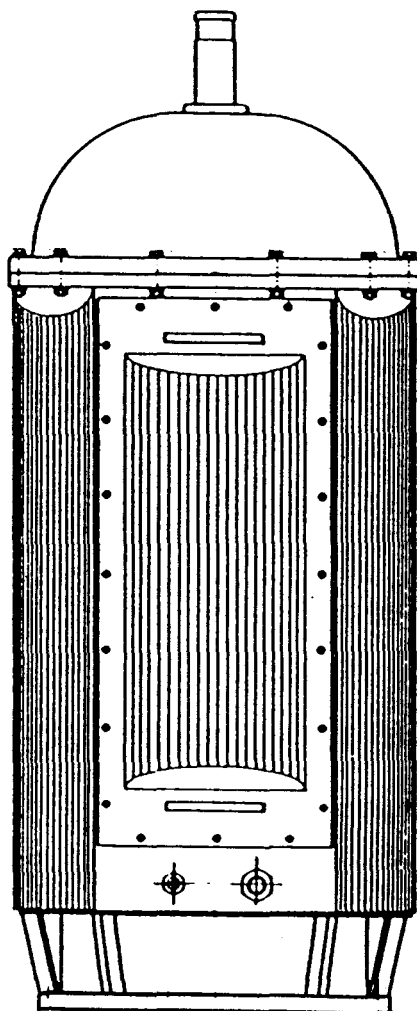


OPERATING AND SERVICE MANUAL

TU 4015

ANTENNA TUNER



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Dansk Radio AS



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SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. Dansk Radio AS assumes no liability for the customer's failure to comply with these requirements.

GROUND THE EQUIPMENT

To minimize shock hazard, the equipment chassis and cabinet must be connected to an electrical ground. The equipment is equipped with a three-conductor ac power socket. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove equipment covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

SAFETY SUMMARY (continued)

DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY EQUIPMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the equipment.

DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this equipment. Use extreme caution when handling, testing, and adjusting.

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APPENDIX 1

Assembling of cable connectors



SECTION 1 GENERAL INFORMATION

1.1 Introduction

This Operating and Service Manual contains information required to install, operate, test, adjust and service the TU4015.

Specifications are listed in paragraph 1.6. These specifications are the performance standards or limits against which the TU4015 is tested.

Due to experience obtained from the production and operation of the equipment, minor differences between the TU4015 and the manual may occur.

Wherever possible such differences are dealt with in Section 7 "MANUAL CHANGES".

The electrical modules of the TU4015 are listed in Section 6.

1.2 Safety Considerations

This manual contains information, cautions and warnings which must be followed to ensure safe operation and to maintain the TU4015 in a safe condition.

1.3 Description

The TU4015 is a fast antenna tuner for shipboard use. The control of the tuner is carried out by means of a serial data bus from a SE4010, an exciter located in the transmitter.

The serial data bus is compatible with RS485, strappable between 1200, 2400, 4800 and 9600 bps, with a maximum distance between the exciter and the antenna tuner of 150 meters.

The TU4015 is configured as a L matching circuit with a lowpass characteristic. The inductors and capacitors are discrete binary weighted elements switched by high speed reed relays.

The TU4015 incorporates a dummy load used for transmitter tests as well as tuning.

The housing of the tuner is especially designed for a low thermal resistance which combined with the temperature controlled forced air circulation and temperature supervisors ensures a low stressing of the components in the tuner.

1.4 Accessories Supplied.

The following accessories are supplied with the TU4015.

One Operating and Service Manual, DRA part no. 210641
One Connector Kit, DRA part no. 210634-001
Standard Spare Parts Kit, DRA part no. 210690

1.5 Accessories Available

The following items are available for use with the TU4015.

Depot Spares Kit. Consult factory.

Special Tools Kit, DRA part no. 210638-001

1.6 Specifications

FREQUENCY RANGE

1.5 - 30 MHz

RF POWER CAPABILITY

1000 W PEP/average

INPUT IMPEDANCE

50 ohms, VSWR < 1.5 (Narrow Bandwidth), N-connector

ANTENNA TYPE

Danish Navy KUF1200 (12 m. whip antenna)

BANDWIDTH

Narrow band: Depending upon antenna impedance

Broad band : +/-5%, max. +/-500 kHz

TUNING MODES

Automatic

Manual

Silent/memory with 99 channels

Silent/manual

TUNING TIME

Automatic : < 1 sec. Narrow band

Silent/memory: < 20 msec.

DUMMY LOAD

500 W/50 ohms/1 minute built-in

HEATING ELEMENT

Built-in, activated below 5°C

COOLING

Natural convection. Internal air circulation ensured by controlled blower. Overheat alarm (75°C) provided.

REMOTE CONTROL

Fully remotely controlled by exciter SE4010

9600 Baud, RS485.

Cable length between SE4010 and ATU up to 150 m.

SELF-TEST PROGRAM (BITE)

Automatic self-test program enabling test of all functions down to relay level.

MTBF

5000 hrs.

INPUT POWER

115/220 Vac +/-10%, 47-63 Hz

POWER CONSUMPTION

With heating element off: 170 W max.(220 Vac)

With heating element on : 530 W max.(220 Vac)

OPERATING ENVIRONMENT

Temperature : -40°C to +55°C operating
-40°C to +75°C storage

Relative humidity : 95% at 40°C

Vibration : 3-10 Hz +/- 2 mm
10-150 Hz +/- 1g

Shock : 20 g pp, 17-20 Hz sine decaying to
half amplitude in 5 cycles.

Wind load : 250 kpm load on tuner tap.

Enclosure protection : IEC529, IP46

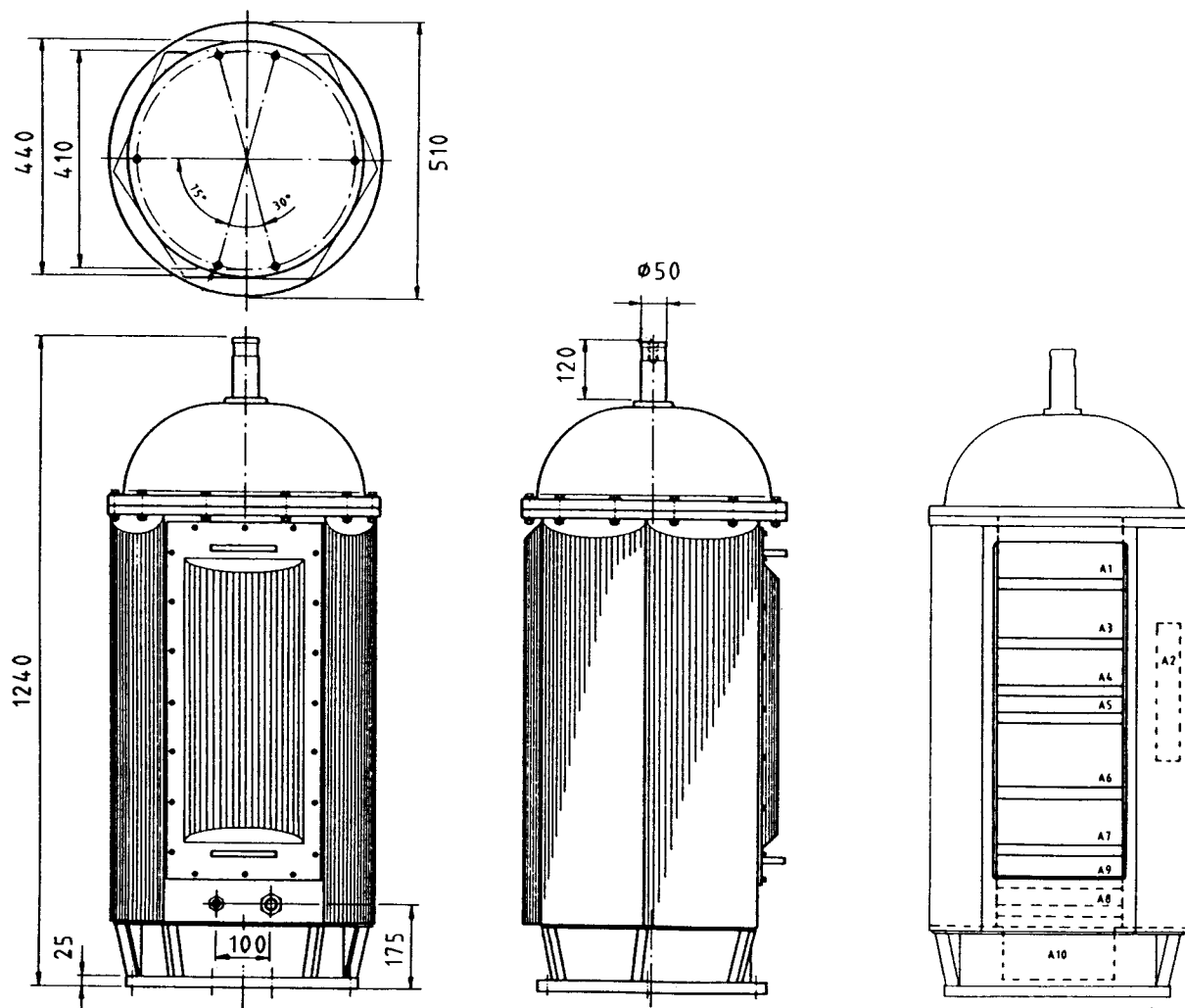
WEIGHT

96 kg approx.

DIMENSIONS

See drawings on the following pages.

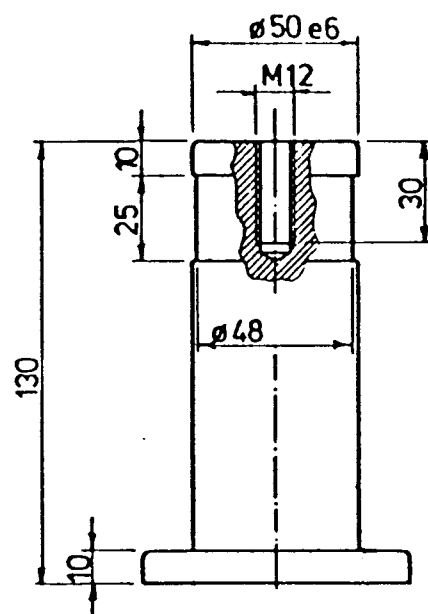
DIMENSIONS



Note: Six holes for mounting: Diam.: 14 mm

DIMENSIONS continued

Antenna Stud.



SECTION 2 INSTALLATION

2.1 Introduction

This section of the manual provides installation instructions for the TU4015. It also includes information about initial inspection and damage claims, preparation for use and information on repacking for shipment.

2.2 Initial Inspection

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer cover. Read the safety summary at the front of this manual before installing or operating the TU4015.

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the TU4015 has been checked mechanically and electrically. If the contents are incomplete, if there is a mechanical damage or defect, or if the TU4015 does not pass the performance tests, notify the nearest Dansk Radio agent. If the shipping container is damaged, or if the cushioning material shows signs of stress, notify the carrier as well as the Dansk Radio agent.

A full report of the damage should also be forwarded to Dansk Radio.

Include the following:

- Order number
- Model and serial number
- Name of forwarding agency

2.3 Storage

The TU4015 may be stored or shipped at temperatures within the limits -40°C to +75°C. It is advisable to protect the TU4015 from extreme temperature variation which can cause excessive condensation.

2.4 Repacking for shipment

The shipping container for the TU4015 has been carefully designed to protect the TU4015 and its accessories during shipment. This container and its associated packing material should be used when repacking for shipment. If shipping to Dansk Radio for service is planned, attach a tag indicating the type of service required, return address, model number and full serial number. Mark the container FRAGILE to ensure careful handling.

2.5 Mounting information

The TU4015 is designed for mounting on a ship deck or bridge wing. The tuner is secured with six 12 mm bolts. Please refer to Section 1, Specifications, Dimensions for position of the bolts.

To reach the full performance of TU4015 it is vital to establish a heavy grounding between the tuner housing and the metal surface of the ship. Failure to follow the mounting installation can result in degraded performance.

When placing the tuner it can be convenient first to mount one bolt and use this as a fixing aid. The mounting holes are the non threaded holes. Locating the rest of the mounting holes is done by rotating the tuner around the first bolt.

The housing of TU4015 shall be grounded via a heavy copper strap between the base and the ground plane in the installation. The distance between the tuner and the grounding point shall be as short as possible.

The copper strap shall have a minimum width of 50 mm and a minimum thickness of 1 mm.

On both sides of the base are two threaded holes which accept 8 mm bolts.

2.6 Power Requirements

115/220V, +/-10%, 47-63 Hz.

CAUTION

The TU4015 is normally set at the factory for 220 Vac.

The selection of 115 volt nominal mains voltage is made by moving a codeplug on the power supply assembly A10A1 and inserting a short circuit on the blower controller A13. To change the mains voltage setting, proceed as follows:

(refer to Fig. 2.1 and Fig. 2.2).

- a. Disconnect the control plug from the TU4015.
- b. Remove the door assy by unscrewing the twenty screws holding

the door. The screws are captive and will therefore not need to be fully unscrewed.
Tools are available in Special Tool Kit 210638.

- c. Disconnect the flatcable located in the right side of the rack by operating the ejectors on the connectors starting from the top. Bend the flatcable out of the door opening. Disconnect the flatcable located in the left side of the rack by operating the ejectors on the connectors, starting from the A9 module.
Disconnect the two coax cables from the A9 module.
- d. Loosen the screws holding the frames of the A3, A4, A7, A9, A8 modules with an umbraco key. Starting from the A3 module, undo the screws with a umbraco screw driver and remove the module. The screws are captive and will therefore not need to be fully unscrewed.
Tools are available in Special Tool Kit 210638.

note

When removing the A3 module remember to disconnect the flat cable located on the assembly.

- e. Remove the top cover from the power supply assembly by unscrewing the six screws holding the cover.
- f. Remove the codeplug P1 from J7 (220 Vac) and reinsert the plug in J6 (115 Vac). Refer to fig. 2.1.
- g. Change the fuses F1 and F2 according to table 2.1.
- h. Reposition the top cover on the power supply assembly and fasten the six screws.
- i. Loosen the six screws holding the A13 module. The module is located between the left rack side and the outer tuner housing.
After loosening the screws carefully remove the module and disconnect P1.
- j. Install a strap as shown in figure 2.2.
(115 Vac: Strap mounted; 220 Vac: No strap mounted)
- k. Reconnect P1 and reinstall the A13 module. Fasten the six screws.
- l. Reinstall the modules starting from A8.
- k. Reconnect the two flatcabels starting from the bottom.
Reconnect the two coax cabels.

- m. Mount the door assembly and fasten the twenty screws.
- n. Reconnect the control plug.

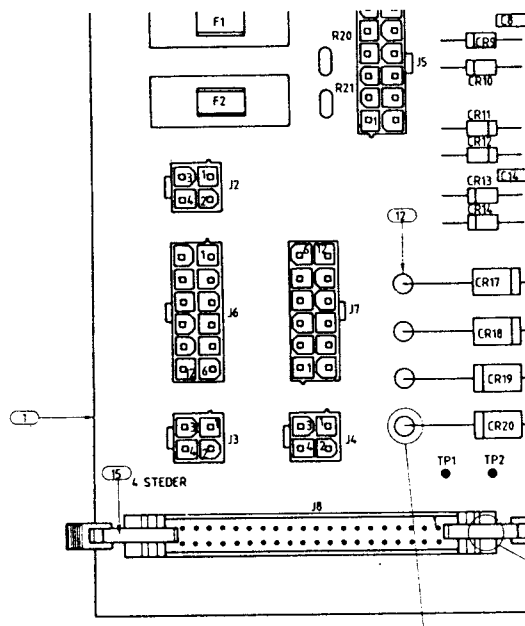


Figure 2.1. Code plug on A10A1

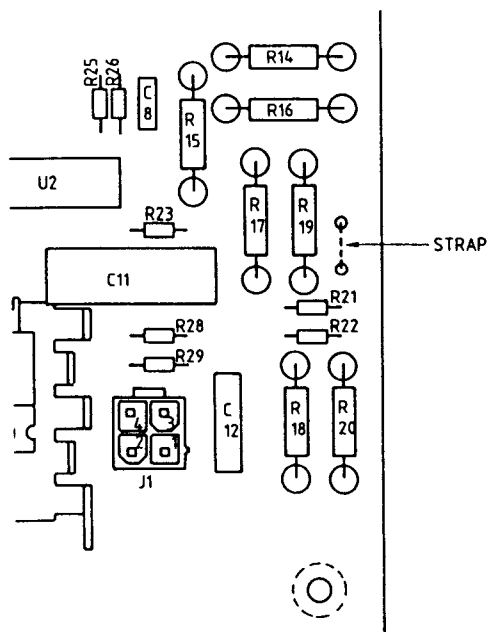


Figure 2.2. Strap on A13

2.7 Fuses

Table 2.1 Fuse Ratings

Fuse	Fuse Rating
F1	1A T (220 V)
"	2A T (115 V)
F2	2A T (220 V)
"	4A T (115 V)

2.8 Control cable

The control cable contains both mains power and data lines. The control plug accepts four lines with 1.2 mm² and eight lines with 0.5 mm². The cable must be with twisted pairs and must be screened.

The cable may have a maximum outer diameter of 12.5 mm.

2.9 Control Socket J1

The Control socket contains both the data and the mains power lines. The Control socket connections are as follows:

pin	circuit	description
A	RS485B	RS485 data line
B	RS485A	RS485 data line
C	ATU SENSE	
D	GND	Signal ground
E	uP STOP	Microprocessor halt
F	POWER ON	Tuner power supply control
G	TUNER READY	
H	MUTE	Muting of transmitter
J	MAINS PHASE	Common
K	MAINS PHASE	
L	MAINS COMMON	Common
M	MAINS COMMON	

Figure 2. Control socket

The appropriate cable connector may be ordered from Dansk Radio Part no. 235055-002.

2.9.1 Mains lines

To allow the greatest distance between the antenna tuner and the mains supplier, both the mains phase and the mains common can be supplied via two pins on the control socket. Via the appropriate cable connector this allows a square of 1 mm², using a standard twisted cable.

If using two wires for the mains phase and two for the mains

common it must be two wires twisted for the phase and two wires twisted for common.

During installation it is advisable to measure the mains voltage present in the TU4015 to ensure that the mains voltage at the power supply is within limits.

2.9.2 Data lines

To allow the greatest distance between TU4015 and SE4010, it is advisable to use a cable with a square of 0.25 mm^2 .

The wires must be twisted pairs. The only lines demanded to be twisted together, except for the phase and common, are the lines marked RS485B and RS485A. These are the data lines.

2.9.3 Assembling the Control plug

To ensure proper operation of the TU4015 it is important to follow the assembling instructions carefully. Appendix 1 of this manual contains assembling instructions.

2.9.4 Final protection of control connector

For final protection of the connector against corrosion, wrap self-vulcanizing rubber around the connector. The rubber must cover the gap between the socket and the plug. It is advisable to cover all of the plug and the gap between the plug and the cable as well.

2.9.5 Tx connector

The Tx connector is a special water tight type meant for cable types RG 8/U, RG 8A/U and RG 213/U.

The appropriate cable connector may be ordered from Dansk Radio Part no. 206139-001.

2.9.6 Assembling the Tx connector

To ensure proper operation of the TU4015 it is important to follow the assembling instructions carefully. Appendix 1 of this manual contains assembling instructions.

2.9.7 Final protection of TX connector

For final protection of the connector against corrosion, wrap self-vulcanizing rubber around the connector. The rubber must cover the gap between the socket and the plug. It is advisable to cover all of the connector and the gap between the connector and the cable as well.

2.9.5 Antenna stud

The antenna tuner is made to accept a whip antenna. The antenna stud has the dimensions shown in Section 1, Specifications, Dimensions.

The stud includes a threaded hole accepting a M12 bolt and a recessed area for locking of the whip antenna by pined screws.

2.10 Installation Check-out

When the installation is complete, refer to section 3 (OPERATION) and fully check the operation of the TU4015.



SECTION 3 OPERATION

3.1 Introduction

This section of the manual contains instructions for proper operation of the TU4015. The TU4015 itself has no operators panel, but all operations are carried out from the front panel of the exciter SE4010.

3.2 The ATU control system

The control of TU4015 is carried out on two levels. The first level, being the automatic level, is only applicable in narrow band tuning, which is automatically initiated each time the frequency of the exciter is changed. Included in the first level is also recalling of 99 channels with tuner presets. The second level is only accessible through program selection. This second level includes broad band tuning, manual tuning and silent tuning.

3.3 Front Panel Features

Figure 3.1 identifies and describes the functions of the front panel controls and indicators of the exciter SE4010 used during control of the TU4015.

3.4 Power/Warm-up

The model requires a power source of 115 or 220 Vac, single phase. The selection of power source is described in Section 2, Installation.

The power switch on the front panel (see Figure 3.1) has two positions, OFF and ON.

Power is applied to some circuits whenever the tuner is connected to the power source. As the tuner has a built-in heating element and a forced air circulation it is important that it remains connected to the power source to maintain the temperature of the tuner within the operational temperature range.

3.5 Initial Conditions SE4010

Consult the SE4010 manual for initial conditions.

3.6 System Initial Condition

After the power has been switched on, the SE4010 will establish contact with TU4015.

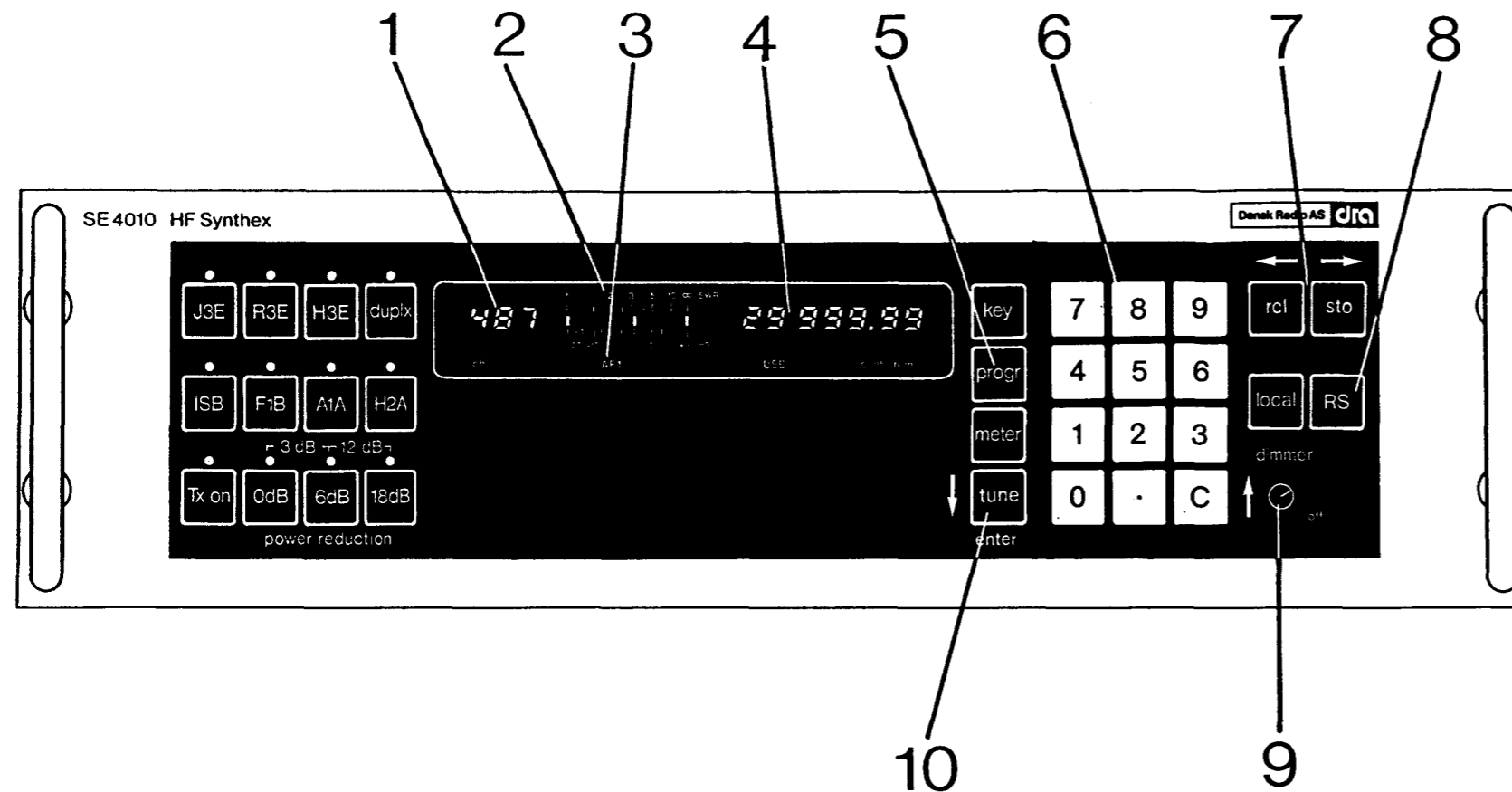
WARNING

If the Mains for the tuner has been disconnected and the temperature are below -10°C , malfunction of the tuner can occur during power on. If operating at low temperatures, always wait one (1) hour after establishment of Mains voltage, before operation of the tuner.

3.7 Self Test

The self test operations are initiated by utilizing a program function. The self test is then carried out by the built-in microprocessor by means of a ROM-based diagnostic program package. For further information see section 8.

Figure 3.1
Front Panel Features



- 1 3-DIGIT display for memory and programming operations and for status information.
- 2 BARGRAPH Meter. Analogue indication of output power of the transmitter and the VSWR of the tuner input.
- 3 METER Annunciators. Indicate information displayed on the bargraph meter.
- 4 ALPHANUMERIC display. Displays the frequency, error codes, failure modes and program information..
- 5 PROGRAM key. Key for entering the program mode.
- 6 ENTRY group. This group includes the numeric data keys and the clear key. The clear key is also used for "up arrow" program operation.

- 7 REGISTER group. These keys are used for storing and recalling of user-programmed channels, recalling of preprogrammed channels and for "back arrow" and "forward arrow" key programming operation.
- 8 RS key. Recalls the tuned settings of the tuner.
- 9 DIMMER/MAINS control. Used for control of the light intensity on the front panel indicators.
- 10 TUNE/ENTER key. Used to accept an entry, to tune the antenna tuner to a frequency and as "down arrow" key by programming operation.

3.8 Switch Meter

Selection of different signals for display on the bargraph meter is possible by toggling the meter pushbutton. The selected signal is shown by annunciators below the meter. The following possibilities are applicable for control of the tuner:

"pwr": The forward power of the corresponding transmitter is displayed.

"SWR": The VSWR at the output of the transmitter is displayed.

3.9 Tx on

The Tx on key turns the power amplifier of the corresponding transmitter on and off. When the LED above the button is lit the transmitter is switched on. The power amplifiers has to be on during all tune modes except manual/silent and recall of a pretuned channel.

3.10 Introduction to tuning

The TU4015 can be tuned using different procedures. The procedures are accessible on two levels. The first level is the automatic narrow band tune procedure which is initiated every time the Tune key is pressed. The second level is only accessible through the program mode where broad band tuning, manual tuning and manual/silent tuning is performed. For further information about the second level see paragraph 3.11.

3.10.1 The tuning strategy

The TU4015 is configured as a L-led with a lowpass characteristic. The capacitor in the L-led can be located at two places as shown in figure 3.2.

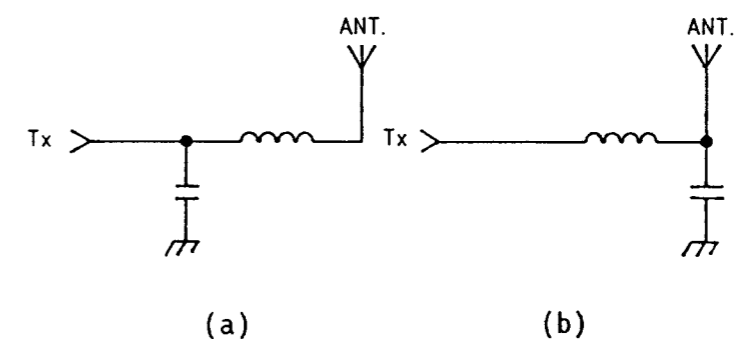


figure 3.2

Figure 3.2a is identified as Type 1 and 3.2b as Type 2. The selection of which type to use during tuning, is made automatically by the program in automatic tuning and are

chosen by the operator in manual tuning.

The tuning strategy operates in a Polar Impedance chart, shown in figure 3.3.

The Polar Impedance chart is divided into four quadrants, numbered 1 through 4. This information allows the operator to detect which quadrant the antenna impedance is located in.

With the aid of the quadrant- and SWR-information the operator can manually set the elements of the tuner to obtain a low SWR.

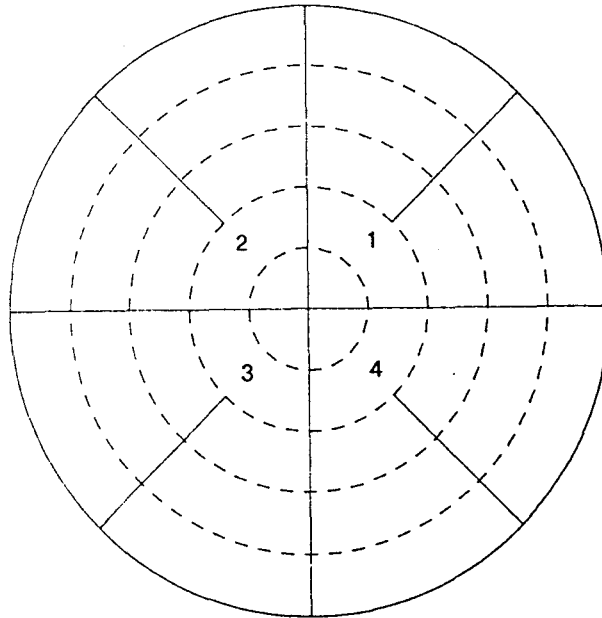


figure 3.3

3.10.2 Example of manual tuning with a Type 1 configuration

Figure 3.4 shows a Polar Impedance chart with a typical impedance point for a whip antenna at a low frequency.

Tuning is carried out by increasing the value of the inductor, whereby the impedance of the antenna is shifted around the Polar impedance chart along the line marked L in figure 3.4, until a shift from quadrant 2 to 1 is obtained. The inductor is then decreased until quadrant 2 is obtained.

The next step is to increase the value of the capacitors, whereby a shift from quadrant 2 to 1 is obtained. Next the value of L is decreased until quadrant 2 is obtained, then the value of C is increased until quadrant 1 is obtained and so on.

Through these shift between quadrant 1 and 2 with the L and C elements the SWR of the tuner will decrease, as indicated on the bargraph meter, to an acceptable level.

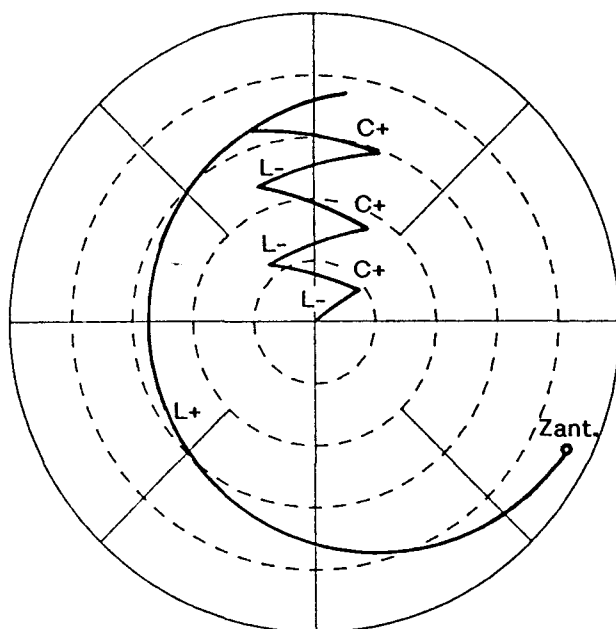


figure 3.4

3.10.3 Example of manual tuning with a Type 2 configuration

Figure 3.5 shows a Polar Impedance chart with a typical impedance point for a whip antenna at a high frequency.

Tuning is carried out by increasing the value of the capacitor, whereby the impedance of the antenna is shifted around the Polar impedance chart along the line marked C in figure 3.5, until a shift from quadrant 3 to 2 is obtained. The operator may experience that a shift from quadrant 3 to 2 is not possible. In this case increase the value of L to obtain the shift.

The next step is to increase the value of the inductors, whereby a shift from quadrant 2 to 1 is obtained. Next the value of C is decreased until quadrant 2 are obtained, then the value of L is increased until quadrant 1 is obtained and so on.

Through these shift between quadrant 1 and 2 with the L and C elements the SWR of the tuner will decrease, as indicated on the bargraph meter, to an acceptable level.

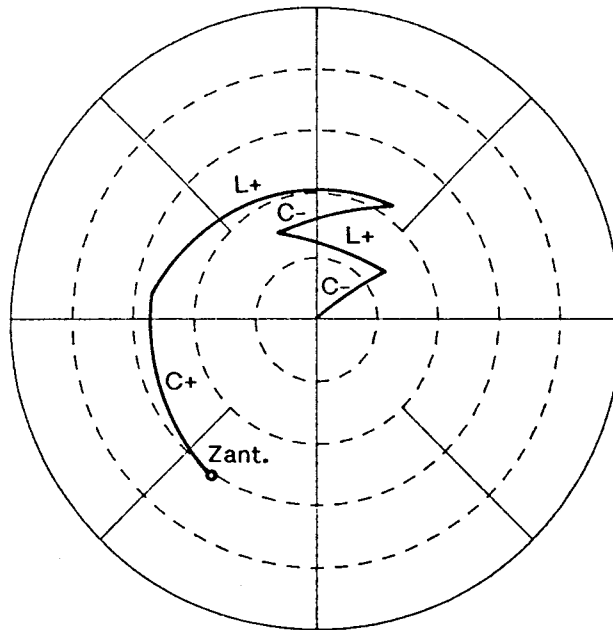


figure 3.5

3.10.4 Elements available

The elements in the tuner are configured in a binary sequence. The inductor elements are presented for the operator as numbers between 0 and 2047. The numbers for the inductors correspond to a factor of 0.05 $\mu\text{H/bit}$.

When operating with a Type 1 configuration the greatest number for the inductors available is 2047 while in a Type 2 configuration the greatest number available is 127.

The capacitor elements are presented for the operator as a number between 0 and 1535 in the frequency range 1.5-26.112 MHz and as a number between 0 and 511 in the frequency range 26.112-29.999 MHz. The numbers for the capacitors correspond to a factor of 5pF/bit.

3.10.5 Automatic Narrow Band tuning

Every time the frequency of the transmitter is changed a tuning procedure has to be initiated.

Example, Automatic tuning at 10 MHz and Tx is off:

keystrokes	display
	12345.60
1	1
0	10
0	100
0	1000
0	10000

<u>tune</u>	10000.00	updating of the exciter with the new frequency
<u>Tx</u>	10000.00	the transmitter is turned on and the annunciator marked <u>tune</u> is flashing indicating that no tuner settings exist.
<u>tune</u>	10000.00	the tuning is initiated and the annunciator marked <u>tune</u> will disappear indicating that the tuner is ready.

If the Tx is on when a new frequency is selected the tuning will be initiated whenever the tune key is pressed. The adaptive facilities of the tuner will, each time the tune key is pressed, check the memory in the tuner for a setting of the particular or a nearby frequency. In case of a setting the tuner will test the setting and only select a new setting if the memory setting results in a high VSWR.

NOTE

It is only necessary to initiate a tuning procedure if the tune annunciator is flashing

3.11 Operational Status/error messages

During operation it is possible that different messages will appear in the exciter display. For further information see section 8.

3.12 Introduction to the program function

Selecting the program function.

NOTE: Paragraph 3.12 describes program functions of the TU4015. For program functions dealing with SE4010, please refer to the operating manual of the SE4010.

The program function is selected by pressing the PROGR key followed by the program number. The program number is accepted by pressing the enter key.

A main menu for the selected program is displayed. By using the horizontal arrow keys, sub menus will be displayed (if any).

A menu (main or sub) is accepted by pressing enter. Now the display is scrolled through messages using the vertical arrow buttons. If sub messages exist to a message, these are recalled by the horizontal arrow buttons.

The last messages are followed by a return to the former setting of TU4015 when the downwards arrow button is pressed.

When in a program function the **RS** key may be used to return to the former settings.

The operation of the programs can be illustrated in this way:

- 1) Select the program.
- 2) The main menu will be displayed.

main menu

- 3) The menus are scrolled by **<--** and **-->** keys.

main menu <—> sub menu 1 <—> sub menu 2 <—>

- 4) The first message is displayed when a menu is selected by pressing **enter** while the menu is shown.

message 1

- 5) Sub messages may be scrolled using **<--** and **-->** keys.

message 1 <—> sub mess.1.1 <—> sub mess 1.2 <—>

- 6) Messages are scrolled using the down arrow and the up arrow keys

message 1 <—> sub mess.1.1 <—> sub mess 1.2 <—>

*
*
*
*

message N <—> sub mess.N.1 <—> sub mess.N.2 <—>

- 7) Pressing the down-arrow keys after the last message returns the SE4010 to the former setting.

The TU4015 has several programs:

Program 50: Self Test
Program 51: Antenna tuner memory programming
Program 52: Antenna tuner memory clearing
Program 53: Broad Band select
Program 54: Dummy load ON/OFF
Program 55: Supervision of tuner power condition
Program 56: Battle ON/OFF
Program 57: Manual tuning, Narrow Band
Program 58: Manual, Silent Tuning

3.12.1 Self Test

Program 50

The Self Test program is used to test the function of the tuner.
For further information see section 8.

3.12.2 Antenna Tuner memory programming

Program 51

The programmable channels 1 through 99 are synchronized with the memory channels of the exciter, SE4010.

The channels of the exciter must be stored before the tuner

channels can be stored. This means that when an exciter set-up is stored in a programmable channel between 1 and 99, program 51 is used to store the tuner setting for that channel.

Later on when the channel is recalled, the tuner circuit will be adjusted according to the stored setting without any tune power.
(Silent memory tuning).

A recalled channel programmed with tuner setting is indicated on the display by an "A" in front of the channel number.

To utilize program 51 it is necessary that Tx is switched on.

To initiate program 51 proceed as follows:

keystrokes

display

12345.60

progr
5
1
enter

PrG.	no.
PrG.	no. 5
PrG.	no. 51
XXX	XXXXXX

The display will now contain one of three different messages:

1) display

Atu. CHAn= _

This display means that all programmed channels between 1 and 99 contain tuner settings. It is now possible to restore or retune the settings of the tuner. Proceed as follows:

keystrokes display

Atu. CHAn= _ Key in the channel number to be retuned, eg no. 5:

5
enter

A. 5 XXXXXX.XX Where XXXXX.XX are the frequency of channel, stored in the exciter

The dot after "A" is flashing to indicate that an operation is carried out. In stead of using the numeric keyboard it is possible to scroll through the channels with the "forward arrow" and "back arrow" keys. After selection of the wanted channel continue as follows:

enter n. 5 XXXXXX.XX

The dot after "n" is flashing to indicate that an operation is carried out. The "n" indicates that a narrow band channel is selected. To select a broad band channel operate either the "forward arrow" or the "backward arrow" keys. A broad band channel will be indicated with a "b" in the display. Continue as follows:

enter Atu. CHAn= _

The tuner performs a tuning and returns with a request for a new channel to be retuned. If no further retuning is required simply press RS to terminate the program. The exciter will come up with the last retuned channel.

2) display

A.yy XXXXX.XX

where yy is the first channel which does not contain tuner setting and XXXXX.XX is the frequency of the channel. The dot after the "A" is flashing to indicate that an operation is carried out. Using "back arrow" and "forward arrow" keys scrolls the display through the channels which do not contain tuner setting. In order to establish tuner settings for the channel proceed as follows:

keystrokes	display
<u>enter</u>	n. yy XXXXXX.XX

The tuner establishes tuner settings for the channel and then displays the next channel without tuner settings. If no further channels without tuner settings exist then 1) or 3) will be displayed. To terminate the program press RS.

2)	display
	ALL TunEd

This display means that all 99 channels contain tuner settings. The display will change to 1) after 3 seconds. To terminate the program press RS.

3.12.3 Antenna Tuner memory clearing

Program 52

After installation or service inspection of the antenna tuner or the antenna, the stored indication of tuner setting in the synthex memory must be cleared using program 52. When program 52 is selected, "CLr Atu.CHAn" will appear on the display. Pressing the "enter" key clears indication of tuner setting in channels 1 through 99 and returns to the former setting of the synthex. Pressing "RS" instead of "enter" leaves program 52.

3.12.4 Broad Band select

Program 53

The tuner has a facility for broad band tuning. This enables the operator to achieve a low VSWR over a frequency range of +/- 5%, max. +/- 500 kHz, relative to the center frequency. The facility is only accesible during frequency selection and by the use of the program function.

To select broad band tuning continue as follows:

keystrokes	display
	12345.60
<u>1</u>	fr. 1.
<u>0</u>	fr. 10.
<u>0</u>	fr. 100.
<u>0</u>	fr. 1000.
<u>0</u>	fr. 10000.
	The new frequency has been selected
<u>progr</u>	PrG. no.
<u>5</u>	PrG. no. 5
<u>3</u>	PrG. no. 53
<u>enter</u>	on brd.bAnd

Now it is possible to select the broad band facility by operation

of the tune key or leave restoring the narrow band function by operation of the RS key.

<u>enter</u>	b.Fr.	10000.00	The tuner is ready to initiate a broad band tuning
<u>enter</u>	b.	10000.00	The tuner is now selecting the appropriate elements for broad band operation

The broad band facility has to be selected for each new center frequency. A broad band setting is indicated with a "b" in the left display on the exciter.

The facility of the broad band tuning can only be utilized when using an external controller for the exciter.

3.12.5 Dummy Load ON/OFF Program 54

For transmitter testing a 500 W dummy load is available in the tuner.

NOTE

The dummy load is temperature protected, therefore prolonged transmitter test can result in a reduction of output power.

The dummy load can only be activated by program 54. In order to select the dummy load, proceed as follows:

keystrokes	display
<u>progr</u>	12345.60
<u>5</u>	PrG. no.
<u>4</u>	PrG. no. 5
<u>enter</u>	PrG. no. 54
	oFF d. LoAd The dummy load is off

By operating the "forward arrow" or "back arrow" keys it is possible to toggle between dummy load on and off.

<u>--></u>	on	d. LoAd	The dummy load is on
<u>enter</u>	d.on	12345.60	Exciter settings from before program 54 was initiated

When the dummy load has been set on, transmitter test can be carried out on different frequencies. The dummy load is first switched off through the use of program 54.

3.12.6 Supervision of tuner power condition

Program 55

When the tuner is operating it is possible to display the reflection coefficient (r.), the forward power (P.f.), the reflected power (P.r.) and the antenna current (i.A.) in the tuner. The selection of program 55 does not affect the operation of the tuner or transmitter.

The only keys accessible when program 55 is selected are Tx , enter , sto "backward arrow", rcl "forward arrow" and Rs . The Tx can be used to turn off the transmitter, while the other keys are used to select measuring points and to terminate the program.

The value in the display is not the real value, but a figure of merit in the range between 0 and 255. The value 255 displayed corresponds to the the real values as follows:

Reflection coefficient (r.)	: 1
Vforward (P.f.)	: 2000 Watt
Vreflected (P.r.)	: 2000 Watt
Antenna current (i.A.)	: 14 Amp.

By selecting program 55, the reflection coefficient for the tuner appears at the display. By using the "back arrow" or "forward arrow" keys it is possible to scroll through the measuring points.

To leave the program press either enter or RS.

Example, Viewing the antenna current:

keystrokes	display	
	12345.60	
<u>progr</u>	PrG. no.	
<u>5</u>	PrG. no. 5	
<u>5</u>	PrG. no. 55	
<u>enter</u>	r. XXX	where XXX represents the reflection coefficient
<u>--></u>	P.f. XXX	Where XXX represents the forward power
<u>--></u>	P.r. XXX	Where XXX represents the reflected power
<u>--></u>	i.A. XXX	where XXX represents the antenna current
<u>RS</u> or <u>enter</u>	12345.60	Exciter settings from before program 55 was initiated




3.12.7 Battle ON/OFF

Program 56



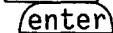
The program function Battle ON/OFF allow the operator to bypass all the protection systems in the tuner.

WARNING

When battle on has been selected no protection of the tuner exist. Malfunction in the tuner or maloperation by the operator will cause permanent damages to the tuner.

keystrokes	display
	12345.60
	PrG. no. 5
	PrG. no. 56
	oFF bAttLE

By operating the "forward arrow" or "back arrow" keys it is possible to toggle between battle on and off.

	on	bAttLe	Battle on has been selected
or			
			
		12345.60	Former exciter settings




To restore the protection system of the tuner apply program 56 and select battle off.

3.12.8 Manual tuning, Narrow Band

Program 57

In manual tuning it is possible to tune the transmitter to a low VSWR operating the inductors and capacitors in the tuner. The entering of the elements can be either through the numeric keys or the "back arrow" or "forward arrow" keys.

Example, Manual Narrow Band tuning:

keystrokes	display
	10000.00
	PrG. no.
	PrG. no. 5
	PrG. no. 57

The lightbar that indicates the type of information available on the bargraph meter shifts to SWR.

enter ☐ X tYPE 1 Where 1 indicates that the tuner is in the type 1 configuration. ☐ X denotes the quadrant in a polar impedance chart where the antenna impedance is located

The type of configuration can be toggled by the "back arrow" and "forward arrow" keys.

-->
or
<-- ☐ X tYPE 2 Where 2 indicates that the tuner is now in the Type 2 configuration.

Each time the "back arrow" or the "forward arrow" keys is activated a new measurement are made. To leave the type selection continue as follows:

enter ☐ X L xxx Where xxx indicates the preset value for the inductors at the selected frequency. ☐ X still denotes the quadrant in a polar impedance chart

To select a new value for the inductance two operations are possible, either using the numeric keys or the "back arrow" or "forward arrow" keys.

Each time the "back arrow" or the "forward arrow" keys is activated a new measurement is made.

If the numeric keys are used to select a new value, a new measurement has to be initiated. To enter a value of 64 proceed as follows:

6
4
enter ent. L 6
ent. L 64
☐ X L 64 Where 64 indicates the value for the inductance. ☐ X denotes the quadrant of the new measurement.

To leave the Inductor selection proceed as follows:

enter ☐ X C yyy Where yyy indicates the preset value for the capacitance. ☐ X denotes the quadrant of the new measurement.

To select a new value for the capacitance two operations are possible, either using the numeric keys or the "back arrow" or "forward arrow" keys.

Each time the "back arrow" or the "forward arrow" keys is activated a new measurement is made.

If the numeric keys are used to select a new value, a new measurement has to be initiated. To enter a value of 32 proceed as follows:

<u>3</u>	ent.	C	3	
<u>2</u>	ent.	C	32	
<u>enter</u>	□ X	C	32	Where 32 indicates the value for the capacitance. □ X denotes the quadrant of the new measurement.

At any time it is possible to go backward or forward in the tuning procedure by operating the "up arrow" and "down arrow" keys. If a satisfying SWR has been obtained, the manual tuning is terminated as follows:

<u>enter</u>	EnD	tuning
--------------	-----	--------

The tuner is ready to terminate the manual tuning procedure and asks for confirmation:

<u>enter</u>	10000.00	Former exciter display
--------------	----------	------------------------

The tuner is now ready for operation.

3.12.9 Manual, Silent Tuning Program 58

Program 58 has two menus, the main menu is displaying of tuner settings and the sub-menu manual setting of the tuner elements. The main menu does not interrupt the tuner operation, but only displays the settings of the elements.

The sub-menu allows the operator to select tuner settings without applying tune power.

The menus are scrolled by <-- and --> keys.

Example, Displaying the tuner settings:

keystrokes	display	
	10000.00	
<u>progr</u>	PrG.	no.
<u>5</u>	PrG.	no. 5
<u>8</u>	PrG.	no. 58
<u>enter</u>	rcl	SILEnCE
<u>enter</u>	Type X	Where X denotes the selection of either a Type 1 or 2 configuration.

<u>enter</u>	L	YYYY	Where YYYY denotes the setting of the inductors.
<u>enter</u>	C	ZZZZ	Where ZZZZ denotes the setting of the capacitors.
<u>enter</u>		10000.00	Former exciter display

NOTE

The settings displayed in the main menu are only valid for the frequency on which they are generated, either through automatic tuning or program 57-58.

Example, Entering new tuner settings:

keystrokes	display	
	10000.00	
<u>progr</u>	PrG. no.	
<u>5</u>	PrG. no. 5	
<u>8</u>	PrG. no. 58	
<u>enter</u>	rcl SILEnCE	
<u>--></u>	Sto SILEnCE	
<u>enter</u>	Type 1	Where 1 indicates that that the tuner is in the Type 1 configuration.

The type of configuration can be toggled by the "back arrow" and "forward arrow" keys.

<u>--></u>		
or		
<u><--</u>	Type 2	Where 2 indicates that that the tuner now is in the Type 2 configuration.
<u>enter</u>	L 0	The Type of configuration is now accepted. Using either the numeric keys or the "back arrow" and "forward arrow" keys it is now possible to select a inductor value

To enter a value of 64 for the inductor, proceed as follows:

<u>6</u>	ent. L 6	
<u>4</u>	ent. L 64	
<u>enter</u>	L 64	The tuner now holds the value of 64 for the inductor

enter

C

0 The value for the inductor in the tuner is accepted. Now using either the numeric keys or the "back arrow" and "forward arrow" keys it is possible to select a capacitor value

To enter a value of 32 for the capacitor, proceed as follows:

3
2
enter

ent. C 3
ent. C 32
C 32

The tuner now holds the value of 32 for the capacitor

enter

end tuning

The settings of the elements in the tuner has to be accepted by the operator

enter

10000.00

The tuner is now ready for operation



SECTION 6 REPLACEABLE PARTS

6.1 Introduction

This section contains information for ordering parts.

6.2 Replaceable Parts List

The following pages list replaceable parts and are organized as follows:

- a. Electrical assemblies in alphanumerical order by reference designation.
- b. Electrical assemblies and their components by alphanumerical order by reference designation.

The information given for each part consists of the following:

- a. Complete reference designation.
- b. Dansk Radio stock number.
- c. Description of part.
- d. Total quantity in first higher level.

The total quantity in first higher level for each part is given only once - at the first appearance of the part number per lower level.

6.3 Ordering Information

To order a part listed in the replaceable parts list, quote the DRA part number, indicate the quantity required and address the order to Dansk Radio.

To order a part that is not listed in the replaceable parts list, include the equipment model number, equipment serial number, the description and function of the part, and the number of parts required. Address the order to Dansk Radio.

PARTS LIST

PRINTET..... 90/09/10
PARTS LIST PER.. 90/09/07

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	59 231965-001	HOUSING ASSY	1				
2	1,000	ST	59 231966-001	DOOR ASSY	2				
3	2,000	ST	46 231970-001	BRACKET, RACK/HOUSING	2				
4	1,000	ST	46 231970-002	BRACKET, RACK/HOUSING	2				
5	1,000	ST	59 210450-001	RACK ASSY	1				
6	1,000	ST	59 210451-001	ANTENNA COUPLER ASSY	1				
7	1,000	ST	89 210452-001	INDUCTOR BANK 1, A1	1			A1	
8	1,000	ST	89 210453-001	DUMMY LOAD ASSY, A2	1			A2	
9	1,000	ST	89 210454-001	INDUCTOR BANK 2, A3	1			A3	
10	1,000	ST	89 210455-001	INDUCTOR BANK 3, A4	1			A4	
11	1,000	ST	89 210456-001	CAPACITOR BANK, A5	1			A5	
12	1,000	ST	60 210461-001	BROAD BAND 1, A6	1			A6	
13	1,000	ST	89 210462-001	BROAD BAND 2, A7	1			A7	
14	1,000	ST	89 210457-001	CONTROLLER ASSY, A8	1			A8	
15	1,000	ST	89 210458-001	DETECTOR, A9	1			A9	
16	1,000	ST	89 210459-001	POWER SUPPLY ASSY, A10	1			A10	
17	1,000	ST	89 210460-001	FLAT CABLE ASSY	2				
18	1,000	ST	32 210617-001	CABLE, POWER W5	2				
19	1,000	ST	32 210618-001	CABLE, HF	2				
20	12,000	ST	51 200552-044	SCREW M 6X20 CAP SOCH SST	4				
21	18,000	ST	53 200559-005	WASHER LOCK 6.1X1.6MM	4				
22	6,000	ST	51 200552-041	SCREW M 6X10 CAP SOCH SST	4				
23	12,000	ST	51 222823-093	SCREW M 8X50 FLAT HEX. A2	4				
24	24,000	ST	53 200556-007	WASHER FLAT 8.4X1.6MM	4				
25	12,000	ST	52 200682-005	NUT, SELF LOCK M8	4				
26	1,000	ST	44 231952-001	GASKET, O-RING	3				
27	1,000	ST	30 210621-001	CABLE ASSY W8	1				
28	1,000	ST	60 210596-001	TEMP. CONTROL, A13	1				
29	2,000	ST	54 232356-005	SCREW PROPELLER SST 1/4X0	4				
30	1,000	ST	41 210651-001	NAMEPLATE, ANT. TUNER	3				
31	20,000	G	78 200799-001	COMPOUND. THERMAL, SILICONE	4				
32	5,000	G	78 204729-001	GREASE, WHITE	4				
33	1,000	ST	51 205476-001	SCREW SPEC	4				
34	1,000	ST	60 210690-001	KIT, STD. SPARES TU4015	1				B
35	12,000	ST	53 200559-006	WASHER LOCK 8.1X2.0MM	4				C

Dansk Radio AS



DK-2630 Taastrup,
Denmark
Telex 33358 danios dk.
Telefax +45 42 52 23 80

TITLE:
ANTENNA TUNER TU-4015

DOCUMENT NO.:
09 - 231950-001

REV:
C

SHEET NO.:
1 OF 2

PARTS LIST

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DK-2630 Taastrup,
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Telex 33358 darios dk.
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TITLE:
ANTENNA TUNER TU-4015

DOCUMENT NO.:
09 - 231950-001

REV:
C

SHEET NO.:
2 OF 2

PARTS LIST

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PARTS LIST PER.. 90/09/07

FIND NO.	QTY REQ	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	41 210430-001	RACK	2				
2	1,000	ST	59 210476-001	REAR PLATE ASSY, A12	1				
3	1,000	ST	41 210515-001	STRENGTHENING PLATE	2				
4	1,000	ST	32 210464-001	CABLE, HEAT, W 7	1				
5	4,000	ST	51 230433-057	SCREW M 5X20 CT SK HD SST	4				
6	8,000	ST	51 222790-053	SCREW M 3X45 POZIDR. A2	4				
7	8,000	ST	44 235051-001	CLAMP, CABLE, Ø2.5MM	4				
8	2,000	ST	44 235051-002	CLAMP, CABLE, Ø5.0MM	4				
9	24,000	ST	51 230433-016	SCREW M2.5X 8 CT SK HD SST	4				
10	24,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4				
11	1,000	ML	76 201242-002	ADHESIVE, LOCTITE 242	4				
12	2,000	ST	36 223811-011	BLOWER 115V 3100RPM/ 60HZ	4				
13	36,000	ST	51 232495-011	SCREW M 3X 8 TP. POZIDR. A2	4				A1
14	2,000	ST	45 201197-049	STRAP, CABLE, NAT \16X2.5	4				
15	12,000	ST	21 200909-030	RES WW 120R / 30.0J	4			R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12	
16	1,000	B	78 200799-001	COMPOUND. THERMAL, SILICONE	4				
17	1,000	ST	48 210650-001	ASSY LABEL	1			A1	
18	1,000	ST	48 210650-003	ASSY LABEL	1			A3	
19	1,000	ST	48 210650-004	ASSY LABEL	1			A4	
20	1,000	ST	48 210650-005	ASSY LABEL	1			A5	
21	1,000	ST	48 210650-006	ASSY LABEL	1			A6	
22	1,000	ST	48 210650-007	ASSY LABEL	1			A7	
23	1,000	ST	48 210650-009	ASSY LABEL	1			A9	
24	1,000	ST	48 210650-008	ASSY LABEL	1			A8	
***** BILL OF DOCUMENTATION *****									
			210450 EC	RACK ASSY					
			210450 PD	RACK ASSY TU4015					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

Dansk Radio AS



DK-2630 Taastrup,
Denmark
Telex 33358 danos dk.
Telefax +45 42 52 23 80

TITLE:
RACK ASSY

DOCUMENT NO.:
59 - 210450-001

REV:
A1

SHEET NO.:
1 OF 1



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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	2,000	ST	52 200560-008	NUT, PLAIN HEX M10	4				
2	1,000	ST	41 210530-001	PIN, THREADED	2				
3	1,000	ST	51 222B23-048	SCREW M10X25 FLAT.HEX. A2	4				
4	1,000	ST	41 210425-001	WASHER, ANTENNA COUPLER	2				
5	1,000	ST	44 200472-054	PACKING, O-RING 64.5MM	4				
6	1,000	ST	59 210512-001	STUD ASSY, ANTENNA COUPLER	1				
7	1,000	ST	41 210424-001	GLASS FIBRE TOP	1				
8	1,000	ST	89 210541-001	CABLE, ASSY W1	2				
9	2,000	ST	54 204703-112	PIN HEADLESS 6X32MM	4				
10	0,200	ML	76 201242-004	ADHESIVE, LOCTITE 601	4				
11	3,000	ST	53 200559-007	WASHER LOCK 10.2X2.2MM	4				
12	1,000	ST	52 200556-008	WASHER FLAT 10.5X2.0MM	4				
13	1,000	G	78 204729-001	GREASE, WHITE	4				
***** BILL OF DOCUMENTATION *****									
			210451 PD	ANTENNA COUPLER ASSY					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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TITLE:
ANTENNA COUPLER ASSY

DOCUMENT NO.:
59 - 210451-001

REV:
A

SHEET NO.:
1 OF 1



PARTS LIST

PRINTET..... 90/10/10

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210546-001	PWB, INDUCTOR ASSY A1	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1				
3	22,000	ST	51 232495-011	SCREW M 3X 8 TP.POZIDR.A2	4				B1
4	2,000	ST	41 210576-001	SHIELD, A1	2				
5	1,000	ST	41 210575-001	PLATE, CONNECTOR	2				
6	1,000	ST	41 210705-001	CONTACT, KNIFE	2				D
7	1,000	ST	41 210577-001	COIL ASSY, L1	1			L1	
8	1,000	ST	41 210578-001	COIL ASSY, L2	1			L2	
9	11,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4				C
10	11,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4				
11	4,000	ST	52 235019-004	NUT, SQUARE M 4	4				
12	10,000	ST	51 222790-012	SCREW M 3X10 POZIDR. A2	4				C
13	4,000	ST	56 224537-012	SPACER, THREADED M3X40MM	4				
14	2,000	ST	52 200682-001	NUT, SELF LOCK. M 3	4				
15	1,000	ST	51 222790-013	SCREW M 3X12 POZIDR. A2	4				C
16	1,000	ST	56 201599-002	SPACER, SLEEVE 5.5MM	4				
17	1,000	ST	52 202221-001	NUT, CAP, HEX M 3	4				
18	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4				
19	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4				
20	4,000	ST	46 210511-001	BRACKET	2				
21	0,150	M	32 200820-001	WIRE, ELEC, AWG-20 BRN	4				
22	0,300	M	32 201579-020	CABLE, ELEC, AWG-14 BLK	4				E
23	1,000	ST	30 210567-012	CABLE ASSY	1			W4	
24	1,000	ST	30 210567-009	CABLE ASSY	1			W5	
25	1,000	ST	32 210567-001	CABLE ASSY	2			W6	
26	1,000	ST	30 210550-004	CABLE ASSY	2			W7	
29	1,000	ST	30 210567-008	CABLE ASSY	1			W1	
30	2,000	ST	31 211918-402	EJECTOR, LRG LATCH LONG	4				
31	17,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C3, C4, C5, C6, C7, C9, C10, C11, C12, C13, C14, C15, C17, C18, C19	C
32	2,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C8, C16	C1
33	3,000	ST	23 202032-001	DIDDE 1N4007	4			CR1, CR2, CR3	C
34	1,000	ST	33 232496-001	RELAY SPDT 26.5 VDC	4			K1	
35	1,000	ST	33 235000-001	RELAY REED 24VDC	4			K2	
37	1,000	ST	21 215402-001	RES NTC 22K / 0.50K	4			R11	

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TITLE:
INDUCTOR BANK 1, A1

DOCUMENT NO:
89 - 210452-001

REV:
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PARTS LIST

PRINTET..... 90/10/10

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
38	1,000	ST	21 221380-550	RES FILM 3K65 / 0.50F	4			R12	
39	3,000	ST	21 208010-301	RES FILM 10K0 / 0.25F	4			R13, R14, R20	
40	1,000	ST	21 221380-650	RES FILM 3K65 / 0.50F	4			R15	
41	3,000	ST	21 221380-532	RES FILM 2K37 / 0.50F	4			R17, R18, R19	
42	3,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R10, R16, R22	F
43	1,000	ST	21 235004-138	RES FILM 510K / 0.5 J	4			R21	
44	1,000	ST	31 211918-018	CONN FLAT 16-PIN	4			J1	
45	1,000	ST	24 232315-004	IC, LM2903N	4			J1	
46	1,000	ST	31 206019-002	CONN, COAX, RECP., UHF	4			J2	
47	1,000	ST	48 210650-001	ASSY LABEL	1				
48	1,000	ST	33 232330-004	RELAY REED 24.0VDC	4			K3	C
49	1,000	ST	30 210681-001	CABLE ASSY	1			W8	C
50	1,000	ST	30 210681-002	CABLE ASSY	1			W11	C
51	1,000	ST	56 210682-001	SPACER	1				C
52	4,000	ST	51 222790-022	SCREW M 4X20 POZIDR. A2	4				C
***** BILL OF DOCUMENTATION *****									
1001			210452 PD	INDUCTOR BANK 1, A1					
1002			210452 EC	INDUCTOR BANK 1 A1 TU4015					
1003			210452 TP	A1, L-BANK 1					
1004			210452 MM	INDUCTOR BANK 1 A1					
1005			206460 AS	ESD, PROTECTION & MARKING					
1006			201350 AS	WORKMANSHIP					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				
	1,000	ST	231950-002	ANT. TUNER TU-4015, OLIVE	1				

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TITLE:
INDUCTOR BANK 1, A1

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	41 210543-001	MOUNTING PLATE	2				
2	6,000	ST	53 200556-005	WASHER FLAT 5.3X1.0MM	4				D
3	1,000	G	78 200799-001	COMPOUND.THERMAL,SILICONE	4				
5	9,000	ST	56 201599-002	SPACER, SLEEVE 5.5MM	4				
6	9,000	ST	51 222790-014	SCREW M 3X16 POZIDR. A2	4				D
7	6,000	ST	53 200559-002	WASHER LOCK 3.1X0.8MM	4				B
8	10,000	ST	51 222790-012	SCREW M 3X10 POZIDR. A2	4				D
9	6,000	ST	51 200555-010	SCREW, CAPTIVE, HEX SOCK	2				D
10	6,000	ST	53 200559-004	WASHER LOCK 5.1X1.2MM	4				
11	2,000	ST	46 210545-001	BRACKET, COAX CONNECTOR	2				
12	4,000	ST	52 200682-001	NUT,SELF LOCK.M 3	4				
13	1,000	ST	37 210513-001	PWB,DUMMY LOAD A2 TU4015	3				
14	1,000	ST	30 210630-001	CABLE, FLAT	1			W1	
15	2,000	ST	31 206019-002	CONN, COAX, RECP., UHF	4			J1, J2	
16	9,000	ST	30 210590-001	TERMINAL LUG. PREFORMED	1				
17	1,000	ST	30 210627-001	CABLE ASSY	1			W2	
18	1,000	ST	31 201702-022	TAG, SOLDER	4				
19	1,000	ST	56 200908-001	SPACER, 8 PIN	4				
20	21,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21	
21	8,000	ST	23 202032-001	DIODE 1N4007	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8	
22	3,000	ST	33 232330-003	RELAY REED 24.0VDC	4			K1, K2, K3	
23	2,000	ST	33 232330-004	RELAY REED 24.0VDC	4			K4, K5	
24	1,000	ST	21 235020-003	RES FILM 28R / 250K	4			R1	
25	1,000	ST	21 235020-002	RES FILM 14R / 250K	4			R2	
26	1,000	ST	21 235020-001	RES FILM 7R0 / 250K	4			R3	
27	2,000	ST	21 208010-301	RES FILM 10K0 / 0.25F	4			R6, R7	E
28	1,000	ST	21 235021-002	RES NTC 40K / 0.4 G	4			R5	
30	1,000	ST	21 208010-401	RES FILM 100K / 0.25F	4			R8	C
31	3,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R9, R15, R16	
32	1,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R13	
33	1,000	ST	24 200399-001	IC, LM111H	4			U1	
34	2,000	ST	26 235032-003	TRANSISTOR, PNP, BC327-25	4			Q1, Q2	

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TITLE:
DUMMY LOAD ASSY, A2

DOCUMENT NO.:
89 - 210453-001

REV:
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SHEET NO.:
1 OF 2

PARTS LIST

PRINTET..... 90/10/10

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
35	2,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R10, R11	
36	2,000	ST	21 235004-037	RES FILM 33R / 0.5 J	4			R12, R14	
37	1,000	ST	21 235004-025	RES FILM 10R / 0.5 J	4			R17	
38	1,000	ST	48 227700-001	LABEL, BERYLLIUMOXID	3				A1
39	1,000	ST	53 200556-004	WASHER FLAT 4.3X0.8MM	4				C
40	1,000	ST	21 208010-273	RES FILM 5K62 / 0.25F	4			R4	E
***** BILL OF DOCUMENTATION *****									
1001			210453 EC	DUMMY LOAD ASSY					
1002			201350 AS	WORKMANSHIP					
1003			202702 TP	TEST PROCEDURE					
1004			210453 PD	DUMMY LOAD ASSY					
1005			210453 MM	DUMMY LOAD A2					
1006			210453 TP	A2, LOAD ASSY					
1007			206460 AS	ESD, PROTECTION & MARKING					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				
	1,000	ST	231950-002	ANT. TUNER TU-4015, OLIVE	1				

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TITLE:
DUMMY LOAD ASSY, A2

DOCUMENT NO.:
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PARTS LIST

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FIND NO.	QTY REQ	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210559-001	PWB, INDUCTOR ASSY A3	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1				
3	22,000	ST	51 232495-011	SCREW M 3X 8 TP.POZIDR.A2	4				A1
4	3,000	ST	41 210485-001	CONTACT, KNIFE	2				
5	1,000	ST	41 210579-001	COIL ASSY, L1	1				
6	1,000	ST	41 210580-001	COIL ASSY, L2	2				
7	14,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4				B
8	6,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4				
9	6,000	ST	51 222790-012	SCREW M 3X10 POZIDR. A2	4				B
10	6,000	ST	52 200682-001	NUT, SELF LOCK.M 3	4				
11	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4				
12	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4				
13	8,000	ST	52 235019-004	NUT, SQUARE M 4	4				
14	1,000	ST	30 210626-001	TRAFD, CURRENT	2				
15	2,000	ST	51 200683-009	SCREW NO4X3/8 TPG PH SST	4				
16	2,000	ST	41 210589-001	SHIELD,A3	2				
17	3,000	ST	30 210567-010	CABLE ASSY	2			W5, W7, W8	
18	1,000	ST	30 210567-011	CABLE ASSY	2			W9	
19	0,100	M	32 201579-020	CABLE, ELEC, AWG-14 BLK	4			W6	C
20	2,000	ST	30 210550-004	CABLE ASSY	2			W3, W4	
21	1,000	ST	30 210633-001	CABLE ASSY	2			W2	
22	1,000	ST	30 210629-001	CABLE	2			W1	
23	12,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C5, C6, C7, C8, C9, C10, C11, C13, C14, C15, C16	
24	2,000	ST	23 235009-001	DIODE SCHOTTKY 70V/15MA	4			CR1, CR2	
25	5,000	ST	23 202032-001	DIODE 1N4007	4			CR3, CR4, CR5, CR6, CR7	
26	1,000	ST	31 211918-026	CONN FLAT 20-PIN	4			J1	
27	1,000	ST	31 211918-102	CONN FLAT 10-PIN	4			J2	
28	3,000	ST	33 235000-001	RELAY REED 24VDC	4			K1, K2, K3	
29	1,000	ST	33 232330-004	RELAY REED 24.0VDC	4			K4	
30	2,000	ST	26 235032-003	TRANSISTOR, PNP, BC327-25	4			Q1, Q2	
31	2,000	ST	21 235004-121	RES FILM 100K / 0.5 J	4			R1, R3	
32	1,000	ST	21 235004-105	RES FILM 22K / 0.5 J	4			R2	
33	1,000	ST	21 235004-045	RES FILM 68R / 0.5 J	4			R4	
34	1,000	ST	21 235006-029	RES FILM 15R / 6.0 J	4			R5	
35	1,000	ST	21 208010-237	RES FILM 2K37 / 0.25F	4			R6	

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TITLE:
INDUCTOR BANK 2, A3

DOCUMENT NO.:
89 - 210454-001

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
36	2,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R7, R8	
37	1,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R9	
38	2,000	ST	21 235004-037	RES FILM 33R / 0.5 J	4			R10, R11	
39	1,000	ST	24 216361-002	IC, --258 OP.AMP. DUAL	4			U1	
40	2,000	ST	22 235003-001	CAP. PLAST 1N0 / 100K	4			C2, C3	
41	1,000	ST	22 235003-005	CAP. PLAST 4N7 / 100K	4			C17	
42	4,000	ST	31 211918-402	EJECTOR, LK6 LATCH LONG	4				
43	1,000	ST	48 210650-003	ASSY LABEL	1				
44	3,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R12, R13, R14	
45	2,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C4, C12	
***** BILL OF DOCUMENTATION *****									
1001			210454 PD	INDUCTOR BANK 2, A3					
1002			210454 EC	INDUCTOR BANK 2 A3 TU4015					
1003			210454 TP	A3, L-BANK 2					
1004			210454 MM	INDUCTOR ASSY A3					
1005			206460 AS	ESD, PROTECTION & MARKING					
1006			201350 AS	WORKMANSHIP					
1007			235358 TP	A3, L-BANK 2, STRØMDETECT					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210542-001	PWB, INDUCTOR BANK 3 A4	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1			H5	
3	16,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4			H2	
4	21,000	ST	51 232495-011	SCREW M 3X 8 TP.POZIDR. A2	4			H6	A1
5	16,000	ST	52 200682-001	NUT, SELF LOCK. M 3	4			H8	
6	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4			H3	
7	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4			H4	
8	2,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4				
9	14,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4			H1	B
10	8,000	ST	52 235019-004	NUT, SQUARE M 4	4			H10	
11	24,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24 C25, C27, C28	
12	3,000	ST	22 232498-021	CAP. CER 20P / 2500D	4			C26	E
13	1,000	ST	22 232499-014	CAP. CER 10P / 2500D	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8	E
14	8,000	ST	23 202032-001	DIODE 1N4007	4			K1, K2, K3, K4, K5 K6, K7, K8	
15	5,000	ST	33 235000-002	RELAY REED 24VDC	4			L1	
16	3,000	ST	33 235000-001	RELAY REED 24VDC	4			L2	
17	1,000	ST	25 210558-001	COIL ASSY, L1	2			L3	
18	1,000	ST	25 210557-001	COIL ASSY, L2	2			L4	
19	1,000	ST	25 210556-001	COIL ASSY, L3	2			L5	
20	1,000	ST	25 210555-001	COIL ASSY, L4	2			L6	
21	1,000	ST	25 210554-001	COIL ASSY, L5	2			L7	
22	1,000	ST	41 210553-001	COIL ASSY, L6	2				
23	1,000	ST	41 210552-001	COIL ASSY, L7	2				
24	1,000	ST	31 211918-050	CONN FLAT 40-PIN	4			J1	
25	2,000	ST	41 210485-001	CONTACT, KNIFE	2			P1, P2	
26	1,000	ST	32 210550-001	CABLE ASSY	2			W1	D
27	0,900	M	32 201579-020	CABLE, ELEC, AWG-14 BLK	4			W1, W2, W3, W4, W5, W6, W9, W10, W11, W12 W7, W8, W13	F
32	3,000	ST	32 210567-001	CABLE ASSY	2			W14	
35	1,000	ST	32 210568-001	CABLE ASSY	2			W15	
36	1,000	ST	32 210550-002	CABLE ASSY	2				
37	16,000	ST	51 222790-013	SCREW M 3X12 POZIDR. A2	4			H7	B

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TITLE:
INDUCTOR BANK 3, A4

DOCUMENT NO.:
89 - 210455-001

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PARTS LIST

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
38	1,000	ST	48 210650-004	ASSY LABEL	1				
39	2,000	ST	21 211183-005	RES FILM 2M2 / 0.25J	4			R1, R2	E
***** BILL OF DOCUMENTATION *****									
1001			210455 PD	INDUCTOR BANK 3 A4					
1002			210455 EC	INDUCTOR BANK 3, A4					
1003			210455 TP	A4, L-BANK 3					
1004			210455 MM	INDUCTOR BANK 3 A4					
1005			206460 AS	ESD, PROTECTION & MARKING					
1006			201350 AS	WORKMANSHIP					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210539-001	PWB, CAPACITOR BANK	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1			H7	
3	2,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4				
4	1,000	ST	31 108813-003	TERMINAL 4.2MM	4			H1	
5	26,000	ST	30 210590-001	TERMINAL LUG, PREFORMED	1			H2	
6	6,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4			H3	B
7	10,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4			H4	D1
8	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4			H5	
9	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4			H6	
10	21,000	ST	51 232495-011	SCREW M 3X 8 TP. POZIDR. A2	4			H8	A1
11	4,000	ST	51 222790-013	SCREW M 3X12 POZIDR. A2	4			H9	B
12	4,000	ST	52 200682-001	NUT, SELF LOCK. M 3	4			H10	
13	44,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C51, C52, C53, C54, C55, C56, C57, C58, C59	
14	1,000	ST	22 232498-105	CAP. CER 5P0 / 2500D	4			C3	
15	1,000	ST	22 232498-014	CAP. CER 10P / 2500D	4			C4	
16	1,000	ST	22 232498-021	CAP. CER 20P / 2500D	4			C5	
17	3,000	ST	22 232498-115	CAP. CER 40P / 2500B	4			C6, C8, C12	
18	6,000	ST	22 232498-125	CAP. CER 80P / 2500B	4			C7, C13, C14, C60, C61, C62	
20	2,000	ST	22 232467-073	CAP. MICA 316P / 1000F	4			C9, C65	
21	2,000	ST	22 232467-088	CAP. MICA 649P / 1000F	4			C10, C66	
22	4,000	ST	22 232467-102	CAP. MICA 1N27 / 500F	4			C11, C67, C68, C69	
24	1,000	ST	21 235004-109	RES FILM 33K / 0.5 J	4			R1	
25	1,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R2	
26	17,000	ST	23 202032-001	DIODE 1N4007	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11, CR12, CR14, CR15, CR16, CR17, CR18	
27	12,000	ST	33 232330-003	RELAY REED 24.0VDC	4			K1, K2, K3, K4, K5, K6, K7, K8, K9, K10, K11, K15	

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TITLE:
CAPACITOR BANK, A5

DOCUMENT NO:
89 - 210456-001

REV:
D1

SHEET NO:
1 OF 2

PARTS LIST

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PARTS LIST PER.. 90/09/07

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
28	2,000	ST	33 235000-002	RELAY REED 24VDC	4			K13,K14	
29	2,000	ST	46 210484-001	CONTACT KNIFE	2			P1,P2	
30	1,000	ST	31 211918-058	CONN FLAT 50-PIN	4			J1	
31	1,000	ST	26 235030-003	TRANSISTOR, NPN BC337	4			Q1	
32	1,000	ST	25 210551-001	COIL ASSY,L1	2			L1	
33	2,000	ST	32 210550-003	CABLE ASSY	2			W1,W2	
34	1,000	ST	48 210650-005	ASSY LABEL	1				
35	2,000	ST	25 210708-001	COIL ASSY	2			L2,L3	D
***** BILL OF DOCUMENTATION *****									
1001			210456 PD	CAPACITOR BANK,A5					
1002			210456 ED	CAPACITOR BANK A5 TU4015					
1003			210456 TP	A5, CAPACITOR BANK					
1004			210456 MM	CAPACITOR BANK A5					
1005			206460 AS	ESD, PROTECTION & MARKING					
1006			201350 AS	WORKMANSHIP					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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TITLE: CAPACITOR BANK, A5	DOCUMENT NO.: 89 - 210456-001	REV: D1	SHEET NO.: 2 OF 2
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PARTS LIST

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210548-001	PWB, COMPENSATION 1 A6	3				
2	2,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4				
3	1,000	ST	59 210463-001	FRAME ASSY	1			H6	
4	16,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4			H2	B
5	4,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4			H3	
6	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4			H4	
7	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4			H5	
8	21,000	ST	51 232495-011	SCREW M 3X 8 TP. POZIDR. A2	4			H7	A1
9	12,000	ST	52 235019-004	NUT, SQUARE M 4	4			H8	
10	12,000	ST	30 210590-001	TERMINAL LUG. PREFORMED	1			H1	
11	21,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21	
12	1,000	ST	21 235004-093	RES FILM 6K8 / 0.5 J	4			R1	
13	1,000	ST	21 235004-073	RES FILM 1K0 / 0.5 J	4			R2	
14	1,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R3	
15	1,000	ST	21 235004-105	RES FILM 22K / 0.5 J	4			R4	
16	12,000	ST	23 202032-001	DIODE 1N4007	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11, CR12	
17	6,000	ST	33 232330-003	RELAY REED 24.0VDC	4			K1, K2, K3, K4, K5, K6	
18	2,000	ST	41 210485-001	CONTACT, KNIFE	2			P1, P2	
19	1,000	ST	31 211918-058	CONN FLAT 50-PIN	4			J1	
20	2,000	ST	26 235030-003	TRANSISTOR, NPN BC237	4			Q1, Q2	
21	1,000	ST	41 210581-001	COIL ASSY, L1	2			L1	
22	1,000	ST	41 210582-001	COIL ASSY, L2	2			L2	
23	1,000	ST	41 210583-001	COIL ASSY, L3	2			L3	
24	1,000	ST	32 210567-002	CABLE ASSY	2			W1	
25	1,000	ST	32 210567-003	CABLE ASSY	2			W2	
26	1,000	ST	32 210567-004	CABLE ASSY	2			W3	
27	1,000	ST	32 210567-005	CABLE ASSY	2			W4	
28	1,000	ST	32 210567-006	CABLE ASSY	2			W5	
29	1,000	ST	32 210567-007	CABLE ASSY	2			W6	
30	1,000	ST	48 210650-006	ASSY LABEL	1				

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TITLE:
BROAD BAND 1, A6

DOCUMENT NO.:
60 - 210461-001

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210549-001	PWB, A7	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1			H6	
3	2,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4				
4	14,000	ST	30 210590-001	TERMINAL LUG, PREFORMED	1			H1	
5	8,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4			H2	B
6	4,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4			H3	
7	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4			H4	
8	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4			H5	
9	21,000	ST	51 232495-011	SCREW M 3X 8 TP.POZIDR.A2	4			H7	A1
10	4,000	ST	52 235019-004	NUT, SQUARE M 4	4			H8	
11	21,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21	
12	47,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C63, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74	
13	3,000	ST	22 232498-014	CAP. CER 10P / 2500D	4			C22, C26, C27	
14	2,000	ST	22 232498-021	CAP. CER 20P / 2500D	4			C23, C75	
15	2,000	ST	22 232498-115	CAP. CER 40P / 2500G	4			C24, C25	
16	2,000	ST	22 232498-125	CAP. CER 80P / 2500G	4			C76, C77	
17	7,000	ST	23 202032-001	DIODE 1N4007	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7	
18	7,000	ST	33 232330-003	RELAY REED 24.0VDC	4			K1, K2, K3, K4, K5, K6, K7	
19	2,000	ST	41 210485-001	CONTACT, KNIFE	2			P1, P2	
20	1,000	ST	31 211918-058	CONN FLAT 50-PIN	4			J1	
21	1,000	ST	41 210584-001	COIL ASSY, L1	2			L1	
22	2,000	ST	32 210567-006	CABLE ASSY	2			W1, W2	
23	1,000	ST	48 210650-007	ASSY LABEL	1				
24	2,000	ST	21 200876-032	RES FILM 2M2 /10000J	4			R1, R2	

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TITLE:
BROAD BAND 2, A7

DOCUMENT NO.:
89 - 210462-001

REV:
B1


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PARTS LIST

PRINTET..... 90/09/10
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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
*****	*****	***	*****	*** BILL OF DOCUMENTATION	***	*****	*****	*****	*****
1001			210462 PD	BROAD BAND 2, A7					
1002			210462 EC	BOARD BAND 2 A7 TU4015					
1003			210462 TP	A7, BROAD BAND 2					
1004			210462 MM	BROAD BAND 2 A7					
1005			206460 AS	ESD, PROTECTION & MARKING					
1006			201350 AS	WORKMANSHIP					
*****	*****	***	*****	***** NEXT ASSY *****	***	*****	*****	*****	*****
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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PARTS LIST

PRINTET..... 90/11/02

PARTS LIST PER.. 90/11/01

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	43,000	ST	22 221220-003	CAP. POLY 22N / 63K	4			C1, C2, C3, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C74	
2	2,000	ST	22 221721-010	CAP. CER 1N0 / 100K	4			C4, C5	
3	3,000	ST	22 235010-006	CAP. ELC 6U8 / 25M	4			C45, C63, C66	
4	21,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62, C64, C65, C67, C68	
5	4,000	ST	22 221721-002	CAP. CER 220P / 100K	4			C69, C70, C72, C73	
6	2,000	ST	22 221561-014	CAP. CER 47P0 / 100G	4			C75, C76	
7	13,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C71, C77, C78, C79, C80, C81, C82, C83, C84, C85, C86, C87, C88	F
8	88,000	ST	23 200352-001	DIODE 1N4148	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR15, CR16, CR17, CR18, CR19, CR20, CR21, CR22, CR23, CR24, CR25, CR26, CR27, CR28, CR29, CR38, CR39, CR40, CR41, CR42, CR43, CR44, CR45, CR46, CR47, CR48, CR49, CR50, CR51, CR52, CR53, CR62, CR63, CR64, CR65, CR66, CR67, CR68, CR69, CR70, CR71, CR72, CR73, CR74, CR75, CR76, CR77, CR86, CR87, CR88, CR89, CR90, CR91, CR92, CR93, CR94, CR95, CR96, CR97, CR98, CR99, CR100, CR101, CR110, CR111, CR112, CR113, CR114, CR115, CR116, CR117, CR118, CR119, CR120, CR121, CR124, CR125, CR126, CR127,	

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TITLE:
CONTROLLER ABA1 TU4015

DOCUMENT NO.:
60 - 210421-001

REV:
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PARTS LIST

PRINTET..... 90/11/02

PARTS LIST PER.. 90/11/01

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
9	4,000	ST	23 223807-001	LED ARRAY 10 ELEMENT RED	4			CR128, CR129	
10	1,000	ST	31 211918-157	CONN FLAT 50-PIN	4			CR8, CR9, CR10, CR11	
11	1,000	ST	31 211918-049	CONN FLAT 40-PIN	4			J1	
12	1,000	ST	31 235043-022	CONN, PCB 10-POL, ANGLE	4			J2	
13	4,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4			J3	
14	3,000	ST	25 200730-003	COIL, RF	4			L1, L2, L3	
15	43,000	ST	26 235036-001	TRANSISTOR, FET BST76A	4			Q1, Q2, Q3, Q6, Q7, Q8, Q9, Q10, Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26, Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34, Q35, Q36, Q37, Q38, Q39, Q40, Q41, Q42, Q43, Q44, Q45	
16	1,000	ST	26 235031-003	TRANSISTOR, NPN, BC547B	4			Q4	
17	1,000	ST	26 235032-003	TRANSISTOR, PNP, BC327-25	4			Q5	
18	13,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R1, R2, R3, R4, R5, R6, R7, R8, R9, R11, R14, R94, R124	
19	1,000	ST	21 235004-091	RES FILM 5K6 / 0.5 J	4			R10	
20	1,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R12	
21	44,000	ST	21 235004-073	RES FILM 1K0 / 0.5 J	4			R13, R22, R23, R24, R25, R26, R27, R28, R37, R38, R39, R40, R41, R42, R43, R44, R53, R54, R55, R56, R57, R58, R59, R60, R69, R70, R71, R72, R73, R74, R75, R76, R85, R86, R87, R88, R89, R90, R91, R92, R106, R127, R128, R130	F
22	2,000	ST	21 235004-114	RES FILM 51K / 0.5 J	4			R15, R16	
23	4,000	ST	21 235004-081	RES FILM 2K2 / 0.5 J	4			R116, R117, R118, R119	
24	12,000	ST	21 235005-301	RES FILM 10K0 / 0.4 F	4			R95, R96, R98, R99, R100, R101, R102, R112, R113, R114, R115, R129	E
25	8,000	ST	21 235004-115	RES FILM 56K / 0.5 J	4			R103, R104, R105, R107, R108, R109, R110, R111	
26	4,000	ST	21 235004-066	RES FILM 510R / 0.5 J	4			R120, R121, R122, R123	

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TITLE:
CONTROLLER A8A1 TU4015

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60 - 210421-001

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PARTS LIST

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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
27	1,000	ST	21 235005-355	RES FILM 36K5 / 0.4 F	4			R97	B
28	1,000	ST	24 230988-002	IC, --80C85	4			U1	
29	1,000	ST	24 207443-016	IC, 27C256-20	4			U2	
30	1,000	ST	24 213585-001	IC, 8K X 8BIT	4			U5	
31	1,000	ST	24 223961-002	IC, --28C64, 8KX8 EEPROM	4			U6	
32	1,000	ST	24 235018-001	IC, MP690, WATCHDOG	4			U7	
33	2,000	ST	24 213289-095	IC, CD74HCT373E	4			U8, U15	
34	3,000	ST	24 206072-095	IC, --74HCT138	4			U9, U11, U23	
35	2,000	ST	24 200466-095	IC, --74HCT08, AND GATE	4			U10, U17	
36	2,000	ST	24 200464-095	IC, --74HCT04, HEX INVERT	4			U12, U19	
37	2,000	ST	24 207437-095	IC, --74HCT374	4			U14, U29	
38	2,000	ST	24 200497-095	IC, --74HCT32	4			U16, U38	
39	1,000	ST	24 207432-095	IC, CD74HCT245E	4			U13	
40	1,000	ST	24 208799-201	IC, SNJ55189AJ/883	4			U18	
41	5,000	ST	24 235049-095	IC, --74HCT377, F-F	4			U20, U21, U22, U24, U25	
42	1,000	ST	24 235001-001	IC, ADC0848	4			U26	
43	1,000	ST	24 230989-002	IC, USARD	4			U27	
44	1,000	ST	24 221579-003	IC, --65176B	4			U28	
45	5,000	ST	24 213541-095	IC, CD74HCT161E	4			U30, U31, U41, U42, U43	
46	2,000	ST	24 211620-002	IC, CD4066BC	4			U32, U33	
47	1,000	ST	24 203469-002	IC, --5406J	4			U34	
48	1,000	ST	24 213271-004	IC, TLO74IN	4			U35	
49	1,000	ST	24 204755-002	IC, SN5407J	4			U36	
50	1,000	ST	24 200462-095	IC, --74HCT00, NAND GATE	4			U39	
51	1,000	ST	24 200808-095	IC, --74HCT74	4			U44	
52	1,000	ST	23 200341-009	DIODE ZENER 1N751A 5V1	4			VR1	
53	5,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R17, R18, R19, R20, R21	
54	1,000	ST	20 BR433853	CRYSTAL 6,14400MHZ HC18-U	4			Y1	F
55	1,000	ST	33 235058-001	SWITCH, PWB 120V/0.25A	4			S1	
56	4,000	ST	31 206133-007	SOCKET, 28PIN	4				
57	1,000	ST	31 206133-008	SOCKET, 40PIN	4				
58	15,000	MM	34 222837-004	TAPE, DOUBLE-SIDED 1.6MM	4				
59	1,000	ST	37 210422-001	PWB, CONTROLLER A8	3				
60	2,000	ST	51 202476-067	SCREW M2.5X10SLTD CYL SST	4				
61	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4				
62	4,000	ST	51 200683-007	SCREW M04X1/4 TPG PH SST	4				

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TITLE:
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FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210540-001	PWB, DETECTOR A9	3				
2	1,000	ST	59 210463-001	FRAME ASSY	1				
3	21,000	ST	51 232495-011	SCREW M 3X 8 TP.POZIDR.A2	4				A1
4	1,000	ST	46 210484-001	CONTACT KNIFE	2			P1	
5	2,000	ST	51 222790-019	SCREW M 4X10 POZIDR. A2	4				B
6	2,000	ST	52 200682-002	NUT, SLFLKG, HEX M4	4				
7	1,000	ST	41 210570-001	SHIELD, BOX TUNE	2				
8	1,000	ST	41 210569-001	SHIELD COVER, TUNE	2				
9	1,000	ST	41 210571-001	SHIELD REAR, TUNE	2				
10	1,000	ST	41 210572-001	SHIELD BOX, HIGH POWER	2				
11	1,000	ST	41 210573-001	SHIELD COVER, HIGH POWER	2				
12	1,000	ST	41 210574-001	SHIELD REAR, HIGH POWER	2				
13	6,000	ST	45 201197-019	STRAP, CABLE, NAT \44X4.8	4				
14	4,000	ST	51 202476-001	SCREW M 3X 5 SLTD CYL SST	4				
15	4,000	ST	52 200682-001	NUT, SELF LOCK. M 3	4				
16	2,000	ST	51 202476-068	SCREW M2.5X12SLTD CYL SST	4				
17	2,000	ST	52 200560-014	NUT, PLAIN HEX M 2.5	4				
18	6,000	ST	30 210590-001	TERMINAL LUG. PREFORMED	1				
19	0,070	M	32 200843-008	WIRE COP TIN-CTD Ø0.8 MM	4				
20	0,100	M	32 200843-008	WIRE COP TIN-CTD Ø0.8 MM	4				
21	3,000	G	79 202785-010	SOLDER CORED TIN ALLOY	4				
22	8,000	ST	56 200533-001	CLAMP LOOP	4				C
23	0,070	M	32 200843-007	WIRE COP TIN-CTD Ø1.0 MM	4				
24	0,140	M	32 200843-005	WIRE COP TIN-CTD Ø1.5 MM	4				
25	3,000	G	76 200457-001	ADHESIVE SEALANT 3744 RTV	4				
27	2,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4				
28	2,000	ST	31 201702-023	TAG, SOLDER	4				
29	4,000	ST	22 235037-002	CAP. VAR 5-60P / 300	4			C1, C2, C16, C17	
30	1,000	ST	22 232498-014	CAP. CER 10P / 2500D	4			C3	
31	7,000	ST	22 235003-001	CAP. PLAST 1N0 / 100K	4			C4, C8, C9, C10, C11, C26, C29	
33	13,000	ST	22 221220-009	CAP. POLY 220N / 63K	4			C6, C7, C12, C13, C23, C24, C25, C27, C28, C40, C41, C42, C43	
34	1,000	ST	22 221571-007	CAP. CER 6P8 / 500C	4			C14	
35	1,000	ST	22 221571-009	CAP. CER 10P / 500G	4			C15	
36	1,000	ST	22 221561-003	CAP. CER 5P6 / 100C	4			C18	
37	7,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C19, C20, C21, C22, C45, C46,	

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38	10,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C49 C30, C31, C32, C33, C34, C35, C36, C37, C38, C39	
39	1,000	ST	22 232498-105	CAP. CER 5P0 / 2500D	4			C44	
40	2,000	ST	22 221561-018	CAP. CER 100P / 100G	4			C47, C48	
41	14,000	ST	23 235009-001	DIODE SCHOTTKY 70V/15MA	4			CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR15, CR16, CR17, CR18	
42	3,000	ST	23 202032-001	DIODE 1N4007	4			CR11, CR13, CR14	
43	1,000	ST	23 200352-001	DIODE 1N4148	4			CR12	
44	1,000	ST	31 211918-018	CONN FLAT 16-PIN	4			J1	
45	1,000	ST	31 200764-002	CONN SMB RECP 50R	4			J2	
46	6,000	ST	31 200764-003	CONN SMB RECP 50R	4			J4, J5, J6, J7, J8, J9	
47	3,000	ST	33 232330-003	RELAY REED 24.0VDC	4			K1, K2, K3	
48	8,000	ST	25 200730-001	COIL	4			L1, L2, L3, L4, L5, L6, L7, L8	
49	2,000	ST	26 235031-003	TRANSISTOR, NPN, BC547B	4			Q1, Q2	
50	1,000	ST	26 235036-001	TRANSISTOR, FET BST76A	4			Q3	
51	16,000	ST	21 235004-056	RES FILM 200R / 0.5 J	4			R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16	
52	9,000	ST	21 235004-045	RES FILM 68R / 0.5 J	4			R17, R23, R29, R68, R69, R74, R76, R82, R89	E
53	13,000	ST	21 235004-121	RES FILM 100K / 0.5 J	4			R18, R19, R24, R25, R31, R32, R33, R34, R38, R78, R79, R80, R81	
54	7,000	ST	21 235004-105	RES FILM 22K / 0.5 J	4			R20, R26, R39, R70, R71, R75, R77	
55	2,000	ST	21 235004-057	RES FILM 220R / 0.5 J	4			R72, R73	
56	2,000	ST	21 235005-247	RES FILM 3K01 / 0.4 F	4			R21, R27	
57	2,000	ST	21 235005-283	RES FILM 7K15 / 0.4 F	4			R22, R28	
58	1,000	ST	21 235004-123	RES FILM 120K / 0.5 J	4			R30	
59	2,000	ST	21 235004-091	RES FILM 5K6 / 0.5 J	4			R35, R94	
60	1,000	ST	21 202118-002	RES ADJ 1K0 / 0.50M	4			R36	
61	1,000	ST	21 235004-081	RES FILM 2K2 / 0.5 J	4			R37	
62	2,000	ST	21 235004-101	RES FILM 15K / 0.5 J	4			R40, R42	
63	3,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R41, R43, R86	

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64	6,000	ST	21 235006-049	RES FILM 100R / 6.0 J	4			R44, R45, R46, R47, R48, R49	
65	6,000	ST	21 235006-200	RES FILM 402R / 6.0 J	4			R50, R51, R52, R53, R54, R55	
66	2,000	ST	21 235006-037	RES FILM 33R / 6.0 J	4			R56, R57	
67	10,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R58, R59, R60, R61, R62, R63, R64, R65, R97, R98	E
68	2,000	ST	21 235004-042	RES FILM 51R / 0.5 J	4			R66, R67	
69	2,000	ST	21 235004-129	RES FILM 220K / 0.5 J	4			R84, R91	
71	2,000	ST	21 235004-110	RES FILM 36K / 0.5 J	4			R83, R90	
72	2,000	ST	21 235004-093	RES FILM 6K8 / 0.5 J	4			R85, R92	
73	1,000	ST	21 235004-085	RES FILM 3K3 / 0.5 J	4			R93	
74	1,000	ST	21 207730-001	RES VAR 10K / 0.50K	4			R87	
75	2,000	ST	21 235004-099	RES FILM 12K / 0.5 J	4			R88, R96	
76	1,000	ST	21 235004-113	RES FILM 47K / 0.5 J	4			R95	
77	1,000	ST	25 210562-001	TRAFO, CURRENT 30TNS	2			T1	
78	1,000	ST	25 210561-001	TRAFO, VOLTAGE 30TNS	2			T2	
79	1,000	ST	25 210560-001	TRAFO, VOLTAGE 20TNS	2			T3	
80	2,000	ST	25 210563-001	TRAFO, CURRENT 20TNS	2			T4, T5	
81	2,000	ST	24 213271-004	IC, TL074IN	4			U1, U6	
82	1,000	ST	24 235002-001	IC, ---4051B	4			U2	
83	1,000	ST	24 235008-001	IC, OPR. AMP. DUAL	4			U3	
84	1,000	ST	24 232315-004	IC, LM2903N	4			U4	
85	1,000	ST	24 216361-005	IC, OP AMP	4			U5	
86	1,000	ST	32 210600-001	CABLE, DETEC, HIGH POWER	2			W1	
87	1,000	ST	32 210601-001	CABLE, DETECTOR, TUNER	2			W2	
88	1,000	ST	32 210602-001	CABLE, COAX	2			W4	F
89	1,000	ST	48 210650-009	ASSY LABEL	1				
90	1,000	ST	32 210602-002	CABLE, COAX	2			W3	F
***** BILL OF DOCUMENTATION *****									
1001			210458 EC	DETECTOR A9					
1002			210458 PD	DETECTOR, A9					
1003			210458 TP	A9, DETECTOR					
***** NEXT ASSY *****									

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1	1,000	ST	60 210472-001	REGULATOR, A10A1	1				
2	1,000	ST	41 210447-001	PLATE, JUNCTION	2				
3	7,000	ST	56 201599-011	SPACER, SLEEVE 6.0MM	4				
4	11,000	ST	52 200682-001	NUT, SELF LOCK. M 3	4				
5	11,000	ST	53 200556-003	WASHER FLAT 3.2X0.5MM	4				
6	1,000	ST	51 200552-049	SCREW M 6X60 CAP SOCH SST	4				
7	1,000	ST	53 200556-006	WASHER FLAT 6.4X1.6MM	4				
8	1,000	ST	52 200682-004	NUT SELF LOCK M6	4				
9	0,700	G	78 200799-001	COMPOUND. THERMAL, SILICONE	4				
10	1,000	ST	41 210446-001	SCREEN SHIELD	2				
11	1,000	ST	60 210631-001	TRANSFORMER ASSY, TU4015	1				
12	2,000	ST	45 232387-002	CLAMP, CABLE	4				
13	3,000	ST	45 201197-049	STRAP, CABLE, NAT \16X2.5	4				

1001			210459 PD	POWER SUPPLY ASSY, A10					
1002			210459 TP	A10, POWER SUPPLY ASSY					

	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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1	1,000	ST	37 210598-001	PWB, REGULATOR A10A1	3				
2	9,000	ST	52 200560-003	NUT, PLAIN HEX M 3	4				
3	15,000	ST	51 202476-002	SCREW M 3X 6 SLTD CYL SST	4				
4	4,000	ST	51 200683-007	SCREW ND4X1/4 TPG PH SST	4				
5	10,000	ST	56 235040-001	HEAT SINK, TINNED 15K/W	4			MP3, MP4, MP5, MP6, MP7, MP8, MP9, MP10, MP11, MP12	
6	2,000	ST	41 210482-001	PLATE, HEAT SINK	2			MP1, MP2	
7	2,000	ST	31 202146-004	FUSE HOLDERS NYLON	4				
8	1,000	ST	33 201270-017	FUSE 5X20 SLOW 1,0 A	4			F1(22	
9	0,000	ST	33 201270-020	FUSE 5X20 SLOW 2,0 A	4			F1(11	
10	1,000	ST	33 201270-020	FUSE 5X20 SLOW 2,0 A	4			F2(22	
11	0,000	ST	33 201270-023	FUSE 5X20 SLOW 4,0 A	4			F2(11	
12	16,000	ST	56 202152-002	INSULATOR PEARL, \ 4.19X1	4				
13	5,000	ST	54 202168-030	COLLAR SLEEVES 1.3X10 MM	4				
14	1,000	ST	30 210625-001	CODEPLUG, TU4015 A10	1				
15	4,000	ST	31 211918-402	EJECTOR, LKG LATCH LONG	4			J8-9	
16	2,000	ST	56 201201-003	INSULATOR, PLATE, MICA	4				
17	0,500	G	78 200799-001	COMPOUND, THERMAL, SILICONE	4				
18	1,000	ST	22 202085-020	CAP. MP 100N / 630K	4			C1	
19	12,000	ST	22 221220-007	CAP. POLY 100N / 63K	4			C2, C7, C8, C13, C14, C18, C20, C21, C27, C28, C29, C30	
20	2,000	ST	22 215700-001	CAP. ELC 1M5 / 400	4			C3, C9	
21	4,000	ST	22 221220-012	CAP. POLY 680N / 50K	4			C4, C10, C16, C23	
22	3,000	ST	22 221220-009	CAP. POLY 220N / 63K	4			C5, C11, C27	
23	2,000	ST	22 235010-007	CAP. ELC 10U / 25M	4			C6, C12	
24	1,000	ST	22 215700-021	CAP. ELC 3M3 / 16Q	4			C15	
25	1,000	ST	22 235010-018	CAP. ELC 33U / 10M	4			C17	
26	1,000	ST	22 215700-014	CAP. ELC 3M3 / 63Q	4			C19	
27	1,000	ST	22 200512-007	CAP. ELC 22U / 40T	4			C22	
28	3,000	ST	22 221220-013	CAP. POLY 1U0 / 50K	4			C24, C25, C26	
29	1,000	ST	31 235044-004	CONN, PWB, MALE 6-POLE	4			J1	
30	3,000	ST	31 235043-001	CONN, PWB RECP. 4-PIN	4			J2, J3, J4	
31	3,000	ST	31 235043-003	CONN, PWB RECP. 12-PIN	4			J5, J6, J7	
32	1,000	ST	31 211918-149	CONN FLAT 40-PIN	4			J8	
33	1,000	ST	31 211918-101	CONN FLAT 10-PIN	4			J9	
34	3,000	ST	26 235034-001	TRANSISTOR NPN DARLINGTON	4			Q1, Q4, Q7	

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TITLE:
REGULATOR, A10A1

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35	3,000	ST	26 235022-001	THYRISTOR 16A/200V	4			Q2, Q5, Q8	
36	3,000	ST	26 235024-002	TRANSISTOR, BC557B	4			Q3, Q6, Q14	
37	2,000	ST	26 235033-001	TRANSISTOR, PNP, BC640	4			Q9, Q10	
38	1,000	ST	26 235031-003	TRANSISTOR, NPN, BC547B	4			Q11	
39	2,000	ST	26 235035-004	TRANSISTOR NPN DARLINGTON	4			Q12, Q13	
40	3,000	ST	21 235004-113	RES FILM 47K / 0.5 J	4			R1, R5, R9	
41	3,000	ST	21 235004-025	RES FILM 10R / 0.5 J	4			R2, R6, R10	
42	2,000	ST	21 208010-281	RES FILM 6K81 / 0.25F	4			R3, R7	
43	2,000	ST	21 208010-308	RES FILM 11K8 / 0.25F	4			R4, R8	
44	1,000	ST	21 235004-045	RES FILM 68R / 0.5 J	4			R11	
45	1,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R12	
46	2,000	ST	21 235004-089	RES FILM 4K7 / 0.5 J	4			R13, R14	
47	2,000	ST	21 235004-049	RES FILM 100R / 0.5 J	4			R15, R22	B
48	2,000	ST	21 202335-005	RES WW R22 / 1.00K	4			R16, R17	
49	1,000	ST	21 208010-179	RES FILM 649R / 0.25F	4			R18	
50	1,000	ST	21 208010-232	RES FILM 2K10 / 0.25F	4			R19	
51	2,000	ST	21 232419-015	RES VOLT SENS S07K140	4			R20, R21	
52	6,000	ST	24 207487-021	IC, --7805	4			U1, U2, U3, U4, U5, U6	
53	18,000	ST	23 202032-001	DIODE 1N4007	4			CR1, CR2, CR3, CR4, CR7, CR8, CR9, CR10, CR11, CR12, CR13, CR14, CR21, CR22, CR23, CR24, CR25, CR26	
54	4,000	ST	23 200352-001	DIODE 1N4148	4			CR5, CR6, CR15, CR16	
55	4,000	ST	23 222210-003	DIODE MR502	4			CR17, CR18, CR19, CR20	
56	1,000	ST	23 203527-015	DIODE ZENER 9V1/0.4W J	4			VR1	
57	1,000	ST	23 203527-014	DIODE ZENER 8V2/0.4W J	4			VR2	
58	1,000	ST	23 203527-023	DIODE ZENER 20V /0.4W J	4			VR3	
59	2,000	ST	56 200852-005	INSULATOR BUSHING	4				
60	1,000	ST	22 221220-003	CAP. POLY 22N / 63K	4			C31	

*** BILL OF DOCUMENTATION ***									

			210472 EC	REGULATOR A10A1 TU4015					
			210472 MM	REGULATOR A10A1					
			210472 PD	REGULATOR, A10A1					

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1	1,000	ST	31 211919-009	CONN SOC. FLAT 16PIN	4			P1	
2	1,000	ST	31 211919-053	STRAIN RELIEF FLAT 16PIN	4				
3	1,000	ST	31 211919-013	CONN SOC. FLAT 20PIN	4			P2	
4	1,000	ST	31 211919-054	STRAIN RELIEF FLAT 20PIN	4				
5	1,000	ST	31 211919-025	CONN SOC. FLAT 40PIN	4			P3	
6	1,000	ST	31 211919-057	STRAIN RELIEF FLAT 40PIN	4				
7	4,000	ST	31 211919-029	CONN SOC. FLAT 50PIN	4			P4, P5, P6, P7	
8	4,000	ST	31 211919-058	STRAIN RELIEF FLAT 50PIN	4				
9	1,000	ST	31 211919-001	CONN SOC. FLAT 10PIN	4			P8	
10	1,000	ST	31 211919-051	STRAIN RELIEF FLAT 10PIN	4				
11	1340,000	MM	32 213292-009	CABLE, FLAT	4				
12	1,000	ST	31 235079-029	CONN, PLUG 50-P	4				
13	1,000	ST	31 235079-058	STRAIN RELIEF 50-P	4				
***** BILL OF DOCUMENTATION *****									
			210460 PD	CABLE ASSY W6					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				

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1	1,000	ST	41 210429-001	REAR PLATE	2				
2	13,000	ST	41 210473-001	CONTACT SPRING	3				
3	1,000	ST	41 210474-001	CONTACT RAIL	2				
4	1,000	ST	41 210477-001	CONTACT RAIL	2				
5	2,000	ST	41 210478-001	CONTACT RAIL	2				
6	1,000	ST	41 210479-001	CONTACT RAIL	2				
7	1,000	ST	41 210480-001	CONTACT RAIL	2				
8	1,000	ST	41 210481-001	CONTACT RAIL	2				
9	26,000	ST	51 222790-013	SCREW M 3X12 POZIDR. A2	4				B
10	26,000	ST	53 200559-002	WASHER LOCK 3.1X0.8MM	4				
14	1,000	ST	32 210622-001	CABLE ASSY, W 2	2				
15	1,000	ST	30 210622-002	CABLE ASSY W3	1				
16	13,000	ST	41 231958-001	SPACER	2				B
17	13,000	ST	41 231957-001	NUT, MENDING	2				B
***** BILL OF DOCUMENTATION *****									
			210476 PD	REAR PLATE ASSY					
***** NEXT ASSY *****									
	1,000	ST	210450-001	RACK ASSY	1				

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TITLE:
REAR PLATE ASSY, A12

DOCUMENT NO.:
59 - 210476-001

REV:
B

SHEET NO.:
1 OF 1



PARTO LIST


PRINT..... 90/09/10
PARTS LIST PER.. 90/09/07

FIND NO.	QTY REQ	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	1,000	ST	37 210595-001	PWB, TEMP. CONTROL A13	3				
2	1,000	ST	53 200559-002	WASHER LOCK 3.1X0.8MM	4				C
3	6,000	ST	52 200509-005	NUT, CLINCH M 4/1.8MM	3				D
4	2,000	ST	51 222790-012	SCREW M 3X10 POZIDR. A2	4				C
5	2,000	ST	52 200682-001	NUT, SELF LOCK.M 3	4				C
6	6,000	ST	22 221220-001	CAP. POLY 10N / 63K	4			C1, C2, C3, C7, C8, C9	
7	2,000	ST	22 235012-006	CAP. ELC 100U / 16T	4			C4, C10	
8	3,000	ST	22 202085-020	CAP. MP 100N / 630K	4			C5, C6, C11	
9	1,000	ST	22 202085-015	CAP. MP 2N2 / 630K	4			C12	
10	1,000	ST	31 235043-001	CONN, PWB RECP. 4-PIN	4			J1	
11	1,000	ST	25 235042-001	CHOKE, 1.5A	4			L1	
12	2,000	ST	26 235034-001	TRANSISTOR NPN DARLINGTON	4			Q1, Q2	
13	2,000	ST	26 235011-004	TRIAC, TO220 400V/ 8A	4			Q3, Q4	
14	1,000	ST	56 235040-001	HEAT SINK, TINNED 15K/W	4			MP1	
15	1,000	ST	21 235004-105	RES FILM 22K / 0.5 J	4			R1	
16	2,000	ST	21 235004-109	RES FILM 33K / 0.5 J	4			R2, R30	
17	3,000	ST	21 235004-097	RES FILM 10K / 0.5 J	4			R3, R8, R26	
18	1,000	ST	21 235004-121	RES FILM 100K / 0.5 J	4			R4	
19	1,000	ST	21 235004-091	RES FILM 5K6 / 0.5 J	4			R5	
20	1,000	ST	21 235004-111	RES FILM 39K / 0.5 J	4			R6	
21	1,000	ST	21 235004-118	RES FILM 75K / 0.5 J	4			R7	
22	4,000	ST	21 235004-067	RES FILM 560R / 0.5 J	4			R9, R10, R28, R29	
23	4,000	ST	21 235004-075	RES FILM 1K2 / 0.5 J	4			R11, R21, R22, R23	
24	2,000	ST	21 215402-001	RES NTC 22K / 0.50K	4			R12, R27	
25	8,000	ST	21 229324-039	RES FILM 3K3 / 2.0 J	4			R13, R14, R15, R16, R17, R18, R19, R20	
26	1,000	ST	21 235004-099	RES FILM 12K / 0.5 J	4			R24	
27	1,000	ST	21 235004-113	RES FILM 47K / 0.5 J	4			R25	
28	2,000	ST	24 232497-001	IC, CA3059	4			U1, U2	
29	6,000	ST	51 230433-036	SCREW M 4X 8 CTSK.HD SST	4				B
***** BILL OF DOCUMENTATION *****									
001			210596 PD	TEMP. CONTROL A13 TU4015					
002			210596 EC	TEMP. CONTROL A13 TU4015					
003			210596 TP	A13, TEMP. CONTROL ASSY					

PARTS LIST


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PARTS LIST PER.. 90/09/07

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1004			210596 MM	TEMP. CONTROL A13					
***** NEXT ASSY *****									
	1,000	ST	231950-001	ANTENNA TUNER TU-4015	1				
Dansk Radio AS  DK-2630 Taastrup. Denmark Telex 33358 danios dk. Telefax +45 42 52 23 80				TITLE: TEMP. CONTROL, A13		DOCUMENT NO.: 60 - 210596-001		REV: D	SHEET NO.: 2 OF 2

PARTS LIST

PRINTET..... 90/10/10

FIND NO.	QTY RQD	U M	ITEM OR DOCUMENT NUMBER	NOMENCLATURE	I T	PREP NO.	BIN	REFERENCE DESIGNATION	LINE REV
1	2,000	ST	41 210588-001	WALL COILFORM, MEDIUM	1				
2	4,000	ST	42 210585-005	ROD, COIL FORM	2				
3	2,000	ST	46 210547-002	SUPPORT, COIL FORM	2				
4	4,400	M	32 201623-003	WIRE, COPPER-AG Ø2.4MM	4				
5	1,000	B	76 200457-001	ADHESIVE SEALANT 3744 RTV	4				B
6	1,000	ST	41 210733-001	SPACER PLATE F.COIL ASSY	1				C
7	120,000	NM	75 221987-001	RUBBER SECTIONAL	4				C
***** BILL OF DOCUMENTATION *****									
			210580 PD	COIL ASSY, L2					
***** NEXT ASSY *****									
	1,000	ST	210454-001	INDUCTOR BANK 2, A3	1				
Dansk Radio AS 				TITLE: COIL ASSY, L2		DOCUMENT NO.: 41 - 210580-001		REV: C	SHEET NO.: 1 OF 1

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PARTS LIST PRINTET..... 90/10/10

PARTS LIST PRINTET..... 90/10/10

[illegible]

TITLE:
SPACER PLATE F.COIL ASSY

DOCUMENT NO:
41 - 210733-001

REV:
A

SHEET NO.:
1 OF 1

Dansk Radio AS



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Denmark
Telex 33358 darios dk.
Telefax +45 42 52 23 80



SECTION 8 SERVICE

8.1 Introduction

This section provides information for servicing the TU4015.

8.2 Theory of Operation

The overall theory of operation is explained at the end of this section in Service Sheet, ASSY 231950, ANTENNA TUNER, Configuration.

Detailed theory of operation is located opposite the schematics.

8.3 Trouble Shooting

WARNING

Read the Safety Summary at the front of this manual before trouble shooting the TU4015.

By the use of front panel controls, note as many symptoms of the malfunction as possible. From these symptoms it can usually be determined which assembly is malfunctioning. The Self-Test Program and the Fault Analysis Table (table 8.4 and 8.5) can be used as a guide.

When a problem has been isolated to a particular assembly or circuit, the faulty component(s) may be located using the detailed theory of operation shown on the page opposing the appropriate schematic.

8.4 Self-Test Program Program 50

The Self Test program runs through a test sequence where the different relays/components are tested. The Self Test program use the built-in dummy load as a reference and measures the reflection coefficient obtained by excitation and de-excitation of the different relays. When the test has been carried out, all detected errors are displayed.

To carry out the test a transmitter has to be connected.

To initiate the test continue as follows:

keystrokes	display
	12345.60
<u>progr</u>	PrG. no.
<u>5</u>	PrG. no. 5
<u>0</u>	PrG. no. 50
<u>enter</u>	AtU tSt.

By pressing the enter key the test is started. If the transmitter is off, the following display will appear:

keystrokes	display
<u>enter</u>	AtU tr. OFF

Turn on the Tx and continue as follows:

<u>enter</u>	ATU. tSt.
--------------	-----------

The dot after "ATU" lights up, indicating that the Self Test is running. When the Self Test has been carried out the display will show the soft-ware version of the tuner, e.g.:

rEL. 1.0b

Pressing the enter key the display will, if no failures have been detected, show the following display:

ATU End tSt.

To terminate the Self Test continue as follows:

<u>enter</u>	12345.60
--------------	----------

The exciter will now display the settings from before the Self Test was initiated.

If an error is detected during the test sequence the following display may occur, when the test sequence is finished:

display
Err C 6

With this error information and table 8.5 it is possible to find the faulty module and locate the possibly faulty component(s).

Pressing enter will display the next error detected and so on until all errors have been displayed. When all errors have been displayed the following display will appear:

ATU EnD tSt.

To terminate the Self Test continue as follows:

<u>enter</u>	12345.60
--------------	----------

8.4.1 Fatal errors

Some errors detected in the test sequence are classified as fatal errors, because they can consist of fault(s) located either in the connected transmitter and fault(s) in the measuring system of the tuner. If one of these errors is detected the test program will be terminated before the test sequence is finished.

The fatal error messages are listed in tabel 8.4

8.5 Operational Status/error messages

During operation different messages can appear in the exciter display.

The messages are divided into two groups, one group containing the communication/controller status, the other containing current and temperature status.

8.5.1 Communication/controller status

The message concerning the communication status will be displayed in the following manner:

display

Atu oFF.LinE

When the message is displayed the communication link between the tuner and the exciter is interrupted. The exciter will reestablish the communication link, inform that the communication is reestablished by restoring the exciter set-up from before the communication break down. During communication break down the tuner continue to operate.

The message concerning the controller status will be displayed in the following manner:

display

Atu FAIL

When this message appears on the display the transmitter will be interlocked, because the controller has been interrupted and no control of either relays nor communication exists.

The exciter will exclude the control of the tuner in its main program. The tuner can be restarted by turning off and then on the power for the exciter.

8.5.2 Current/temperature status

The tuner is protected against current overload in the tuner.

If the tuner settings result in a too high current the transmitter will be interlocked, the transmitter output power will be reduced

by 3 dB, regardless of the power setting, followed by a message in the display:

display

err. Cur. o.L.

While the message is still present in the display, the interlock will be reset and shortly after the message will disappear.

The tuner is protected against extreme temperatures inside the housing. The protection operates on two temperature levels. The first level causes a 3 dB reduction in transmitter output power, regardless of the power settings, followed by a message in the display:

display

err. Atu. tPr.

The display will disappear after a while. If the temperature level still exceeds the level after 2 minutes, a further reduction of 3 dB in transmitter output power will occur. This will continue until either no further transmitter power reduction is possible or the temperature level has fallen below the first level.

If the second temperature level is exceeded, the same display message will appear as when reaching the first temperature level, but this time the transmitter will be turned off.

As long as the high temperature exist inside the housing, the message will exist on the display, and it will not be possible to turn the transmitter on again.

8.6 Preventive Maintenance

Painted and fibre glass surfaces can be cleaned with a solution of soap and water. Do not use metallic brushes on any part of the tuner.

If repairing the painting of the tuner housing, never paint the fibre glass top.

Paint on the fibre glass hat can lead to flashover from the antenna stud to ground due to the high voltages present at the antenna.

8.7 Front Door Removal

To remove the front door, in order to service the modules in the tuner, proceed as follows:

- a. Remove the door by first loosening the twenty screws holding the door with an umbraco key. Then unscrew the screws with a umbraco screw driver. The screws are captive

and will therefore not need to be fully unscrewed. Use the two door handles to hold the door.

Both tools are available in Special Tool Kit 210638.

To reinstall the door, proceed as follows:

- a. Use the two handles to fix the door.
- b. Fasten all twenty captive screws loosely.
- c. Use a umbraco key to fasten the screws securely.

8.8 PC-Board Assembly Removal.

Removal of the different PC-Boards demands different levels of dismantling. The sequences for PC-board removal are described in the following sub-paragraphs. In all cases it is necessary to remove the front door, as described in paragraph 8.7, and the flat cable located in the right side of the rack. The location of the flat cable and the different modules can be seen on drawing 231950-PD, ANTENNA TUNER TU-4015, which are found at the end of this section.

8.8.1 Flat cable removal.

To remove the flat cable in the right side of the rack, proceed as follows:

- a. Disconnect the flat cable located in the right side of the rack by operating the ejectors on the connectors starting from the top. Bend the flat cable out of the door opening. It is only possible to remove the flat cable until and including assembly A7 without removal of assemblies.

8.8.2 Removal of PC-Board Assembly A1 and A3.

To remove the PC-Board assembly A1 it is necessary to remove assembly A3 in advance. The flat cable has to be removed as described in paragraph 8.8.1. Proceed as follows:

- a. Remove the A3 module in the same way as described in paragraph 8.8.3 a. When withdrawing the module carefully disconnect the flat cable, located on the right side of module, by operating the ejector on the socket, J2.
- b. Disconnect the cable, W1, located between the antenna stud and the A1 module.
Remove the module in the same way as described in paragraph 8.8.3 a.

To insert the modules simply apply the operations in reverse.

8.8.3 Removal of PC-board Assembly A4, A5, A6, A7.

To remove the PC-Board assembly A4 through A7 proceed as follows:

- a. Loosen the screws holding the frames of the applicable module with an umbraco key. Then unscrew the screws with a umbraco screw driver and remove the module. The screws are captive and will therefore not need to be fully unscrewed.

Both tools are available in Special Tool Kit 210638.

To resinsert the modules simply apply the operation in reverse.

8.8.4 Removal of PC-Board Assembly A2.

To remove the PC-board assembly A2 it is necessary first to remove the A3 module, applying paragraph 8.8.2 a, the modules A4, A5, A6, A7 by applying paragraph 8.8.3 a.

To remove the A2 module proceed as follows:

- a. Disconnect the two cables W2 and W3 from the A2 module.
- b. Remove the strenghtening plate located in the right side of the rack first by loosening the four screws with a screw-driver. It is not necessary to fully remove the screws.
- c. Loosen the six screws holding the mounting plate of the A2 module with an umbraco key. Then unscrew the screws with a umbraco screw driver and remove the module carefully through the hole from the strenghtening plate. The screws are captive and will therefore not need to be fully unscrewed.

Both tools are available in Special Tool Kit 210638.

To reinstall the module simply apply the operation in reverse.

8.8.5 Removal of PC-Board Assembly A8 and A9.

To remove the PC-board assemblies A8 and A9 it is necessary first to remove the A7 module, applying paragraph 8.8.3 a.

To remove the A9 and A8 module proceed as follows:

- a. Disconnect the two coax cables W4 and A8W1.
- b. Disconnect the flat cable located in the left side of the rack by operating the ejectors. Bend the cable out of the door opening.
- c. Remove the cable W5 by operating the lock on the connector.
- d. Remove the A9 module by applying paragraph 8.8.3 a.
- e. Remove the A8 module by applying paragraph 8.8.3 a.

To reinstall the modules simply apply the operation in reverse.

8.8.6 Removal of PC-Board Assembly A10.

To remove the PC-Board assembly A10 it is necessary to remove the A8 and A9 module, applying paragraph 8.8.5.

To remove the A10 module proceed as follows:

- a. Unscrew, with an umbraco key, and remove the six screws holding the top cover. Remove the top cover.

The tool is available in Special Tool Kit 210638.

- b. Unplug all connectors on the A10 module, and carefully lift out the module.

To reinstall the module simply apply the operation in reverse.

8.8.7 Removal of PC-Board Assembly A13.

To remove the PC-board assembly A13 it is necessary first to remove the A3 module, applying paragraph 8.8.2 a, the module A4, applying paragraph 8.8.3 a.

To remove the A13 module proceed as follows:

- a. Unscrew the six screws holding the A13 module. The screws need not to be fully removed. The module is located between the left rack side and the outer tuner housing.

After loosening the screws, carefully remove the module and disconnect P1.

To reinstall the module simply apply the operation in reverse.

8.9 Servicing PC-Boards

All the PC-boards have plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board.

8.10 MOS Handling Precautions

All MOS devices are subject to damage from static charge build-up. The generation of static charges is not a problem, but the accumulation of static charges is. In general, any device not connected directly to ground can accumulate static charges. Electrical discharge can occur to ground or to any object or person having a lower potential. Therefore, handling precautions are recommended for all personnel coming into contact with MOS devices.

When handling or testing MOS devices, observe the following precautions.

- a) Ground test equipment and tools used in testing or handling MOS devices.
- b) Apply no power to board assembly while MOS device is being installed. This permits accumulated static charges on MOS device to be safely removed before power is applied.
- c) When not in use, short all MOS leads.
This prevents voltage differences from occurring on leads

WARNING

When accomplishing step d, never expose personnel directly to hard electrical ground. For safety reasons, resistance of at least 100 Kohms should be placed between using personnel and hard electrical ground.

- d) Do not handle MOS devices by their leads. Before handling any MOS device, personnel should touch electrical ground to discharge accumulate static charges.
- e) Avoid use of plastics, rubber, and silk in MOS areas. Do not use any material susceptible to static charge accumulation.
- f) Handle circuit boards and modules containing MOS devices in the same manner as individual MOS devices. Regardless of configuration, whenever leads of MOS devices are exposed, damage due to static-charge build-up can occur.
- g) Use conductive, grounded table tops in MOS work area.
- h) Humidity in work area should be maintained above 50%.
Static charge generation increases exponentially as relative humidity decreases.

8.11 Logic Devices

This TU4015 uses two different families of logic circuits: MOS, and TTL. Most of the logic devices used in this TU4015 are TTL and are represented by unmarked logic symbols on the schematics. Logic elements, not belonging to the TTL Logic family, are so indicated on the schematics.

Table 8.1 below lists typical voltage levels associated with each family used in this TU4015.

Table 8.1 Typical Logic Levels

Logic Family	High Level	Low Level
TTL	3 - 5V	0.2V
MOS	5 - 15V	0V

8.12 Test and Measuring access to assemblies.

The very compact design of TU4015 prevent direct access to the different assemblies during test and repair.

To verify the functions on the different assemblies it is necessary to remove, using paragraph 8.8, and test the assembly outside the tuner housing. This can be accomplished using extension cabels. RF test with modules outside the tuner is not possible.

The Controller Assy, A8, contains light emitting diodes to display the status of the relays. Be aware that some relays are controlled by positive logic, while others are controlled by negative logic. Also be aware that not all relays are manually controllable.

Extension cabels are available in Special Tool Kit 210638.

8.13 Replacement of Relays

The TU4015 uses four different types of relays. Three of the relays are reed relays and the fourth is a vacuum relay.

To select the work procedure, in order to replace a faulty or worn-out relay, find the relay find number in the schematic diagram. Then, using the find number, locate the part number in the parts list for the applicable assy. The part number is then used in the following table to find the work procedure.

Relay parts number	Paragraph
33-232496-001	8.13.1
33-235000-001	8.13.2
33-235000-002	8.13.2
33-232330-003	8.13.2
33-232330-004	8.13.2

Table 8.2

8.13.1 Replacement of relay, vacuum.

Follow the work description carefully:

- a. Unsolder and carefully disconnect the wires leading to the relay on the component side.
- b. Unsolder and carefully remove the wires between the PWB and the relay socket.
- c. Use an open-end or adjustable spanner to loosen and remove the relay nut.

When mounting a relay, use removal procedure in reverse.

8.13.2 Replacement of relay, reed 12 Amp.

The 12 Amp reed relay comes in two versions, one for two wire ends and one for one wire end and a terminal lead. To remove and replace a relay follow the work description carefully:

- a. Unsolder and carefully disconnect the wires leading to the relay. If the relay has one termination for wire and one terminal lead, then remove the solder from the terminal lead. Then using a small tool and a soldering iron, carefully apply heat and bend the terminal lead away from the termination point.
- b. Use an open-end or adjustable spanner and a screw-driver to loosen and remove the two screws and nuts holding the relay.
- c. Unsolder the two relay pins from the PCB and carefully remove the relay.

When mounting a relay, use removal procedure in the following sequence: b -c -a. In paragraph a. use a pincer to form the terminal lead around the terminal point.

8.13.3 Replacement of relay, reed 6 Amp.

Follow the work description carefully:

- a. Unsolder the connection between the solder lug from the PCB and the relay tip at both ends of the relay.
- b. With the use of a pair of tweezers and a soldering iron carefully bend the solder lug away from the relay tip at both ends.
- c. Unsolder the four relay pins from the PCB and carefully remove the relay.
- d. When mounting a relay, use removal procedure in reverse.

Table 8.4 Fatal Self Test error messages

Error code	Module	Possible faulty component(s)
Err Ad.con.	A8	The A/D converter failed
Err SYSt.1	Tx	The transmitter muting is not functioning.
	A9	The High power Detector.
Err PF.L1	Tx	The tune power is too low.
	A9	K1, K2, K3, R44 through R57, or low power detector.
Err Pr.L1	Tx	The tune power is too low.
	A9	K1, K2, K3, R44 through R57, or low power detector.
Err r.L	A9	Low power detector.
Err PF.L2	Tx	The Tx muting is not functioning.
	A9	Low power detector.
Err Pr.L2	Tx	The Tx muting is not functioning.
	A9	Low power detector.
Err SYSt.3	Tx	The Tx muting is too slow.

Table 8.5 Self Test error messages

Error code	Module	Possible faulty component(s)
Err PF.H	Tx	The tune power is low.
Err Pr.H	Tx	The tune power is too high
	A9	The input SWR for the Tx is too high. K1, K2, K3, R44 through R57
Err r.H	A9	The input SWR for the Tx is too high K1, K2, K3, R44 through R57
Err PF.H2		The Tx muting is low
Err Pr.H2		The Tx muting is low
Err SYSt.2		The SWR for the internal dummy load is too high.
	A2	R1, K3, R2, K2, R3, K1, K5
	A3	K1, K2, K3, K4
	A4	L1, K1, C25, C26, C27, C28, R1, R2, K8
	A5	C3, C4, K1, K2, L1, K15
	A6	K1, K2, K6
	A7	K1, K7, C22, C26, C27, K2, K3, K7
Err L 1	A4	L1, K1
Err L 2	A4	L2, K2
Err L 3	A4	L3, K3
Err L 4	A4	L4, K4
Err L 5	A4	L5, K5
Err L 6	A4	L6, K6
Err L 7	A4	L7, K7
Err L 9	A3	L2, K2
Err L 10	A3	L1, K1

Table 8.5 continued

Error code	Module	Possible faulty component(s)
Err C 2	A5	C4, K2
Err C 3	A5	C5, K3
Err C 4	A5	C6, K4
Err C 5	A5	C8, C12, K5
Err C 6	A5	C7, C13, K6
Err C 7	A5	C14, C60, C61, C62, K7
Err C 8	A5	C9, C65, K8
Err C 9	A5	C10, C66, K9
Err C 10	A5	C11, C67, K10
Err C 11	A5	C68, C69, K11
Err Lb 3	A6	L3, K1, K2, K5, K6
Err Lb 1	A6	L1, K1, K2, K3, K6
Err Lb 4	A7	L1, K1
Err Lb 3	A6	L3, K1, K2, K5, K6
Err Cb 1	A7	C22, K2
Err Cb 2	A7	C26, C27, K3
Err Cb 3	A7	C23, C75, K4
Err Cb 4	A7	C24, C25, K5
Err Cb 5	A7	C76, C77, K6
Err BB	A7	K7
Err cP 1	A5	L1, K15
Err cP 2	A4	C25, C26, C27, C28, R1, R2, K8
Err tP	A5	K13, K14, Q1

C

C

C

C

APPENDIX 1 ASSEMBLING OF CABLE CONNECTORS

A1. Introduction.

To ensure proper operation of the TU4015 it is important to follow the assembling instructions carefully. The assembling instructions are the instructions given by the manufactures of the connectors.

A1.1. Control Connector. DRA part no. 235055-002

A1.1.1. Assembling the Control Connector

To assemble the control plug correctly follow the Assembly instructions on page A1-2 carefully. In paragraph 1. use the dimension A for size 12-14.

A1.1.2 Final protection of control connector

For final protection of the connector against corrosion, wrap self-vulcanizing rubber around the connector. The rubber must cover the gab between the socket and the plug. It is advisable to cover all of the plug and the gap between the plug and the cable as well.

A1.2. Tx connector

The Tx connector is a special water tight type meant for cable types RG 8/U, RG 8A/U and RG 213/U.

The appropriate cable connector may be ordered from Dansk Radio Part no. 206139-001.

A1.2.1 Assembling the Tx connector

To assemble the Tx connector correctly follow the Assembly instructions on page A1-3 carefully. In paragraph 1 through 4 it is possible to use a scalpel. The trim code to use is 5402. The dimensions in the trim code chart are in inches. The dimensions in use converted to mm are as follows:

inches	3/8	5/16	0.5	3/16
mm	9.53	7.94	12.7	4.75

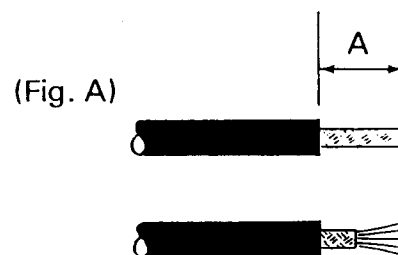
A1.2.2 Final protection of TX connector

For final protection of the connector against corrosion, wrap self-vulcanizing rubber around the connector. The rubber must cover the gab between the socket and the plug. It is advisable to cover all of the connector and the gap between the connector and the cable as well.

AB05-0029 INTERNALLY SCREENED CABLE
TYPE C

1. Strip PVC Sheath back to Dim A, this will expose the Braid which is to be trimmed to within 19.8 mm (0.75") of PVC Sheath and the remainder folded back. (See Fig. A.)

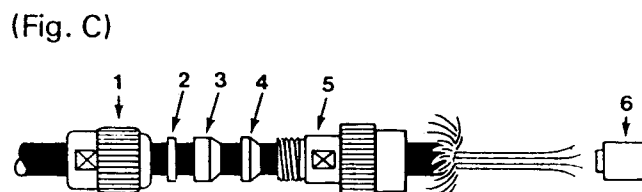
Size	Dimension A
08	34.93 (1.375)
10	36.51 (1.437)
12-14	41.27 (1.625)
16-20	44.45 (1.750)
22-24	49.21 (1.937)



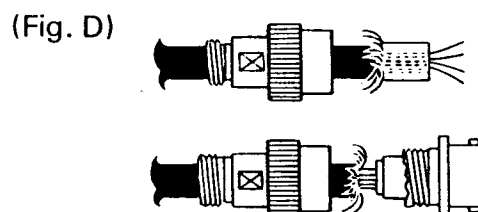
2. Strip 5.3 mm (0.210") to 6.1 mm (0.240") of insulation from each wire and Tin Ends. (Fig. B.)



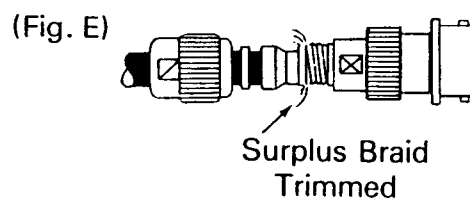
3. Slide onto the cable (1) Nut; (2) Washer; (3) Gasket; (4) Braid Clamp; (5) Clamp Body; (6) Grommet. (Fig. C.)



4. Insert individual wires into Grommet. Slide Grommet back as far as possible. Insert Tinned Ends into Contacts and solder. Slide Grommet over Contacts pushing firmly against rear of Connector Insert. (Fig. D.)

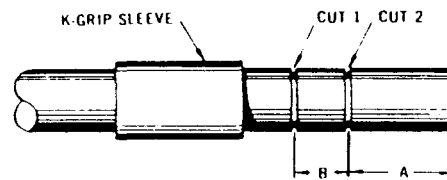


5. Screw Clamp Body onto Connector. Fold Braid at right angles to cable and slide forward Braid Clamp. Smooth down and trim surplus Braid. Slide up Gasket Washer and Screw on Nut. (Fig. E.)




CABLING PROCEDURE CP-400 (K-Grip, Jr.)


TRIM CODE CHART				
CODE	A	B	C	D
401	25/64	3/16	.468	7/64
402	13/32	3/16	.375	7/32
403	7/16	7/32	.493	5/32
411	39/64	3/16	.639	5/32
413	11/16	3/16	.717	5/32
414	29/64	7/32	.556	7/64
415	1/2	3/16	.530	5/32
416	27/64	3/16	.453	5/32
422	5/16	3/16	.375	1/8
433	11/32	3/16	.375	5/32
444	7/16	9/32	.500	7/32
446	21/64	9/32	.500	7/64
460	9/16	3/16	.541	13/64
466	37/64	7/32	.650	9/64
480	.281	.406	.500	.187
489	11/32	11/32	.500	3/16
499	29/64	11/32	.609	3/16
5402	3/8	5/16	.500	3/16
5406	13/32	9/32	.500	3/16




1. Cut cable end square. slide K-GRIP sleeve over jacket and with jacket trim jig make cuts 1 and 2 in jacket.




2. Remove jacket to dimension "A." flare or bulge back braid and trim with scissors at edge of jacket.



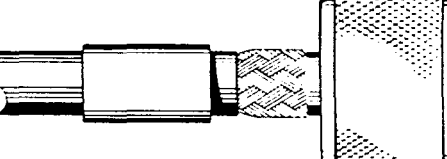
3. Remove jacket to dimension "B."



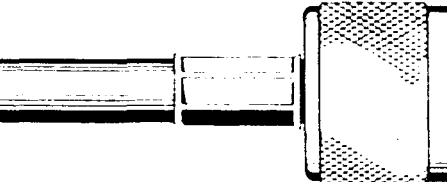
4. Using dielectric trim jig, trim dimension "C." Exposed center conductor length will be equal to dimension "D" of trim code.



5. Solder or crimp contact to center conductor.



6. Push K-GRIP, Jr. over dielectric and under braid until dielectric bottoms in connector, or, for small cable, until shoulder on center contact bottoms against contact positioning jig. When the "B" dimension in the trim code is 0, the K-GRIP, Jr. is pushed under both braid and jacket. Teflon jackets may be slit axially 1/4" in two places to facilitate entry of the K-GRIP.



7. Slide K-GRIP sleeve against shoulder on body and form hex.

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ASSY 231950, ANTENNA TUNER, Configuration
Service Sheet

The signal from the transmitter is used by the Detector Assembly A9 to measure the forward power, the reverse power, and the phase and modulus of the antenna impedance. This information is used, together with frequency information, by the Controller Assembly A8 to decide which tuning procedure and preset values to use.

The tuning elements are configured as a L-led with a lowpass characteristic.

The assemblies A1, A3, A4 and A5 forms a narrowband tuner with two possible configurations, one being the capacitive element (A5) located at the transmitter input, the other being the capacitive element located at the antenna output.

The Dummy Load Assembly A2 serves two purposes, one being a dummy load, the other being a loss introducing element during broad band tuning.

Assembly A6 and A7 are the broad band tuning elements.

The Controller Assembly A8 performs the overall control of the antenna tuner and the data transmission between TU4015 and SE4010.

Typical tasks handled by the assembly:

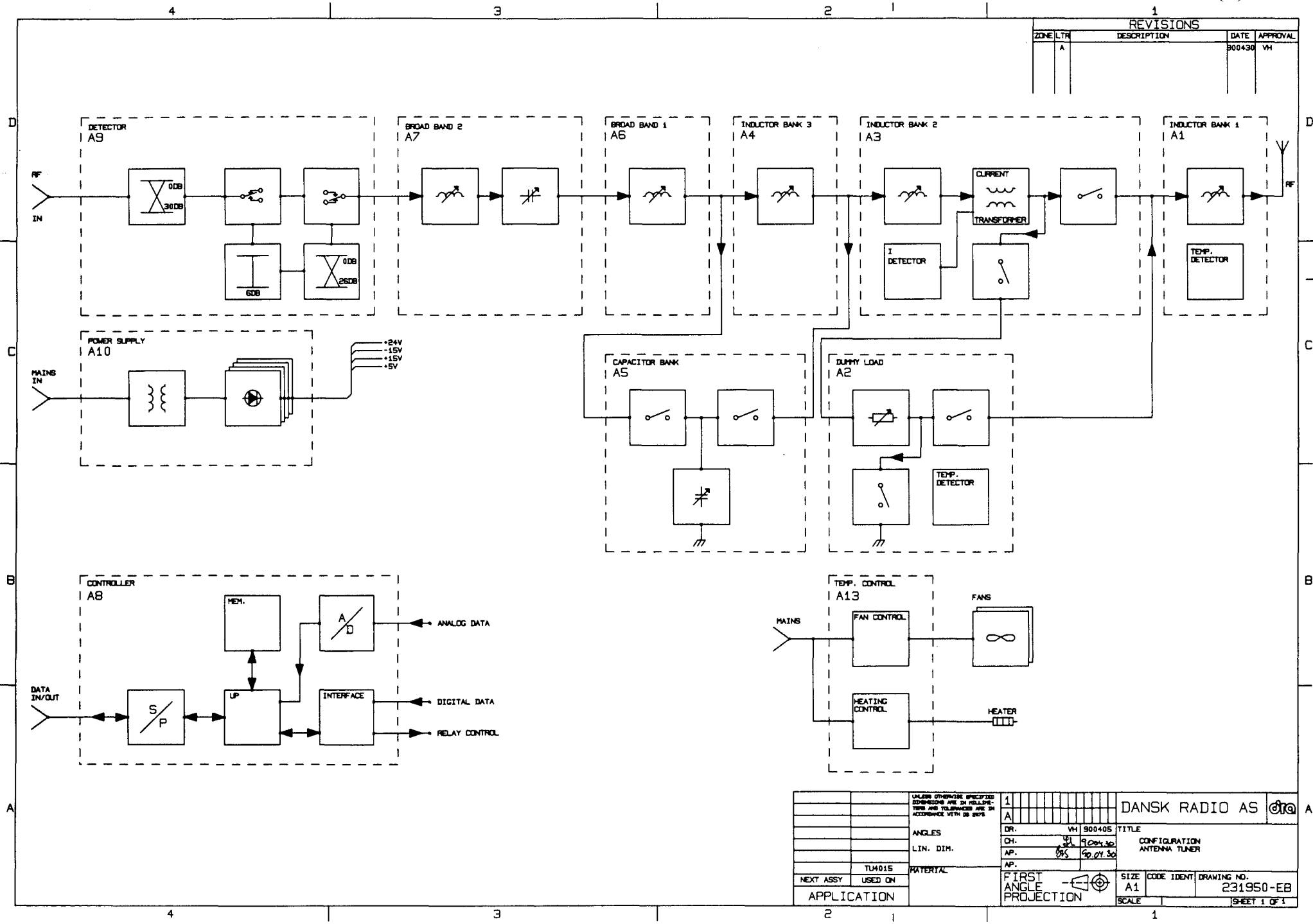
- Control of the individual assemblies.
- Calculations.
- Programmable memory set-ups.
- Data communication.
- Diagnostic routines.
- Adaptive tuning control.

Communication between the Controller Assembly and the remaining assemblies is conducted over two ribbon cables. One cable contains the relay control lines, supervisory lines and supply for all assemblies except the Detector Assembly A9.

The other cable contains supply for the Controller Assembly and the Detector Assembly A9, as well as control and data lines between the the Controller and the Detector Assembly.

The Power Supply Assembly A10 supply the four voltages used by the assemblies in the tuner. The power supply can operate both on 115 and 220 Vac, single phase. Because of noise consideration the power supply is a linear type.

The Temperature Control Assembly A13 controls the blowers used for forced air circulation, activated at approximately 35°C, and the heating elements, activated at approximately +10°C, used under low temperature conditions.



REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
	A		900430
			VH

DANSK RADIO AS		TITLE	
CONFIGURATION		ANTENNA TUNER	
DR.	VH 900405	SIZE	A1
CH.	900430	CODE IDENT	231950-EB
AP.	900430	DRAWING NO.	231950-EB
AP.		SCALE	1
FIRST ANGLE PROJECTION		SHEET 1 OF 1	



4

3

2

1

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
B1	A	9009305	900529
	B		900711
			VH/605

1	14R
2	7R
3	28R
4	N.U.
5	RS ON
6	N.U.
7	TEMP
8	GND
9	24VC
10	24VC

1	S0
2	S1
3	/Z/
4	-60B
5	CURRENT
6	GND
7	GND
8	24VC
9	+15V
10	-15V
11	+5V
12	+5V
13	+5V
14	+5V
15	+5V
16	+5V
17	+5V
18	+5V
19	+5V
20	+5V
21	+15V
22	+15V
23	+15V
24	+15V
25	-15V
26	-15V
27	-15V
28	-15V
29	-15V
30	GND
31	GND
32	GND
33	GND
34	GND
35	GND
36	GND
37	GND
38	N.U.
39	N.U.
40	N.U.

1	24VA
2	24VA
3	24VB
4	24VB
5	24VC
6	24VC
7	GND
8	1A
9	BYP. BR
10	N.U.
11	51U2
12	6U4
13	TEMP
14	12U6
15	28R
16	14R
17	7R
18	RS ON
19	25U6
20	1U5
21	3U2
22	1U6
23	1U6
24	U4
25	U2
26	U1
27	U1
28	TOP
29	TOP
30	TOP
31	TOP
32	TEMP
33	TEMP
34	TEMP
35	TEMP
36	TEMP
37	TEMP
38	TEMP
39	TEMP
40	TEMP
41	TEMP
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45	TEMP
46	TEMP
47	TEMP
48	TEMP
49	TEMP
50	TEMP

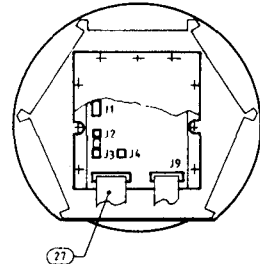
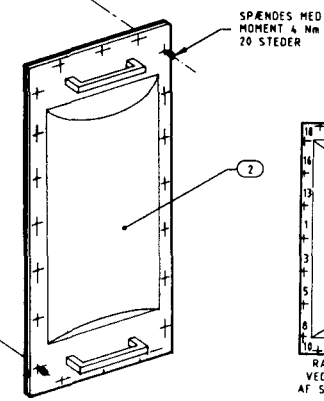
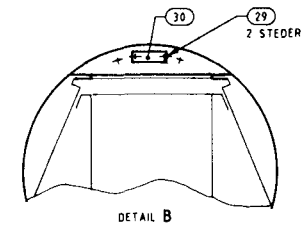
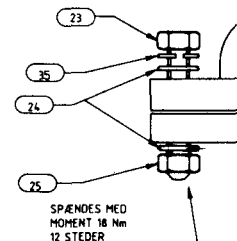
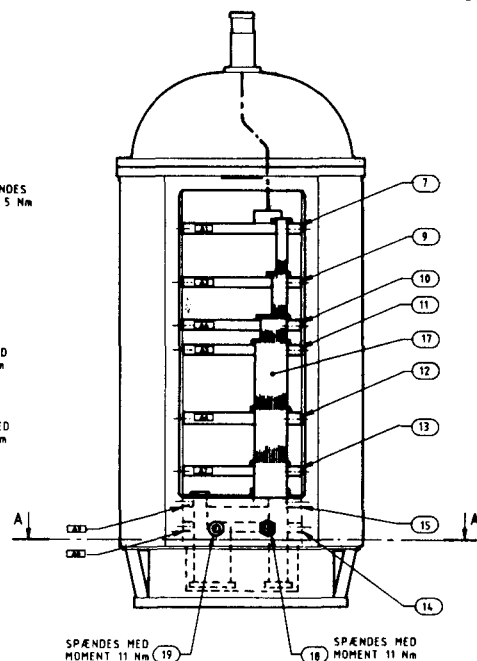
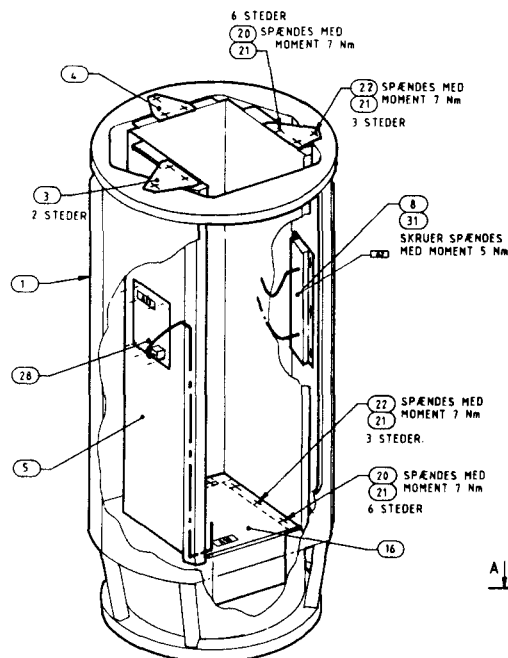
VS	TUNER	AB	A10
RS48GB	J1	J3	J1
RS48GA		10	
ATU SENSE		9	
GND		8	
OF STOP		7	
POWER ON		6	
TUNER READY		5	
MUTE		4	
MAINS1		3	
MAINS1		2	
MAINS2		1	
MAINS2			

DANSK RADIO AS		DR	
TITLE TUNER INTERCONNECTION TU4015		DATE 900529	
AP. 900531		AP. 900531	
MATERIAL TU4015		SIZE A1	
NEXT ASSY USED ON		CODE IDENT 231950-EC	
APPLICATION		DRAWING NO. 231950-EC	
FIRST ANGLE PROJECTION		SHEET 1 OF 1	



- 1 MONTER PER (1001)
 2 CIRCUIT DIAGRAM (1002)
 3 KONTROLLER OG AFPRØV PER (1003)

CHANGE ORDER/REVISION		CO	REV	CO	REV	CO	REV
CO	9702	REV	B	CO		REV	
CHKD	CM	CM	CM	CHKD	CM	CHKD	CM



SNIT A-A

TABLE 1	
ITEM NO	FARVE
.001	SMK GRÅ
.002	OLIVEN

MATERIAL: PL		GENERAL TOLERANCE —		PROJECTION ⊕		TERMA Elektronik AS FOLM 10057 HOLMSTADEN 4, DK-8620 LYSTRUP, DENMARK	
REVISION STATUS OF SHEETS (OTHER THAN 1):							
SHEET NO.:							
REVISION:							
CODE: 1 SHEETS INITIAL RELEASE: 900314							
DATE OF THIS ISSUE: 900831							
REV: B							
DOCUMENT NO. 231950 PD							
SHEET NO. 1							

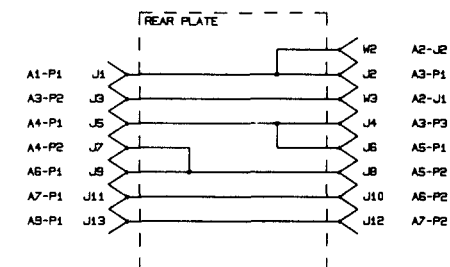
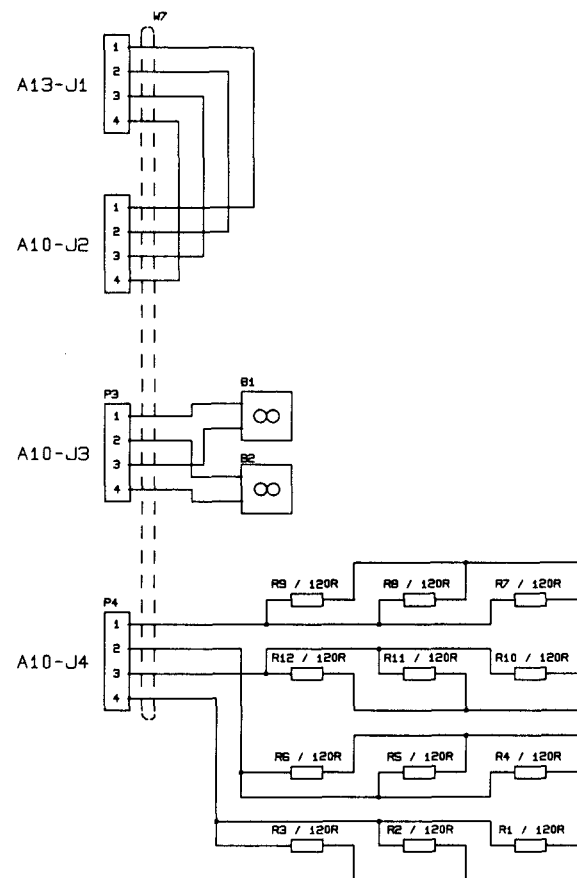
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REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
	A		900529
			VH



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS AND TOLERANCES ARE IN ACCORDANCE WITH BS 8878		1	DANSK RADIO AS		
ANGLES		A	TITLE		
LIN. DIM.		DR. VH 900418	RACK ASSY		
MATERIAL		CH. 47 900529	SIZE A1		CODE IDENT
NEXT ASSY USED ON		AP. 185 900530	DRAWING NO. 210450-EC		
APPLICATION		FIRST ANGLE PROJECTION	SCALE		SHEET 1 OF 1



ASSY 210452, INDUCTOR BANK 1

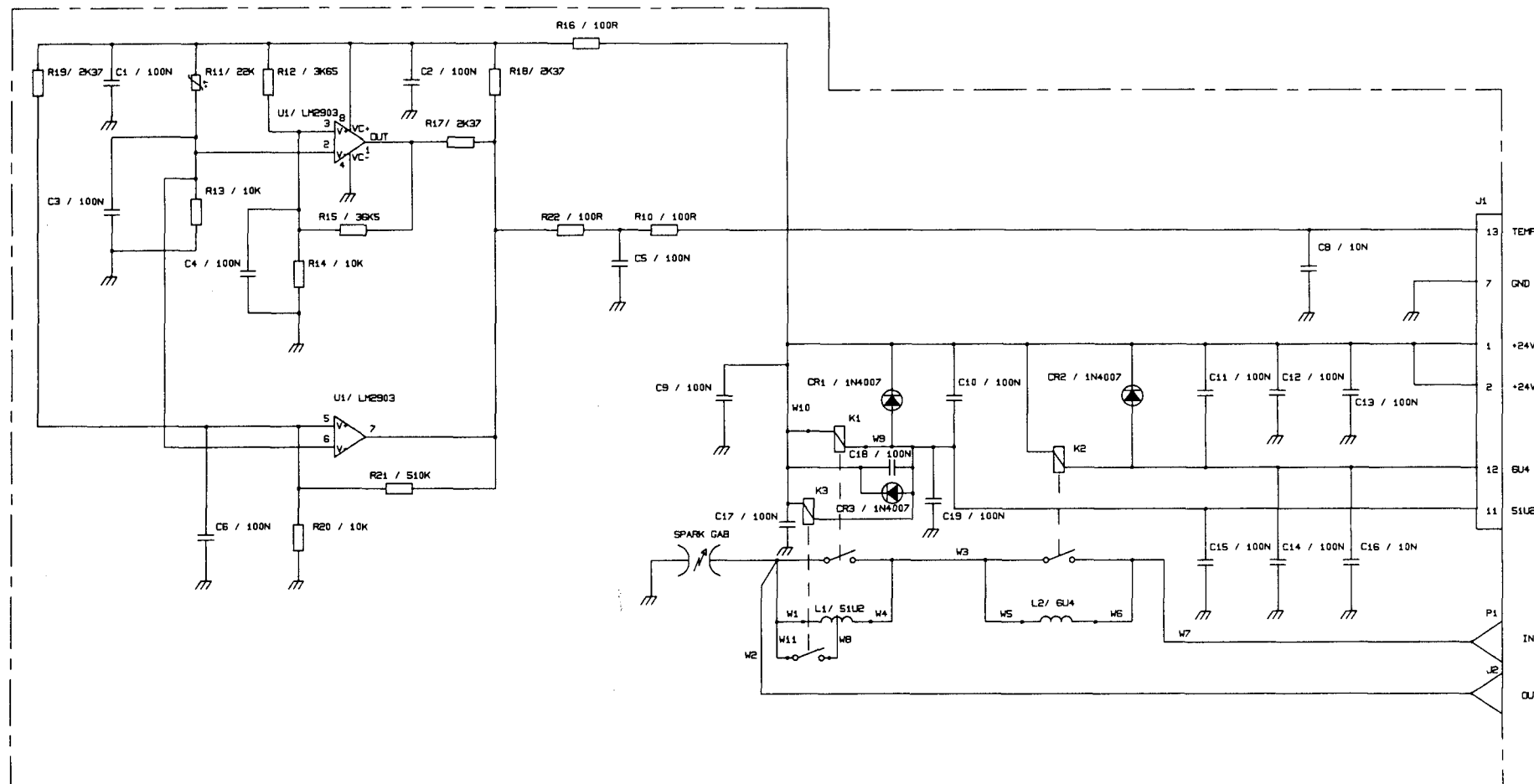
Service Sheet A1


The two inductors in Inductor Bank 1 are activated by a high level on the control input on J1.

To protect the tuner from high voltages a spark gap is located close to the antenna outlet.

A dual temperature measuring circuit, supervised by the controller, are located on the Inductor Bank 1. Both measuring devices are formed as comparators. One of the temperature measuring circuits, U1a, has an attack temperature of 70°C and hysteresis of 10°C. The output is connected with the output from the second temperature measuring device, U1b, through a resistor R17. The second temperature measuring device has an attack level of 80°C.

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
A	B	AED9140	800408
			800523
			VH
			VH



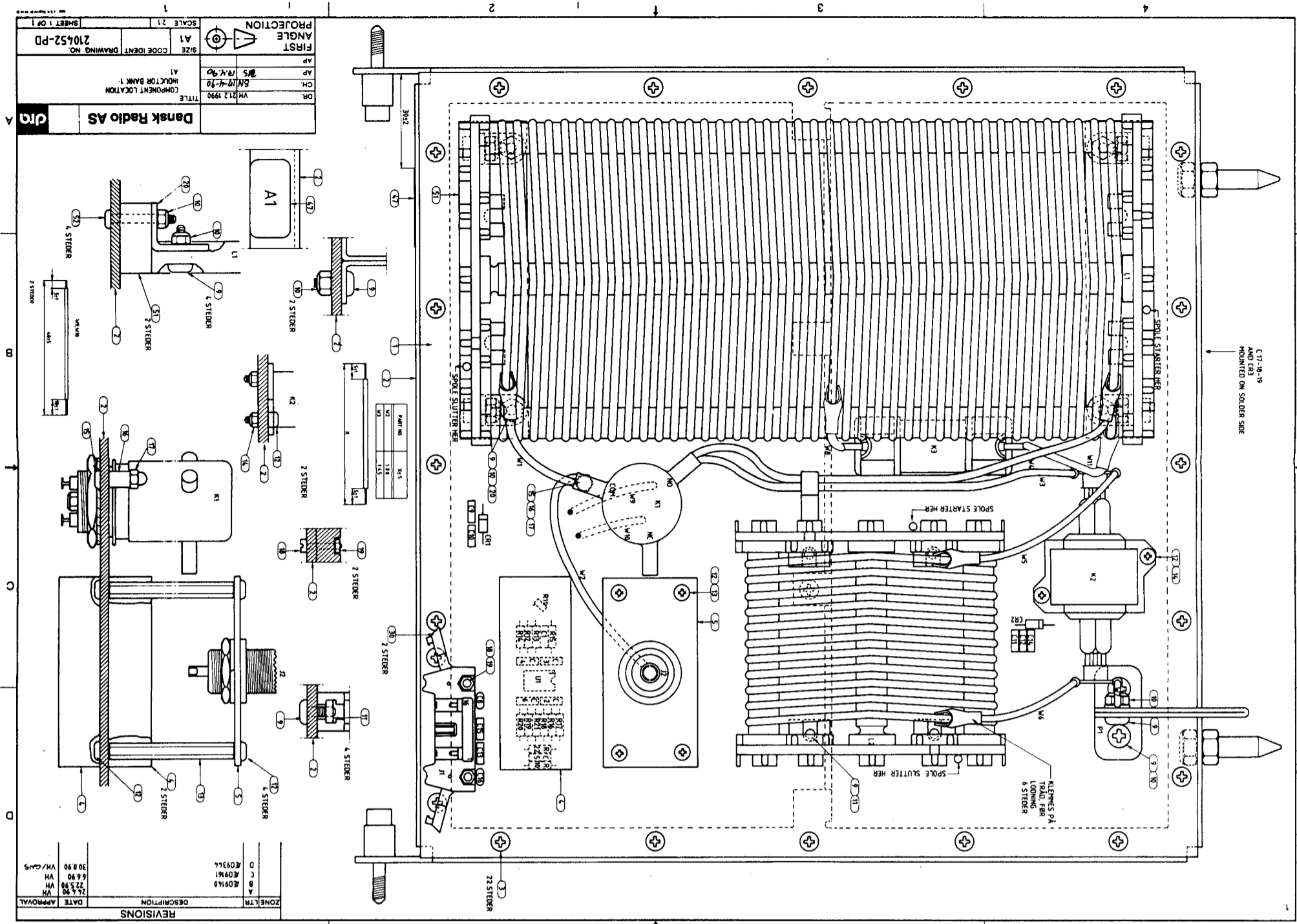
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH IS 8079		1		DANSK RADIO AS			
				B					
		ANGLES		DR.		VH 12.1.90		TITLE	
				CH.		12.1.90		INDUCTOR BANK 1	
		LIN. DIM.		AP.		12.1.90		TU4015 A1	
				AP.					
TU4015		MATERIAL		FIRST ANGLE PROJECTION		SIZE A1		CODE IDENT DRAWING NO.	
NEXT ASSY USED ON								210452-EC	
APPLICATION						SCALE		SHEET 1 OF 1	

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ASSY 210453, DUMMY LOAD

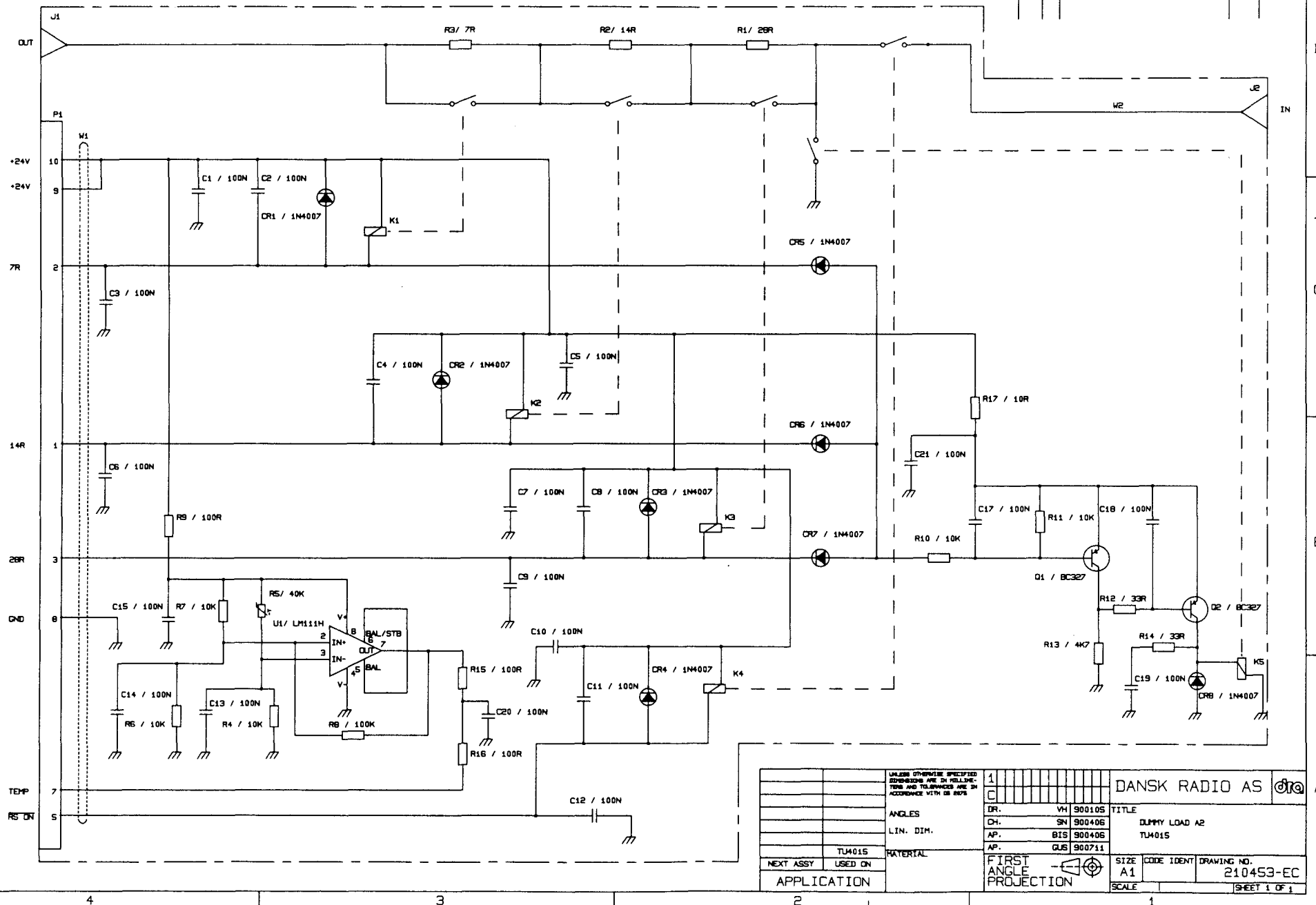
Service Sheet A2

The Dummy Load consists of three resistors in series giving a combined value of 49 ohms.

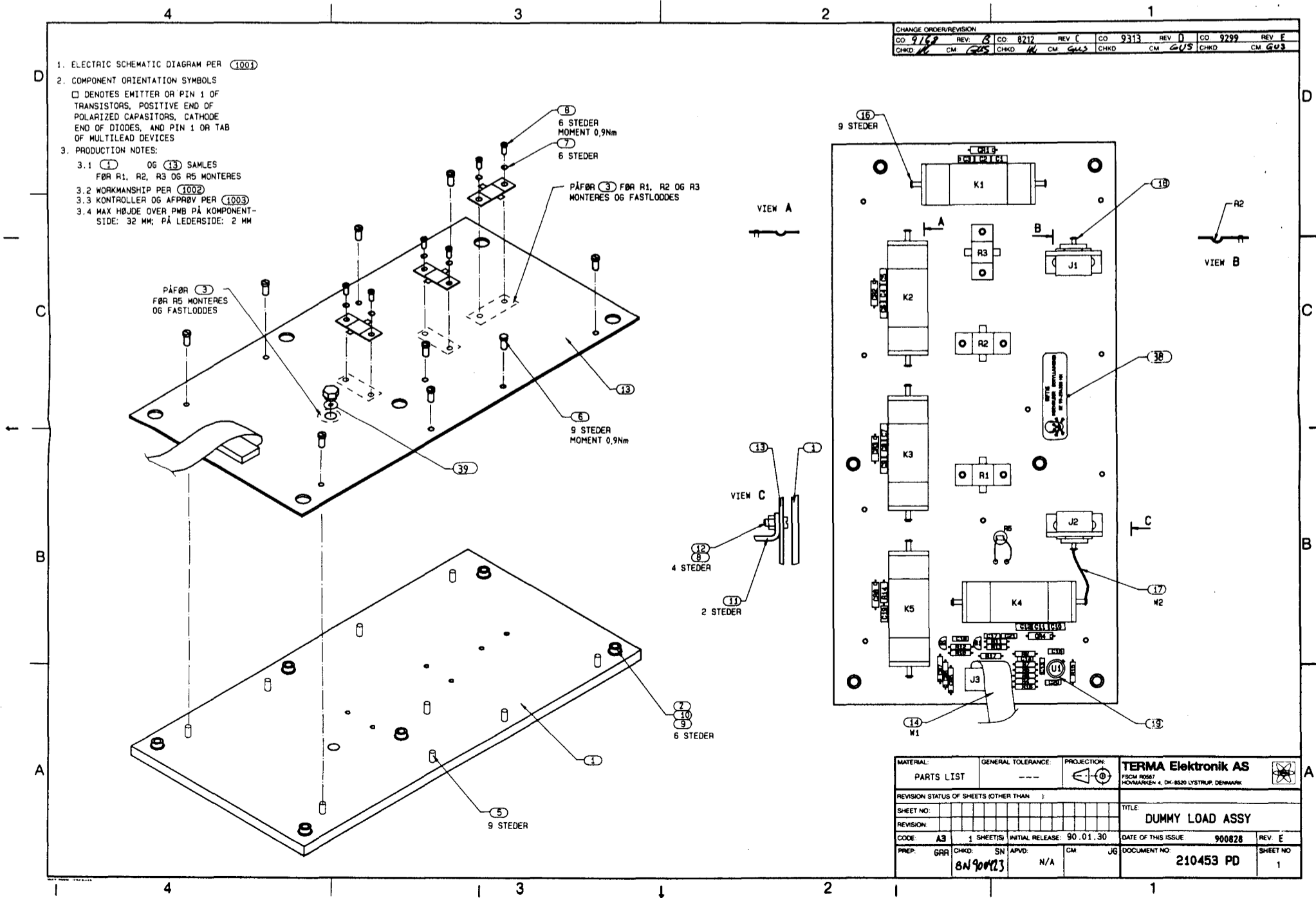
When the control lines 7R, 14R and 28R are high the relay K5 is automatically energized and the series combination of the three resistors are grounded forming a dummy load of 49 ohms.

When the control line RS ON is activated, thereby energizing K4, the resistors are used to lower the Q of the antenna during broadband operation. During the broadband tuning, a maximum of two resistors are available to avoid the relay K5 energizing.

The Dummy Load is temperature protected by a temperature measuring device R5. The circuit around U1 forms a comparator supervised by the Controller. The attack level of the protection is a temperature of 100°C and a release temperature of approximately 80°C.







ASSY 210454, INDUCTOR BANK 2

Service Sheet A3

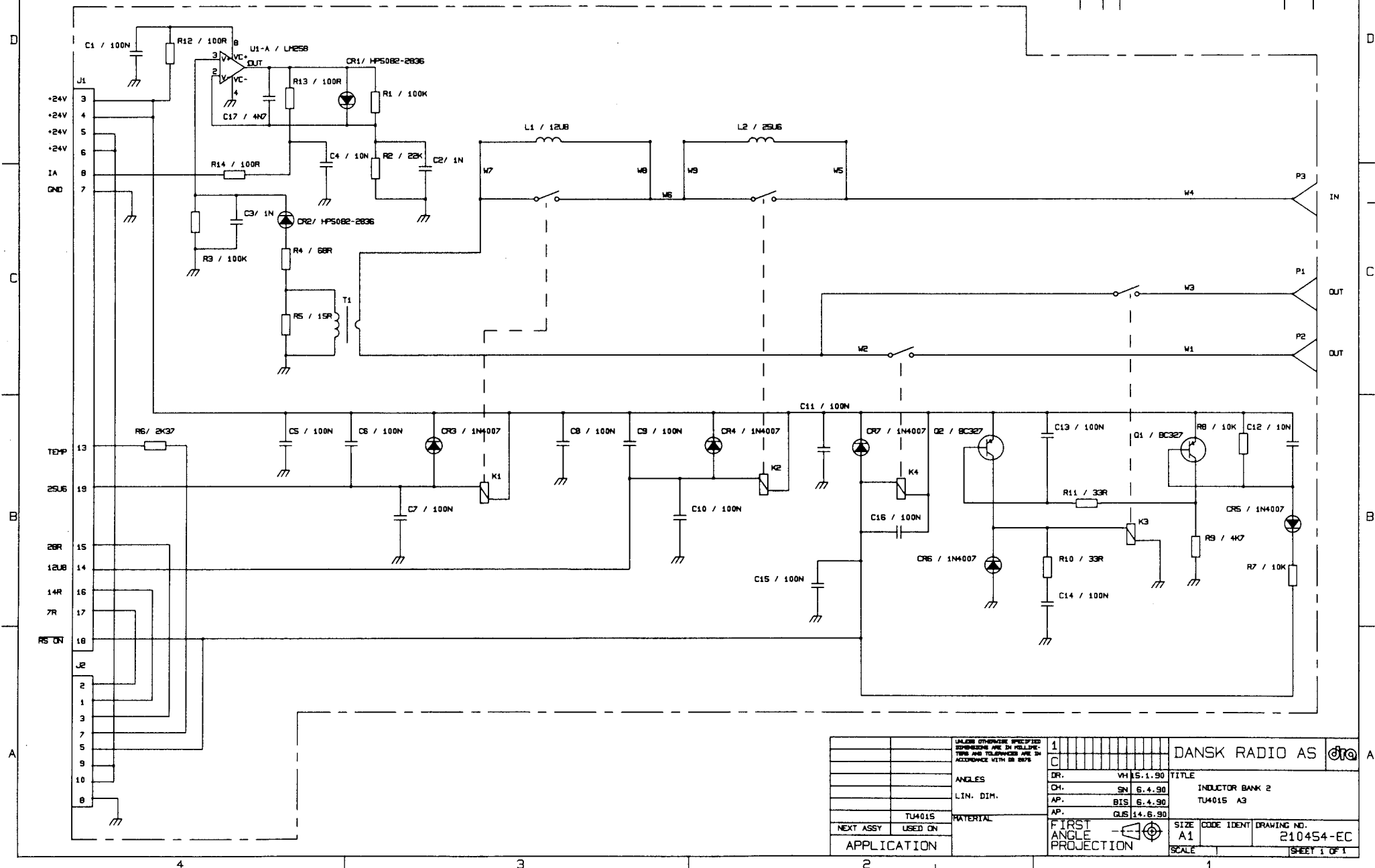
The Inductor Bank 2 consists of two inductors and a current transformer. The inductors are controlled by K1 and K2, the inductors are active when a high level is present at the control input on J1.

The current transformer, T1, is used to measure the current in the inductors and thereby the antenna current. The current in the transformer is converted to a voltage by R5 and the rectified (by CR2) voltage is buffed by U1 giving an output voltage of +10 Vdc approx. with a RF-current of 14 A-rms.

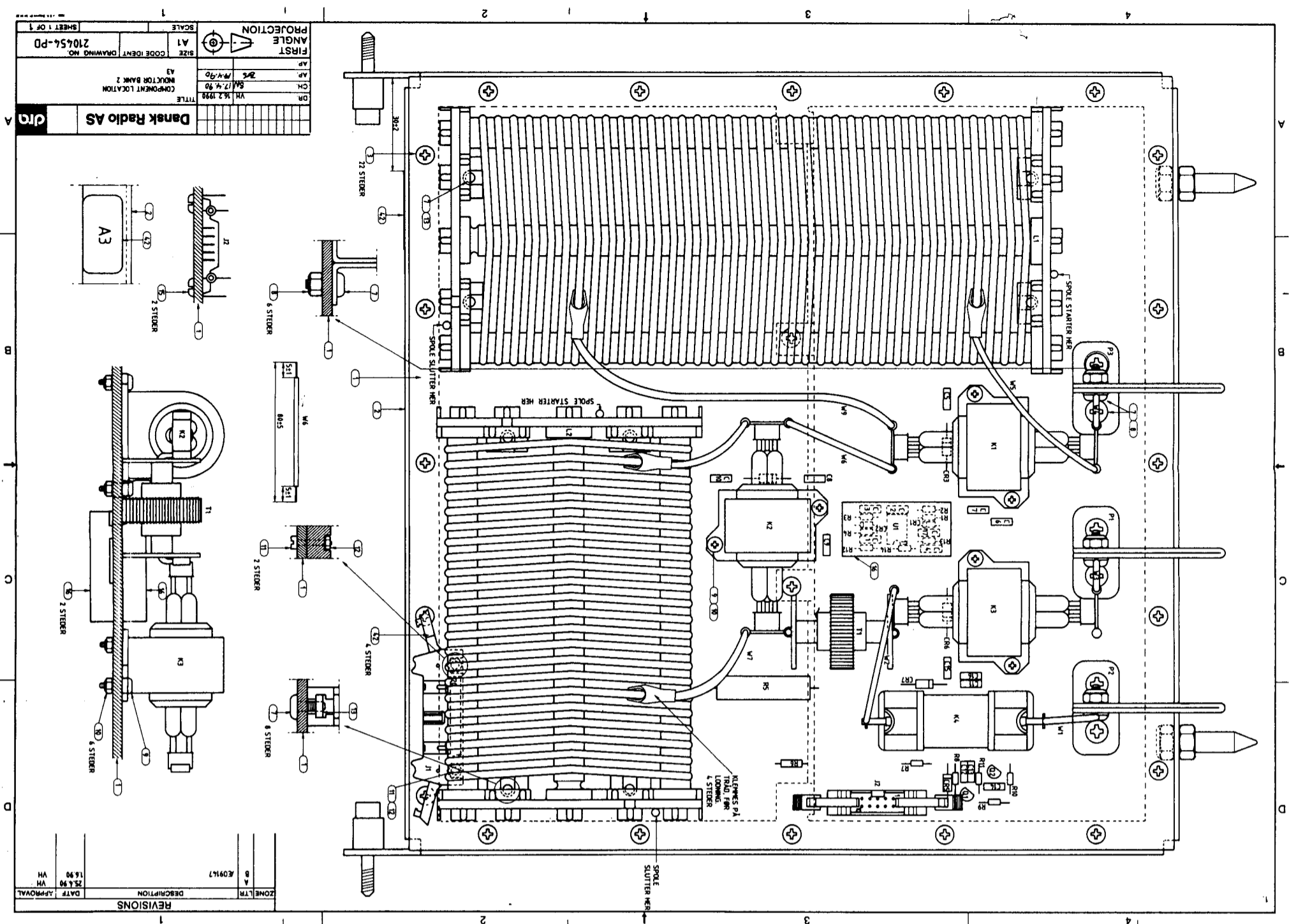
The Inductor bank has two outputs, one for interconnection to Inductor Bank 1 (through K3) and one for interconnection to the Dummy Load (through K4). The energizing of K3 is done with a high level on the control terminal RS ON. A low level on the control terminal energizes K4 and turn on Q1 thereby turning off Q2, de-energizing K3.

The control signals for the Dummy Load A2 are routed through the Inductor Bank 2.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	/E08175	900406	VH
	B	/E08325	900614	VH/ QUS
	C		900815	VH/ QW3







ASSY 210455, INDUCTOR BANK 3

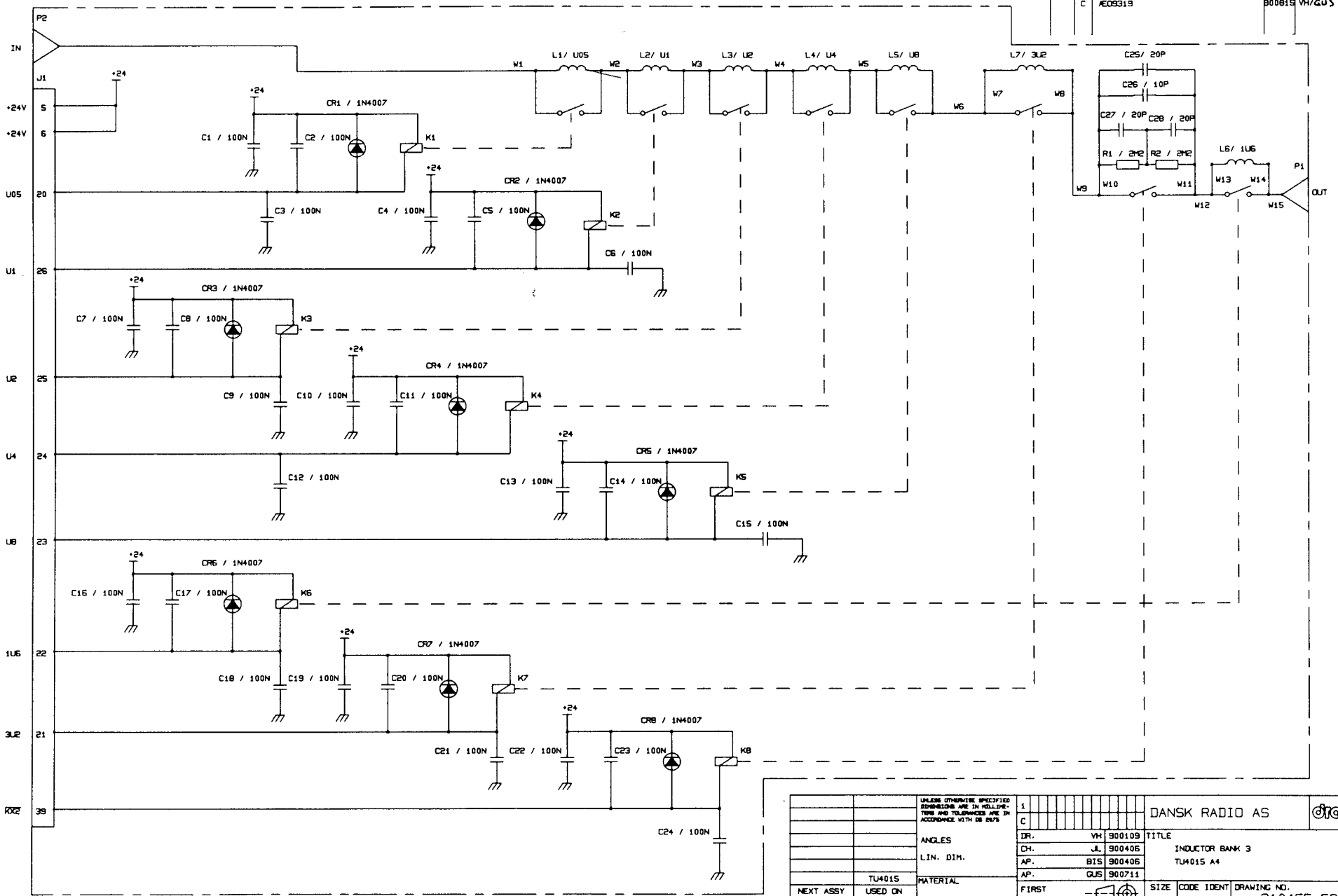
Service Sheet A4

The Inductor Bank 3 consists of seven inductors and one capacitor (formed by 3 capacitors in parallel, namely C25-26-27). The inductors are controlled by the relays K1 through K7, while the capacitor (used for compensation of residual induction) are controlled by K8.

Both the inductors and the capacitor are active when a high level is present on the control pins on J1.

Parallel to the capacitors, C25-C26-C27, two resistors are located. These resistors are used as DC-pass for the static discharge of the tuner.

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE APPROVAL
A		AE09303	900406 VH
B		AE09319	900711 VH/GUS
C			900815 VH/GUS



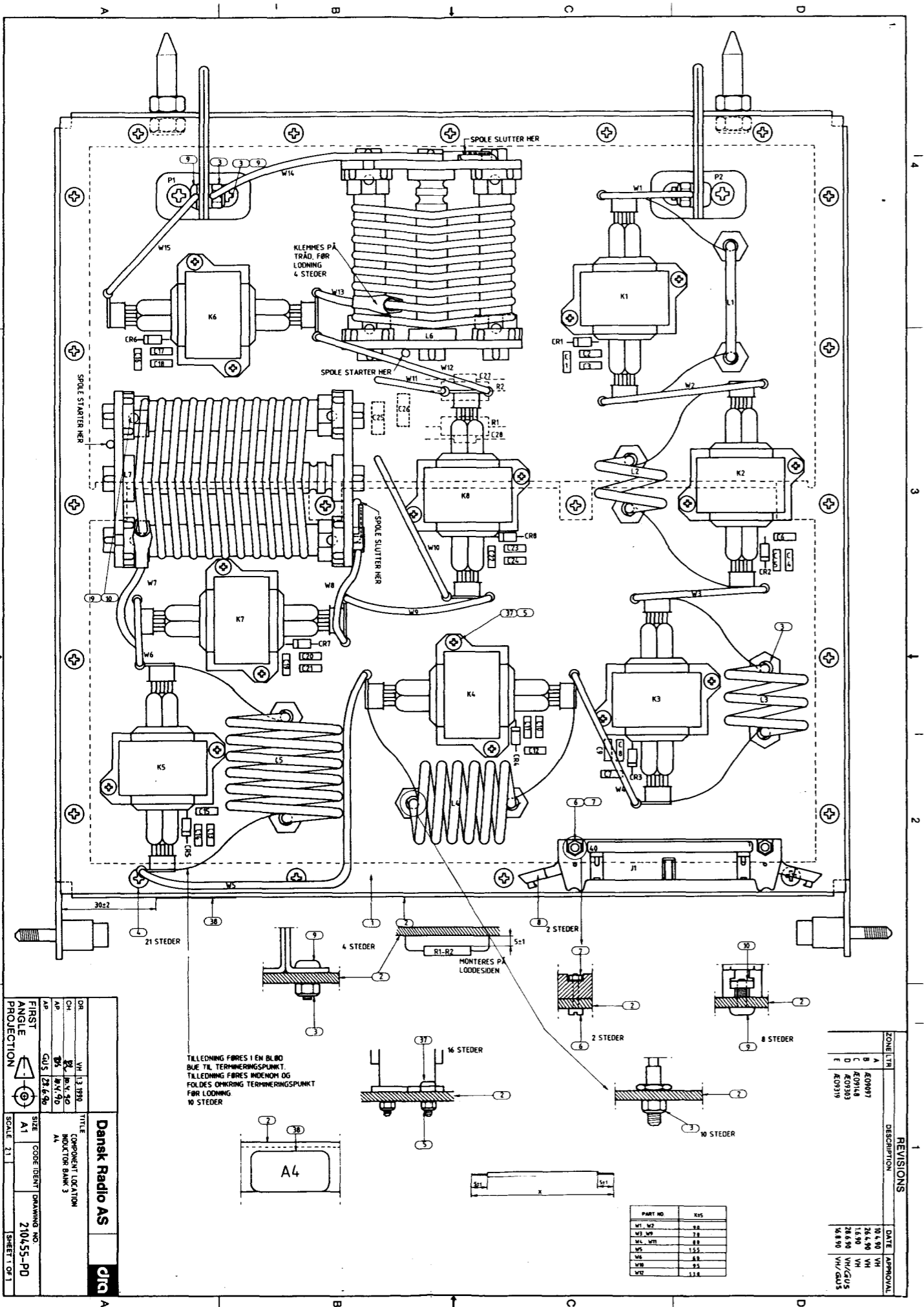
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH BS 8875		1		DANSK RADIO AS		dra	
ANGLES		DR. VH 900109		TITLE			
LIN. DIM.		CH. JL 900406		INDUCTOR BANK 3			
TU4015		AP. B15 900406		TU4015 A4			
NEXT ASSY		AP. GUS 900711		SIZE		CODE IDENT	
USED ON		MATERIAL		DRAWING NO.		210455-EC	
APPLICATION		FIRST ANGLE PROJECTION		SCALE		SHEET 1 OF 1	

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DR

CH

AP

GP

W1 3 398

R1, R2 4 50

W3 4 50

W4 50

CR1 23 6.50

SIZE

SCALE

A1

2:1

Dansk Radio AS

JIC

TITLE

COMPONENT LOCATION

ACTOR BANK 3

CODE IDENT

DRAWING NO

SHEET 1 OF 1

FIRST ANGLE PROJECTION

210455-PD

REVISIONS	
ZONE / TH	DESCRIPTION
A	420987
B	4209148
C	4209148
D	4209148
E	4209148
F	4209148
DATE / APPROVAL	
10.4.90	VAH
15.9.90	VAH
15.9.90	VAH/CAUS
15.9.90	VAH/CAUS

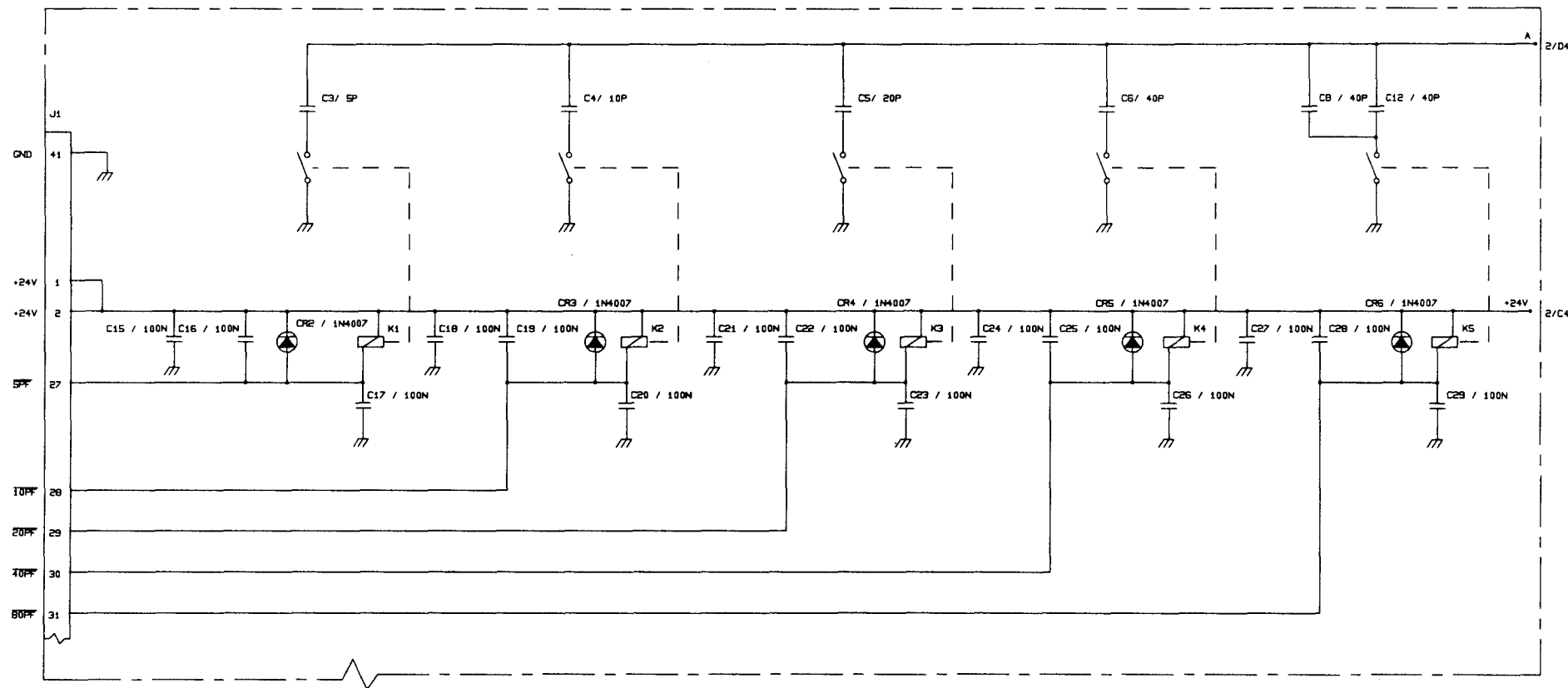
ASSY 210456, CAPACITOR BANK

Service Sheet A5

The capacitor bank consists of 22 high power capacitors forming binary weighted sequences of 11 bits (the highest value consists of two capacitors, C13-C14, in parallel) with a minimum resolution of 5 pF.

The capacitors are controlled through the relays K1 through K12, each relay is energized by a low level on the control pin on J1.

REVISIONS			
ZONE	LTN	DESCRIPTION	DATE
S.2	A	AE09342	800406
	B		800815
			APPROVAL
			VH
			VH/GUS



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH IS 2875		1/2		DANSK RADIO AS		DRG	
ANGLES		DR. VH 900110		TITLE			
LIN. DIM.		CH. JHL 900406		CAPACITOR BANK			
		AP. BIS 900406		TU4015 AS			
		AP. GUS 900815					
MATERIAL		FIRST ANGLE PROJECTION		SIZE A1		DRAWING NO. 210456-EC	
NEXT ASSY USED ON				SCALE		SHEET 1 OF 2	
APPLICATION							

The inductor, L1, is used to compensate for the stray capacitance in the circuit.

The Capacitor Bank has two outputs, each output defining the configuration of the tuner.

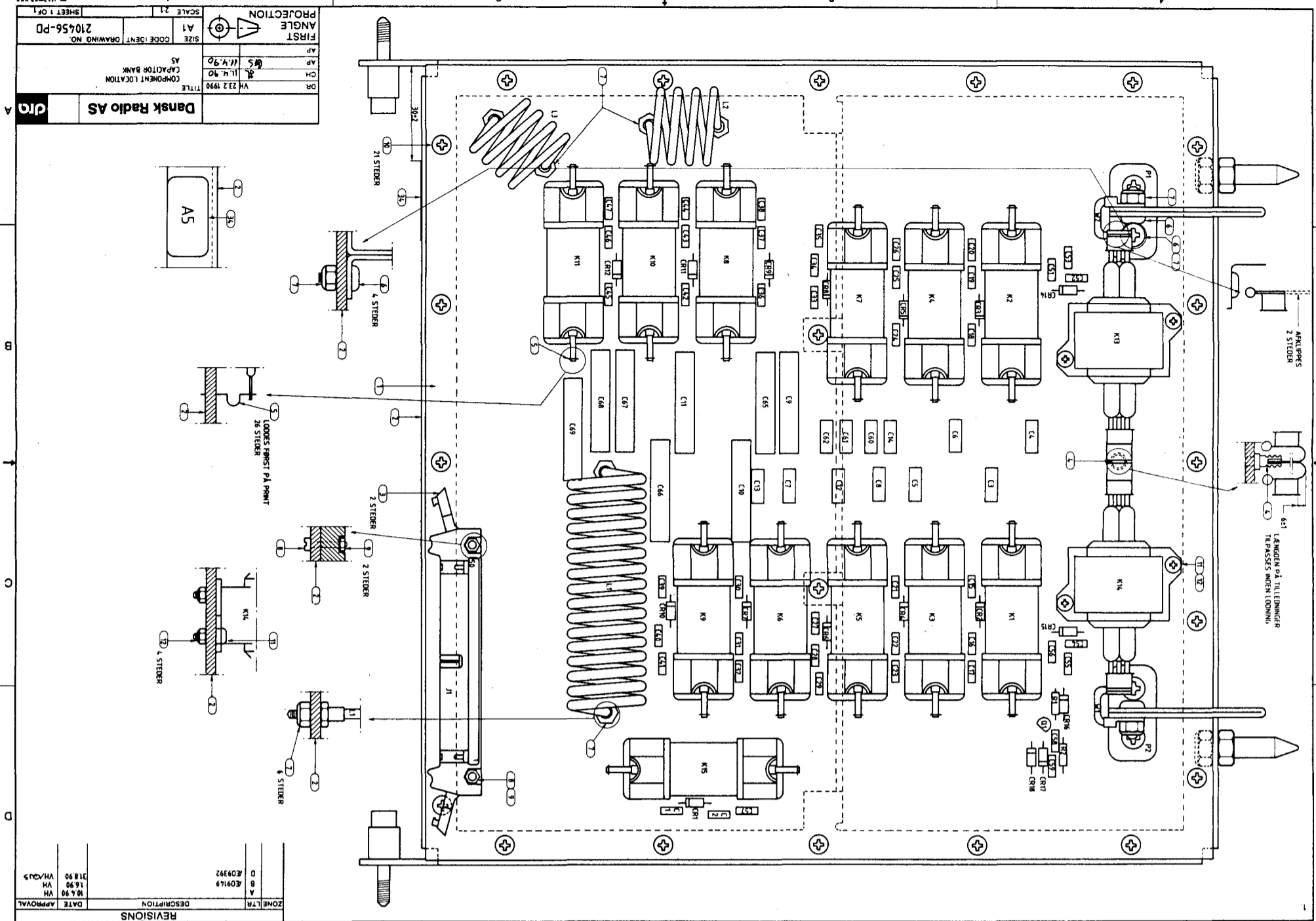
When the Tuner is in the Type 1 mode the output from the capacitor is P2 through K14. When the Tuner is in the Type 2 mode, Q1 is cut off and thereby de-energizing K14, while the output is P1 through K13.

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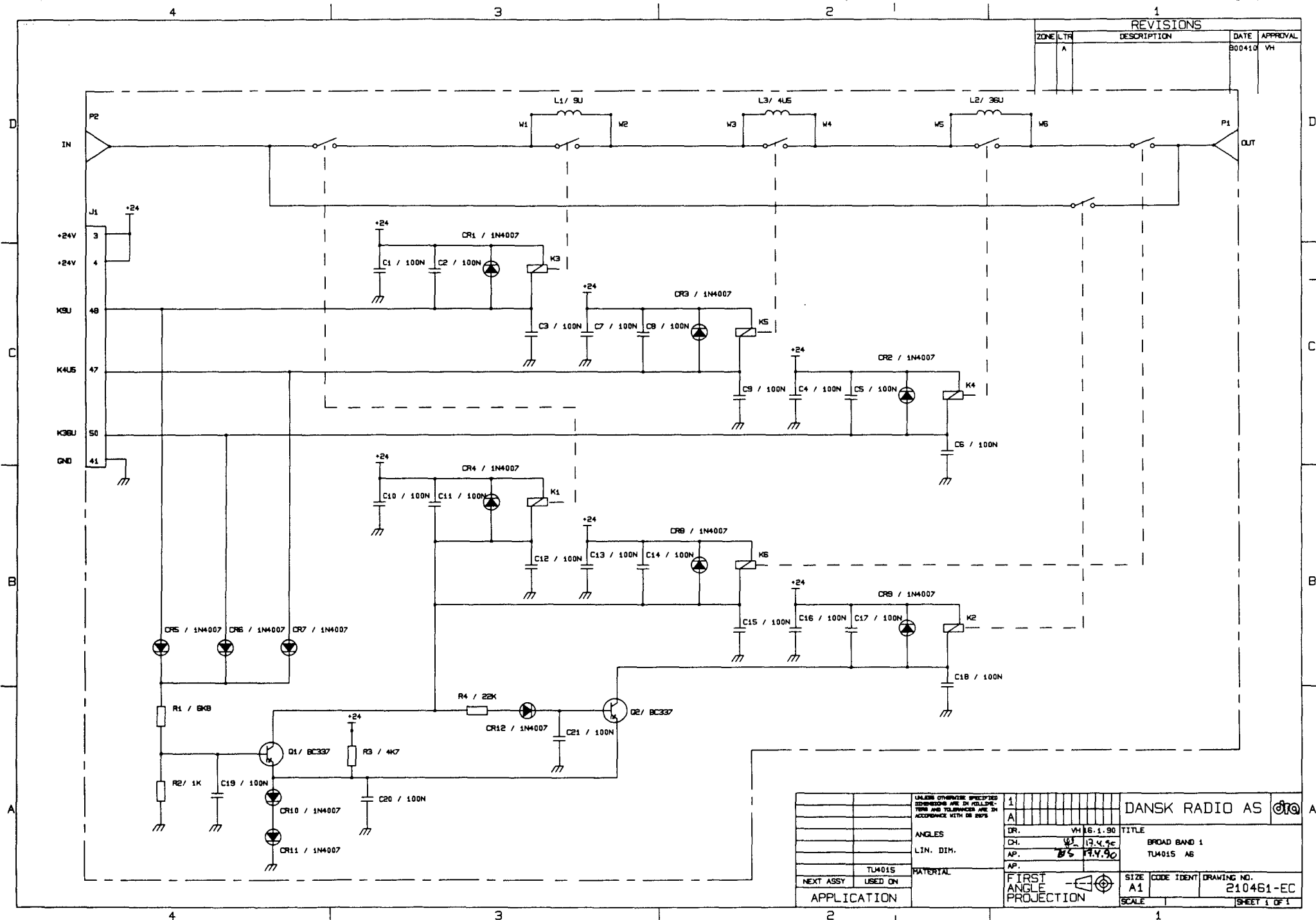


ASSY 210461, BROADBAND 1

Service Sheet A6

The three inductors (L1-L2-L3) are controlled through the relays K3-K4-K5. The inductors are active when a high level is present at one of the control inputs on J1.

To ensure a low residual inductance when none of the inductors are active three more relays are used, one for bypassing and two for disconnection. When no inductors are active relay K2 is active through Q2, thereby bypassing the inductors. If one or more of the inductors are activated the collector of Q1 goes low thereby energizing K1 and K6 and turning off Q2 and thereby de-energizing K2.



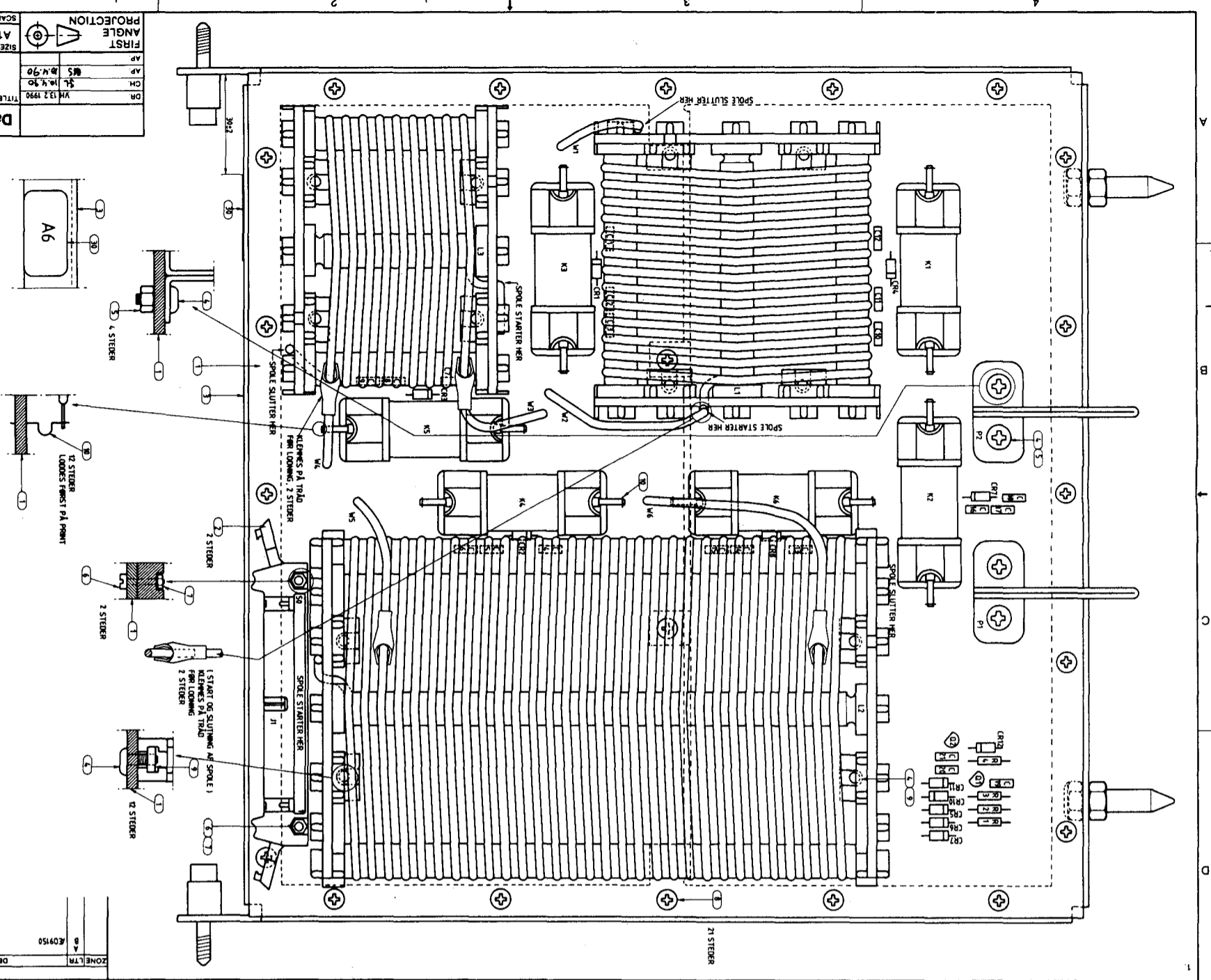
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE IN ACCORDANCE WITH BS 889		1	DANSK RADIO AS		dra	A
ANGLES		LIN. DIM.		DR.	VH 16.1.90		TITLE	
TUM015		MATERIAL		CH.	13.4.90		BROAD BAND 1	
NEXT ASSY		USED ON		AP.	15.4.90		TUM015 AS	
APPLICATION		FIRST ANGLE PROJECTION		AP.				
				SIZE	A1		CODE IDENT	
				SCALE			DRAWING NO.	
							210461-EC	
							SHEET 1 OF 1	

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ASSY 210462, BROADBAND 2

Service Sheet A7

The inductor (L1) and the capacitors (C22 through C27) are controlled by the relays K1 through K6.

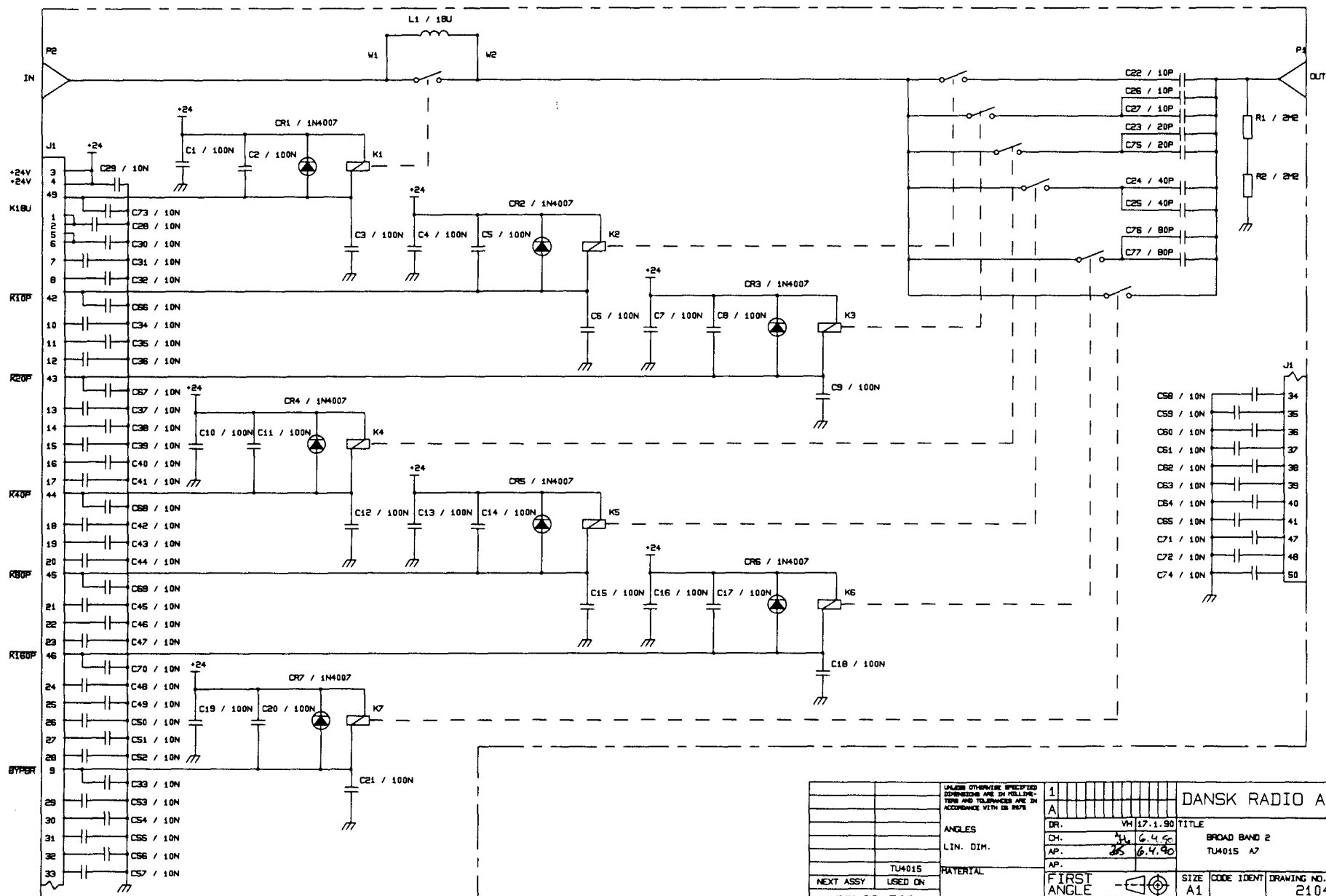
K7 is used to bypass the capacitors.

The inductor is active when a high level is present at the control pin while the rest of the functions are active when a low level is present.

All capacitors with a value of 10 nF are used to decouple the control lines before entering the Controller.

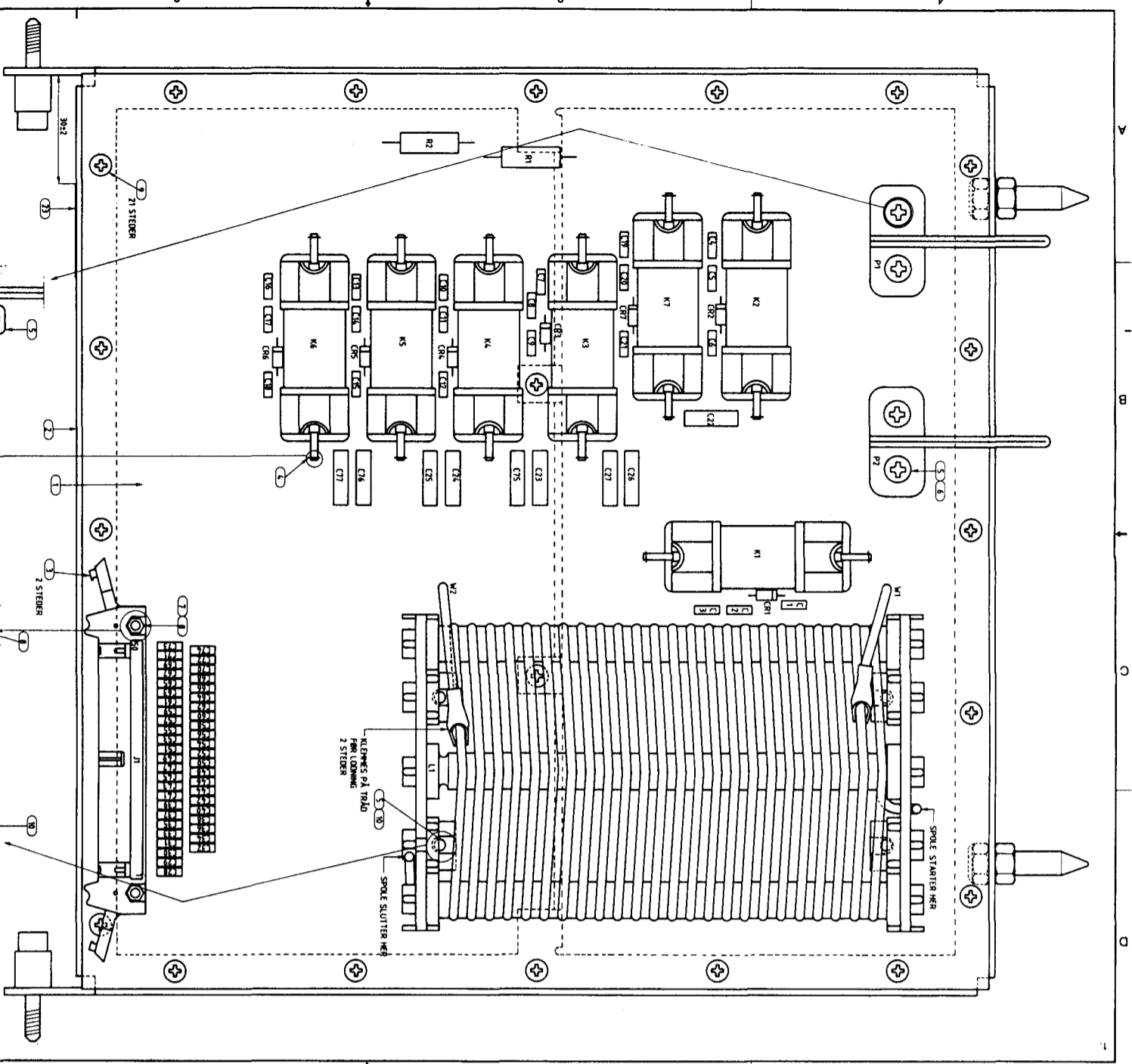
The two resistors, R1-R2, function as static discharge for the tuner.

REVISIONS			
ZONE	LT	DESCRIPTION	DATE
A			900406
			VH



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH GB 2876		1	DANSK RADIO AS		dra
DR.	VH 17.1.90	TITLE			
CH.	6.4.90	BROAD BAND 2			
AP.	25	TU4015 A7			
AP.					
NEXT ASSY		TU4015	FIRST ANGLE PROJECTION		SIZE A1
USED ON			CODE IDENT		DRAWING NO.
APPLICATION			SCALE		210462-EC
					SHEET 1 OF 1







ASSY 210457, CONTROLLER ASSY
Service Sheet A8

210421, CONTROLLER
Service Sheet A8A1

Assy 210457, Controller Assembly

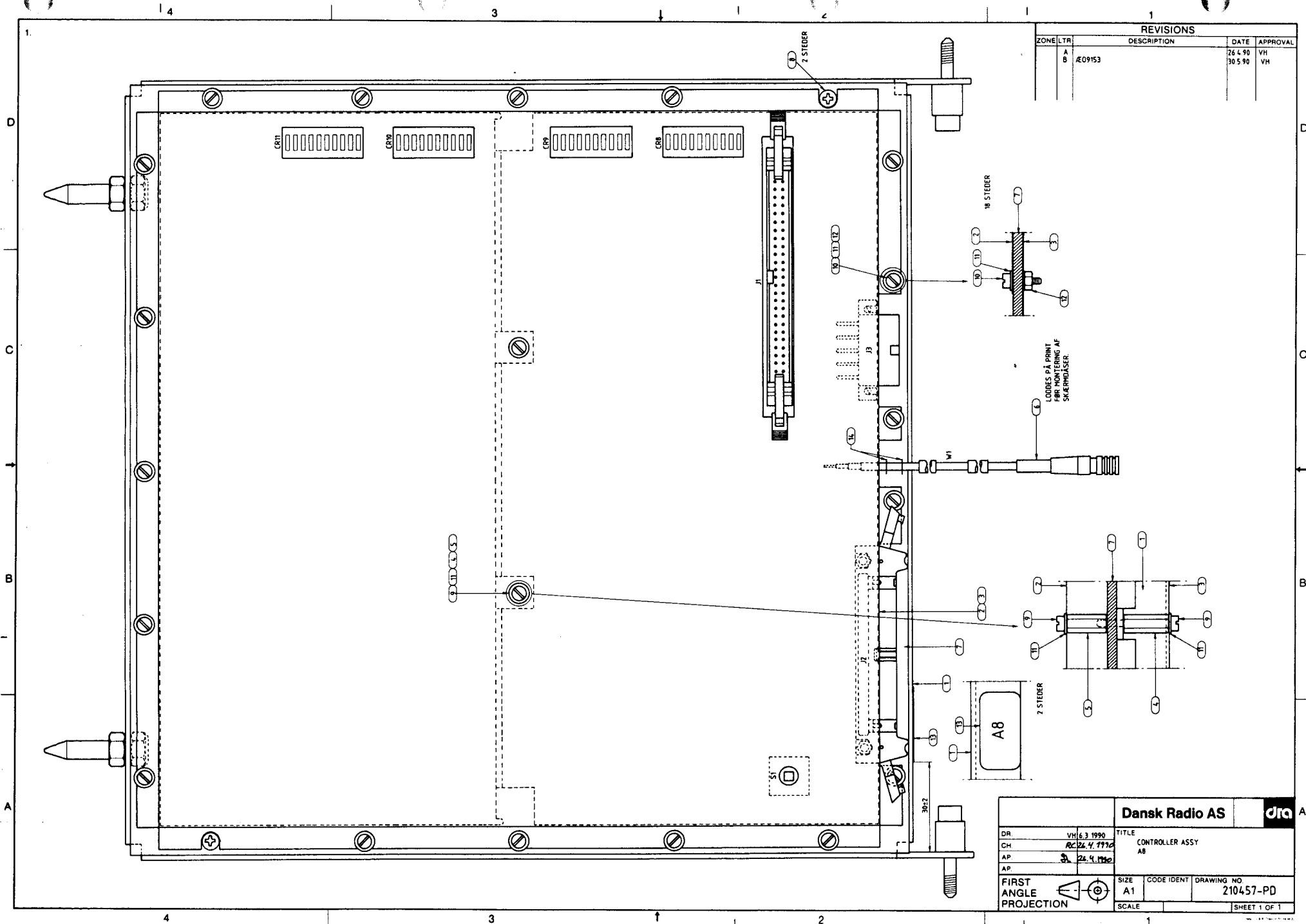
The light-bars CR8 through CR11 indicate the logical level on the lines controlling the relays of the tuner.

Each of the led's has an alphabetic index from A through J. Index A for each of the light-bars denotes the led which is nearest to the connector J1.

A light in a led corresponds to a logical low level on the corresponding control line.

The tabel below defines the led's.

led	control line	led	control line
CR11-J	<u>KX1</u>	CR9-J	<u>KX2</u>
I	K36u	I	u4
H	K18u	H	u2
G	K9u	G	u1
F	<u>K4u5</u>	F	<u>u05</u>
E	<u>K160p</u>	E	<u>RS0N</u>
D	<u>K80p</u>	D	R3 (7R)
C	<u>K40p</u>	C	R2 (14R)
B	<u>K20p</u>	B	<u>R1 (28R)</u>
A	K10p	A	<u>5120p</u>
CR10-J	<u>BYPBR</u>	CR8-J	<u>2560p</u>
I	<u>-6 dB</u>	I	<u>1280p</u>
H	<u>KX2</u>	H	<u>640p</u>
G	<u>TYPE2</u>	G	<u>320p</u>
F	51u2	F	<u>160p</u>
E	25u6	E	<u>80p</u>
D	12u8	D	<u>40p</u>
C	6u4	C	<u>20p</u>
B	3u2	B	<u>10p</u>
A	1u6	A	<u>5p</u>



1. Watch-dog circuit

Generate a reset pulse on power up/down. The software triggers the watch-dog circuit every 100 ms. If no trigger pulse is received the watch-dog generates a reset pulse. When the microprocessor is in halt mode the trigger pulse comes from U10-D.

2. Microprocessor

U1: 8085 microprocessor with 6.144 MHz crystal.

U8: Multiplexing of address lines AB0 - AB7.

U13: Multiplexing of data lines DB0 - DB7

3. EPROM Memory

EPROM memory in the address range: 0000H - 0BFFFH. (Only half of the memory is used in U3)

4. RAM Memory

RAM memory in the address range: 0C000H - 0DFFFH.

5. EEPROM Memory

EEPROM memory in the address range: 0E000H - 0FFFFH.

6. Address Decoding for Memory7. Address Decoding for input/output ports8. Timer

The Timer counts the CLK pulses from the microprocessor. The Output from the timer gives a RST 7.5 interrupt to the microprocessor every 1 ms.

9. 8-bit digital output latch10. ATU SENSE

The "ATU SENSE" is grounded through R13 if the +5V supply is off or if the microprocessor is reset. When +5v power is on, the "ATU SENSE" is connected to +5V by Q5.

11. Output Driver12. 8-bit digital input latch


U15: 8-bit digital input latch.

U18 converts the logical level from 0/15V to 0/5V.

U17A Stops the clock to the USART when "up stop" is active.

Page 10



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH BS 8826		1234 BAAA		DANCE RADIO AS		DR	
		ANGLES		DR. GS 991117		TITLE			
		LIN. DIM.		CH. RC 900426		CONTROLLER ABA1			
210457		TU4015		AP. JHL 900426		TU4015			
		MATERIAL		AP. JLS 900710					
NEXT ASSY		USED ON		FIRST ANGLE PROJECTION				SIZE A1 CODE IDENT DRAWING NO. 210421-EC	
APPLICATION						SCALE		SHEET 1 OF 4	

13. 8-bit address decoding for the relay drivers

14. Relay Drivers

40 latched relay drivers. The led lights when the relay driver is active.

	A	RELEASED	000729	65
--	---	----------	--------	----



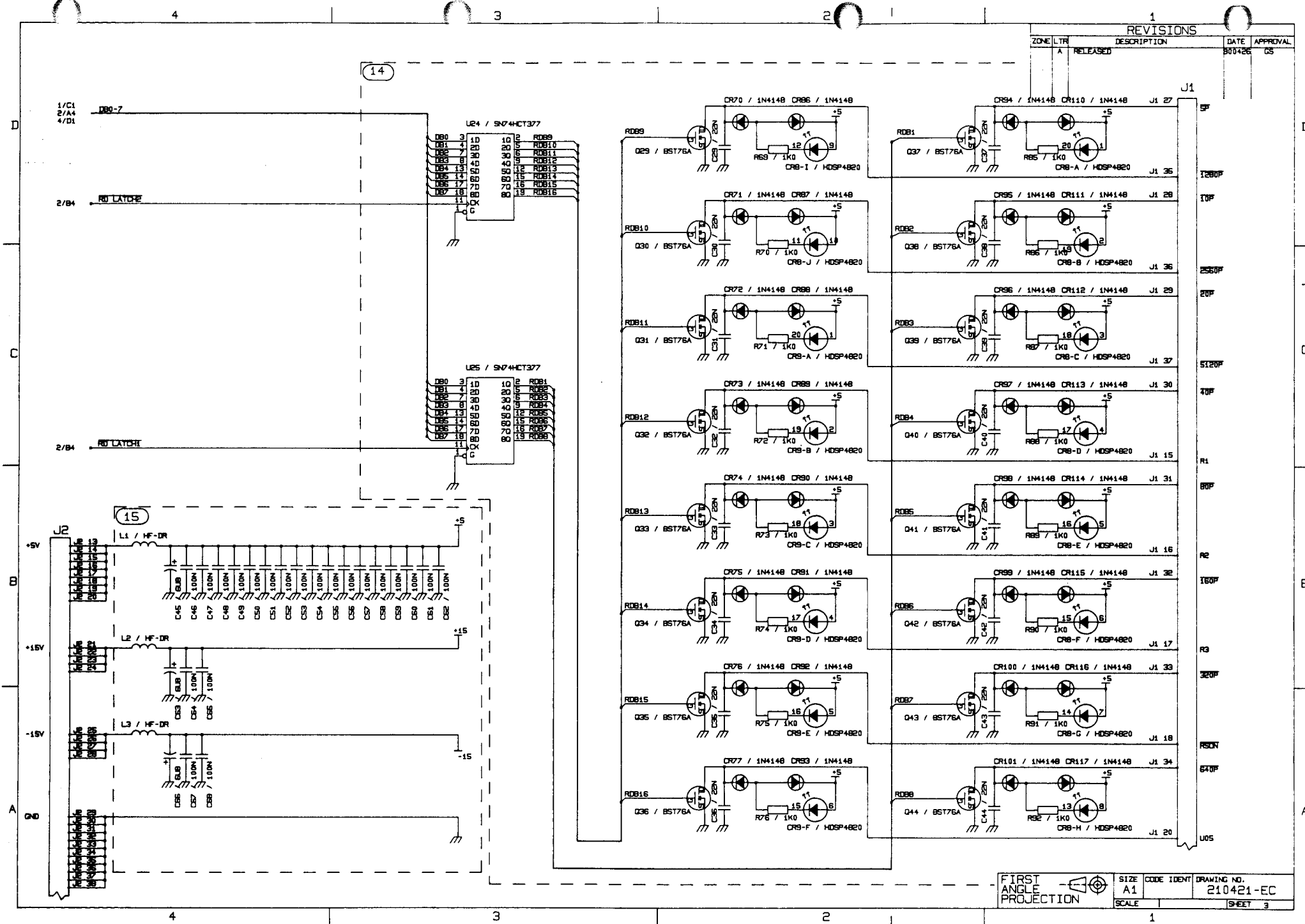
210421 Controller

Schematic 3

14. Relay drivers (continued)

15. Supply Voltage filters

Service Sheet A8A1



16. 8-bit latch

U29: 8 bit latch. For testing the A/D-converter the latch switches the voltage across zenerdiode VR1 to the different A/D-converter channels.

17. 8-bit A/D-converter

U26: 8 channel 8 bit A/D-converter. The analog input signals are attenuated before entering the A/D-converter. The gain of the four channels are: Ch. 1 = 0.5, ch. 2 = 0.15, ch. 4 = 0.5, ch. 5 = 0.5. R115-R123 and CR118-CR121, CR124-CR127 protect the inputs of the A/D-converter.

18. Serial Communication Circuit

U27: USART. Converts serial data to 8 bit parallel data.

When U44 receives a RXRDY (receiver ready) or a TXEMPTY (transmitter empty) from U127, the flip-flop will be set and generates a RST 6.5 interrupt to the microprocessor. The flip-flop is reset by an input command from the microprocessor.

U28: RS485 line driver/receiver.

Receive mode is selected when $\overline{DTR} = 0$ and $\overline{RTS} = 1$

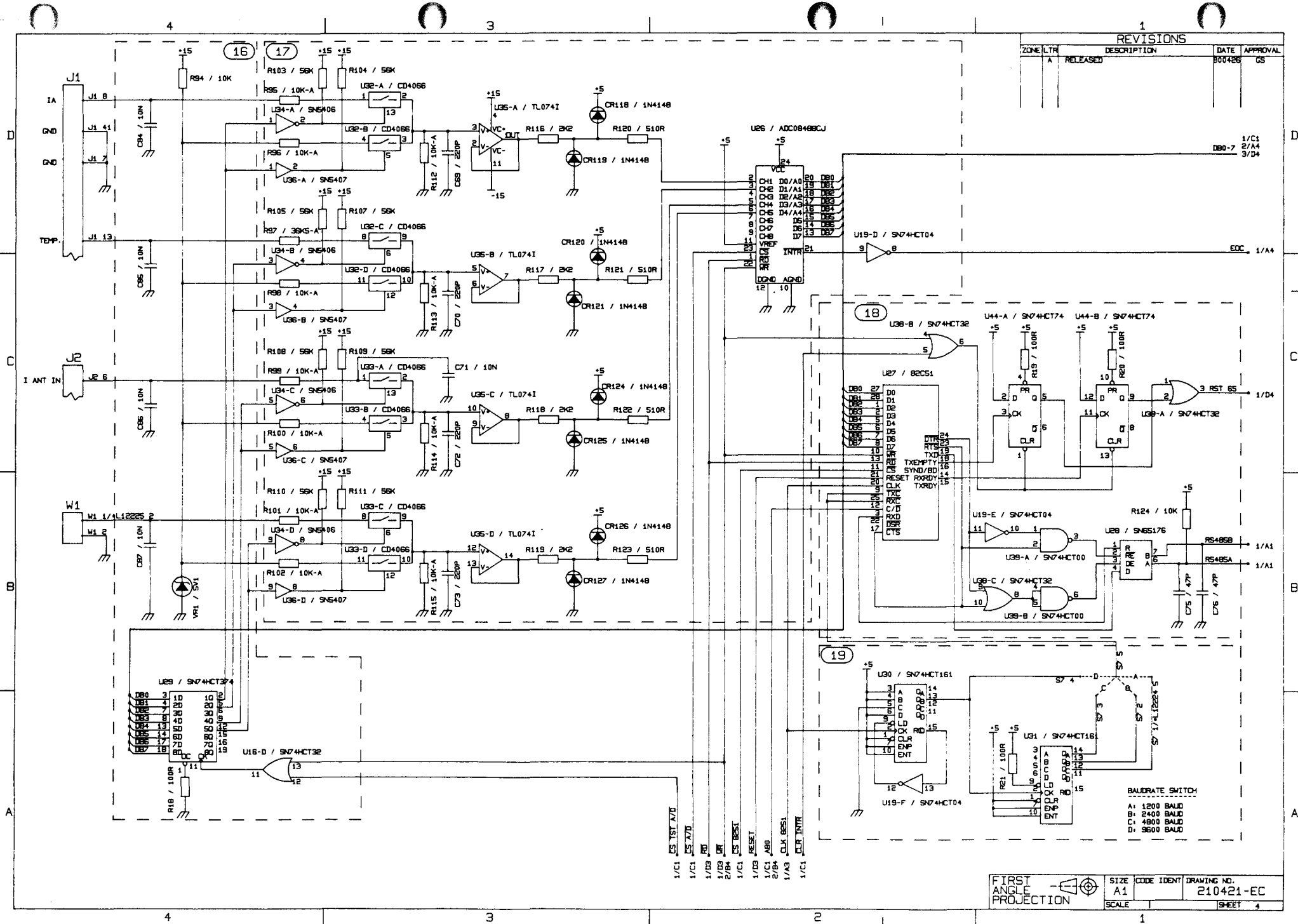
Transmit mode is selected when $\overline{DTR} = 0$ and $\overline{RTS} = 0$

19. USART Clock

The circuit generates the receiver/transmitter clock to the USART. The baud rate is strapable from 1200 to 9600 Baud.

The microprocessor clock of 3.072 MHz is applied to U30. The clock is divided by 5 (614.4 kHz) on output Q_B.

U31 output Q_A divides the 614.4 kHz signal by 2 to 307.2 kHz, Q_B divides by 4 to 153.6 kHz and Q_C divides by 8 to 76.8 kHz.

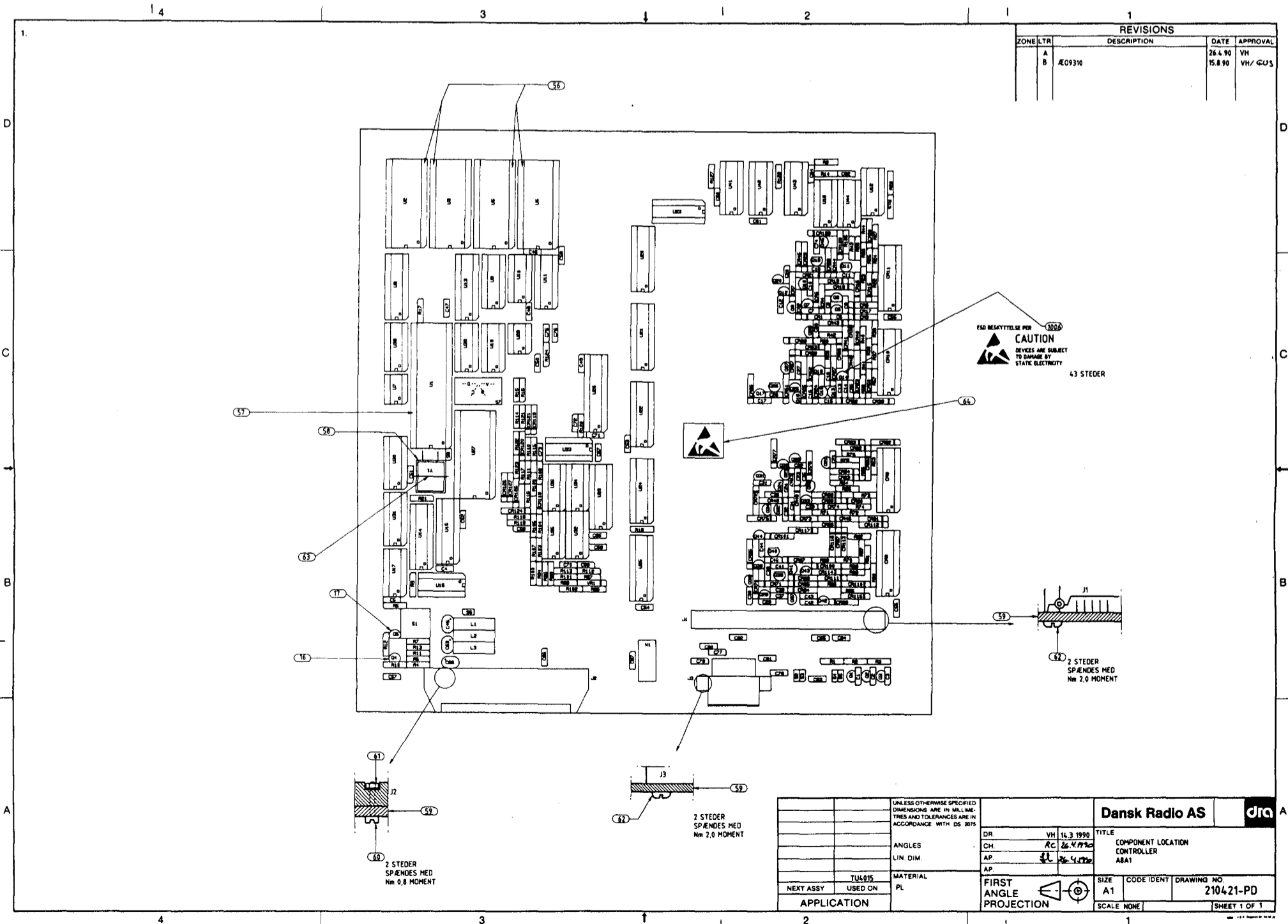


REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
A	RELEASED		800426
			GS

FIRST ANGLE PROJECTION	SIZE A1	CODE IDENT	DRAWING NO. 210421-EC
	SCALE		SHEET 4

BAUDRATE SWITCH
 A: 1200 BAUD
 B: 2400 BAUD
 C: 4800 BAUD
 D: 9600 BAUD





REVISIONS			
ZONE/LTR	DESCRIPTION	DATE	APPROVAL
A	Æ09310	26.4.90	VH
B		15.8.90	VH/GUS

ESD BEHUTTELSE PER 1000V
CAUTION
DEVICES ARE SUBJECT
TO DAMAGE BY
STATIC ELECTRICITY
43 STEDER

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS TOLERANCES ARE IN ACCORDANCE WITH DS 3075		Dansk Radio AS		dra	
		DR	VH	14.3.1990	TITLE		
		CH	RC	26.4.1990	COMPONENT LOCATION		
		AP	31	26.4.1990	CONTROLLER		
		AP			A8A1		
ANGLES		FIRST ANGLE				SIZE	CODE IDENT
LIN DIM		PROJECTION				A1	DRAWING NO.
						210421-PD	
TUL615		MATERIAL					
NEXT ASSY		PL					
USED ON							
APPLICATION							
		SCALE				NONE	SHEET 1 OF 1

ASSY 210458, DETECTOR ASSEMBLY

Service Sheet A9

1. Directional coupler, high power

The 30 dB coupler consists of a current transformer T1 and a voltage transformer T2 and four 50 ohms resistors which are made by parallel connections of 200 ohms resistors. The current transformer is made by a toroid where the coax cable W1 is the primary turn and the secondary is 30 turns. The voltage transformer also is made by a toroid with 30 turns on the primary and 1 turn on the secondary.

The transformed current and voltage from the high power line is supplied to the resistor network. The voltage over R13-R16 is proportional to the forward power on the line and the voltage over R1-R4 is proportional to the reflected power on the line.

C1 and C2 are used for adjustments of the balance of the coupler. STRAP1, STRAP2, STRAP3, J4, J5 AND J6 are only used for adjustment by the factory.

2. Power detectors for high power

The two detectors are identical and consist of a diode detector which is buffered by an operational amplifier with FET-input.

The diodes between output and inverting input provide the temperature compensation.

3. Current detector

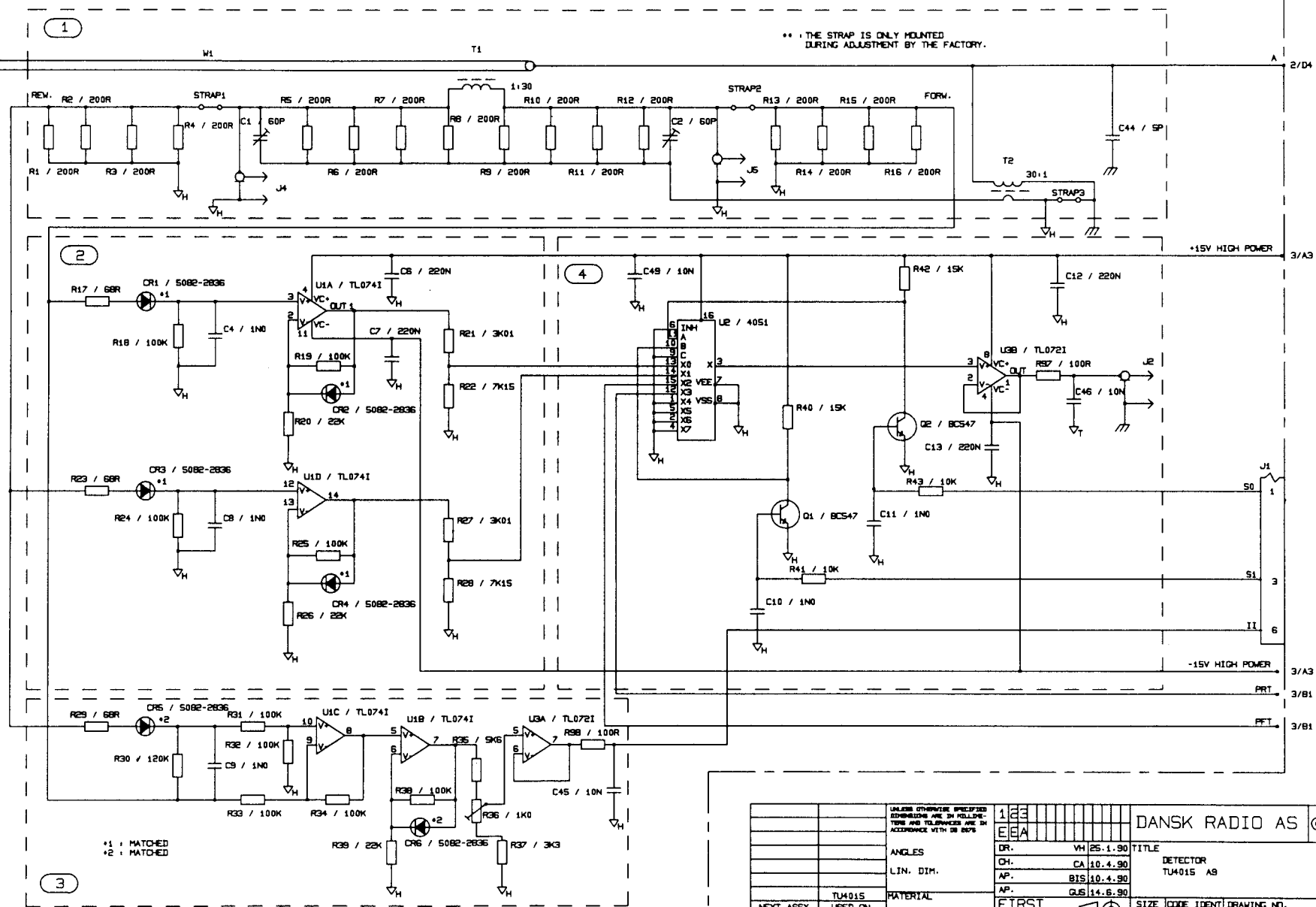
The resulting load of the secondary of T1 is 50 ohms. Therefore the voltage difference between the voltage over R1-R4 and R13-R16 is proportional with the current on the high power line. The voltage difference is rectified by CR5 and C9. The voltage difference over C9 is fed into U1C which is coupled as a subtractor. The output voltage is attenuated by R35-R37. R36 is used to adjust the output level. CR6 provides the temperature compensation.

4. Signal selector

U2 is coupled as an analog one-out-of-four multiplexer. The four DC voltages from the power detectors are selected by this circuit and fed into the SMB connector J2 via U3B.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
1.2	A	AE09142	900409	VH
	B	AE08170	900530	VH/QUS
	C	AE08184	900614	VH/QUS
	D	AE08184	900711	VH/QUS
2	E	AE08357	900829	VH/QUS

** THE STRAP IS ONLY MOUNTED DURING ADJUSTMENT BY THE FACTORY.



*1 : MATCHED
*2 : MATCHED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH DIN 9136		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100	DANSK RADIO AS	DR
ANGLES		DR	VH 25.1.90	TITLE
LIN. DIM.		CH	CA 10.4.90	DETECTOR
NEXT ASSY		AP	BIS 10.4.90	TU4015 AS
APPLICATION		AP	QUS 14.6.90	
MATERIAL		FIRST ANGLE PROJECTION		
TU4015 USED ON		SIZE	A1	CODE IDENT
		SCALE		DRAWING NO.
				210458-EC
				SHEET 1 OF 3

5. 6dB attenuator

The 6dB attenuator is used only while tuning in order to give a generator impedance of close to 50 ohms for the tuning elements. The relays K1, K2 and K3 bypass the attenuator and the tune detector under normal drift.

WARNING! The transmitter tune power is 125 W but the attenuator is not rated to operate with this power continuously.

6. Directional coupler, tune power

The 26 dB coupler consists of current transformer T4 with a ratio of turns of 1:20, voltage transformer T3 with a ratio of turns of 30:1:1 and four 50 ohms resistors made by parallel connections of 100 ohms resistors. One secondary turn of T3 is used in the directional coupler and the other is used in the magnitude detector (8).

The transformed current and voltage from the high power line are supplied to the resistor network. The voltage over R64,R65 is proportional to the forward power on line and the voltage over R58,R59 is proportional to the reflected power on the line.

C16 and C17 are used for adjustments of the balance of the coupler. STRAP4, STRAP5, STRAP6, J7, J8, J9 AND J10 are only used for adjustment by the factory.

7. Phase detector

T5 is a current transformer equal to T4. C18, R72 and R73 are a 90 degrees phase shift network. The transformed current and the phase shifted line voltage are summed vectorial and rectified by CR7/CR8. These two voltages are compared in comparator U4A with open collector output. A positive phase of the load impedance of the detector (P1) results in a high impedance on the comparator output, and a negative phase- in a low impedance on the comparator output.

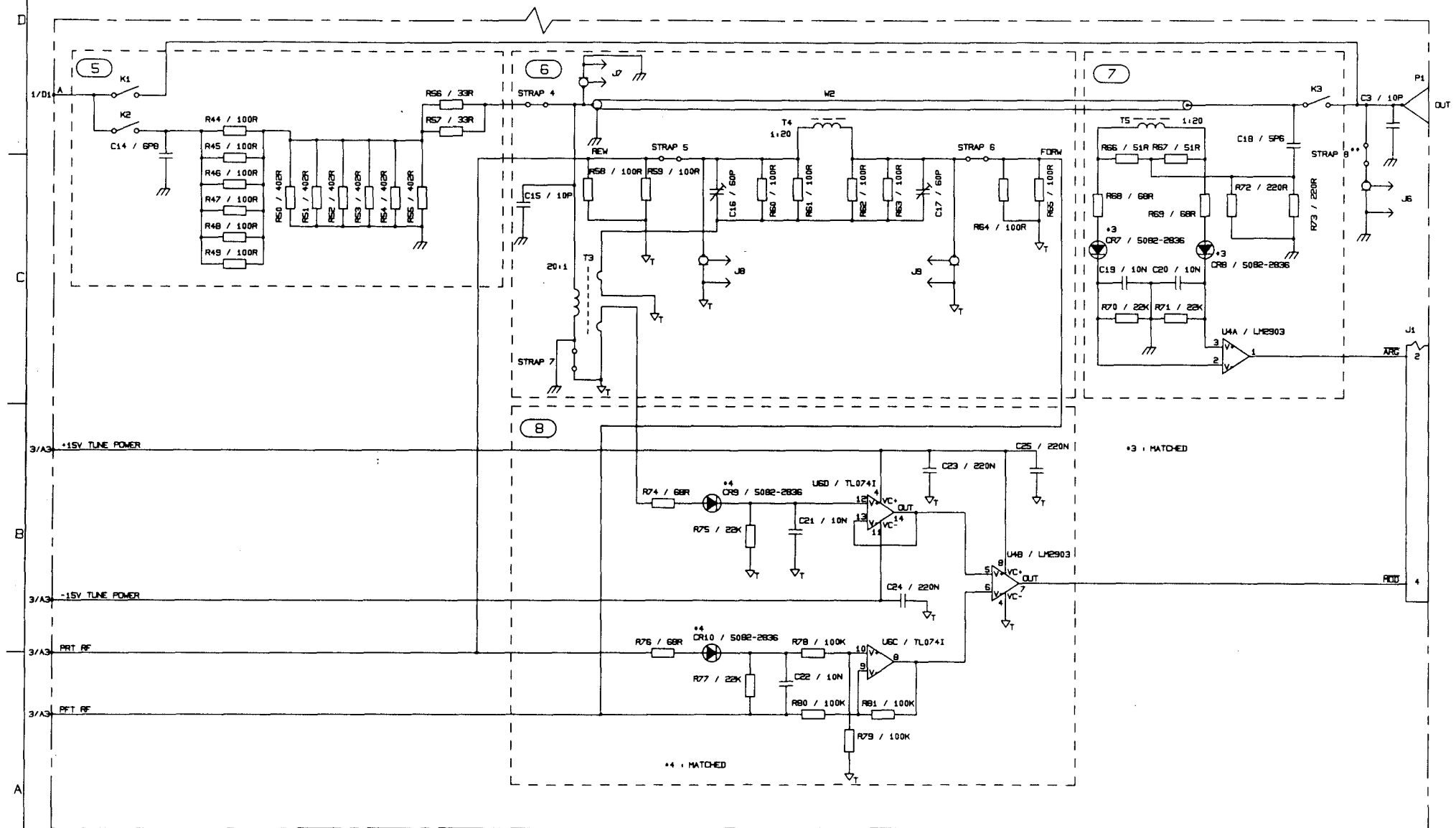
K3 switches the power through the 6dB attenuator and the tune detector.

8. Magnitude detector

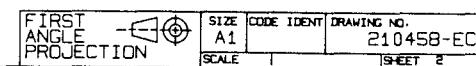
The voltage from the one secondary turn of T3 is rectified by CR9 /C21 and buffered by U6D. The resulting load of the secondary of T4 is 50 ohms. Therefore the voltage difference between the voltage over R58,R59 and R64,R65 is proportional with the current on the high power line. The voltage difference is rectified by CR10 /C22. The voltage difference over C22 is fed into subtractor U6C.

The voltage proportional to the line voltage and the voltage proportional to the line current are compared in comparator U4B with open collector output. A numerical load impedance of the detector (P1) greater than 50 ohms results in a high impedance on the comparator output, an impedance less than 50 ohms in a low impedance on the comparator output.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	AE09142	900405	VH
	B		900530	VH/GUS
	E	AE09357	900829	VH/GUS



Service Sheet A9



9. Power detectors for tune power

The two detectors are identical and consist of a simple diode detector which is buffed by operational amplifiers with FET-inputs (U5A and U5B). The diodes between output and inverting input provide the temperature compensation.

The detected output voltage is amplified by U6A and U6B and fed into the Signal selector (4) via W3 and W4. R87 is used to adjust the voltage level of the detected forward power.

10. Relay circuit

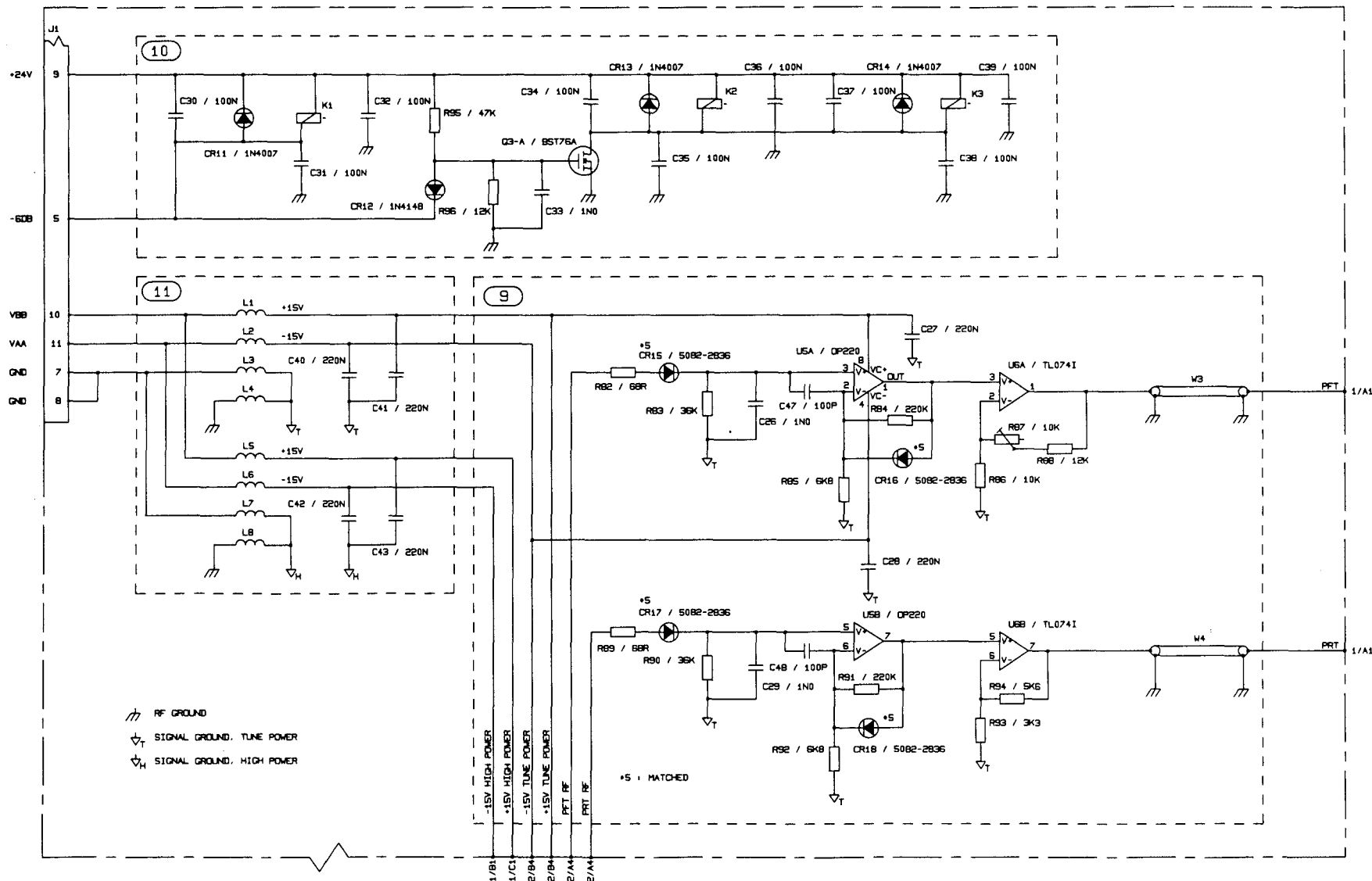
Under normal drift when the -6dB-wire is high impedanced, K1 is closed and Q3 will invert the signal and cause K2 and K3 to be open. When the -6dB-wire is grounded K1 will switch open and K2 and K3 will close.

The capacitors are used to decouple RF-signals on the DC-lines.

11. DC filters

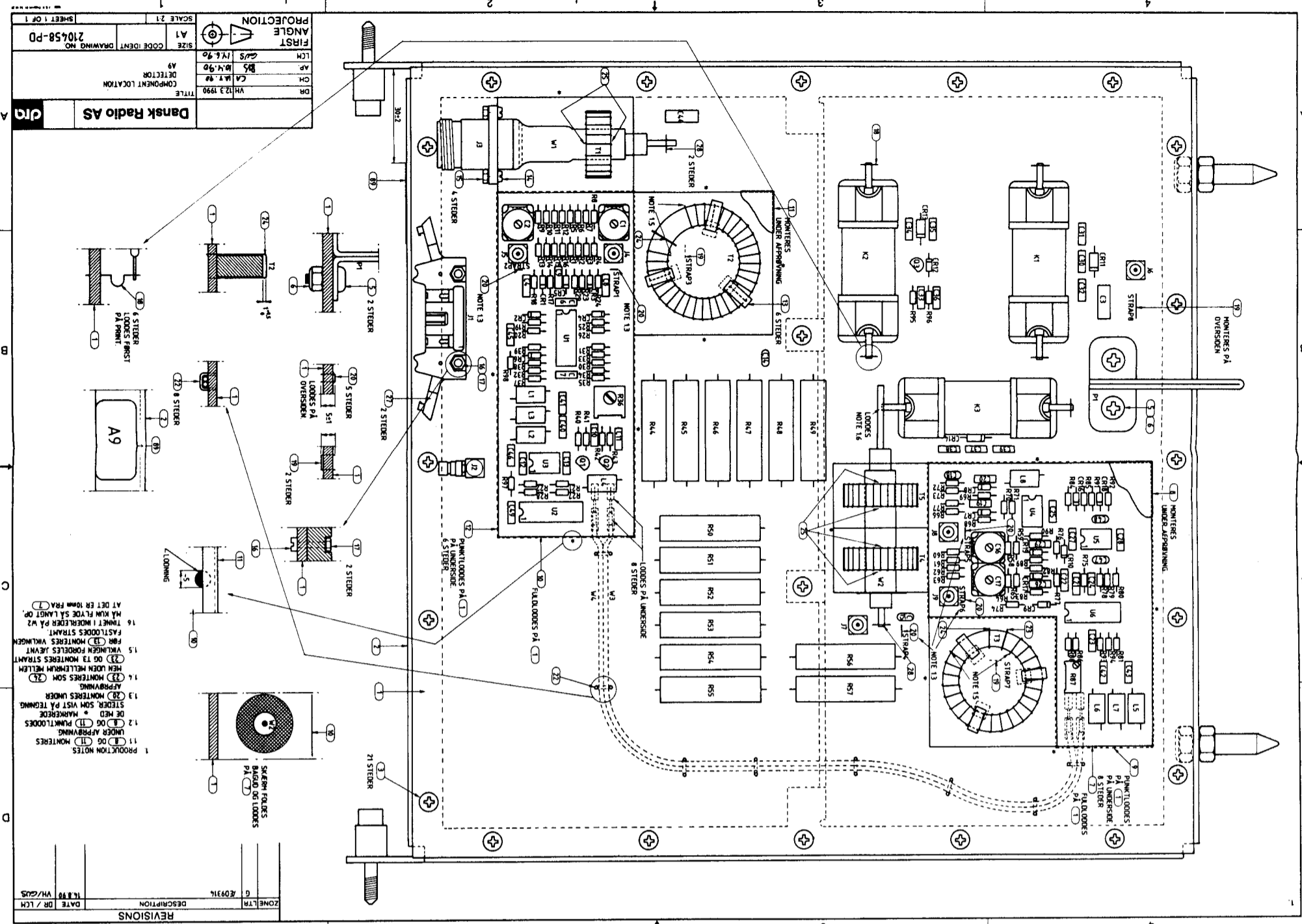
L1, L2, L3, L5, L6 and L7 filter the supply voltages. L4 and L8 provide a DC connection between signal ground and RF ground.

REVISIONS			
ZONE	ILTR	DESCRIPTION	DATE
	A		300409
			VH



FIRST ANGLE PROJECTION	SIZE A1	CODE IDENT	DRAWING NO. 210458-EC
SCALE			SHEET 3





ASSY 210472, POWER SUPPLY

Service Sheet A10A1

1 +5 V, 600 mA Regulator

U3 is a common used +5 V regulator, 7805, with extended temperature range. Thyristor Q8 is normally on. If CR15 is pulled to GND, through Q11, the basis current is removed from Q7 and thereby the gate current for Q8, turning off the +5 V supply.

2 +15 V, 160 mA Regulator

The circuit function in the same manner as 1, except that U2 pin3 are pulled-up to +10 V with Q6, R7-8 to give an output voltage of +15 V.

3 -15 V, 130 mA Regulator

The circuit function in the same manner as 1, except that U1 pin3 are pulled-up to +10 V with Q3, R3-4 to give an output voltage of +15 V.

The positive output from the regulator is grounded and the output is taken from the negative input giving an output of -15 V.

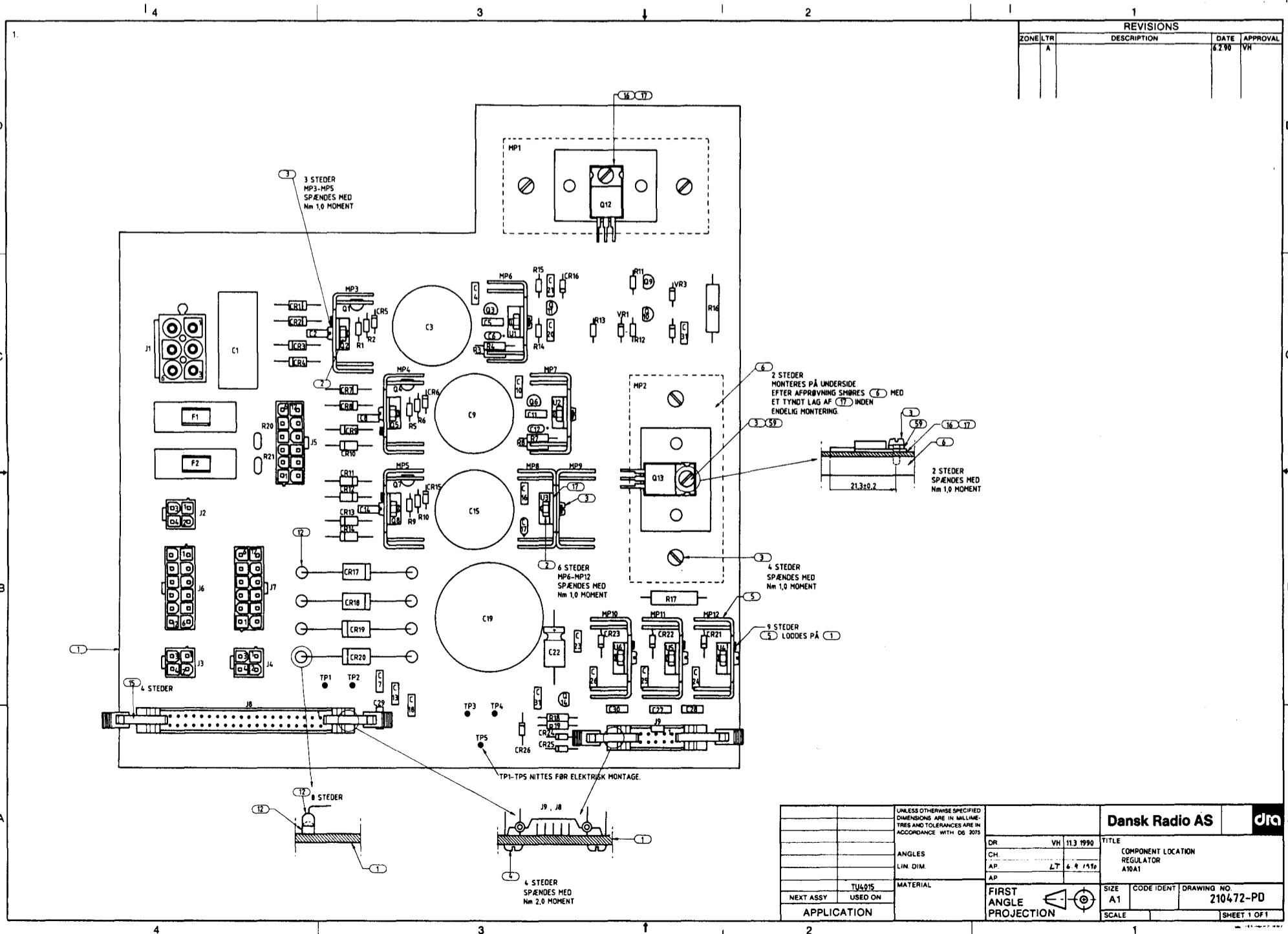
4 +24 V, 3*600 mA Regulator

U4-5-6 are pulled-up to +19 V with Q14, R18-19 to give an output voltage of +24 V.

Q12-13 act as preregulators, with Q9-10 used as current regulators for VR2-3, to give a constant input voltage of +27 V to U4-5-6. CR16 cuts off the +24 V supply through Q11.

A logical 0 at J1 pin 4 forces Q11 to go off, thereby turning on the four supply voltages.





REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
	A		6.2.90
			VH

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETRES AND TOLERANCES ARE IN ACCORDANCE WITH DS 2079		Dansk Radio AS		dra	
DR	VH	11.3	1990	TITLE	
CH				COMPONENT LOCATION	
AP	LT	6	9	REGULATOR	
AP				A10A1	
TULØS		MATERIAL		SIZE	CODE IDENT
NEXT ASSY		USED ON		A1	DRAWING NO.
APPLICATION		FIRST ANGLE PROJECTION			210472-PD
				SCALE	SHEET 1 OF 1

ASSY 210596, TEMPERATURE CONTROL

Service Sheet A13

1. Blower Control

IC U1 incorporates a limiter power supply, differential on/off sensing comparator, zero-crossing detector and a triac trigger circuit.

As the triac is driving an inductive load, the built-in zero-crossing detector cannot be used. Instead the voltage across Q3 is detected by Q1-2, R6-7-8. When the voltage on Q3 is greater than some volts, the gate will be supplied with current from pin 4. This current will flow until the voltage on Q3 is crossing zero.

The comparator operation is provided by overriding the action of the triac trigger circuit. Pin 13 has to be positive with respect to pin 9, for triggering the triac.

R2-3 are applied for hysteresis capability.

R9-10 are transient suppressor components.

L1-C6 are used for noise filtering.

C1-2-3 are RF decoupling capacitors.

2. Heating Element Control

As the load on Q4 is resistive, the built-in Zero-Crossing detector in U2 can be used. Except of that the circuit is identical to 1.

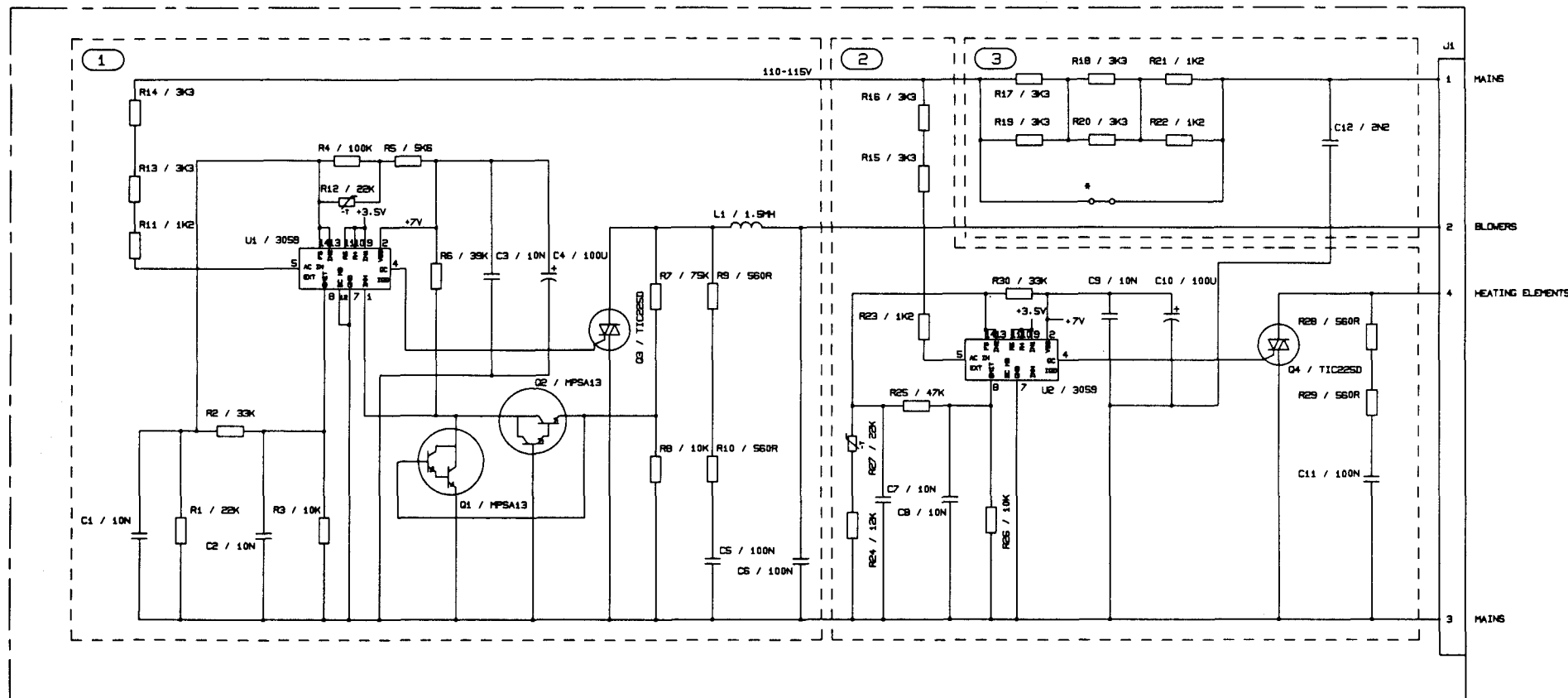
The NTC resistor R27, however, has changed because the opposite action is necessary in this case.


3. 220 V interface

The six resistors are inserted when the circuit operates on a 220 V supply. C12 is an RF decoupling capacitor across the mains supply.

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
	A		300405 VH

* NOTE 1
STRAP ONLY BY 115V
OPERATION



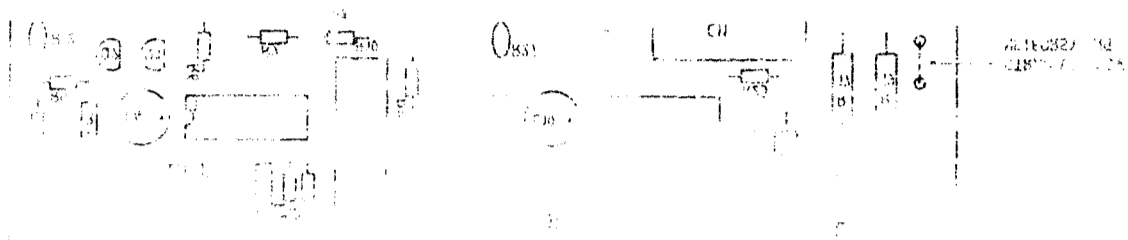
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLI- METERS AND TOLERANCES ARE IN ACCORDANCE WITH BS 6807		1		DANSK RADIO AS		dra	
		ANGLES		DR.		VH 281109		TITLE	
		LIN. DIM.		CH.		LT 94.90		TEMP. CONTROL	
		TU4015		AP.		3/5 94.90		TU4015 A13	
		MATERIAL		AP.					
NEXT ASSY		USED ON		FIRST ANGLE PROJECTION				SIZE	
APPLICATION								CODE IDENT	
								DRAWING NO.	
								210596-EC	
								SCALE	
								SHEET 1 OF 1	

0

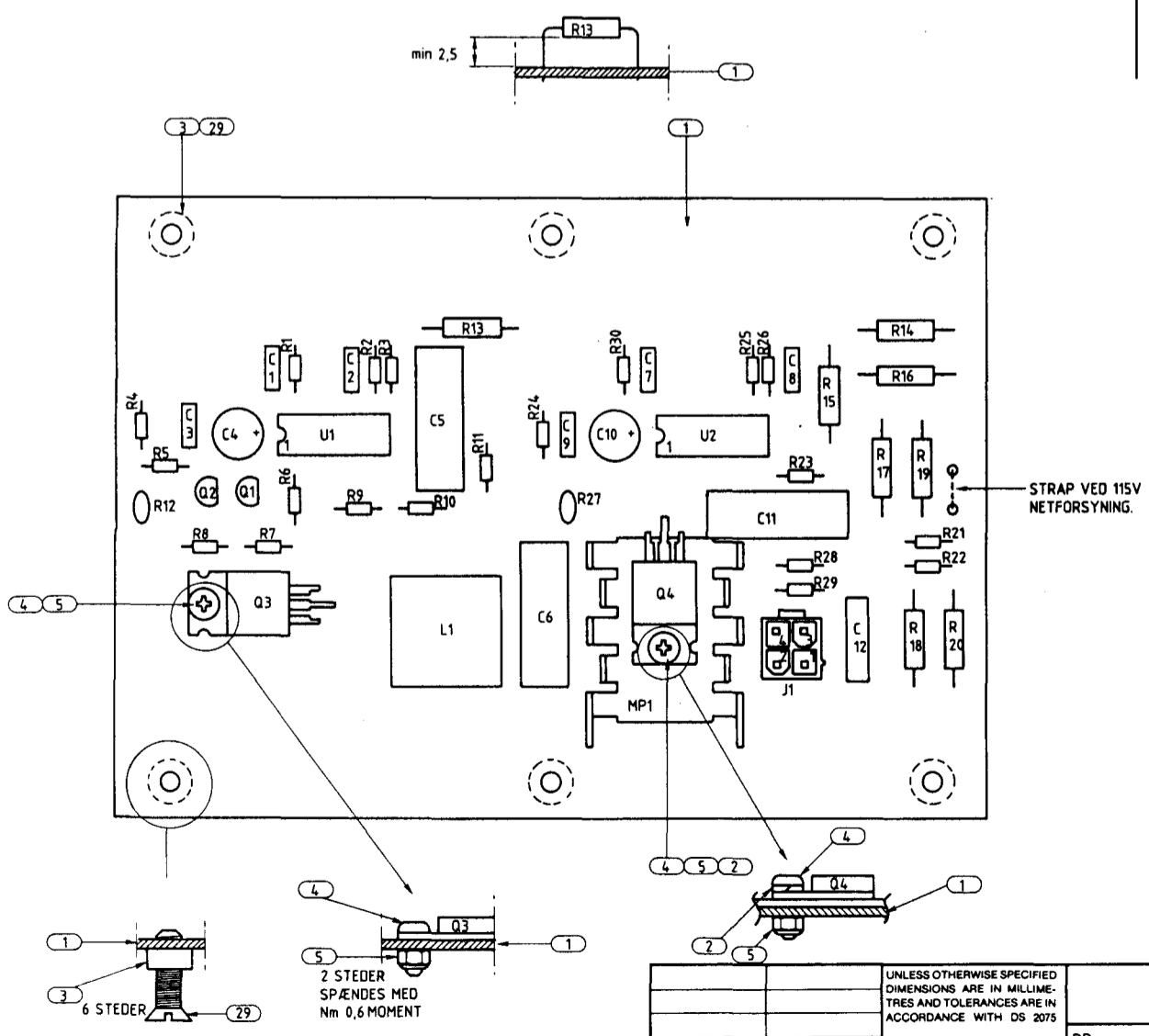
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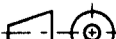
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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
A		Æ09188	9.4.90	VH
B		Æ08239	26.6.90	VH/GUS
C			16.8.90	VH/GUS



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETRES AND TOLERANCES ARE IN ACCORDANCE WITH DS 2075				Dansk Radio AS			
		ANGLES		DR. VH 17.2.90		TITLE COMPONENT LOCATION TEMP. CONTROL A13			
		LIN. DIM.		CH. LT 9.4.90					
				AP. 8/5 9.4.90					
				AP. GUS 26.6.90					
TU4015		MATERIAL		 FIRST ANGLE PROJECTION		SIZE		DRAWING NO.	
NEXT ASSY		USED ON				A 2		210596-PD	
APPLICATION						SCALE 2:1		SHEET 1 OF 1	

