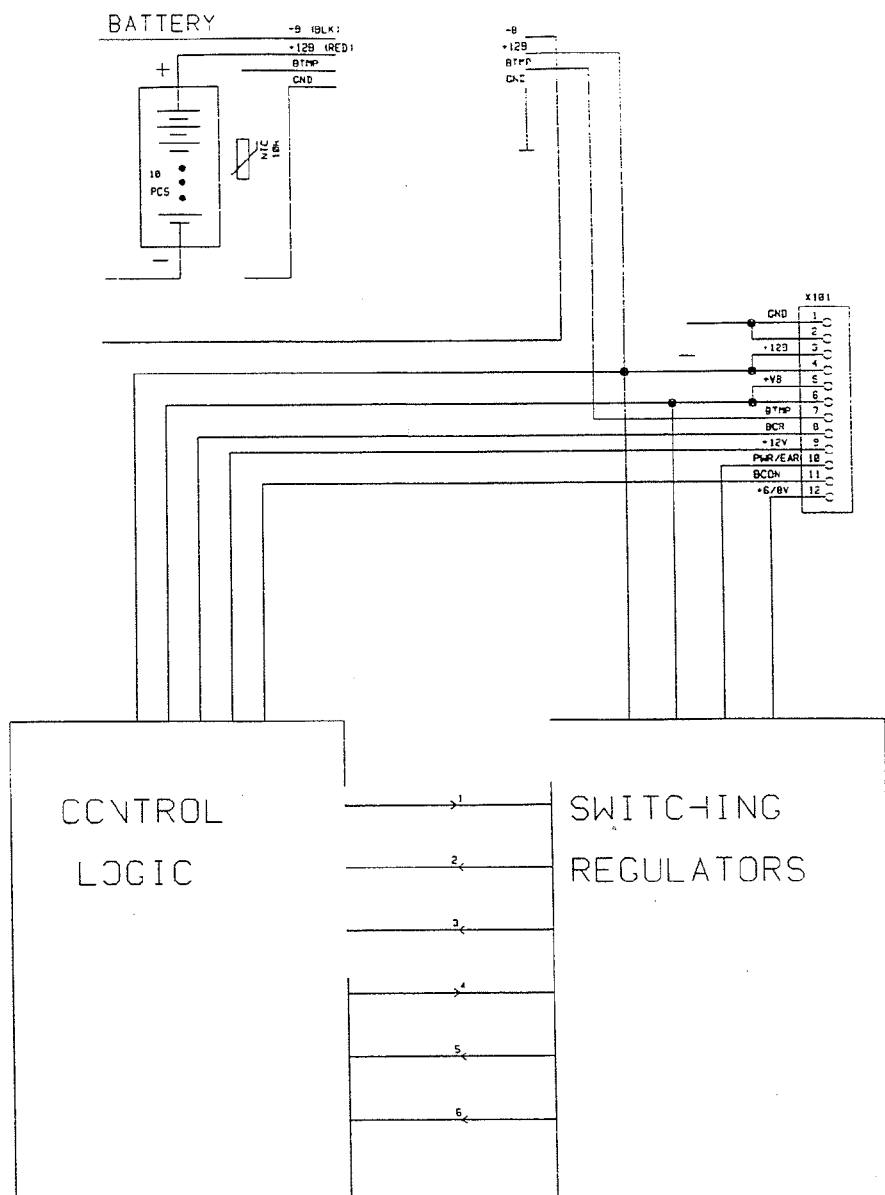
Because the radio unit and the battery pack take their operating voltages from the NiCd battery, current must be supplied from line +VB to the +12B starting line when the battery is totally flat and a charger is connected.

For the above purpose a power transistor V141 is connected as a constant current device by the aid of V134 and R152. The output is connected to the +12B line by diode V140A. This circuit delivers approx. 250 mA current to the battery until its voltage reaches the level of about 6 to 7 V.

Indication of charging mode

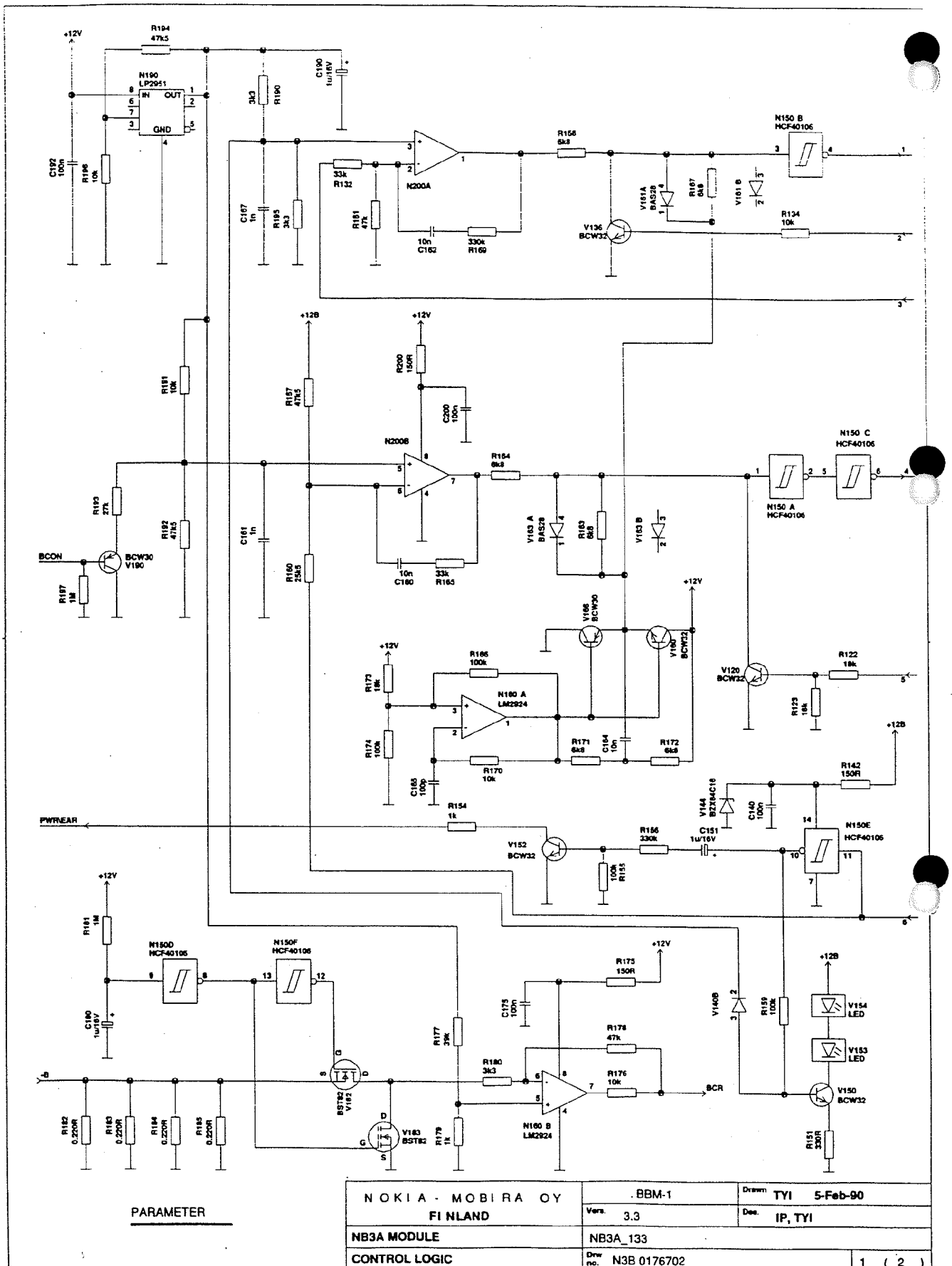
When there is a voltage of over 9 V applied to the +VB line and power is on there are two LEDs, V153 and V154 to indicate that the battery is being charged. They are operated by a constant current generated by V150 the +12B line; when the charger is in operation, the N150E output is in the high state and a constant voltage to the V150 base is 3.6 V.

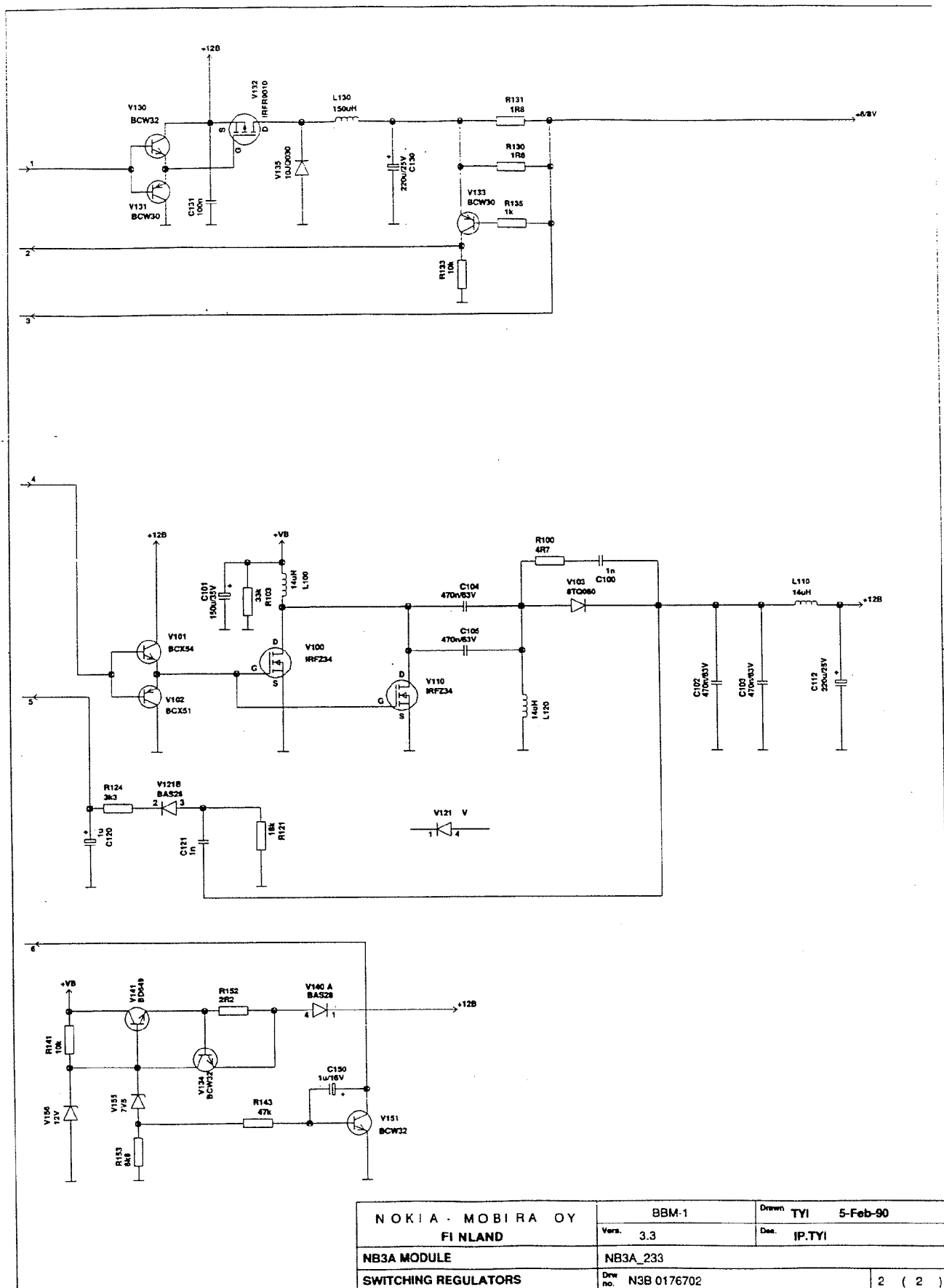


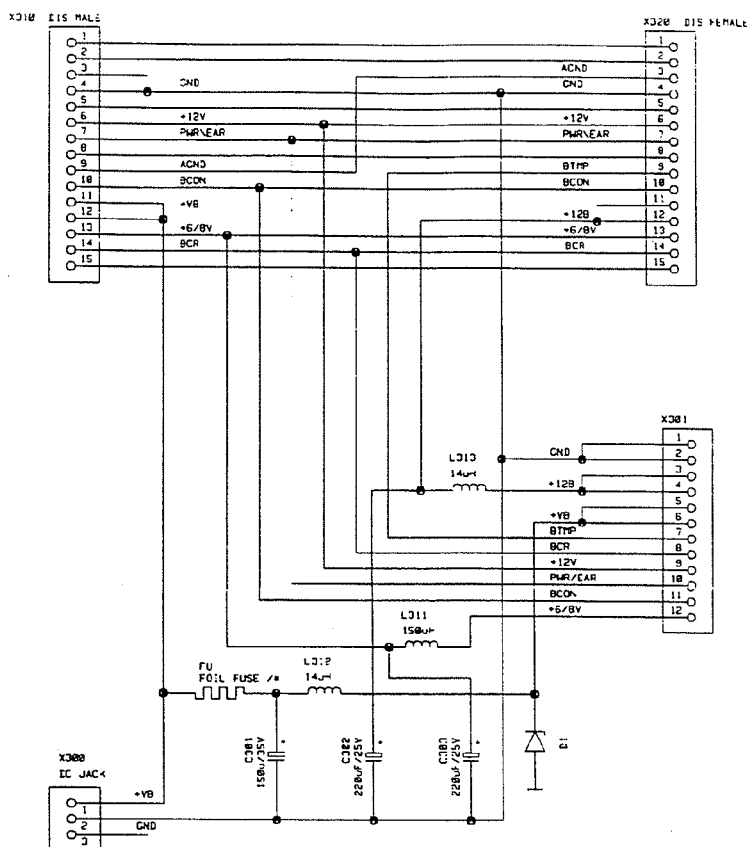


PARAMETER

NOKIA MOBILE PHONES	Proj.	BBM-1	Drawn	TYI	18-Jan-90
	Ver.	3.3	Des.	IP, TY	30-JAN-89
Title	NB3A MODULE/BATTERY				
File	NB3A 33				
Doc	BLOCK DIAGRAM				
Draw no	N3B 0175692				
	1 (2)				







/* : Replace with axial type, Nokia-Mobina code 5111307

NOKIA MOBILE PHONES	Proj	BBM-1	Drawn	TYI	18-Jan-92
	Ver.	3.4	Des.	IP, TYI	
NY3A	File	NY3A 34			
CONNECTOR MODULE	Draw no	N3B 0176702			1 (1)

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

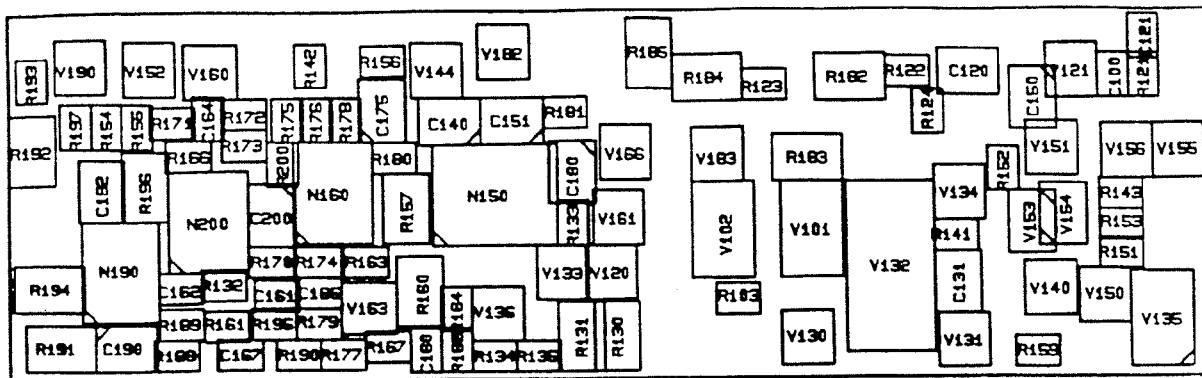
9016TiRa

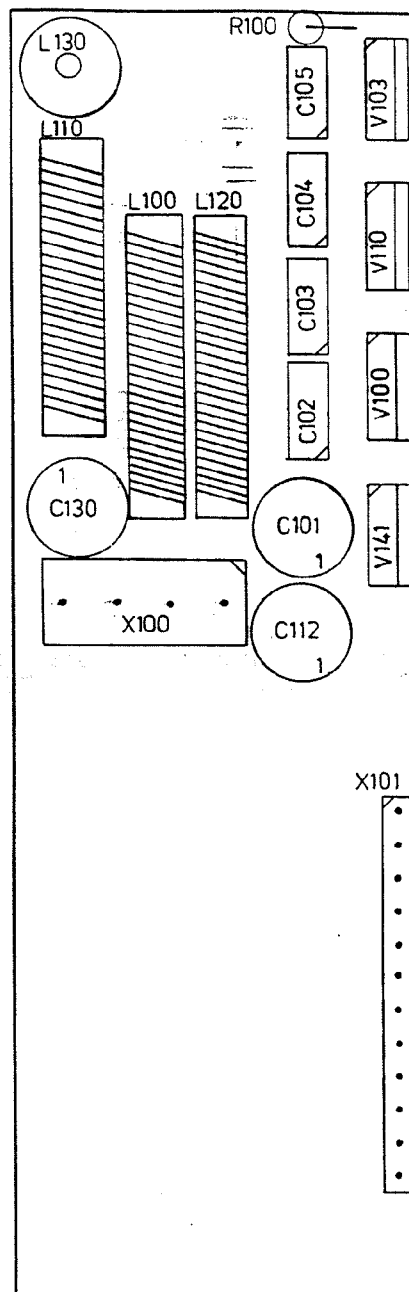
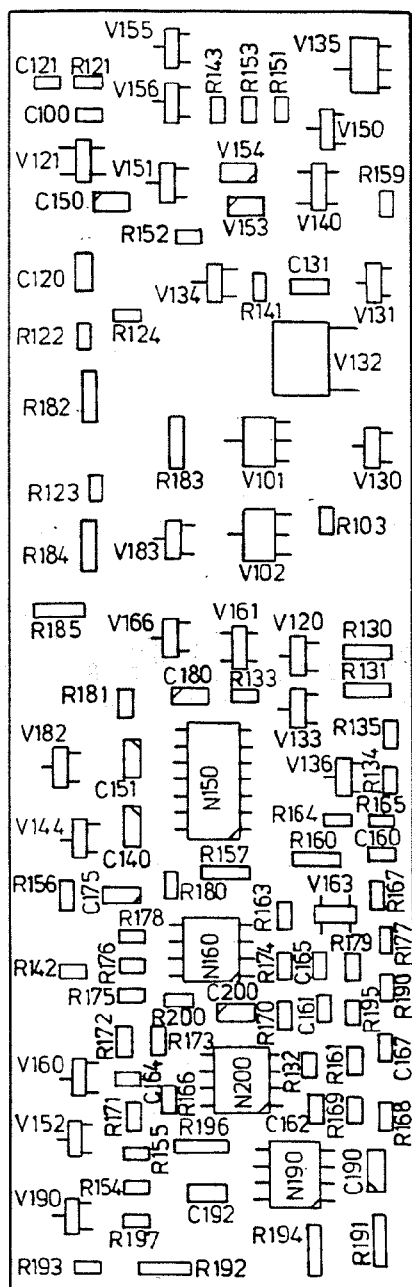
TMX-2 TMF-1

16-1-11

LAYOUT AND FOIL DIAGRAMS OF NB3A

4F 9852169





NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

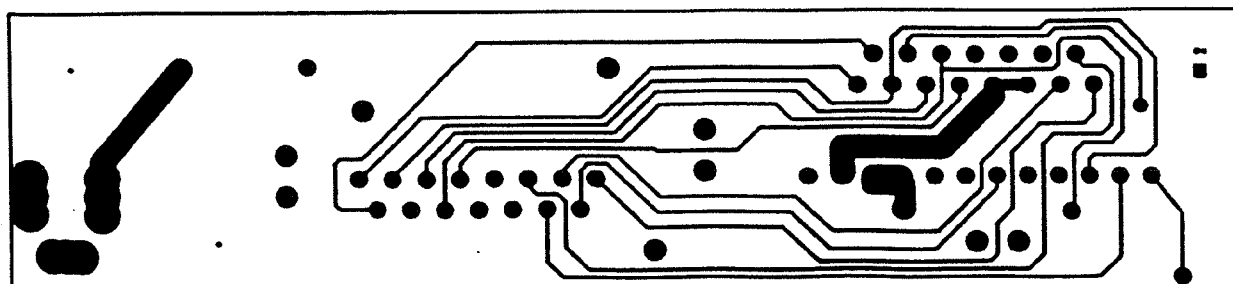
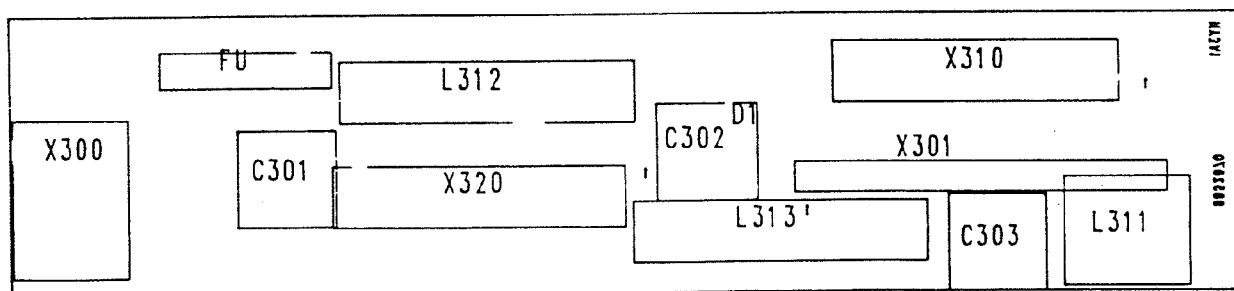
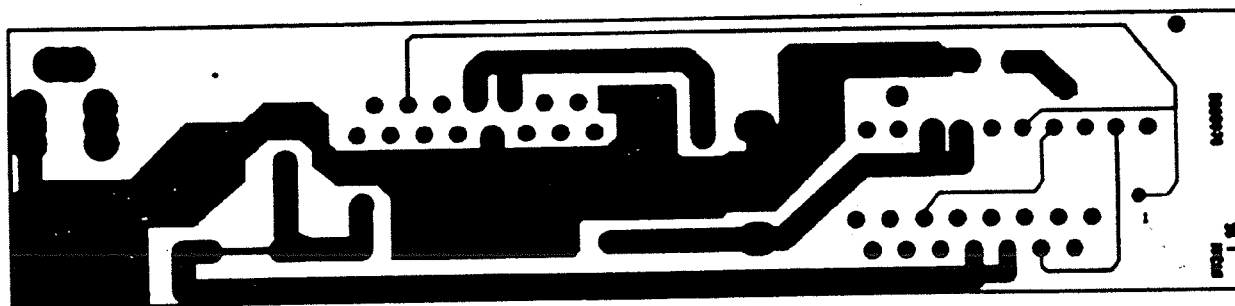
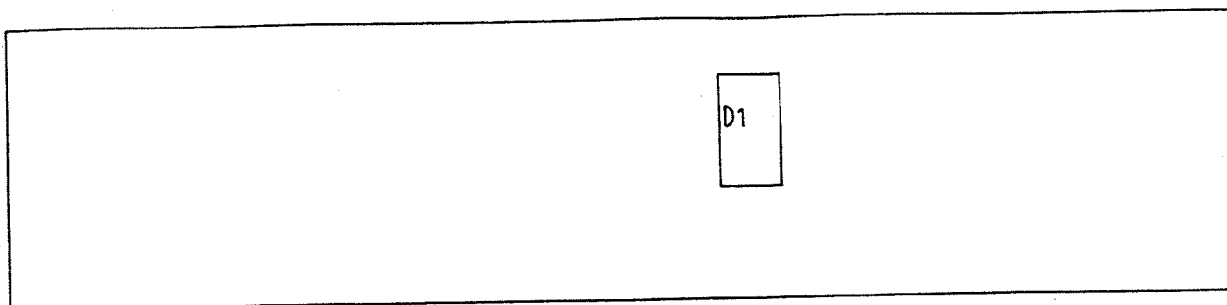
9016TiRa

TMX-2 TMF-1

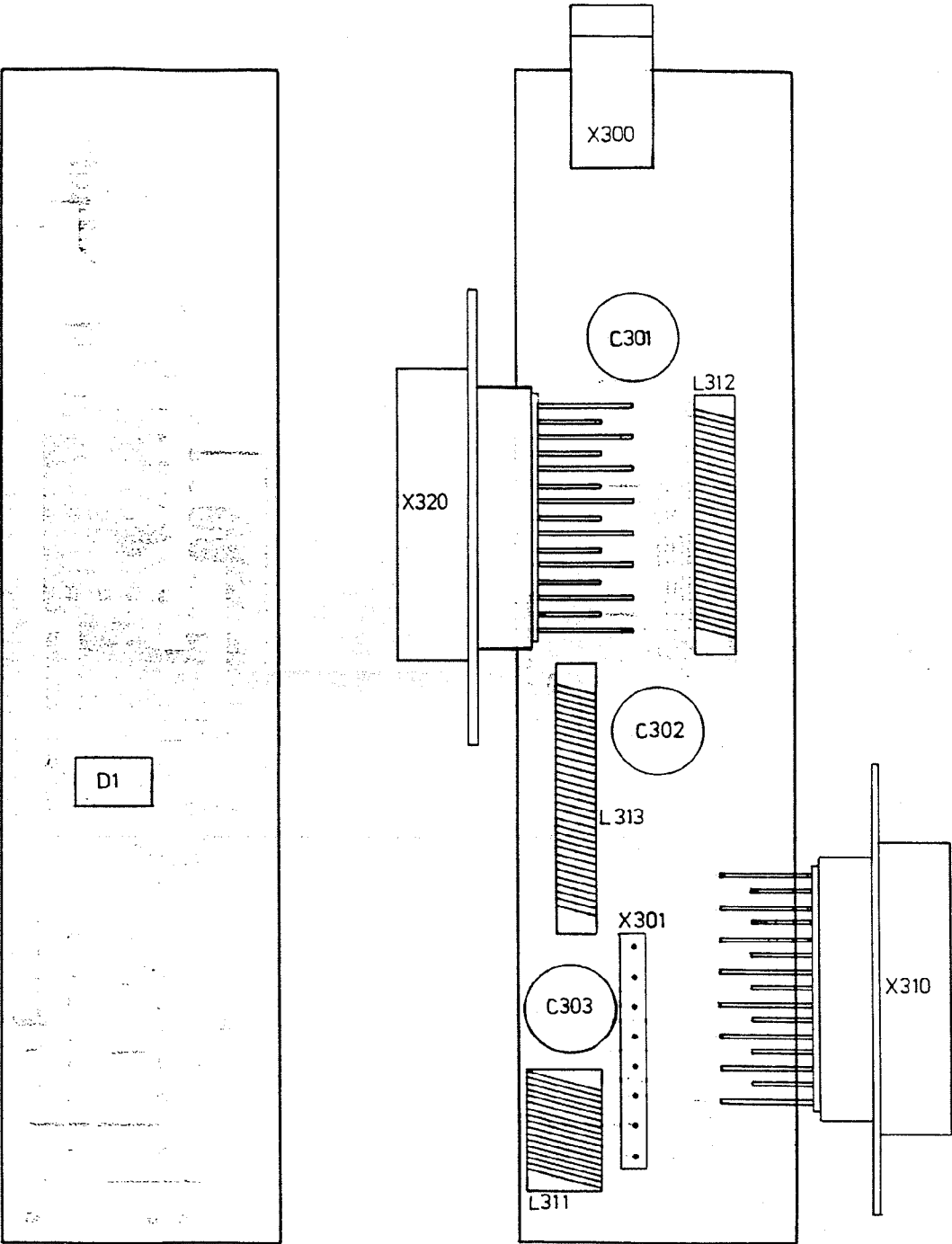
16-1-12

LAYOUT AND FOIL DIAGRAMS OF NY3A

4F 9852070



NY3A1 0176702



NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-13

PARTS LIST OF NB3A version 11.4.90

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R100	1400467	Resistor	4.7	0.25 W MELF 0207
R182	1411123	Resistor	0.22	0.25 W MELF 1206
R183	1411123	Resistor	0.22	0.25 W MELF 1206
R184	1411123	Resistor	0.22	0.25 W MELF 1206
R185	1411123	Resistor	0.22	0.25 W MELF 1206
R130	1411162	Resistor	1.8	0.25 W MELF 1206
R131	1411162	Resistor	1.8	0.25 W MELF 1206
R152	1412279	Chip resistor	2.2	0.06 W 0805
R151	1412303	Chip resistor	330	0.06 W 0805
R135	1412333	Chip resistor	1 k	1 % 0.06 W 0805
R154	1412333	Chip resistor	1 k	1 % 0.06 W 0805
R179	1412333	Chip resistor	1 k	1 % 0.06 W 0805
R133	1412430	Chip resistor	10 k	5 % 0.06 W 0805
R134	1412430	Chip resistor	10 k	5 % 0.06 W 0805
R141	1412430	Chip resistor	10 k	5 % 0.06 W 0805
R170	1412430	Chip resistor	10 k	5 % 0.06 W 0805
R176	1412430	Chip resistor	10 k	5 % 0.06 W 0805
R121	1412511	Chip resistor	18 k	0.06 W 0805
R122	1412511	Chip resistor	18 k	0.06 W 0805
R123	1412511	Chip resistor	18 k	0.06 W 0805
R173	1412511	Chip resistor	18 k	0.06 W 0805
R193	1412609	Chip resistor	27 k	5 % 0.06 W 0805
R103	1412729	Chip resistor	33 k	5 % 0.06 W 0805
R132	1412729	Chip resistor	33 k	5 % 0.06 W 0805
R165	1412729	Chip resistor	33 k	5 % 0.06 W 0805
R155	1413635	Chip resistor	100 k	5 % 0.06 W 0805
R159	1413635	Chip resistor	100 k	5 % 0.06 W 0805
R166	1413635	Chip resistor	100 k	5 % 0.06 W 0805
R174	1413635	Chip resistor	100 k	5 % 0.06 W 0805
R181	1413804	Chip resistor	1.0 M	5 % 0.06 W 0805
R197	1413804	Chip resistor	1.0 M	5 % 0.06 W 0805
R142	1413917	Chip resistor	150	5 % 0.06 W 0805
R175	1413917	Chip resistor	150	5 % 0.06 W 0805
R200	1413917	Chip resistor	150	5 % 0.06 W 0805
R124	1414027	Chip resistor	3.3 k	1 % 0.06 W 0805
R180	1414027	Chip resistor	3.3 k	1 % 0.06 W 0805
R190	1414027	Chip resistor	3.3 k	1 % 0.06 W 0805
R195	1414027	Chip resistor	3.3 k	1 % 0.06 W 0805
R156	1414212	Chip resistor	330 k	0.06 W 0805
R169	1414212	Chip resistor	330 k	0.06 W 0805
R143	1414276	Chip resistor	47 k	1 % 0.06 W 0805
R161	1414276	Chip resistor	47 k	1 % 0.06 W 0805
R178	1414276	Chip resistor	47 k	1 % 0.06 W 0805
R153	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R163	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R164	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R167	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R168	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R171	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R172	1414413	Chip resistor	6.8 k	5 % 0.06 W 0805
R177	1414491	Chip resistor	39 k	1 % 0.06 W 0805
R160	1415311	Resistor	25.5 k	5 % 0.25 W MELF 1206
R191	1415625	Resistor	10.0 k	0.25 W MELF 1206

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-14

R196	1415625	Resistor	10.0 k	0.25 W MELF 1206
R157	1416033	Resistor	47.5 k	5 % 0.25 W MELF 1206
R192	1416033	Resistor	47.5 k	5 % 0.25 W MELF 1206
R194	1416033	Resistor	47.5 k	5 % 0.25 W MELF 1206
C131	2309517	Ceramic cap.	100 n	10 % 50 V X7R 1206 chip
C140	2309517	Ceramic cap.	100 n	10 % 50 V X7R 1206 chip
C175	2309517	Ceramic cap.	100 n	10 % 50 V X7R 1206 chip
C192	2309517	Ceramic cap.	100 n	10 % 50 V X7R 1206 chip
C200	2309517	Ceramic cap.	100 n	10 % 50 V X7R 1206 chip
C165	2310424	Ceramic cap.	100 p	5 % 50 V 0805
C100	2310544	Ceramic cap.	1 n	10 % 50 V X7R 0805 chip
C121	2310544	Ceramic cap.	1 n	10 % 50 V X7R 0805 chip
C161	2310544	Ceramic cap.	1 n	10 % 50 V X7R 0805 chip
C167	2310544	Ceramic cap.	1 n	10 % 50 V X7R 0805 chip
C160	2310752	Ceramic cap.	10 n	20 % 50 V X7R 0805 chip
C162	2310752	Ceramic cap.	10 n	20 % 50 V X7R 0805 chip
C164	2310752	Ceramic cap.	10 n	20 % 50 V X7R 0805 chip
C102	2404094	Polyester cap.	0.47 µ	10 % 63 V
C103	2404094	Polyester cap.	0.47 µ	10 % 63 V
C104	2404094	Polyester cap.	0.47 µ	10 % 63 V
C105	2404094	Polyester cap.	0.47 µ	10 % 63 V
C101	2501595	Electrol.cap.	150 µ	20 % 35 V
C112	2502743	Electrol.cap.	220 µ	20 % 25 V
C130	2502743	Electrol.cap.	220 µ	20 % 25 V
C120	2604216	Tantalum cap.	1 µ	20 % 16 V chip
C150	2604216	Tantalum cap.	1 µ	20 % 16 V chip
C151	2604216	Tantalum cap.	1 µ	20 % 16 V chip
C180	2604216	Tantalum cap.	1 µ	20 % 16 V chip
C190	2604216	Tantalum cap.	1 µ	20 % 16 V chip
L130	3606463	Choke	150 µ	FJ 1342
L100	3606470	Choke	14 µ	± 3 µH FJ 1328
L110	3606470	Choke	14 µ	± 3 µH FJ 1328
L120	3606470	Choke	14 µ	± 3 µH FJ 1328
V103	4100302	Schottky diode	MBR1060	60 V 10 A TO-220
V135	4101112	Schottky diode	10JQ030	30 V 1 A SOT-89
V153	4102998	LED		green 1206 chip
V154	4102998	LED		green 1206 chip
V155	4107025	Zener diode	BZX84B7V5	SOT-23 chip
V144	4107027	Zener diode	BZX84C16	SOT-23 chip
V156	4107160	Zener diode	BZX84C12	SOT-23 chip
V121	4108639	Diode	BAS 28	dual SOT-143
V140	4108639	Diode	BAS 28	dual SOT-143
V161	4108639	Diode	BAS 28	dual SOT-143
V163	4108639	Diode	BAS 28	dual SOT-143
V141	4200498	Transistor	BD649	TO-220
V132	4200610	Transistor	IRFR9010	MOSFET TO-252
V101	4200875	Transistor	BCX54	NPN 1.5 A/45 V SOT-89
V102	4200877	Transistor	BCX51-16	NPN SOT-89
V131	4200909	Transistor	BCW 30	SOT-23
V133	4200909	Transistor	BCW 30	SOT-23
V166	4200909	Transistor	BCW 30	SOT-23
V190	4200909	Transistor	BCW 30	SOT-23
V120	4200917	Transistor	BCW 32	SOT-23
V130	4200917	Transistor	BCW 32	SOT-23
V134	4200917	Transistor	BCW 32	SOT-23
V136	4200917	Transistor	BCW 32	SOT-23
V150	4200917	Transistor	BCW 32	SOT-23

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-15

V151	4200917	Transistor	BCW 32	SOT-23
V152	4200917	Transistor	BCW 32	SOT-23
V160	4200917	Transistor	BCW 32	SOT-23
V100	4202470	MOSFET	IRFZ34	TO-220
V110	4202470	MOSFET	IRFZ34	TO-220
V182	4202671	FET	BST82	SOT-23
V183	4202671	FET	BST82	SOT-23
N190	4301062	IC	LP2951ACM	SO-8
N200	4301199	Op.amplifier		LM 2904 SO-8
N160	4305223	IC	LM2924	comp.+op.amplifier SO-8
N150	4309417	Inverter		40106B7/74HC14 SO-14
X101	5413996	Pin strip		12 pin
X100	5415016	Pin strip		4 pin
	9309435	Grounding plate		A4D 40347
	9309442	Insulating plate		A4D 40348
	9852169	PC board NB3A		30x100 mm

PARTS LIST OF NY3A

ITEM	CODE	DESCRIPTION	VALUE	TYPE
C301	2501595	Electrol.cap.	150 μ	35 V
C302	2502743	Electrol.cap.	220 μ	25 V
C303	2502743	Electrol.cap.	220 μ	25 V
L311	3606463	Choke	150 μ	FJ 1342
L312	3606470	Choke	14 μ	$\pm 3 \mu$ H FJ1328
L313	3606470	Choke	14 μ	$\pm 3 \mu$ H FJ1328
D1	4113827	Transient supressor		SMCG33A
X301	5413996	Pin strip		12 pin
X300	5414943	DC connector		
X320	5430423	D connector		15 pin female
X310	5433664	D connector		15 pin male
	9852070	PC board NY3A		23x100 mm

NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

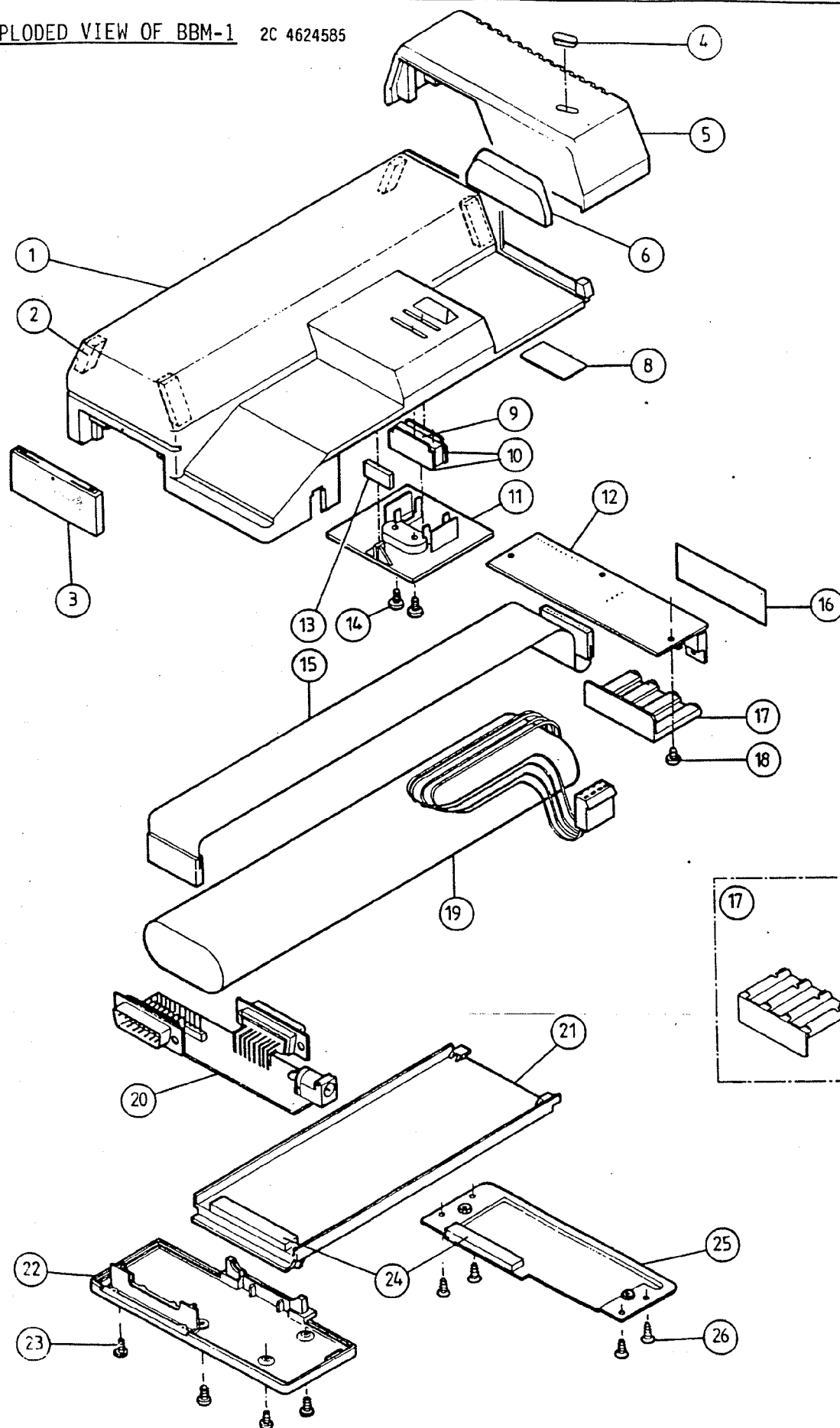
SERVICE

9016TiRa

TMX-2 TMF-1

16-1-16

EXPLODED VIEW OF BBM-1 2C 4624585



NOKIA MOBILE PHONES

BATTERY PACK BBM-1

TMX-1 TMN-1

SERVICE

9016TiRa

TMX-2 TMF-1

16-1-17

ASSEMBLY PARTS OF BBM-1

ITEM	Q'TY	CODE	DESCRIPTION	VALUE
1		9303585	Battery case	A1D 40139
2	4	7313059	Adhesive tape	3x8 mm
3		9303560	Cover	A3D 40143
4		9304451	Lens	A4D 40196
5		9303553	Charging case BBM-1	
5		9309604	Charging case BBM-1N	A3C 40145
5		9311000	Charging case BBM-1LS	3C 20778
5		9310969	Charging case BBM-1VP	4C 20751
5		9309611	Charging case BBM-1T	3C 20535
5		9310159	Charging case BBM-1V	3C 20587
5		9310896	Charging case BBM-1R	3C 20736
6		9307678	Support	A4D 40270
8		9332628	Type label BBM-1/N/T/V	A4D 40195
8		9334287	Type label BBM-1LS	
8		9334287	Type label BBM-1VP	
8		9334216	Type label BBM-1R	
9		6490209	Magnet	25x11x6 mm
10	2	9134841	Magnet plate	4D MD50
11		9303578	Magnet cover	A3D 40142
12		0176692	NB3A module	
13		6490217	Magnet	3x6x15 mm
14	2	6291934	PT screw	KB 2.5x8
15		0179118	Flat cable + connectors	
16		9304490	Insulating plate	A4D 40199 20x55 mm
17		9304444	Button	A4C 40191
18	3	6291765	Screw	
19		4700549	NiCd battery	12 V 1.7 Ah
20		0176702	NY3A module	
21		9303619	Battery cover	A2D 40140
22		9303592	Connector cover	A2D 40141
23	4	6291934	PT screw	KB 2.5x8
24		7313059	Adhesive tape	3x8 mm 0.15 m
25		9303602	Charging cover	A4D 40144
26	4	6291772	Screw	M3x8 FEZN
	2	9307861	Screw	battery<->radio unit
		6291934	Screw	for NY3A module

NOKIA MOBILE PHONES

BATTERY PACK

TMX-1 TMN-1

SERVICE

BBM-2/2QQ

TMX-2 TMF-1

9110HK

16-2-1

BATTERY PACK BBM-2 DESCRIPTION

RELATED DOCUMENTATION

0670002	battery pack BBM-2
0670002	block diagram BBM-2
3B 0200013	block diagram NB3B
3B 0200013	circuit diagrams NB3B
3B 0200014	circuit diagram NY3B
6E 0200013	parts list NB3B
6E 0200014	parts list NY3B
2C 0670002	exploded view
6E 0670002	assembly parts BBM-2
6E 0670004	assembly parts BBM-2QQ

FUNCTIONAL DESCRIPTION

General

The BBM-2/2QQ Battery Pack consists of a NiCd battery with charging electronics. Battery charging is possible only with the radio unit connected because the operation of the NB3B charge converter module is controlled by the radio unit processor.

The unit has the following functions:

- Charging converter for NiCd battery, input voltage 9 to 32 V DC.
Output voltage controllable within range 13 to 16 V.
"Soft start" controlled at 9 V DC.
Output current limited to 3 A.
- 6 V converter, operating when radio unit is in portable mode.
Inoperative when radio unit turns off + 8 V supply on + 6/8 V line.
Input current limited to 0.3 A.
- Battery charge/discharge current measurement circuit with reference level circuitry.
- Battery charging indicated by LEDs.
- Start pulse generation with charger connected.
- Initial recharging of deep-discharged battery.

NOKIA MOBILE PHONES

BATTERY PACK

TMX-1 TMN-1

SERVICE

BBM-2/2QQ

TMX-2 TMF-1

9110HK

16-2-2

Block description

The transceiver controls the charge voltage via the BCON line and reads battery current via the BCR line and battery temperature via the BTEMP line. The transceiver keeps a record of battery capacity by reading the current direction and magnitude and calculating the time. The capacity is displayed in per cent. During charging the rated full capacity is restored, multiplied by 1.1 for efficiency, with a current of about 2.7 A and charging is completed with a current of C/10 over 2 hours. After the 2 hour period, HW power turn off is allowed. The transceiver also adapts to the BCR line value, reading it during start up. This value equals zero battery current and all currents are related to this reference value.

Due to the recorded reference for current and capacity it is NOT RECOMMENDABLE to change the battery base without reprogramming the transceiver. If the battery base is changed, the transceiver adapts to the new reference current after 3 POWER-UPS (power must stay absent over 15 seconds to enable reading the new current reference value). In the above case, the battery will be CHARGED FOR 16 HOURS because it is charged with C/10 current if a 100 % capacity is indicated. On the contrary, if the indicated capacity is 0 % with a new battery in full charge the battery will be overcharged with a reduced current.

Construction

There are two modules in the battery pack: the NB3B charging module and the NY3B connector module. These are interconnected with a 10-wire flat cable.

The male D-connector in the battery pack is nearly identical with radio unit D-connector. This means that all but two contacts from the female connector (radio side) are wired direct to the male connector. The exceptions are:

- 1) The +VB line in the male connector is not connected straight to the radio unit but to the charging module. The output of the charging module supplies the battery and the radio unit via corresponding pins of the D-connector, designated +12B in the female connector.
- 2) Audio ground is separated from the power supply ground to obtain proper interference attenuation. In the radio unit pin number 3 is named AGND; nevertheless, it is connected to the same ground but only in the processor module of the radio unit. On the connector module of the battery pack, pin 3 of the female D-connector is wired to pin 9 of the male connector. This line (number 9) is connected back to its position in the 8-pin system connector (for the handset) on the mounting base, i.e. pin number 3. This also results in the BTMP line not being available on the male D-connector but only on the female one.

NOKIA MOBILE PHONES

BATTERY PACK

TMX-1 TMN-1

BBM-2/2QQ

TMX-2 TMF-1

SERVICE

9110HK

16-2-3

NB3B MODULE CONNECTIONS

Connector X101 (Flat cable connector)

pin	name	description
1	GND	Ground
2	+6/8V	6 V converter output
3,4	+12B	Output of the charge converter and positive pole of the NiCd battery
5,6	+VB	Supply voltage from car battery or network charger
7	BCR	d.c. voltage output of battery current measurement
8	+12V	Operating voltage input
9	BCON	Control input of charge converter
10	BTMP	Connection of internal NTC resistor of battery

Connector X102 (NiCd battery connector)

pin	name	description
1	-B	Negative pole of battery
2	+12B	Positive pole of battery and charge converter output
3	BTMP	Connection of internal NTC resistor of battery
4	GND	Ground connection of NTC

NY3B MODULE CONNECTIONS

Connector X301

(see 2.1 NB3B connector X101)

Connector X310 (D-connector male)

pin	name	description
1,2,5,8 15		No function on NY3B. Pins are wired between X310 and X320.
3,4	GND	Ground
6	+12V	No function on NY3B
7	PWR/EAR	Start pulse output for radio unit
9	AGND	No function on NY3B
10	BCON	No function on NY3B
11,12	+VB	Supply voltage from car battery or network charger for pre-start regulator and NB3B module.
13	+6/8V	No function on NY3B
14	BCR	No function on NY3B

NOKIA MOBILE PHONES

BATTERY PACK

TMX-1 TMN-1

SERVICE

BBM-2/2QQ

TMX-2 TMF-1

9110HK

16-2-4

Connector X320 (D-connector female)

pin	name	description
1,2,5,8 15		No function on NY3B. Pins are wired between X310 and X320.
3	AGND	No function on NY3B
4	GND	Ground
6	+12V	No function on NY3B
7	PWR/EAR	Start-pulse output for radio unit
9	AGND	No function on NY3B
10	BCON	No function on NY3B
11,12	+12B	The output of the pre-start regulator
13	+6/8V	No function on NY3B
14	BCR	No function on NY3B

Connector X300 (Charger connector)

pin	name	description
1	+VB	Supply voltage from car battery or network charger for pre-start regulator and NB3B module.
2	GND	Ground

DESCRIPTION OF THE CHARGE CONVERTER

Output Voltage Control Circuit With BCON Input

The reference voltage at the non-inverting input of the operational amplifier N130A is the voltage difference between the Zener voltage of 7.5 V and the BCON voltage + 0.5 V.

The sensitivity of BCON is determined by the resistance ratio of R130 and R131. This reference voltage is controllable from about 5.1 V to 6.8 V by the BCON input, where the transistor V130 operates as a voltage follower.

The charger output voltage is divided by resistors R134 and R135 and applied to the inverting input of the amplifier.

Input Voltage Control Circuit

The input voltage of the converter is divided by R140 and R141 and applied to amplifier N130B. This disables charger operation if the supply voltage on the +VB line is lower than 9 V. This is needed because the lower the input voltage is the higher is the current. The start up input voltage is thus limited to 9 V. This also makes it possible to use a small, low power 9 V charger; the converter acts as a 9 V constant voltage load.

NOKIA MOBILE PHONES

SERVICE

BATTERY PACK

BBM-2/2QQ

9110HK

TMX-1 TMN-1

TMX-2 TMF-1

16-2-5

Oscillator

The timer N160 generates a saw-tooth wave signal of about 300 kHz for the converter.

C161 is charged via R160 and R161 until the voltage at the threshold pin (6) exceeds $\frac{2}{3}$ of the supply voltage, whereupon the discharge output (7) starts to sink the current and discharge C161 via R161. When the voltage of C161 at the trig pin (2) gets lower than $\frac{1}{3}$ of the supply voltage the discharge output (7) turns to a high impedance state and the voltage of C161 starts to rise again. R161 determines the rate of fall and the sum of R161 and R160 the rate of rise of the wave.

Because of the delay in the timer, the peak to peak value of the signal is much higher than the window between trig and threshold levels.

The voltage divider R162/R163 resets the circuit whenever the supply voltage is less than approx. 4 V. This is needed because the timer will operate even on less than 1 V when other components are no more operative.

Pulse Width Modulator

The a.c. signal from the oscillator is connected to the trig and threshold pins of the PWM. The control voltage determines the pulse ratio: the lower the voltage is the smaller is the pulse ratio until, at a very low control level, the output (3) will stay low because the saw-tooth wave no more gets the triggering level.

Chopper

The pulse-width modulated square wave is used to drive MOSFET switch V222. The drive is boosted by the transistor pair V220, V221.

Assuming constant coil currents, it is easy to follow the operation:

Two current values in the circuit can be handled as constants: current through L220 and another through L221. During the conduction phase of the MOSFET V222 both currents sink to its drain. When V222 is open both currents are fed to capacitance C223 + C224 through diode V223. Both currents flow through C221 but are separate in time and direction and the charge of C221 remains constant (for the long term). The ratio of L220 current to L221 current is the same as the ratio of V222 conductive time to open time, and the peak currents of MOSFET V222 and diode V223 are equal to the sum of the two currents. The peak current is the input current divided by the pulse ratio. The current mean value of MOSFET V222 is equal to the input current, and the mean value of diode V223 current is the peak current minus the MOSFET current.

Input voltage +VB is applied to coil L220 and coil L221 is connected to ground. So the average voltage of C221 is equal to the input voltage +VB.

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The output energy is stored in capacitors C223 and C224 and filtered with L222 and C225 because of the pulsating current waveform.

In practice the input current waveform is a triangular wave and the voltage is smoothed with capacitor C220.

Output Current Control Circuit

Current limiting is based on measuring the ripple voltage of the output capacitors C223 and C224. The ripple voltage is proportional to output current. The ripple is isolated from d.c. by C152 and the peak to peak value is detected by V151. With this d.c. voltage the pulse width is controlled by transistor V150.

DESCRIPTION OF THE 6 V CONVERTER

Output Voltage Control Circuit

The 6 V converter reference voltage is produced by voltage divider R122, R123 from the Zener voltage of 7.5 V. The exact reference value is 6.0 V. This reference is compared by the operational amplifier N100B direct to the output voltage.

Pulse-Width Modulator

The a.c. signal from the oscillator (see under Oscillator) is connected to the trig and threshold pins of the PWM. The control voltage determines the pulse ratio: the higher the voltage is the greater is the pulse ratio until at a very high control level the output (3) stays high because the saw-tooth wave does not get the threshold level.

Current Limit

Input current is measured by resistor R200. When the output current causes a voltage drop of 0.6 V, transistor V200 starts to conduct and pulls the control line state up, increasing the pulse ratio of the PWM. With a higher pulse ratio, the chopper output is lower until the PWM output remains high, whereupon the chopper is inoperative and ceases to supply current.

Chopper

The 6 V chopper is a step-down type and consists of switch V190, Schottky diode V191, coil L190 and output capacitor C190.

The discharge output (7) is an open drain and gives the base current for V190. Output (3), of the push-pull type, boosts the base current, also draining the base charge when turning the transistor off. When the PWM N180 is unpowered, output (3) remains low and the discharge output (7) is in high impedance state, and the switch V190 will remain open.

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OTHER FUNCTIONS ON NB3B

Battery Current Measurement

The negative pole of the NiCd battery is connected to the ground via low-ohm resistors R100 to R103. The charge or discharge current of the battery causes a positive or negative voltage drop over the resistance, and this small voltage is amplified by N100A. The reference voltage is set by resistors R109 and R110 and the gain by the ratio of R106 and R107. In normal operation, MOSFET V100 is conducting and the measuring resistors are connected to the amplifier.

However, when the + 12 V voltage first appears, V100 is kept in the off state and V101 in the on state for a 500 mS time period. During this time the processor of the radio unit can read the reference for zero battery current.

Indication of the Charging Mode

Whenever the charging chopper is operating, transistor V232 gets its base voltage and the two LEDs, V230 and V231 alight and indicate that the battery is being charged. They are operated by a constant current, which is determined by R231.

FUNCTIONS ON NY3B

Start-Pulse Generation

When a voltage of over 9 V is applied to the +VB line, MOSFET V320 receives enough gate voltage to turn on, and the PWR/EAR line is grounded via R322. When capacitor C320 is charged, the transistor turns off.

The start pulse causes the radio unit to turn on when a charger is connected so that the radio unit can start controlling the charging process.

Pre Charging of the Empty Battery

Because the radio unit and the battery pack receive their operating voltages from the NiCd battery its voltage must be sufficient to operate their functions when turned on. For this reason a completely empty battery is charged by the linear regulator when the charger is connected and the battery voltage is very low.

Power transistor V311 is connected as a constant current device with the help of V312 and R313. Voltage divider R311 and R312 reduces the power loss (and output current) when the input voltage is high. The output is connected to the +12B line by diode V313. This circuit supplies a current of about 250 mA to the battery until its voltage reaches a level of about 6 to 7 V.

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16-2-8

TEST OF NB3B MODULE

6 V Converter

The 6 V converter takes the input power from +12B line and gives 6 V/600 mA to +6/8V line. The converter should work when input voltage in +12B line is between 10...16 V. The input should be connected to +12V line also.

Following functional tests should be made:

- Battery current, when not operative (i.e. + 12 V is not connected)
- Output voltage level
- Standby current
- Efficiency
- Current limit

Testing

SETTINGS	RESULTS
- Connect supply voltage to pin +12B of NB3B module - Set the output voltage to $16\text{ V} \pm 0.4\text{ V}$	- The current in +12B line should be $< 300\text{ }\mu\text{A}$
- Connect supply voltage to pins +12B and +12V of NB3B module and measure the output voltage and the input current	- The output voltage should be of 5.7...6.4 V - The input current should be $< 12\text{ mA}$
- Set the supply voltage to $11.0\text{ V} \pm 0.3\text{ V}$ - Connect 150...200 mA load to +6/8V output	- The output voltage should be 5.7...6.4 V and the efficiency $> 74\%$
- Short +6/8V output	- The current should be $< 700\text{ mA}$ - The output voltage should return to 5.7...6.4 V when the short-circuit is removed

Charger Converter

The input voltage of the converter comes from the +VB line. The operating voltage area is 9...32 V. With this area converter should be able to give output voltage of 13...16 V, depending the d.c. voltage level of the control line, BCON.

When the charge converter is in operation i.e. there is input voltage over 9 V in +VB line and + 12 V is connected to the +12B line, charging mode should be indicated by a two led.

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16-2-9

Following functional tests should be made:

- Input current, when not operative
- Standby current value
- Both LEDs should illuminate when charging mode is active
- Output voltage in +12B line controllable 11...16 V by setting 0...5 V control voltage in BCON input
- Efficiency
- Current limiting
- Operating voltage level of low power charger

Testing

SETTING	RESULTS
- Connect the supply voltage to +VB line and d.c. voltage meter to +12B line - Set input supply voltage to 30 ± 0.5 V	- The current in the +VB line should be $< 600 \mu\text{A}$ - The voltage of +12B line should be < 2 V
- Set the input voltage to 12.0 ± 0.3 V - Connect a control voltage to BCON line and set it to zero - Connect + 12 V to +12B line	- The input current should be < 400 mA
- Connect a 150Ω load resistor to the +12B line with d.c. mA meter and d.c. V meter	- The leds should indicate when the converter is operating - The voltage in +12B line should be 12.6...13.2 V
- Set the control voltage in BCON to 5.00 ± 0.10 V	- The output voltage should be 15.5...17.0 V
- Set the output current by the load to 2.8...2.9 A	- The output voltage in +12B line should be 15.5...17.0 V - The efficiency should be $> 84 \%$
- Set the output of the supply to 30 V and the output current by the load to 2.8...2.9 A	- The output voltage in +12B line should be 15.5...17.0 V - The efficiency should be $> 84 \%$
- Load the output voltage down to 14 V	- The output current should be < 4 A
- Set the output current of the converter to 1 A and set the current limit of the power supply to 800...900 mA (or use the low power 9 V charger instead)	- The converter should load the output of the supply to 8.7...9.3 V

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Battery Current Measurement Circuit

The charging and discharging current of the battery is measured and converted to d.c. voltage of 0...5 V, which could be read from the BCR line. Also the circuit has a 500 ms time period after the +12 V is turned on, when it gives reference value for zero battery current.

Following functional tests should be made:

- Zero current reference output within right time period
- The BCR output gives d.c. voltage of 0...5 V, depending of the positive/negative in -B pin over operating area of -3 A...3 A.

Testing

SETTINGS	RESULTS
- Connect power supply to pins +12B - Set the voltage to 13 ± 1 V - Set the oscilloscope to a single sweep mode with the time/div of about 100 ms/div - Connect a current source to -B line - Set the current source output to $2.5 \text{ A} \pm 100 \text{ mA}$ - Connect the +12V line to +12B line	- In the screen of the scope there should be seen a negative-going slope in the BCR line delayed 300...1000 ms from the +12V positive-going slope - BCR voltage level before ramp should be 2.60 ± 0.25 V - The voltage should remain on this level at least 300 ms - BCR voltage level after the ramp should be 0.65 ± 0.27 V d.c. - This level should be reached in 1000 ms
- Disconnect the +12V line from +12B line - Change the polarity of the current source - Connect the +12V line to +12B line	- BCR voltage level before ramp should be again 2.60 ± 0.25 V - BCR voltage level after the ramp should be 4.5 ± 0.27 V d.c.

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TEST OF NY3B MODULE

Linear regulator from +VB to +12B supplies current when battery voltage is so low, that radio unit is not able to connect + 12 V.

When operating voltage is applied to the +12B line and in the +VB line is connected d.c. voltage over 9 V, this should cause start pulse in PWR/EAR line. This is an open collector output with 1 k Ω series resistor and needs a pull-up for testing.

Following functional tests should be made:

- Regulator maximum current and voltage
- Low-level pulse should occur after the leading edge of +VB

Testing the linear regulator

SETTINGS	RESULTS
- Connect the power supply to the +VB line and d.c voltage meter to the +12B line - Set the input supply voltage to 30 ± 1 V	- The current in the +VB line should be 1...5 mA - The voltage of +12B line should be 10...12 V
- Short the output +12B and measure the current	- The current should be 100 ± 50 mA

Testing the start-up pulse

SETTINGS	RESULTS
- Connect the test circuit i.e. 1 kΩ pull-up resistor to 12 V - Set the time/div of the scope to 100 mS/div and connect the voltage (9...32 V) to the +VB line	- There should appear on the screen a negative-going pulse - The low state should be 6 ± 2 V - The duration of above voltage should be 400...1000 mS

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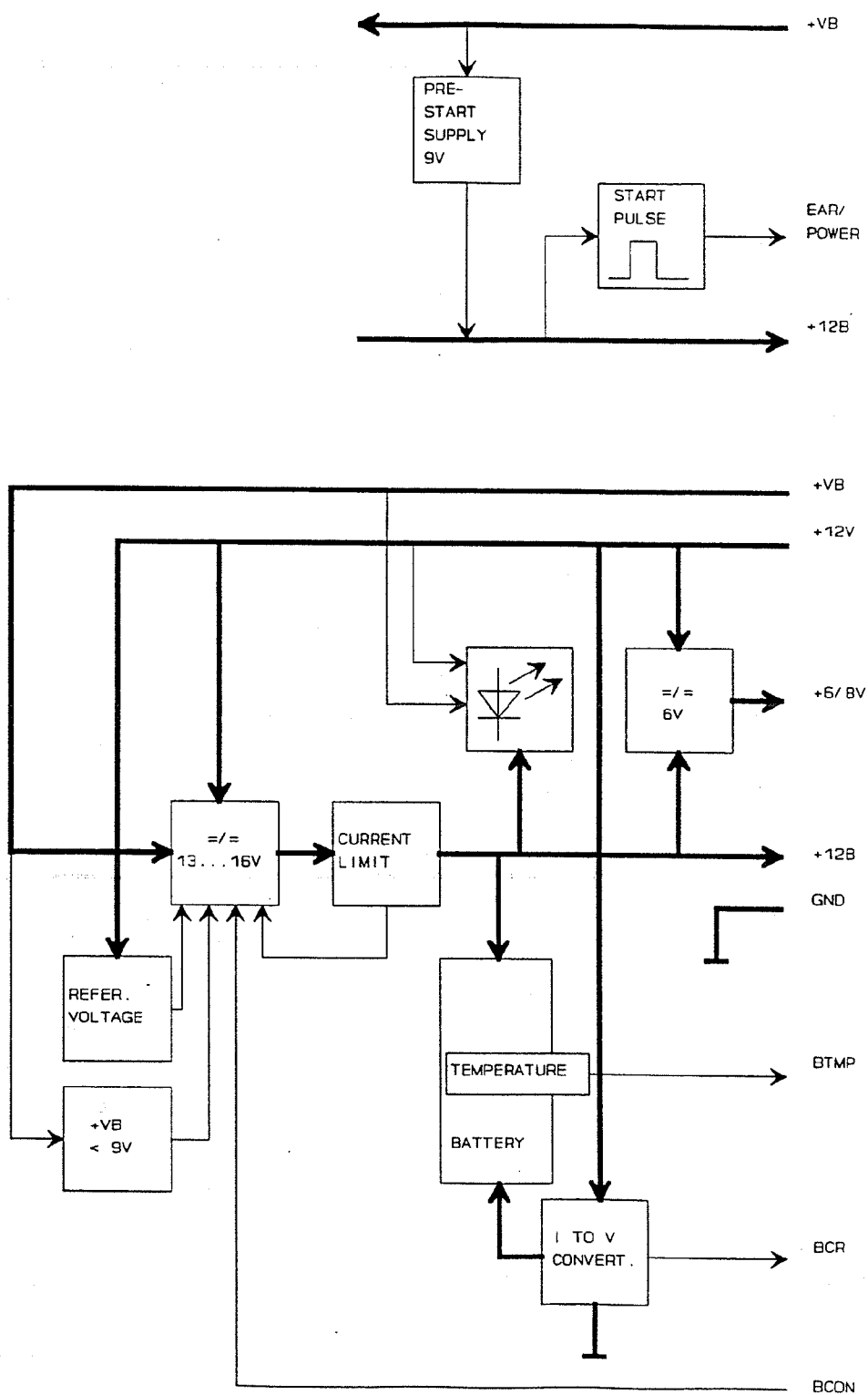
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16-2-12

BLOCK DIAGRAM OF BBM-2/2QQ



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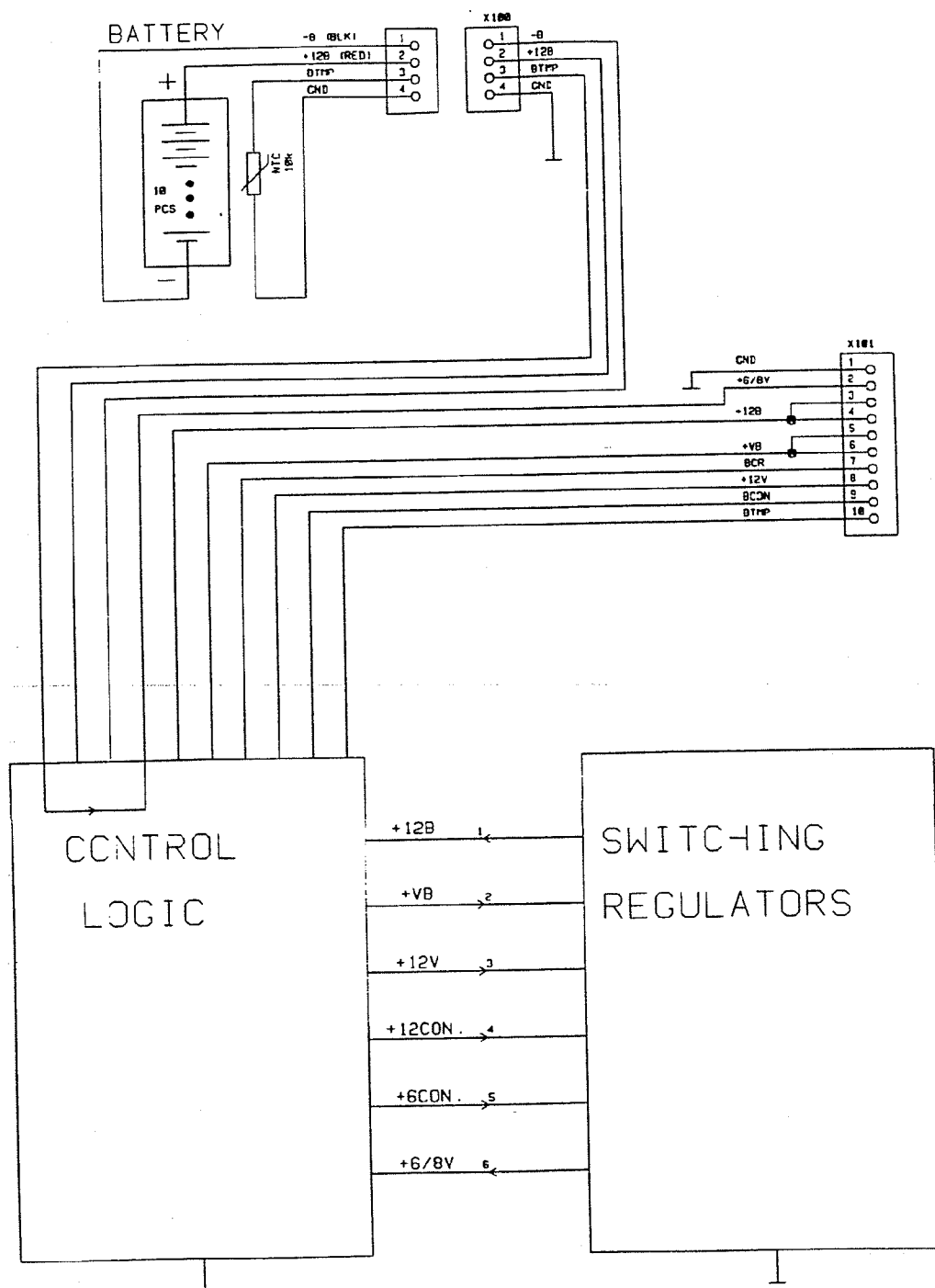
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BLOCK DIAGRAM OF NB3B



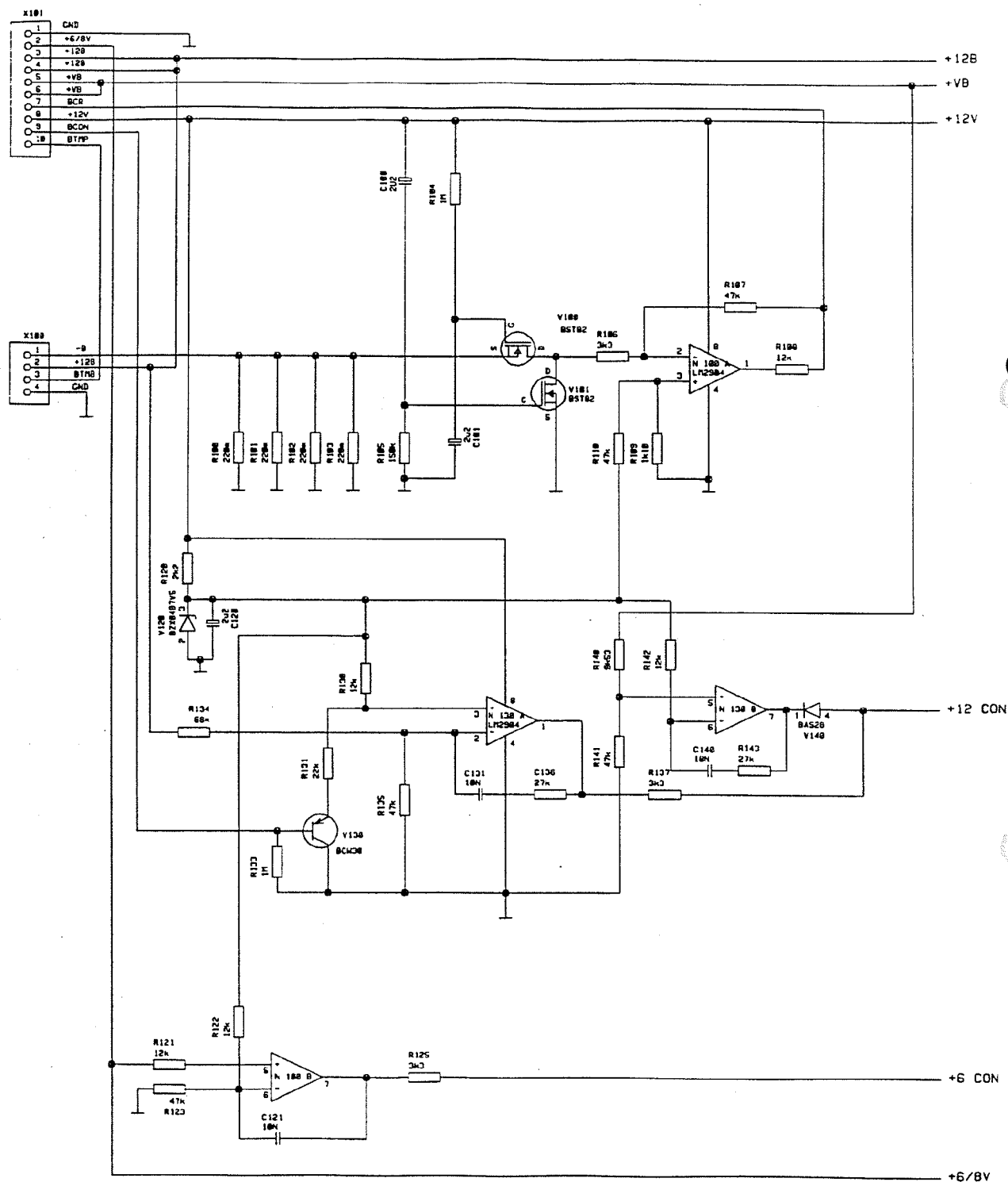
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16-2-14

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CIRCUIT DIAGRAM 1 OF NB3B



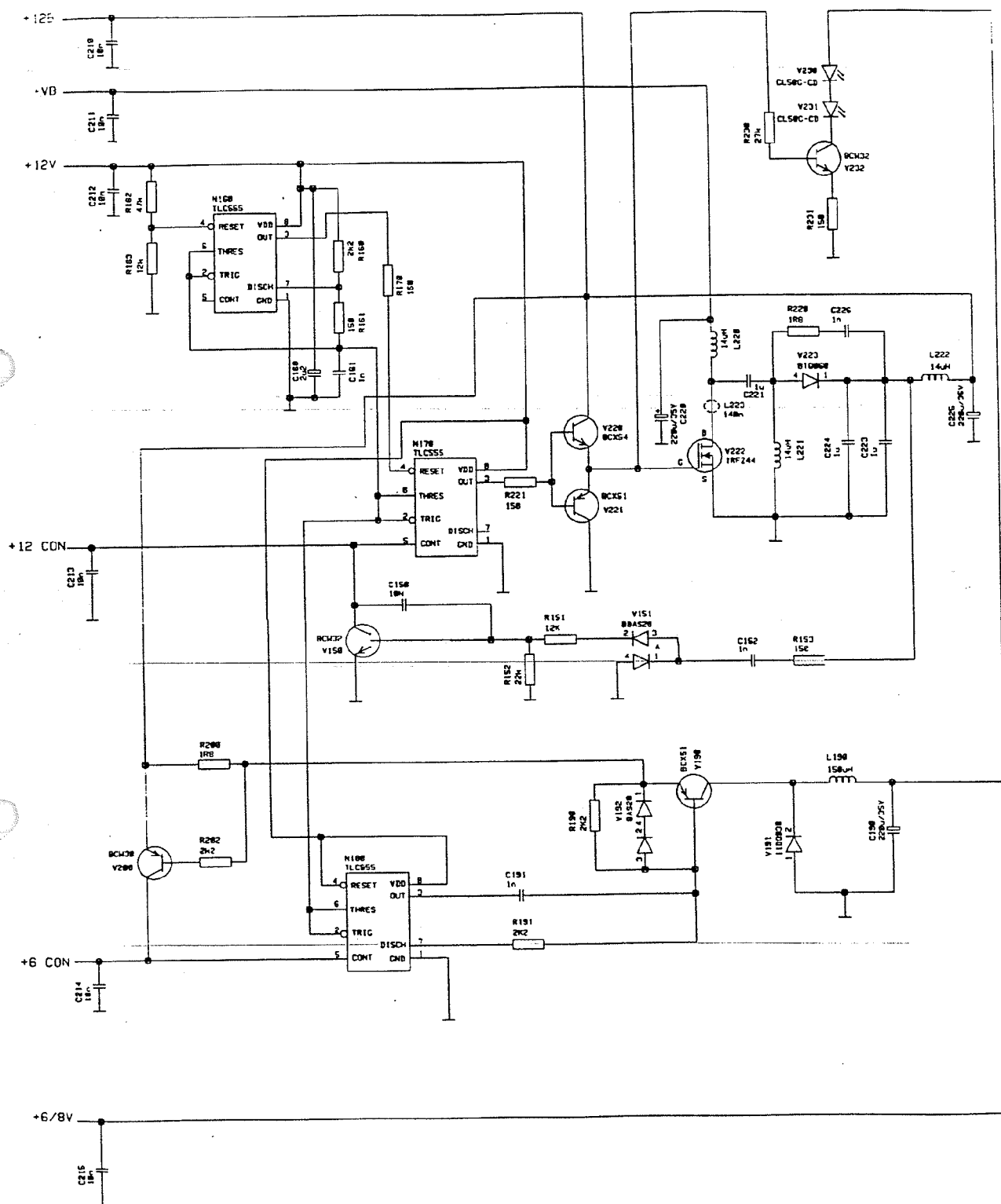
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CIRCUIT DIAGRAM 2 OF NB3B



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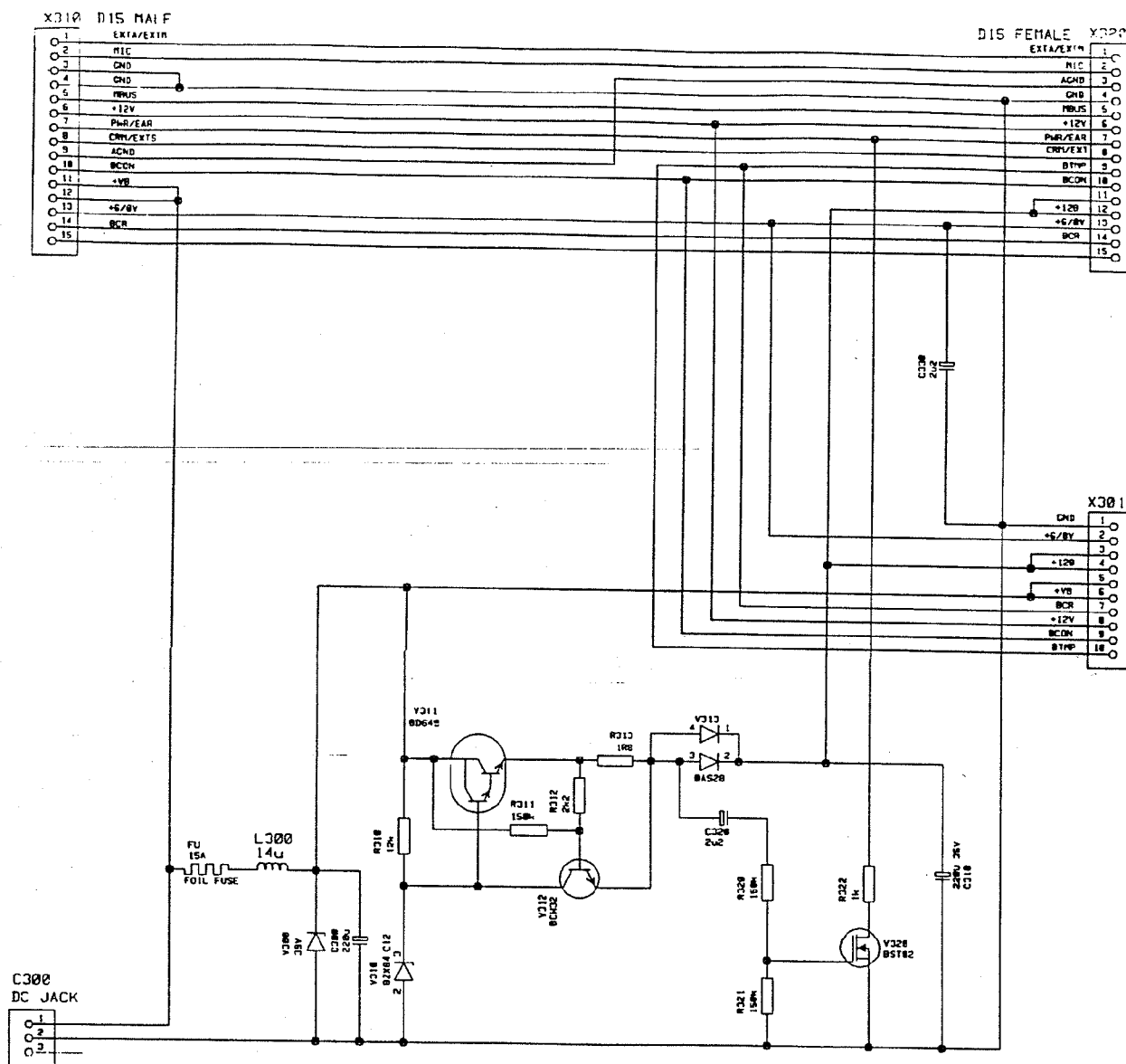
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CIRCUIT DIAGRAM OF NY3B



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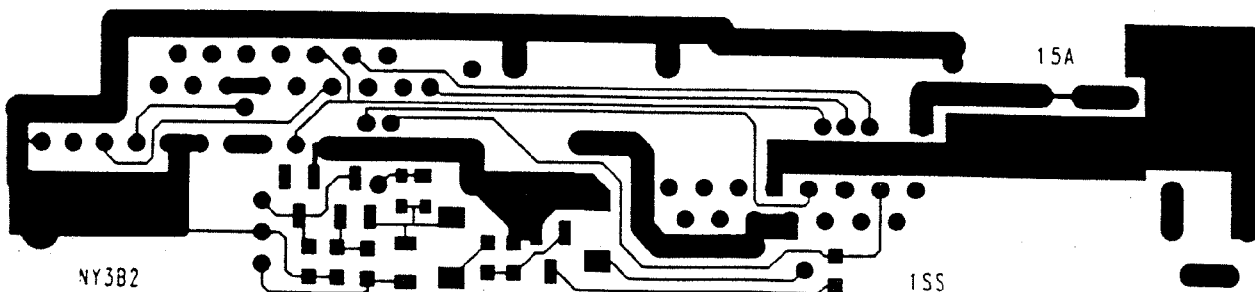
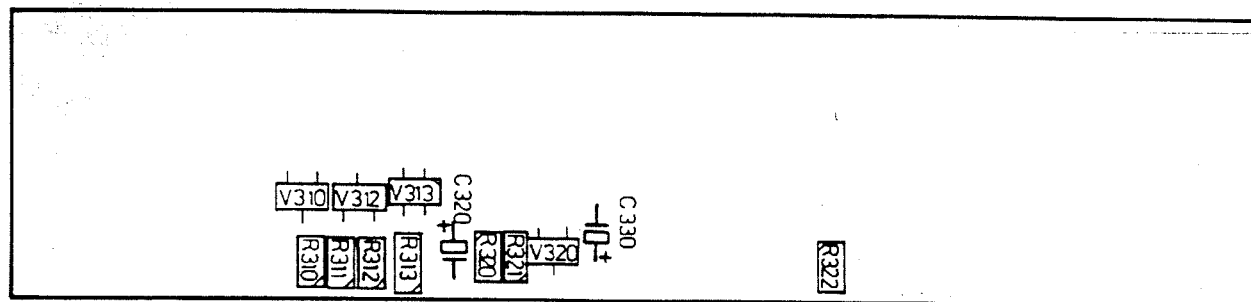
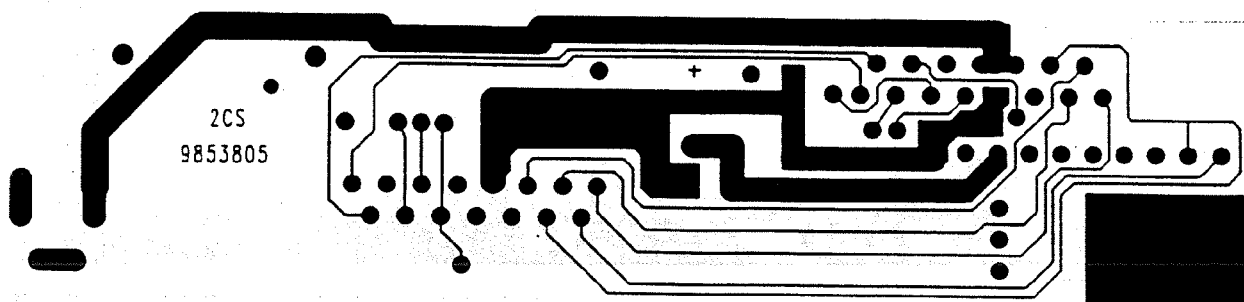
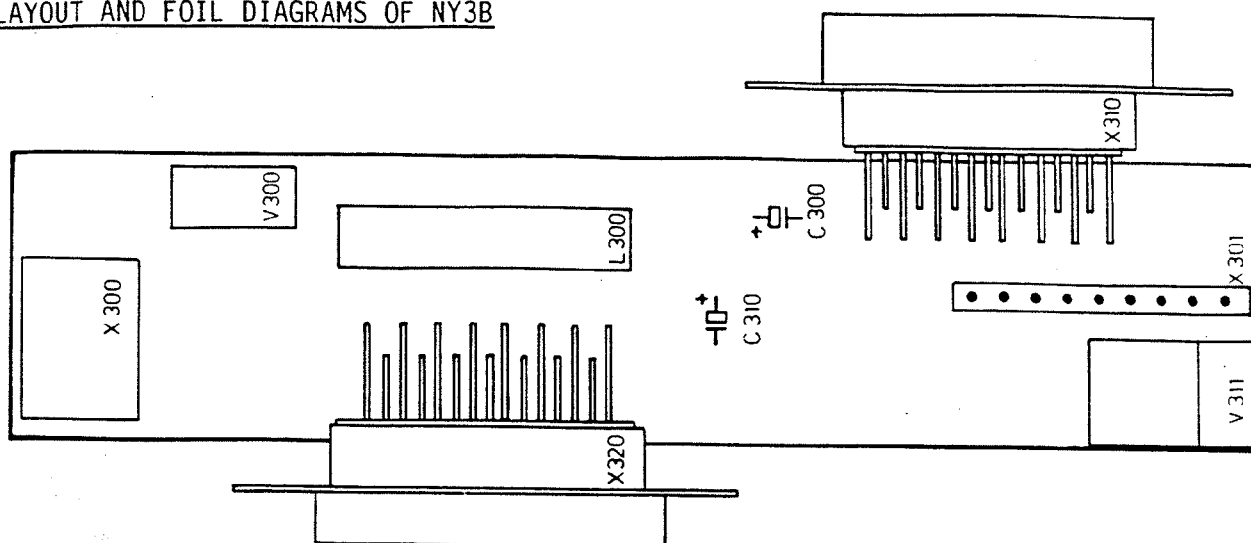
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16-2-18

LAYOUT AND FOIL DIAGRAMS OF NY3B



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16-2-19

PARTS LIST OF NB3B

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R100	1411123	Chip resistor	0.22	0.25 W 1206 MELF
R101	1411123	Chip resistor	0.22	0.25 W 1206 MELF
R102	1411123	Chip resistor	0.22	0.25 W 1206 MELF
R103	1411123	Chip resistor	0.22	0.25 W 1206 MELF
R200	1411162	Chip resistor	1.8	0.12 W 1206 MELF
R220	1411162	Chip resistor	1.8	0.12 W 1206 MELF
R120	1412416	Chip resistor	2.2 k	0.06 W 0805
R160	1412416	Chip resistor	2.2 k	0.06 W 0805
R190	1412416	Chip resistor	2.2 k	0.06 W 0805
R191	1412416	Chip resistor	2.2 k	0.06 W 0805
R202	1412416	Chip resistor	2.2 k	0.06 W 0805
R136	1412609	Chip resistor	27 k	0.06 W 0805
R143	1412609	Chip resistor	27 k	0.06 W 0805
R230	1412609	Chip resistor	27 k	0.06 W 0805
R105	1413709	Chip resistor	150 k	0.06 W 0805
R104	1413804	Chip resistor	1 M	0.06 W 0805
R133	1413804	Chip resistor	1 M	0.06 W 0805
R153	1413917	Chip resistor	150	0.06 W 0805
R161	1413917	Chip resistor	150	0.06 W 0805
R170	1413917	Chip resistor	150	0.06 W 0805
R221	1413917	Chip resistor	150	0.06 W 0805
R231	1413917	Chip resistor	150	0.06 W 0805
R106	1414027	Chip resistor	3.3 k	0.06 W 0805
R125	1414027	Chip resistor	3.3 k	0.06 W 0805
R137	1414027	Chip resistor	3.3 k	0.06 W 0805
R109	1414271	Chip resistor	1.1 k	0.06 W 0805
R140	1414273	Chip resistor	9.53 k	0.06 W 0805
R107	1414276	Chip resistor	47.0 k	0.06 W 0805
R110	1414276	Chip resistor	47.0 k	0.06 W 0805
R123	1414276	Chip resistor	47.0 k	0.06 W 0805
R135	1414276	Chip resistor	47.0 k	0.06 W 0805
R141	1414276	Chip resistor	47.0 k	0.06 W 0805
R162	1414276	Chip resistor	47.0 k	0.06 W 0805
R134	1414300	Chip resistor	68.0 k	0.06 W 0805
R108	1414477	Chip resistor	12.0 k	0.06 W 0805
R121	1414477	Chip resistor	12.0 k	0.06 W 0805
R122	1414477	Chip resistor	12.0 k	0.06 W 0805
R130	1414477	Chip resistor	12.0 k	0.06 W 0805
R142	1414477	Chip resistor	12.0 k	0.06 W 0805
R151	1414477	Chip resistor	12.0 k	0.06 W 0805
R163	1414477	Chip resistor	12.0 k	0.06 W 0805
R131	1414484	Chip resistor	22.1 k	0.06 W 0805
R152	1414484	Chip resistor	22.1 k	0.06 W 0805
C152	2310544	Ceramic cap.	1 n	50 V 0805
C161	2310544	Ceramic cap.	1 n	50 V 0805
C191	2310544	Ceramic cap.	1 n	50 V 0805
C226	2310544	Ceramic cap.	1 n	50 V 0805
C121	2310752	Ceramic cap.	10 n	50 V 0805
C131	2310752	Ceramic cap.	10 n	50 V 0805
C140	2310752	Ceramic cap.	10 n	50 V 0805
C150	2310752	Ceramic cap.	10 n	50 V 0805
C210	2310752	Ceramic cap.	10 n	50 V 0805

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16-2-20

C211	2310752	Ceramic cap.	10 n	50 V 0805
C212	2310752	Ceramic cap.	10 n	50 V 0805
C213	2310752	Ceramic cap.	10 n	50 V 0805
C214	2310752	Ceramic cap.	10 n	50 V 0805
C215	2310752	Ceramic cap.	10 n	50 V 0805
C221	2405707	Ceramic cap.	1 μ	50 V/63 V
C223	2405707	Ceramic cap.	1 μ	50 V/63 V
C224	2405707	Ceramic cap.	1 μ	50 V/63 V
C190	2505263	Electrol. cap.	220 μ	35 V RM3.5 105' 8x20
C220	2505263	Electrol. cap.	220 μ	35 V RM3.5 105' 8x20
C225	2505263	Electrol. cap.	220 μ	35 V RM3.5 105' 8x20
C100	2604304	Tantalum cap.	2.2 μ	20 V
C101	2604304	Tantalum cap.	2.2 μ	20 V
C120	2604304	Tantalum cap.	2.2 μ	20 V
C160	2604304	Tantalum cap.	2.2 μ	20 V
L223	3200047	Ferrite ring		D 3.5x1.3x4.3 mm F2
L190	3606463	Choke	150 μ	FJ1342 D 9.5x11 mm
L220	3606470	Choke	14 μ	+/- 3 μ H 26 turn FJ1328
L221	3606470	Choke	14 μ	+/- 3 μ H 26 turn FJ1328
L222	3606470	Choke	14 μ	+/- 3 μ H 26 turn FJ1328
V191	4100197	Schottky diode	11DQ030	30 V 1 A DO-41
V223	4100302	Schottky diode	MBR1060	60 V 8 A TO-220
V230	4102998	LED		Green 1206
V231	4102998	LED		Green 1206
V120	4107025	Zener diode	7V5	300 mW 2 % SOT-23
V160	4107025	Zener diode	7V5	300 mW 2 % SOT-23
V140	4108639	Diode	BAS28	75 V 250 mA SOT-143
V151	4108639	Diode	BAS28	75 V 250 mA SOT-143
V192	4108639	Diode	BAS28	75 V 250 mA SOT-143
V220	4200875	Transistor	BCX54-16	45 V 1.5 A 1 W SOT-89
V190	4200877	Transistor	BCX51-16	45 V 1.5 A 1 W SOT-89
V221	4200877	Transistor	BCX51-16	45 V 1.5 A 1 W SOT-89
V130	4200909	Transist.	BC857B/BCW30	30 V 100 mA SOT-23
V200	4200909	Transist.	BC857B/BCW30	30 V 100 mA SOT-23
V150	4200917	Transist.	BC847B/BCW32	30 V 100 mA SOT-23
V232	4200917	Transist.	BC847B/BCW32	30 V 100 mA SOT-23
V222	4202471	Mosfet	IRFZ44	60 V 35 A TO-220
V100	4202671	Mosfet	BST82	80 V 175 mA SOT-23
V101	4202671	Mosfet	BST82	80 V 175 mA SOT-23
N100A-B	4301199	IC chip		Op. amplifier SO-8
N130A-B	4301199	IC chip		Op. amplifier SO-8
N160	4309664	IC chip	TLC555ID	CMOS Timer 2-18 V SO-8
N170	4309664	IC chip	TLC555ID	CMOS Timer 2-18 V SO-8
N180	4309664	IC chip	TLC555ID	CMOS Timer 2-18 V SO-8
X101	5414975	Pin strip		1x10 2.25
X100	5415016	Pin strip		1x04 3.96 10.7/3.6 mm
	9853804	PCB	NB3B	

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16-2-21

PARTS LIST OF NY3B

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R313	1411162	Chip resistor	1.8	0.25 W MELF 1206
R312	1412416	Chip resistor	2.2 k	0.06 W 0805
R311	1413709	Chip resistor	150 k	0.06 W 0805
R320	1413709	Chip resistor	150 k	0.06 W 0805
R321	1413709	Chip resistor	150 k	0.06 W 0805
R322	1414271	Chip resistor	1.1 k	0.06 W 0805
R310	1414477	Chip resistor	12.0 k	0.06 W 0805
C300	2505263	Electrol. cap.	220 μ	35 V RM3.5 105' 8x20
C310	2505263	Electrol. cap.	220 μ	35 V RM3.5 105' 8x20
C320	2604304	Tantalum cap.	2.2 μ	20 V
C330	2604304	Tantalum cap.	2.2 μ	20 V
L300	3606470	Choke	14 μ	+/- 3 μ 26 turn FJ1328
V300	4103529	Trans.supr.	33 V	1500 W 33 A
V310	4107160	Zener diode	12 V	300 mW 5 % SOT-23
V313	4108639	Diode	BAS28	75 V 250 mA SOT-143
V311	4200498	Transistor	BD649	100 V 8 A TO-220
V312	4200917	Transist. BC847B/BCW32		30 V 100 mA SOT-23
V320	4202671	Mosfet	BST82	80 V 175 mA SOT-23
X300	5414943	DC connector		HEC 0009-01-110
X301	5414975	Pin strip	1x10	2.54
X310	5430399	D15 connector male		
X320	5430423	D15 connector female		
	6430105	Plastic rivet 2.0x3.0		Socket 6.4
	9853805	PCB NY3B 23x100		

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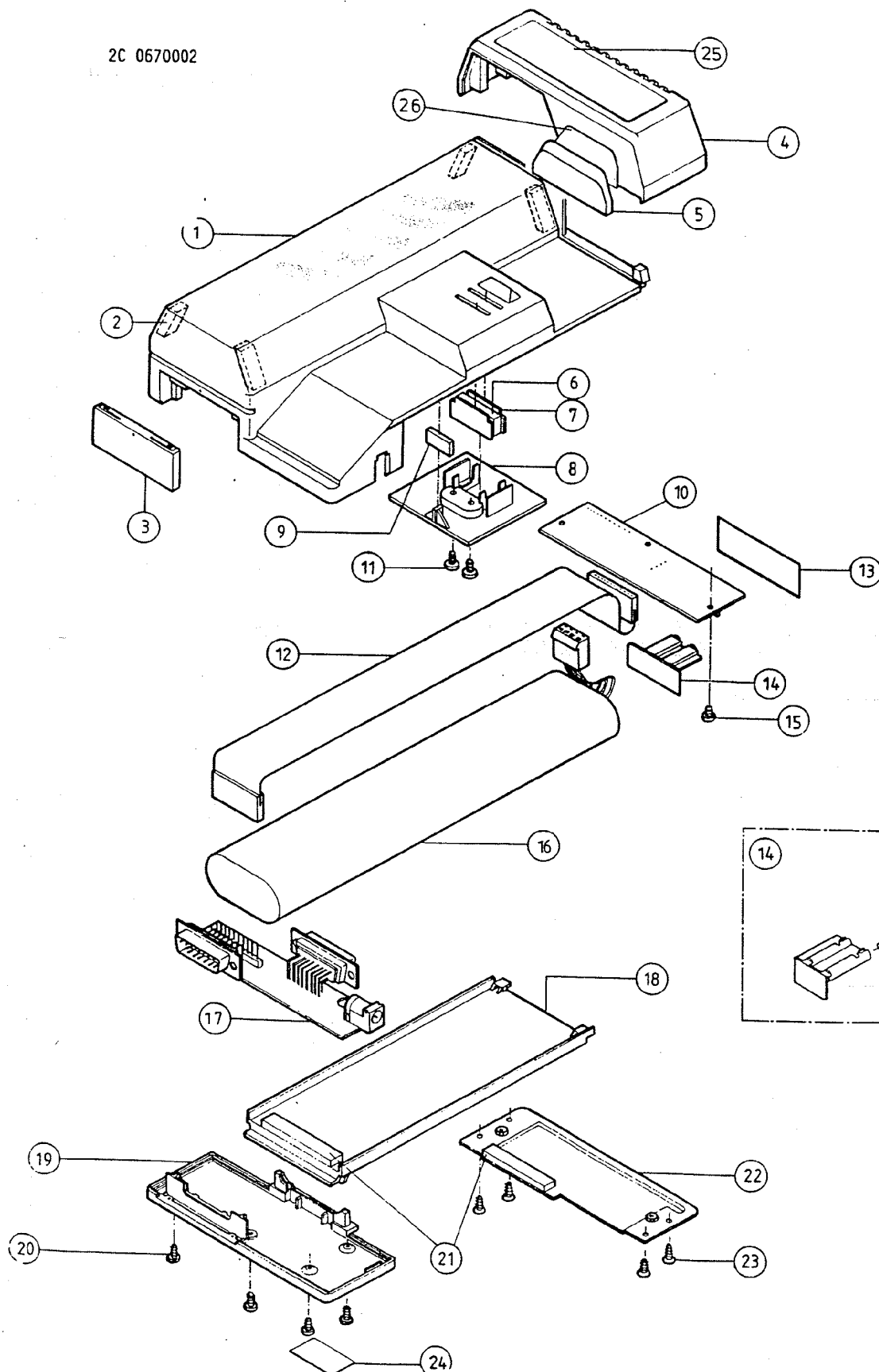
TMX-1 TMN-1

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16-2-22

EXPLODED VIEW OF BBM-2

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16-2-23

ASSEMBLY PARTS OF BBM-2/2QQ

ITEM	Q'TY	CODE	DESCRIPTION	VALUE
1		9303585	Battery case	A1D 40139
2	4	7313059	Adhesive tape	3x8 mm
3		9303560	Cover	A3D 40143
4		9537002	Charging case	3C 20938
5		9307678	Support	A4D 40270
6		6490209	Magnet	25x11x6 mm
7	2	9134841	Magnet plate	
8		9303578	Magnet cover	A3D 40142
9		6490217	Magnet	3x5x15 mm
10		0200013	NB3B module	
11	2	6291934	PT screw	KB 2.5x8
12		5458255	Flat cable	10 pole L320 with connectors
13		9304490	Insulating plate	A4D 40199 20x55 mm
14		9467001	Button for transistors	4C 20989
15	3	6291765	Screw	M 3x5 SFS2976
16		4700549	Battery	NiCd 12 V 1.4 Ah
17		0200014	NY3B module	
18		9303619	Battery cover	A2D 40140
19		9303592	Connector cover	A2D 40141
20	4	6291934	PT Screw	
21	2	7313059	Adhesive tape	3x8 mm
22		9303602	Charging cover	A4D 40144
23	4	6291772	Screw	M3x8
24		9370059	Type label BBM-2 (Mobira, Nokia, Televa, Ptt Telecom, SIP)	
24		9334216	Type label BBM-2 (Matra)	
24		9370101	Type label BBM-2QQ (MTSC, Kuwait)	
25		9380050	Sticker BBM-2 (Mobira)	
25		9380061	Sticker BBM-2 (Blank)	
25		9430003	Sticker BBM-2 (Nokia)	
25		9430004	Sticker BBM-2 (Televa)	
25		9430005	Sticker BBM-2 (Ptt Telecom)	
25		9430006	Sticker BBM-2 (Matra)	
25		9430007	Sticker BBM-2 (SIP)	
25		9430014	Sticker BBM-2QQ (MTSC, Kuwait)	
26		7313777	Tape	20x50 mm
		9380067	Recycling label (Mobira, Televa)	
		9380085	Self adhesive tape	

NOTE! The BBM-2 (code 0670002) and BBM-2QQ (code 0670004), doesn't include sticker and type label. You must order both separately.

INSTALLATION PARTS

2	6350241	Washer	M4 DIN 6798A
	9307861	Screw	4D40273

NOKIA MOBILE PHONES

ACCESSORIES
MOUNTING BASE
9224ARo

TMF-1XS

SERVICE

17-1-1

MOUNTING BASE MBT-1K

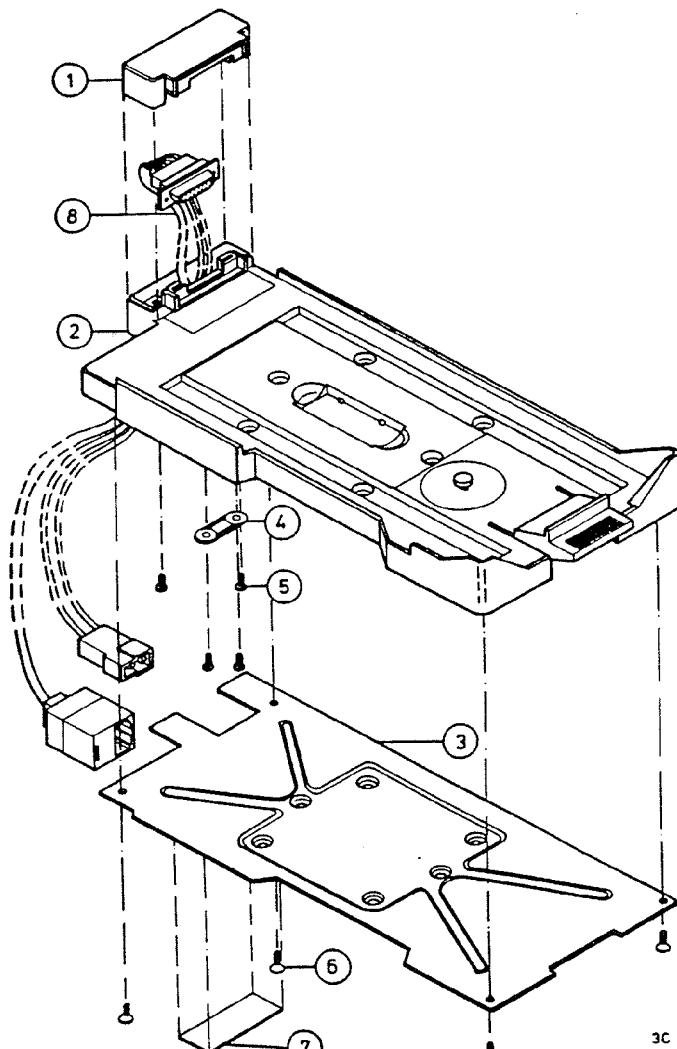
0620002

General assembly parts 0260075

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1		9303793	Conn. case	A3D 40186
2		9303786	Chassis	A1D 40150
3		9510004	Base sheet	3D 20876
4		9460007	Strain relief	
5	4	6291797	Cross rec. screw	KB 35x8
6	4	6291796	Cross rec. screw	KB 35x8
7		9370062	Type label	MBT-1K 4D 21245
8		0254005	Cables	

Installation parts 0260078

4	6151341	Cross rec. screw	M4x30 PZ5.8
4	6270429	Tapping screw	4x35 black PZ
4	6292254	PT tapping screw	KB 40x20 WN1442
4	6310489	Hex nut	M4
4	6340412	Washer	5.1/16.2 x 1.5
4	6350241	Locking washer	A 4.3/8 S=0.5
5	6400929	Cable tie	98 x 2.4 mm black
	9370077	Type label	4D 21266 KMBT1K



NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-1

HANDSFREE HOLDER HFN-1/HFN-1K

ASSOCIATED DOCUMENTATION

4624128 block diagram HFN-1
0176719 circuit diagram NF5A
circuit diagram IGNS
0176719 layout and foil diagrams NF5A
4624128 exploded view HFN-1
3C 4624128 exploded view (assembly kit)
6E 0176719 parts list NF5A
6E 4624128 assembly parts of HFN-1
6E 0260084 assembly parts of HFN-1K

Functional description

HF assembly includes the following functions:

- HF holder, where the cable from the radio unit is changed to a coiled cord type.
- HF microphone, CRM, EXTA and IGNS control signals can be associated to the HF holder. The HF holder includes a VOX module, which perform handsfree function. The HF function is realized so as to obtain a duplex effect.
- Handset joint, which can be attached either onto the HF holder or to the dashboard of vehicle.
- HF microphone, which can be attached e.g. to the sunvisor or to an other corresponding place in vehicle.

Electrical connections and functions

The HF holder includes the following electrical functions:

- VOX operation
- power amplification and speakers
- microphone amplification
- connection to system connector
- connection to handset
- connection to passive handset
- connection to external microphone
- IGNS input from ignition key switch
- IGNS signal processing
- CRM relay control
- EXTA relay control

Mechanical attachment and hook function

The handset is attached with magnet. A small, separate magnet in the HF holder is needed for the hook function.

VOX description

General

The VOX allows a full-duplex appearance, although it attenuates both microphone and speaker signals 37 dB altogether. The duplex effect is accomplished by linear attenuations. In other words, signal is not connected from side to another, but the attenuation of the speaker signal is increased while the attenuation of the microphone signal is decreased.

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-2

The attenuation control is based only on the level of the speaker signal. An advantage resulting from this control procedure is, that whistling due to acoustic feedback does not have effect on the detector's operation. Performance of the detector is stabilized by using suitable time constants; t_r is about 2 ms. Because of short rise time the speaker signal starts quickly and sharp. t_s is about 1 s. This effectively prevents the detector from oscillating.

The most significant disadvantage of the VOX realization is whistling coming via a telephone network. Due to whistling the detector reacts also to a network echo of the microphone signal by attenuating the microphone signal. Because of the attenuation the microphone signal is highly compressed.

Further, the detector attenuates weak speaker signals i.e. expands them. In practice, if the quality of voice channel is very poor, the speaker signal gets almost inaudible. As a positive consequence of this is, that interferences of the speaker signal are attenuated.

Circuit description

Microphone amplifier

The HF microphone is connected to the connector X6. Transistor V110 and capacitor C116 stabilize bias current of the microphone. Amplifier N110-A is a pre-amplifier for the microphone signal. The amplification is about +35 dB.

An analog switch N120-A attenuates the microphone signal 0...37 dB. The attenuation is accomplished so that the switch N120-A is opened and closed with a 20 kHz signal. The ratio "on"/"off" time of this signal varies 100...1%. Amplifier N110-B acts as a buffer without any amplification.

Speaker amplifier

Amplifier N130-A is a buffer with +6 dB amplification.

An analog switch N120-B is of similar type attenuator as N120-A in the microphone amplifier. Amplifier N130-B is a buffer with 0 dB amplification.

Transistor stage V130 acts as a ground level shifter from analog to digital ground. This appeared to be necessary, because voltage differences between digital ground and analog ground can be hundreds of millivolts due to thin wires. The speaker and the final amplifier are connected to digital ground because of their high current consumption. In the connection a base signal generates a following current via R_E (emitter resistor):

$$I_E = (8 \text{ V} - 0.7 \text{ V} - U_B) / R_E$$

This current generates a following voltage in the R_C (collector resistor):

$$U_C = U_{\text{dgnd}} + (R_C \times I_E)$$

NOKIA MOBILE PHONES

ACCESSORIES
HF HOLDER HFN-1/HFN-1K
9146ARo

TMN-1 TMF-1

SERVICE

17-3-3

The collector signal is thus proportional to the digital ground. The connection described above attenuates interferences > 60 dB.

Amplification of the final amplifier N150 can be tuned +6...+23 dB. The speaker is connected to the connector X5.

Tuning of speaker line

Feed a signal of 1 kHz/300 mV_{rms} to EXTS line. Adjust the speaker level to 2.4 V with trimmer R155.

Detector and control of attenuators

Detector N160 is a peak-value-rectifier, which processes the EXTS signal for a control voltage of the attenuators. See the enclosed appendix for correlation between U_{detector} and U_{exts} . Also correlation between the attenuations and U_{detector} is shown in the same appendix.

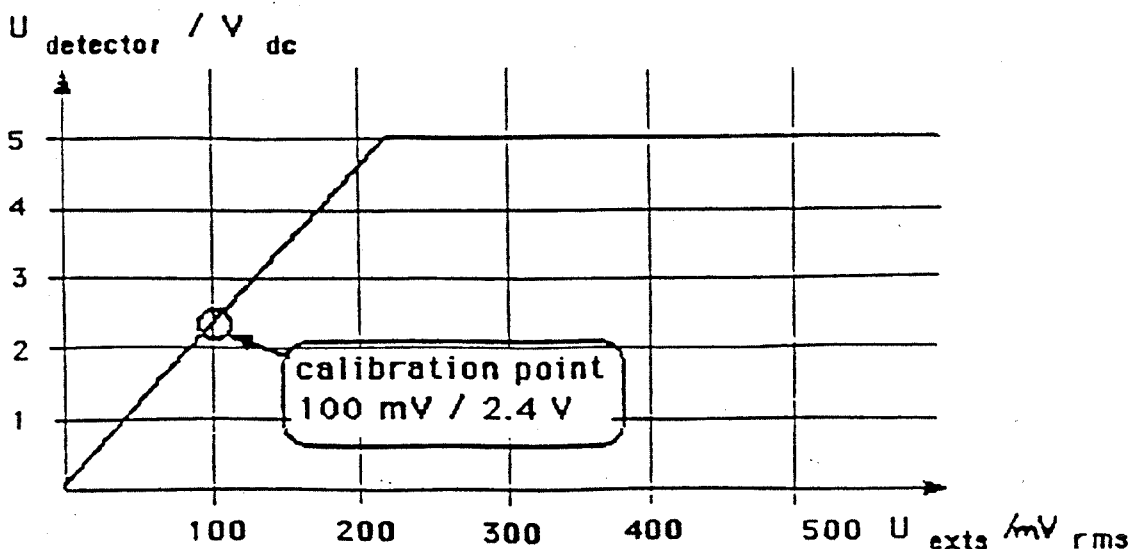
A pulse wave of 20 kHz generated in oscillator N190 drives ramp wave generators, which are performed with the transistors V190, V191, V192. Ramp at the microphone side is rising and at the speaker side sinking.

The ramp voltage and U_{detector} are compared in the comparators N200-A and N200-B. They output a square wave of 20 kHz, the pulse ratio of which depends on U_{detector} . When U_{detector} gets higher, the pulse ratio of the speaker attenuator gets also higher, but the pulse ratio in the microphone attenuator gets smaller.

Detector's time constants

- time constant of rising voltage: 2 ms
- time constant of sinking voltage: 1 s

U_{detector} vs. U_{exts}



NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

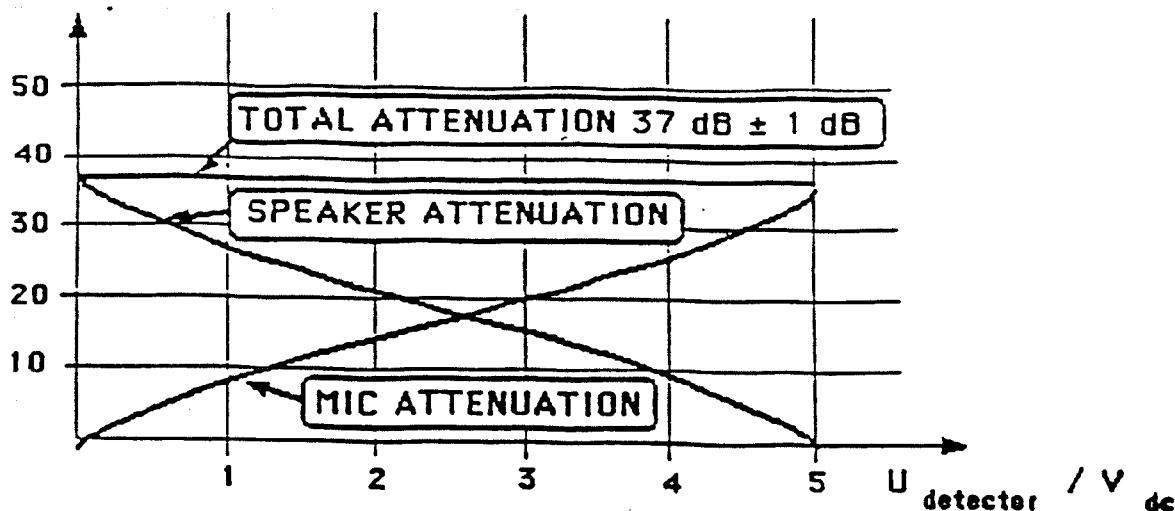
SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-4

Attenuations vs. U_{detector}

ATTENUATION / dB



Connection to other modules

System connector

8-pin modular connector for the following connections:

1	EXTA	
2	MIC/HOOK	
3	GND	Ground for analog signals
4	GND	Ground for power supply, power amplifier and digital signals
5	MBUS	
6	+12V	Operating voltage from the radio unit to the accessories (9.6...16 V), max 1A (0 V, when the radio is switched off)
7	EAR/POWER	
8	CRM	

Handset connector

8-pin modular connector for the following connections:

1	EXTM	Output of the microphone signal 50 mV ± 10 mV -5 dBPa/40 cm, $Z_{\text{out}} < 100 \Omega$
2	MIC/HOOK	
3	GND	Ground for analog signals
4	GND	Ground for power supply, power amplifier and digital signals
5	MBUS	
6	+12V	Operating voltage from the radio to the accessories (9.6...16 V), max 1A (0 V, when the radio is switched off)
7	EAR/POWER	
8	EXTS	Input to the earphone amplifier 50 mV ± 10 mV, 0 dBPa/50 cm includes DC information: $R_{\text{in}} 10 \text{ k}\Omega/\text{GND}$

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

HF HOLDER HFN-1/HFN-1K

SERVICE

9146ARo

17-3-5

Microphone connector

2 pin round jack (d=3.5 mm) for the following lines:

1	EMIC	Microphone input 2.2 k Ω , DC supply to the microphone
2	GND	Signal ground

IGNS connection

This connection is used to check the position of ignition key. When the ignition key is turned, switching on/off information can be read from the EAR/POWER line.

CRM, EXTA

The both signals can be connected to an external relay ($I_{\text{sink}} < 200 \text{ mA}$ to the radio).

NOKIA MOBILE PHONES

ACCESSORIES

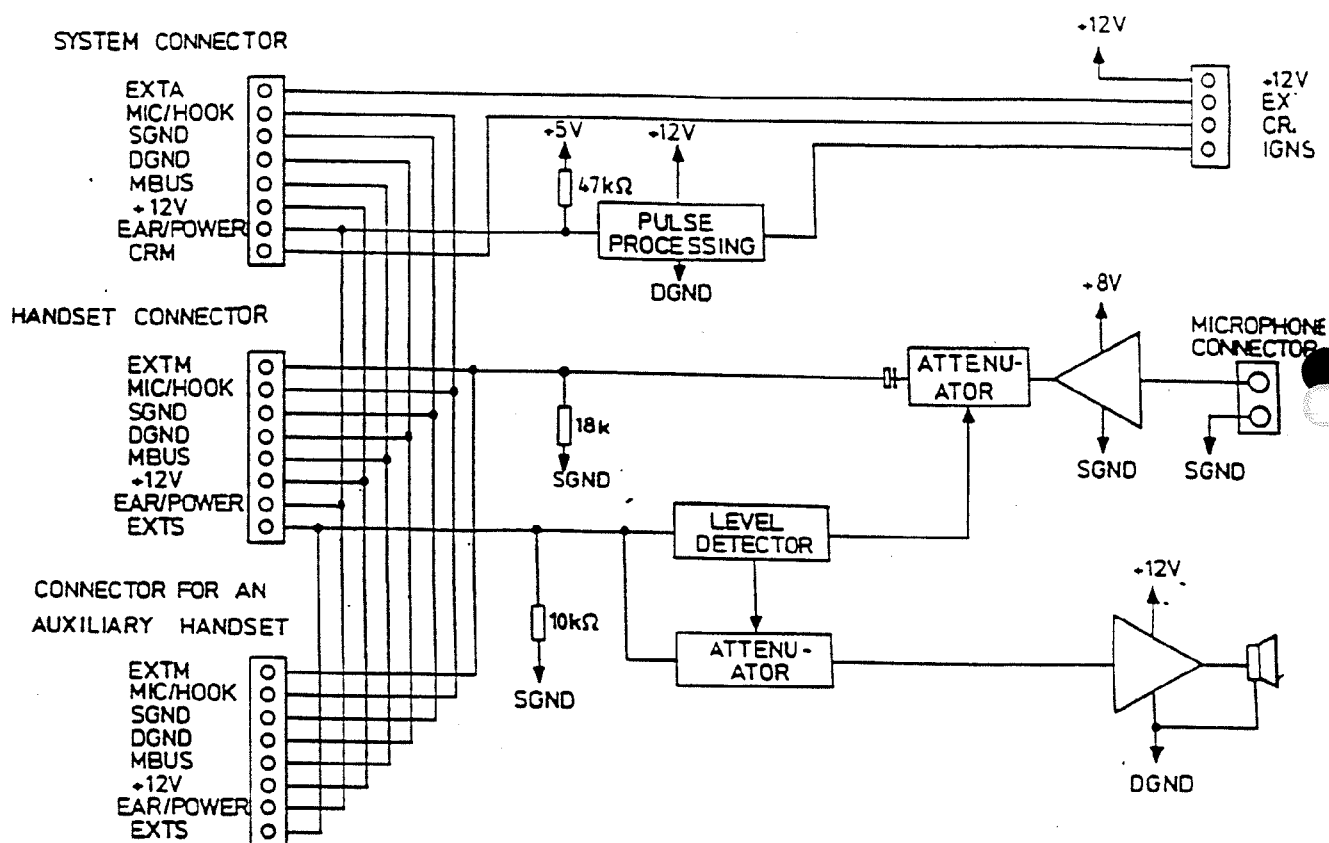
TMN-1 TMF-1

SERVICE

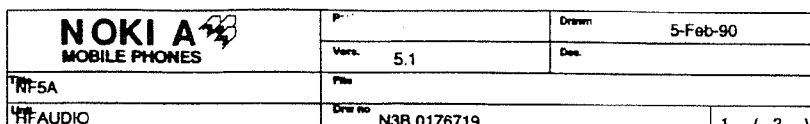
HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-6

BLOCK DIAGRAM OF HFN-1



0176719



NOKIA MOBILE PHONES

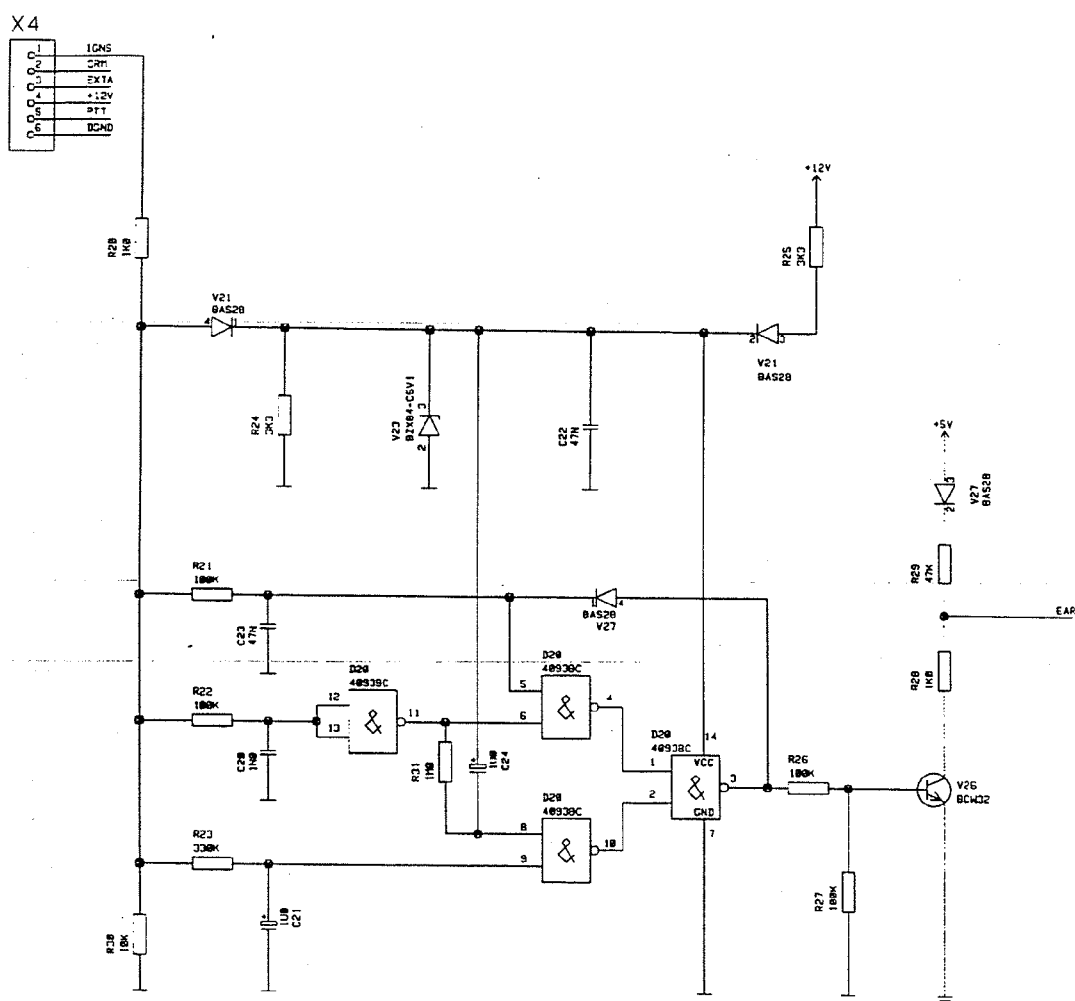
ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-8

CIRCUIT DIAGRAM OF IGNITION SENSE

NOKIA  MOBILE PHONES	Pr	Drawn	18-Jan-90
	Ver. 5.1	Des.	
INP5A	File		
IGNITION SENSE	Doc No	N3B 0173719	2 (2)

17-3-9

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-10

PARTS LIST OF NF5A

ITEM	CODE	DESCRIPTION	VALUE	TYPE
R200	1400146	Resistor	22.1	MELF 0.12 W 0204
R201	1400146	Resistor	22.1	MELF 0.12 W 0204
R157	1400386	Resistor	2.2	MELF 0.25 W 0207
R164	1403394	Resistor	475	MELF 0.12 W 0204
R117	1404447	Resistor	1.21 k	MELF 0.12 W 0204
R202	1406109	Resistor	8.25 k	MELF 0.12 W 0204
R203	1406109	Resistor	8.25 k	MELF 0.12 W 0204
R130	1406902	Resistor	22.1 k	MELF 0.12 W 0204
R191	1408089	Resistor	39.2 k	MELF 0.12 W 0204
R110	1408120	Resistor	47.5 k	MELF 0.12 W 0204
R111	1408120	Resistor	47.5 k	MELF 0.12 W 0204
R131	1408120	Resistor	47.5 k	MELF 0.12 W 0204
R132	1408120	Resistor	47.5 k	MELF 0.12 W 0204
R133	1408120	Resistor	47.5 k	MELF 0.12 W 0204
R166	1408498	Resistor	221 k	MELF 0.12 W 0204
R165	1409636	Resistor	1.0 M	MELF 0.125 W 0204
R119	1412303	Chip resistor	330	0.06 W 0805
R20	1412335	Chip resistor	1 k	0.06 W 0805
R28	1412335	Chip resistor	1 k	0.06 W 0805
R135	1412335	Chip resistor	1 k	0.06 W 0805
R152	1412335	Chip resistor	1 k	0.06 W 0805
R190	1412335	Chip resistor	1 k	0.06 W 0805
R192	1412335	Chip resistor	1 k	0.06 W 0805
R194	1412335	Chip resistor	1 k	0.06 W 0805
R195	1412335	Chip resistor	1 k	0.06 W 0805
R196	1412335	Chip resistor	1 k	0.06 W 0805
R197	1412335	Chip resistor	1 k	0.06 W 0805
R198	1412335	Chip resistor	1 k	0.06 W 0805
R208	1412335	Chip resistor	1 k	0.06 W 0805
R115	1412416	Chip resistor	2.2 k	0.06 W 0805
R167	1412416	Chip resistor	2.2 k	0.06 W 0805
R193	1412423	Chip resistor	4.7 k	0.06 W 0805
R10	1412430	Chip resistor	10 k	0.06 W 0805
R30	1412430	Chip resistor	10 k	0.06 W 0805
R112	1412430	Chip resistor	10 k	0.06 W 0805
R121	1412430	Chip resistor	10 k	0.06 W 0805
R163	1412430	Chip resistor	10 k	0.06 W 0805
R184	1412430	Chip resistor	10 k	0.06 W 0805
R185	1412430	Chip resistor	10 k	0.06 W 0805
R186	1412430	Chip resistor	10 k	0.06 W 0805
R206	1412430	Chip resistor	10 k	0.06 W 0805
R207	1412430	Chip resistor	10 k	0.06 W 0805
R118	1412511	Chip resistor	18 k	0.06 W 0805
R161	1412511	Chip resistor	18 k	0.06 W 0805
R180	1412511	Chip resistor	18 k	0.06 W 0805
R182	1412511	Chip resistor	18 k	0.06 W 0805
R156	1412729	Chip resistor	33 k	0.06 W 0805
R29	1413603	Chip resistor	47 k	0.06 W 0805
R183	1413603	Chip resistor	47 k	0.06 W 0805
R21	1413635	Chip resistor	100 k	0.06 W 0805
R22	1413635	Chip resistor	100 k	0.06 W 0805
R26	1413635	Chip resistor	100 k	0.06 W 0805
R27	1413635	Chip resistor	100 k	0.06 W 0805
R113	1413635	Chip resistor	100 k	0.06 W 0805

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-11

R114	1413635	Chip resistor	100 k	0.06 W 0805
R181	1413635	Chip resistor	100 k	0.06 W 0805
R31	1413804	Chip resistor	1 M	0.06 W 0805
R162	1413804	Chip resistor	1 M	0.06 W 0805
R209	1413804	Chip resistor	1 M	0.06 W 0805
R153	1413829	Chip resistor	10	0.06 W 0805
R154	1413829	Chip resistor	10	0.06 W 0805
R187	1413829	Chip resistor	10	0.06 W 0805
R24	1414029	Chip resistor	3.3 k	0.06 W 0805
R25	1414029	Chip resistor	3.3 k	0.06 W 0805
R116	1414029	Chip resistor	3.3 k	0.06 W 0805
R136	1414029	Chip resistor	3.3 k	0.06 W 0805
R137	1414029	Chip resistor	3.3 k	0.06 W 0805
R151	1414029	Chip resistor	3.3 k	0.06 W 0805
R160	1414029	Chip resistor	3.3 k	0.06 W 0805
R23	1414212	Chip resistor	330 k	0.06 W 0805
R155	1706938	Trimmer pot.	100 k	25 % 0.1 W chip
C22	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C23	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C112	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C117	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C120	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C130	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C134	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C136	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C152	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C154	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C156	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C160	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C163	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C182	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C183	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C192	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C202	2309475	Ceramic cap.	47 n	50 V X7R 1206 chip
C115	2310463	Ceramic cap.	220 p	50 V NPO 0805 chip
C20	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C111	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C131	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C133	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C151	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C190	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C200	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C201	2310544	Ceramic cap.	1 n	50 V NPO 0805 chip
C153	2503803	Electrol.cap.	1000 µ	25 V
C155	2505208	Electrol.cap.	100 µ	16 V
C157	2505208	Electrol.cap.	100 µ	16 V
C21	2604209	Tantalum cap.	1.0 µ	16 V chip
C24	2604209	Tantalum cap.	1.0 µ	16 V chip
C116	2604209	Tantalum cap.	1.0 µ	16 V chip
C118	2604209	Tantalum cap.	1.0 µ	16 V chip
C180	2604209	Tantalum cap.	1.0 µ	16 V chip
C181	2604209	Tantalum cap.	1.0 µ	16 V chip
C185	2604209	Tantalum cap.	1.0 µ	16 V chip
C113	2604248	Tantalum cap.	4.7 µ	16 V chip
C132	2604248	Tantalum cap.	4.7 µ	16 V chip
C161	2604248	Tantalum cap.	4.7 µ	16 V chip
V23	4106819	Zener diode		5 % 5.1 V 350 mW SOT-23
V21	4108639	Diode	BAS28	75 V 250 mA SOT-143

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-12

V27	4108639	Diode	BAS28	75 V 250 mA SOT-143
V160	4108639	Diode	BAS28	75 V 250 mA SOT-143
V162	4108639	Diode	BAS28	75 V 250 mA SOT-143
V1	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V130	4200909	Transistor	BCW30	20 V 100 mA SOT-23
V26	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V110	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V180	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V190	4200917	Transistor	BCW32	30 V 100 mA SOT-23
V192	4200917	Transistor	BCW32	30 V 100 mA SOT-23
N150	4300943	Audio amp.	TDA2002H	5 W TO-220
N180	4301062	Regulator	LP2951ACM	+2...29 V
N200	4305236	Comparator	LM2903D	dual SO-8
N120	4309431	Quad bilat.switch		4066BT SO-14
D20	4309537	NAND		4093BT SO-14
N110	4309576	Op.amplifier	TLC27M21D	4...16 V SO-8
N130	4309576	Op.amplifier	TLC27M21D	4...16 V SO-8
N160	4309576	Op.amplifier	TLC27M21D	4...16 V SO-8
N190	4309664	Timer	TLC555ID	CMOS
X6	5407008	Microphone jack		3.5 mm female
X4	5414051	Socket strip		2 row 6 pole
X1	5416517	Modular conn.		PCB jack 8 pole
X2	5416517	Modular conn.		PCB jack 8 pole
	6150404	Cross rec. screw		M3x10 PZ 5.8
	6310369	Hex nut		M3
	6350202	Locking washer		DIN 6798
	6500200	Isolating sheet		TO-220
	7310523	Isolating tape		
	9303377	Heat sink		
	9852056	PC board NF3A		

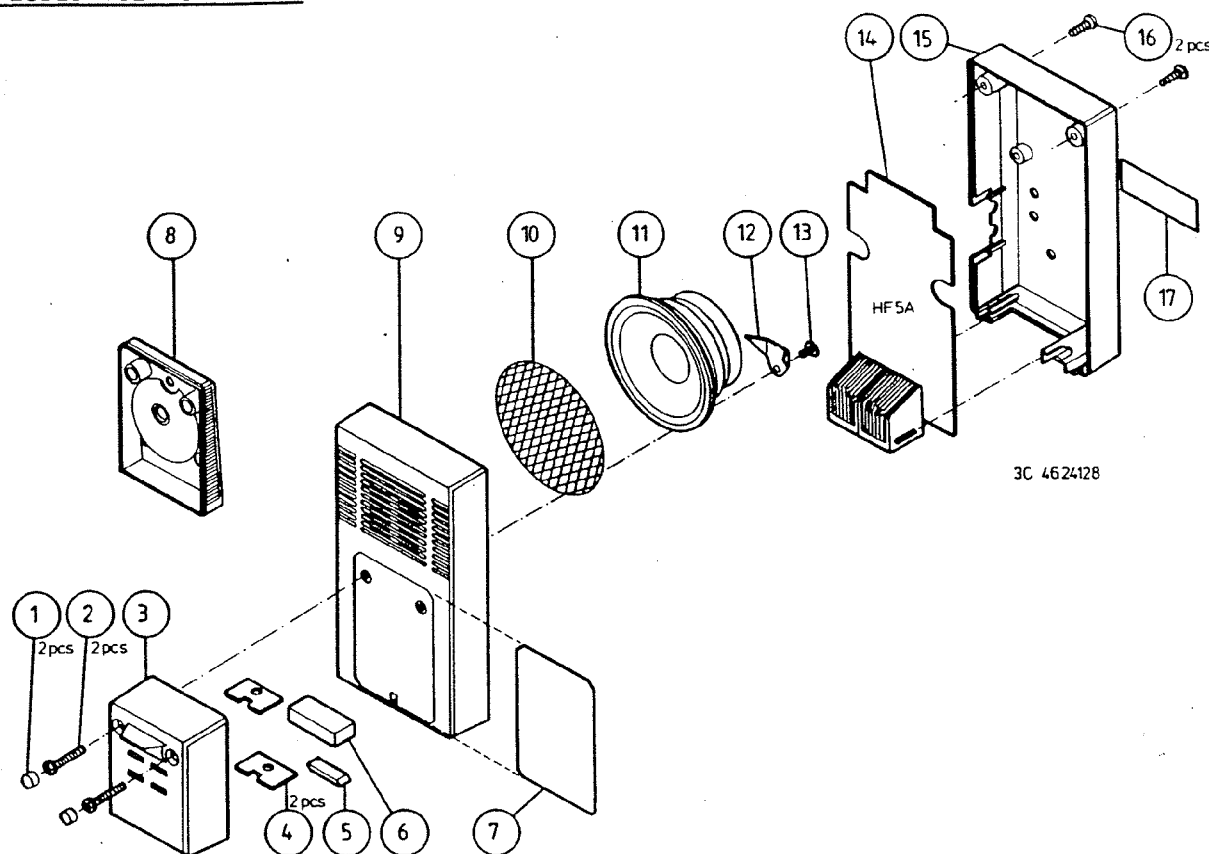
NOKIA MOBILE PHONES

ACCESSORIES
HF HOLDER HFN-1/HFN-1K
9146ARo

TMN-1 TMF-1

SERVICE

17-3-13

EXPLODED VIEW OF HFN-1ASSEMBLY PARTS OF HFN-1

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1	2	9138966	Cover plug	
2	2	6153518	Neck screw	M3x18 PZ5.8
3		9303352	Holder, cover	A2D 40110
4	2	9143309	Magnet plate	CT60A
5		6490217	Magnet	3x6x15 mm
6		6490209	Magnet	25x11x6 mm
7		9307283	Sticker	
8		9303369	Holder, bottom	A2D 40111
9		9303338	Cover	A4D 40133
10		9307124	Loudspeaker cloth	
11		5140474	Loudspeaker	5 W
12		9303320	Holder	A4D 40109
13		6150281	Cross rec. screw	M3x6 PZ5.8
14		0176719	NF5A module	
15		9303345	Bottom	A1D 40108
16	2	6292279	Cross rec. screw	KB30x10 for plastics
17		9332995	Type label	HFN-1
		7113363	Wire	0.15 mm ² white 0.2 m

NOKIA MOBILE PHONES

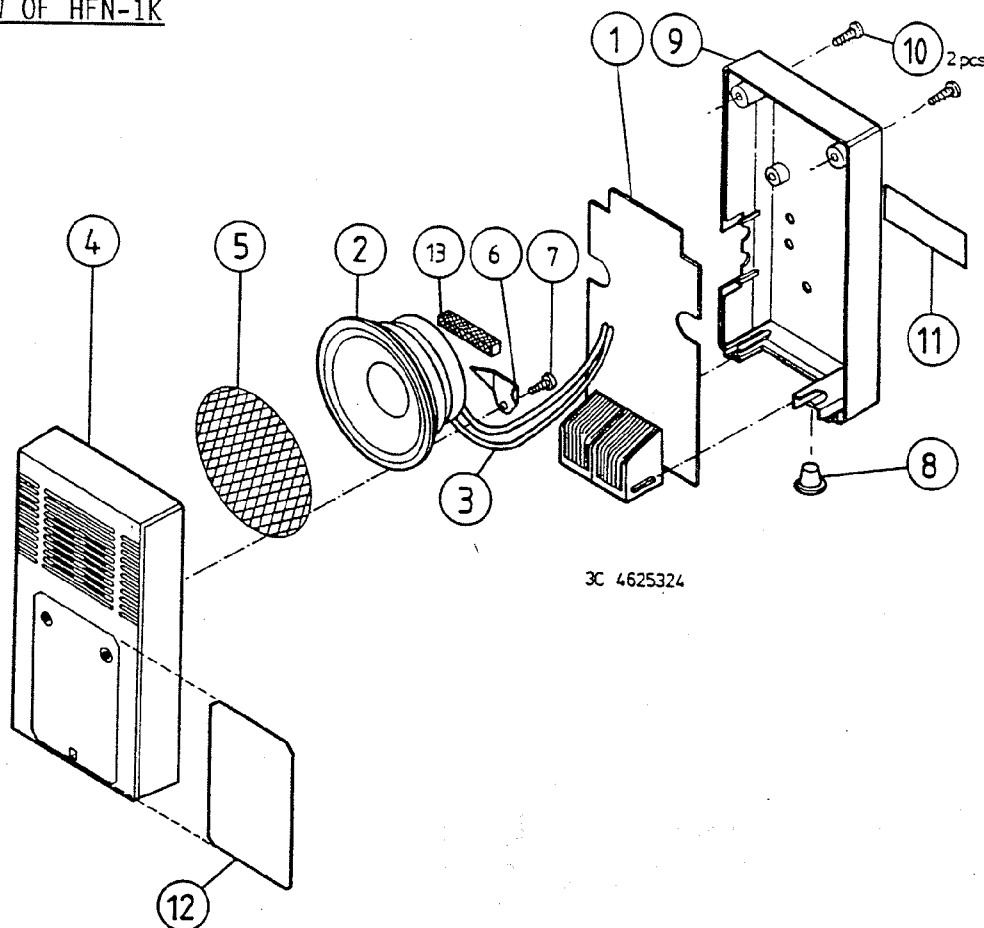
ACCESSORIES

TMN-1 TMF-1

SERVICE

HF HOLDER HFN-1/HFN-1K
9146ARo

17-3-14

EXPLODED VIEW OF HFN-1K

3C 4625324

ASSEMBLY PARTS OF HFN-1K

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1		0176719	NF5A module	
2		5140474	Loudspeaker	D50x23 mm 5 W
3		7113363	Wire	0.15 mm ² 0.2 m
4		9309788	Cover	D4C 20412
5		9309555	Loudspeaker cloth	A4D 40368
6		9309829	Holder	N3D 20416
7		6292279	Cross rec. screw	KB 30x10 WN-1442
8		9309837	Covering plug	N3D 20417
9		9309770	Bottom	N1D 20410
10	2	6292279	Cross rec. screw	KB 30x10 WN-1442
11		9370061	Type label	HFN-1K 4D21111 (FI)
12		9307283	Adhesive tape	HFC-1K A4D 40268
13		7313019	Inseal strip	6x8 mm blk

NOKIA MOBILE PHONES

ACCESSORIES

TMN-1 TMF-1

SERVICE

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17-3-15

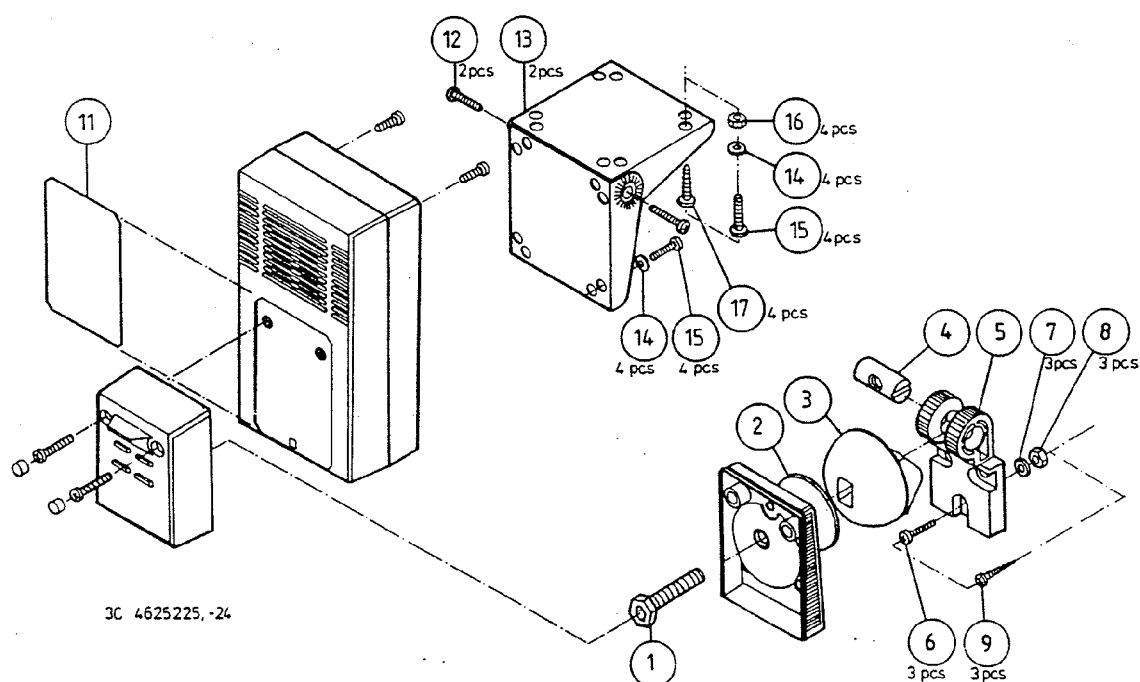
PARTS LIST OF INSTALLATION KIT

Ball joint 4625225

ITEM	Q'TY	CODE	DESCRIPTION	VALUE,TYPE
1		6190767	Hex socket screw	M6x25
2		9302990	Friction rubber	4D 20157
3		9303546	Upper part of joint	3D 40134
4		6332203	Pivot nut	M6x10x20
5		9144119	Lower part of joint	
6	3	6151084	Cross rec. screw	M4x25 PZ5.8
7	3	6340388	Washer	4.3/9 S=0.8
8	3	6310489	Hex nut	M4
9	3	6292254	Tapping screw	40x20 WN1442
		9332593	Type label	4D 40194

Hinge joint 4625224

ITEM	Q'TY	CODE	DESCRIPTION	VALUE,TYPE
4		6150330	Screw	M3x8
2		6150597	Screw	M4x6
4		6270405	Screw	3.5x16
4		6291846	PT screw	KB35x10
4		6350219	Washer	A3.2/6 S=0.4
2		9303673	Hinge ass. part	A3D 40130
		9308329	Installation plate	
		9332586	Type label	



3C 4625225, -24

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ACCESSORIES

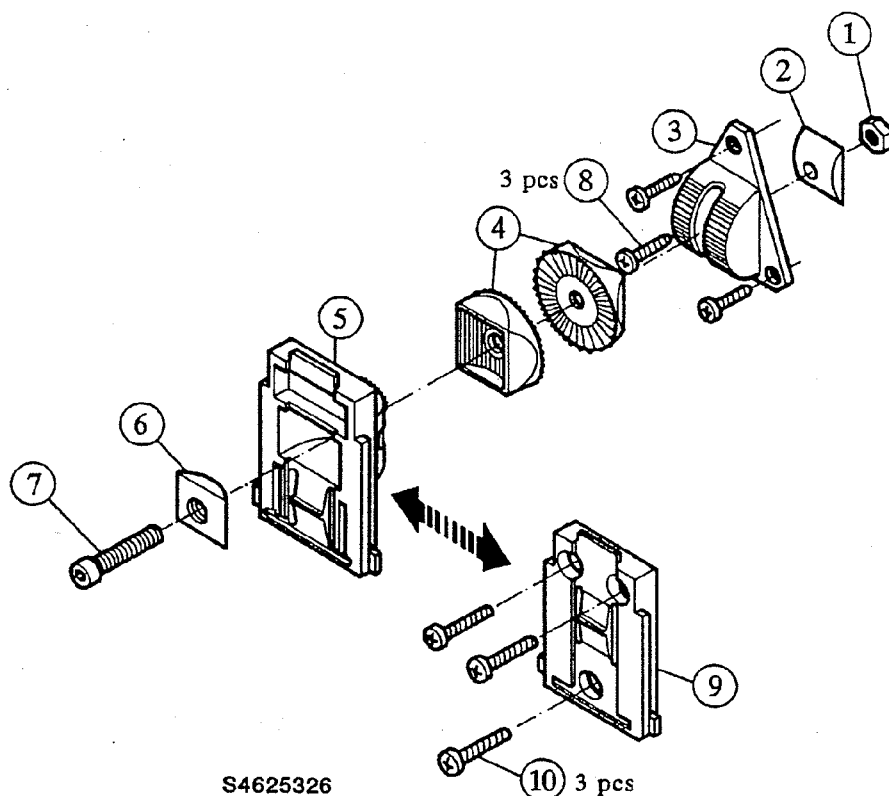
TMN-1 TMF-1

SERVICE

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17-3-16

HF CRADLE INSTALLATION KIT HFK-1K 4625326

EXPLODED VIEWASSEMBLY PARTS

ITEM	Q'TY	CODE	DESCRIPTION	VALUE, TYPE
1		6310601	Hex nut	M 5x20 SFS2219 8.8 FeZn
2		9310279	Bracket	
3		9302119	Cradle	
4		9302126	Joint	CT 94
5		9310254	Joint base	CT 94
6		9310261	Bracket	
7		6190460	Screw	M 5x20 SFS2067 5 FeZn
8	3	6270405	Tapping screw	Bz 3.5x16 DIN7981 FeZn black
9		9310222	Slide part	
10	3	6190460	Tapping screw	FeZn 5x20 SFS2219

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