

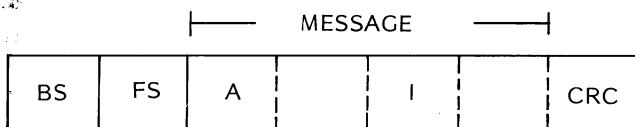
BINARY SIGNALLING

STORNOPHONE 5000

Binary signalling provides the user of a radio-telephone system with improved signalling facilities compatible with 5-tone sequential systems. Binary signalling features are enhanced speed, status message, address calls, all call, identity and other signalling options.

Binary signalling is a method of transmitting a binary coded message as a formatted telegram using only two tones for 0 (1800 Hz) and 1 (1200 Hz).

The binary signal format contains four parts:



BS = Bit Synchronization

FS = Frame Synchronization

Message = Data to be transmitted

CRC = Cyclic Redundancy Check Bits

Bit synchronization is a number of bits transmitted to enable the receiver demodulator to acquire bit synchronization.

Frame synchronization is a bit pattern enabling the demodulator to identify the beginning of a message.

Message bits are the data to be transmitted. These can be divided into an address part and an information part compatible with the system specifications.

Cyclic Redundancy Check is a number of bits calculated from the preceding data bits and used for error detection.

All bits are transmitted with a rate of 1200 bits/sec.

The modulator converts the bitstream from the encoder into an analog signal in accordance with the following rules:

Logic 1 is represented by a 1200 Hz sine wave signal
Logic 0 is represented by a 1800 Hz sine wave signal

Phase coherence exists between adjacent bits.

The demodulator recovers a clock reference signal from the received signal for exact timing and converts a 1200 Hz sine wave signal to logic 1 and a 1800 Hz signal to logic 0.

The modulator/demodulator is an integrated thick film module mounted on the CL5002 Control Logic.

The Binary signalling module can be incorporated in all standard equipment of the 5000 series.

DECODER FUNCTIONS

Individual call to mobile.

Decoding of BAK (BAK = Betriebsartkenzeichen (Message type identification)) code call to a mobile plus base station address (*) plus individual address (**) correctly, constitutes an individual call and results in loudspeaker circuit opening and ignition of call lamp. The base station address (* =3 digits) is fixed for a given system, the individual address (** =3 digits) is pre-selectable, thus giving 999 possible individual numbers per system. Systems are thus expandable beyond 999 users by allocating more than one base station address to the base control unit.

Cleardown of call to mobile.

Decoding of BAK code cleardown plus addresses (*) and (**) = system and individual number causes cancellation of loudspeaker circuit opening but leaves call lamp illuminated until manually reset by double activation of LS enable/disable button.

Status decoding.

The status fields of incoming telegrams will be dumped on four parallel pins capable of delivering 10 mA for direct LED-operation. In the case of ZVEI the status field will be decoded and dumped. In the case of EEA which allows for 3 digit status information, only the least significant digit will be decoded and dumped. In this case the two other status fields will be ignored. Status decoding/dumping will take place on all incoming individual/group calls.

Individual number.

Only one preset individual address consisting of six digits in all is available. In the case of ZVEI 3 digits will be fixed for a given system i. e. "Raute + Hersteller" = system number = fixed. Bits 45-56 constitute the 3 digit individual number giving maximum of 999 users/system. Correspondingly in the EEA system 3 digits are the system number whilst 3 digits are the individual number.

Group numbers.

In both the ZVEI and EEA formats the same group system will be used. A group call will be recognised by decoding BAK code = 'group' plus:

- group 0-9 - last indiv. digit - all bits = 1
- group 0-99 - last two indiv. digits - all bits = 1
- group 0-999 - all indiv. digit bits = 1

Groups of 0/9, 0/99 or 0/999 may thus be called using the same unit.

Receipt of a group call enables the loudspeaker circuit and call lamp. When the squelch function indicates cessation of carrier the loudspeaker and lamp circuits are reset.

Loudspeaker circuit manual enable/disable.

The loudspeaker circuit will normally be capable of being manually enabled/disabled (momentary LS in/out push button). This procedure will also reset the decoder i. e. status read-out etc.

Privacy.

The loudspeaker circuit is, as a customer order option, capable of being reset by the radio receiver's squelch function i. e. not capable of manual enablement. The loudspeaker circuit is, in this case, enabled by reception of an individual or group call and disabled by carrier drop-outs in excess of 5 seconds or use of manual disable button.

Acknowledgement.

The decoder is provided with an output for activation of the encoder in the acknowledgement condition. Acknowledgement transmissions are performed upon reception of an individual call. This is a customer order selectable option.

Status Request.

This function is similar to the acknowledgement function. The difference between the status request and acknowledgement response is the state of the loudspeaker circuit. Acknowledgement is transmitted upon reception of an individual call, which also enables the loudspeaker circuit. The response to a status request is the transmission of an acknowledgement telegram (containing status) without enabling the loudspeaker circuit i. e. without disturbing the mobile.

Horn Alarm

The unit provides a 1.5 sec. current sink capability of 100 mA upon reception of a correct individual call. This operates an external unit. Inhibition of the function is made by an external switch.

ENCODER FUNCTIONS

Call to base.

Pressing the call button causes the transmission of 'call to base' telegram i. e. a call request. This telegram contains the call to base BAK code, status information, base station system number and own identity. The base station recognises the BAK code and system number, and in sophisticated base station solutions will decode/display mobile identity and status information.

Identity transmission.

As a customer option automatic transmission of identity is available. Identity consists of the transmission of a special identity BAK code, status information, base station number and own identity. This transmission takes place at each PTT operation and optionally with a periodicity of 3-∞ sec. The periodicity is a customer order selectable value. During repetitive transmission of identity during speech, the speech signal is blanked in the signalling intervals (53.3 ms periods ZVEI, 80 ms periods EEA).

Acknowledgement.

This is a customer order selectable option which consists of the automatic transmission of a special acknowledgement BAK code, status information, base station number and own identity upon reception of an individual call to mobile. The individual call to mobile, of course, activates the mobile's loudspeaker circuit.

Silent acknowledgement.

As outlined in Status request, a special BAK code can be generated by the base station which results in the mobile transmitting an acknowledgement signal but without activating the loudspeaker circuit or call lamp. During transmission of a 'silent acknowledgement' the loudspeaker will emit a short 'beep'.

Status encoding.

The status field in the ZVEI and EEA formats will be codeable by means of two push-buttons. In the EEA format only the least significant digit will be addressable, the remaining bits will all be zeros.

Selectable addressing.

The encoder is furnished with a semi-fixed calling code in that:

- Base station number are preset.
- The two most significant individual digits are preset.
- The last significant digit is addressable.

The encoder is thus capable of calling 9 individual mobiles in mobile/mobile systems plus the base station.

Selecting the mobiles own individual number automatically results in setting up the correct 'BAK' code and individual number for transmission.

The preset position of the calling code is identical to the corresponding receive (decoder) digits.

Telegram transmission.

Pressing the call request button (=tone button in sequential systems) momentarily results in transmission of a single telegram. Repeated operation results in repeated single telegram transmission. Acknowledgement transmissions are always single telegram transmissions. The transmissions occur every time the decoder detects a call to mobile or status request.

Traffic on air check (Busy)/transmitter blocking.

Prior to manually initiating a telegram or voice transmission, the loudspeaker circuit must be enabled for a 'listen for traffic' check.

Without doing this the transmitter is disabled.

This facility can be circumvented.

Incoming carrier/transmitter inhibition.

As an option the transmitter can be inhibited by the receiver squelch function.

This prevents transmitting from a mobile on an engaged channel. In equipments provided with acknowledgement or silent acknowledgement the transmission of the acknowledgement signal will be transmitted after a fixed delay after decoding of 'call to mobile' or 'status request'.

Signalling delay.

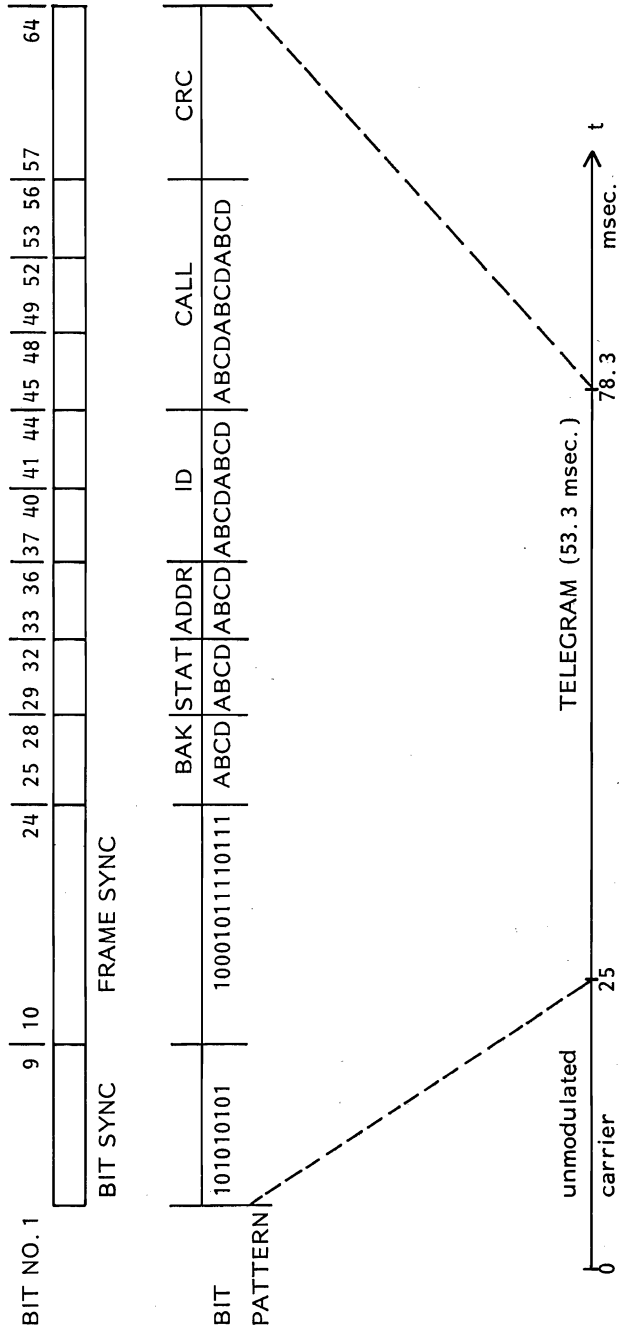
All telegram transmissions is preset by a time delay 30 ms to allow for settling times in transmitter/receiver circuits.

1	16	17	32	33	40	41	44	45	48	49	52	53	56	57	60	61	64	65	68	69	72	73	76	77	80	81	96
---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

1	2	3	4	5	6	7	8	9	10	11	12	13	14
---	---	---	---	---	---	---	---	---	----	----	----	----	----

- 1 = BIT SYNC
- 2 = FRAME SYNC
- 3 = 1 + USER IDENTITY
- 4 = ADDRESS DIGIT 1
- 5 = ADDRESS DIGIT 2
- 6 = ADDRESS DIGIT 3
- 7 = ADDRESS DIGIT 4
- 8 = ADDRESS DIGIT 5
- 9 = ADDRESS DIGIT 6
- 10 = STATUS DIGIT 1 ('0' IN 1 CH SYSTEM)
- 11 = STATUS DIGIT 2 ('0' IN 1 CH SYSTEM)
- 12 = STATUS DIGIT 3
- 13 = BAK (Message Type)
- 14 = CRC Cyclic Redundancy Code

BINARY SIGNALLING FORMAT STORNO



BINARY SIGNALLING FORMAT, ZVEI

CONTROL LOGIC

CL5002

The binary signalling control logic is the interface between the control panel and the radio functions. When fully assembled the control logic has 50 IN/OUT (I/O) function which are split up as follows:

- I/O UART lines
- I/O Handshaking lines
- FFSK I/O lines
- Display scanning (max. 4 digits)
- Keyboard scanning
- Radio interface lines
- I/O lines (options)

Optionally it is possible to have 2 K CMOS RAM with back-up battery added to the RAM of the u-Processor and the expander.

The external program memory is optional with 68K Bytes as standard.

MICROPROCESSOR

The control logic is built around a microprocessor without internal memory.

The microprocessor controls all functions on the control logic board by expansion of its port 0.

EXTERNAL MEMORY

The external program memory is highspeed CMOS (8-bit latch) with 8 address lines A0 - A7.

DISPLAY DRIVER

The display scanner U10 and driver U11 has 4 control outputs (8-bit latch). 4 outputs are used for the display and 4 are used for external functions.

- Bit 0 = Digit 1
- Bit 1 = Digit 2
- Bit 2 = Digit 3
- Bit 3 = Digit 4
- Bit 4 = Audiomute
- Bit 5 = External horn alarm
- Bit 6 = Emerg. output
- Bit 7 = Absent mode

CHANNEL DRIVER

The channel scanner U9 is an 8-bit latch with driver U12 for the channel code.

One channel radios have only 2 digit displays and the 3rd digit strobe is used for 3 indicator diodes:

- Segment A = LS open (yellow)
- Segment B = Busy (green)
- Segment C = TX on (red)

I/O EXPANDER

The 8-bit to 22-bit expander U8 controls the display drivers Q9 - Q16, the keyboard scan and the display segments.

Port A	}	Bit 0	segment A
		Bit 1	segment B
		Bit 2	segment C
Display		Bit 3	segment D
		Bit 4	segment E
		Bit 5	segment F
		Bit 6	segment G
		Bit 7	segment DP
Port B	}	Bit 0	row 3
		Bit 1	row 2
		Bit 2	row 1
Keyboard	}	Bit 3	col. 1
		Bit 4	col. 2
		Bit 5	col. 3
Inputs	}	Bit 6	emgr. input
		Bit 7	PTT
Port C	}	Bit 0	handshake in 0
		Bit 1	handshake in 1
Inputs		Bit 2	RX data (FFSK)
		Bit 3	Squelch detect
		Bit 4	Power failure
		Bit 5	spare in

The u-Processor's port 2 controls:

P20	Address	8 EPROM/CMOS RAM I/O 8155
P21	Address	9 EPROM/CMOS RAM
P22	Address	10 EPROM/CMOS RAM
R23	Address	11 EPROM
P24	Address	12 EPROM/chip select RAM
P25	Address	13 EPROM/clock puls ch. latch
P26	Clock pulse	digit latch
P27	Chip enable	8155.

The u-Processor's port 1 controls:

P10	TX data FFSK (via D flip-flop)
P11	TX enable modem
P12	Loudspeaker mute
P13	Mic. block
P14	TX enable
P15	Alert enable/loudspeaker disable
P16	Loudspeaker open indikator (multichann. radios only)
P17	Spare out

RESET CIRCUIT

When power is turned on the reset circuit puts a high level on the reset input of the u-Processor U1 approximately 2.5 ms after 5V has been applied. If the battery voltage drops below 7V the circuit also supplies the reset input with a high level to retain the RAM data in U1. When the radio is turned off the circuit is kept in active condition to save the information in the two RAM circuits.

TEMPERATURE CIRCUIT

If the temperature rises to above 70⁰ the resistance of R18 will increase and Q4 will be turned off, thereby the key-pads backlight will go off and the current flow through H1 and H2 will be turned to a lower level.

ALERT TONE GENERATOR

The 600 Hz alert tone is derived from the TX clock of MODEM U4 and divided by 2 in U5.

MODEM

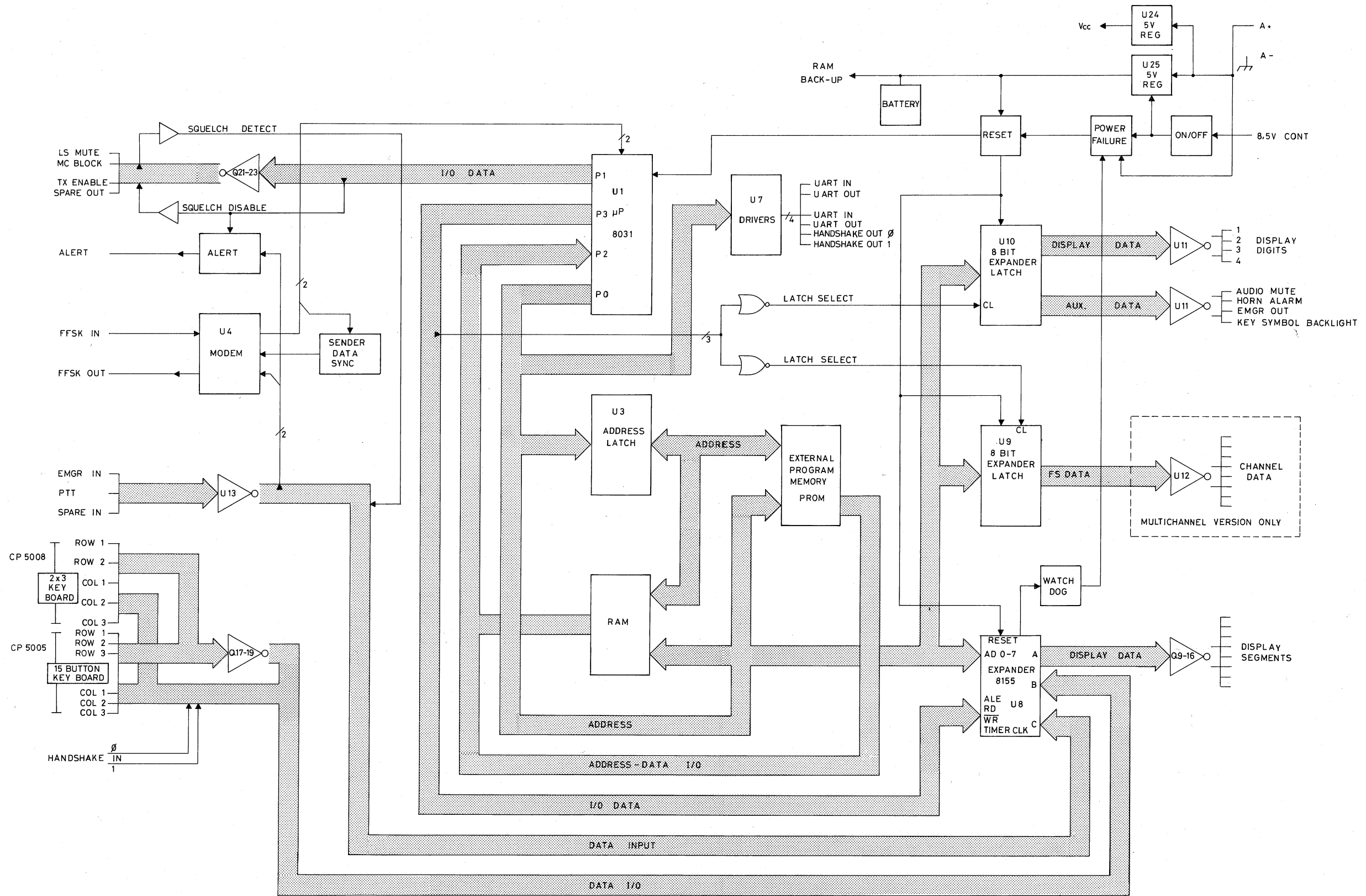
The modem handles the FFSK signal. Both the input signal and output signal is adjustable.

POWER SUPPLY

Two voltage regulators are used to supply the control logic. One, U25, is switched on by Q1 when +8.5V from the radio circuit is present (power on) and the other supplies the RAM, also when the radio is turned off.

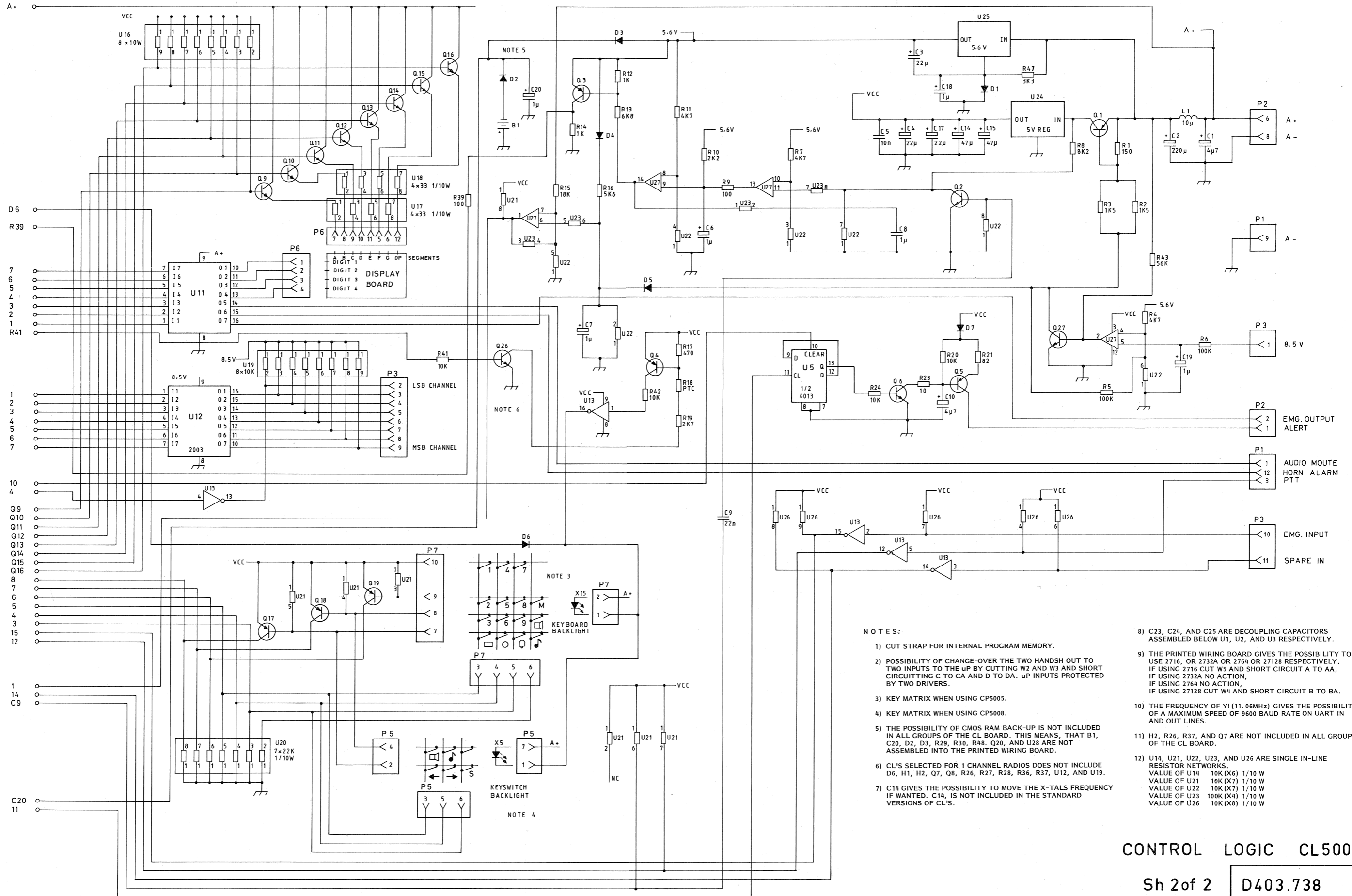
WATCH DOG CIRCUIT

A timer in the expander is driven by the TX clock. If the program runs wild or stops the expander timer runs out and sends a reset pulse to the reset circuit which then resets the u-Processor.



BINARY SIGNALLING
BLOCK DIAGRAM CL5002

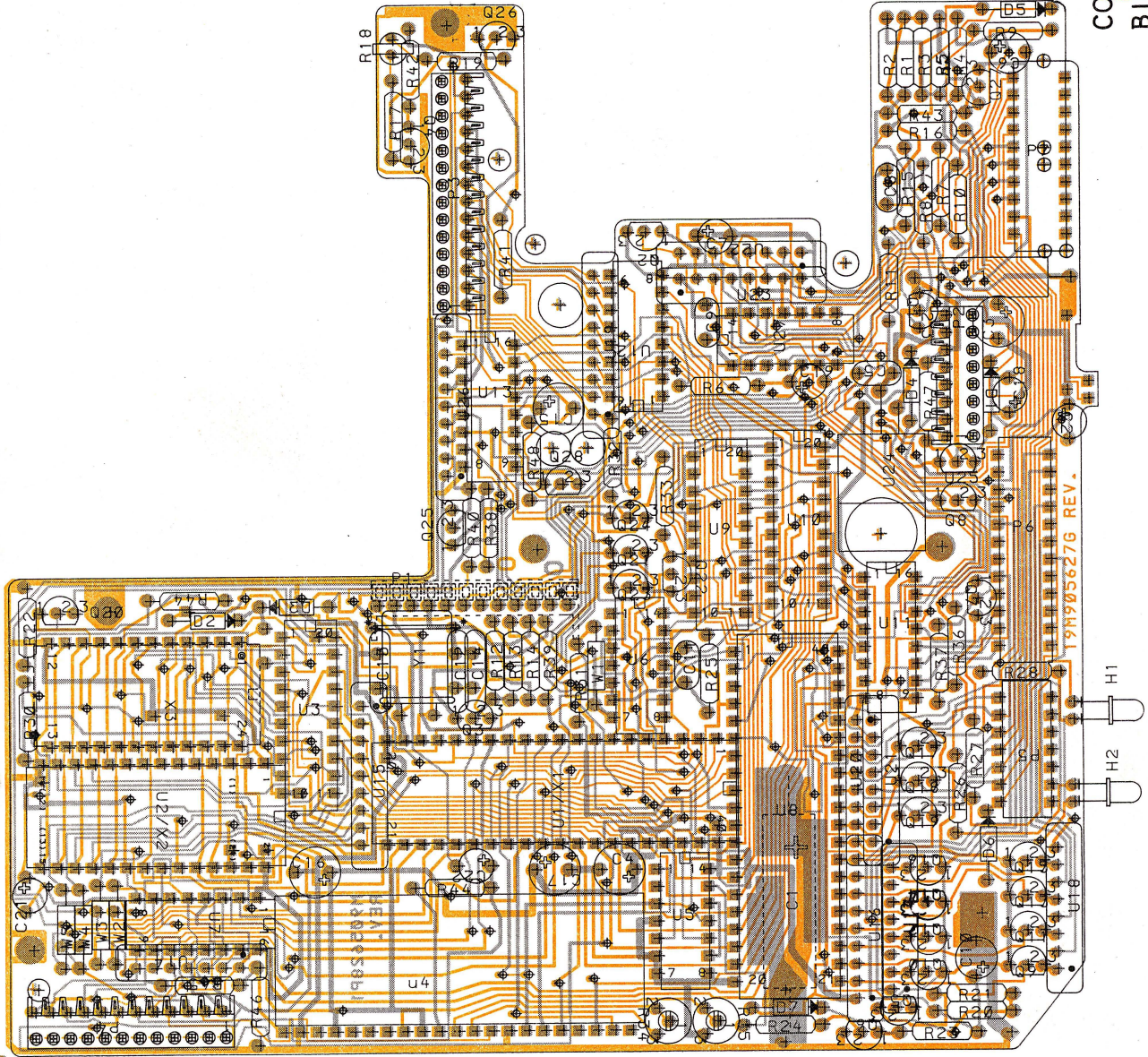
D403.676



NOTES:

- 1) CUT STRAP FOR INTERNAL PROGRAM MEMORY.
- 2) POSSIBILITY OF CHANGE-OVER THE TWO HANDSH OUT TO TWO INPUTS TO THE μP BY CUTTING W2 AND W3 AND SHORT CIRCUITING C TO CA AND D TO DA. μP INPUTS PROTECTED BY TWO DRIVERS.
- 3) KEY MATRIX WHEN USING CP5005.
- 4) KEY MATRIX WHEN USING CP5008.
- 5) THE POSSIBILITY OF CMOS RAM BACK-UP IS NOT INCLUDED IN ALL GROUPS OF THE CL BOARD. THIS MEANS, THAT B1, C20, D2, D3, R29, R30, R48, Q20, AND U28 ARE NOT ASSEMBLED INTO THE PRINTED WIRING BOARD.
- 6) CL'S SELECTED FOR 1 CHANNEL RADIOS DOES NOT INCLUDE D6, H1, H2, Q7, Q8, R26, R27, R28, R36, R37, U12, AND U19.
- 7) C14 GIVES THE POSSIBILITY TO MOVE THE X-TALS FREQUENCY IF WANTED. C14, IS NOT INCLUDED IN THE STANDARD VERSIONS OF CL'S.
- 8) C23, C24, AND C25 ARE DECOUPLING CAPACITORS ASSEMBLED BELOW U1, U2, AND U3 RESPECTIVELY.
- 9) THE PRINTED WIRING BOARD GIVES THE POSSIBILITY TO USE 2716, OR 2732A OR 2764 OR 27128 RESPECTIVELY. IF USING 2716 CUT W5 AND SHORT CIRCUIT A TO AA, IF USING 2732A NO ACTION, IF USING 2764 NO ACTION, IF USING 27128 CUT W4 AND SHORT CIRCUIT B TO BA.
- 10) THE FREQUENCY OF Y1 (11.06MHz) GIVES THE POSSIBILITY OF A MAXIMUM SPEED OF 9600 BAUD RATE ON UART IN AND OUT LINES.
- 11) H2, R26, R37, AND Q7 ARE NOT INCLUDED IN ALL GROUPS OF THE CL BOARD.
- 12) U14, U21, U22, U23, AND U26 ARE SINGLE IN-LINE RESISTOR NETWORKS.

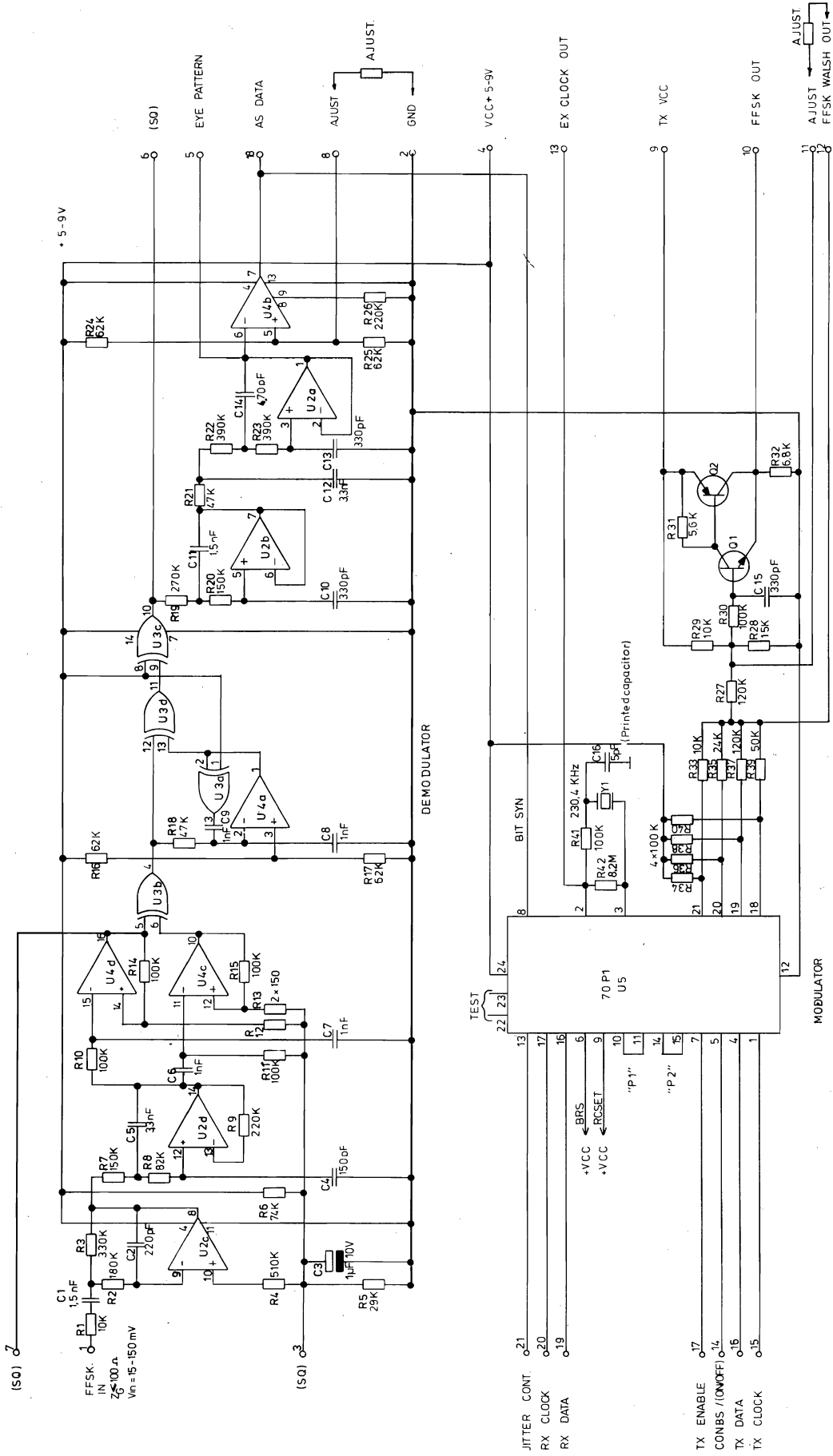
VALUE OF U14	10K (X6)	1/10 W
VALUE OF U21	10K (X7)	1/10 W
VALUE OF U22	10K (X7)	1/10 W
VALUE OF U23	100K (X4)	1/10 W
VALUE OF U26	10K (X8)	1/10 W



19M905627G REV.

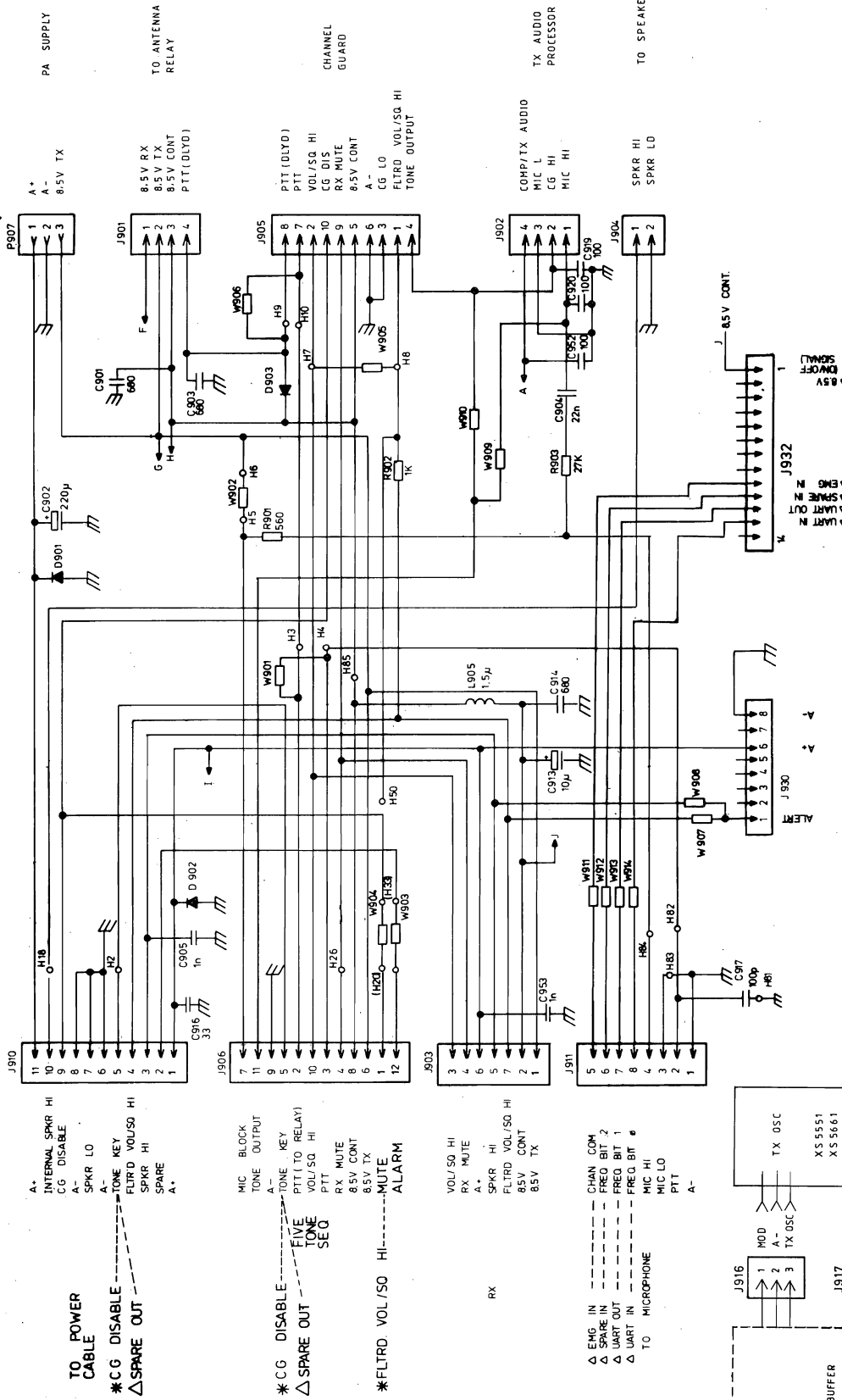
CONTROL LOGIC
BINARY SIGNALLING

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MODEM MD801

D403.751

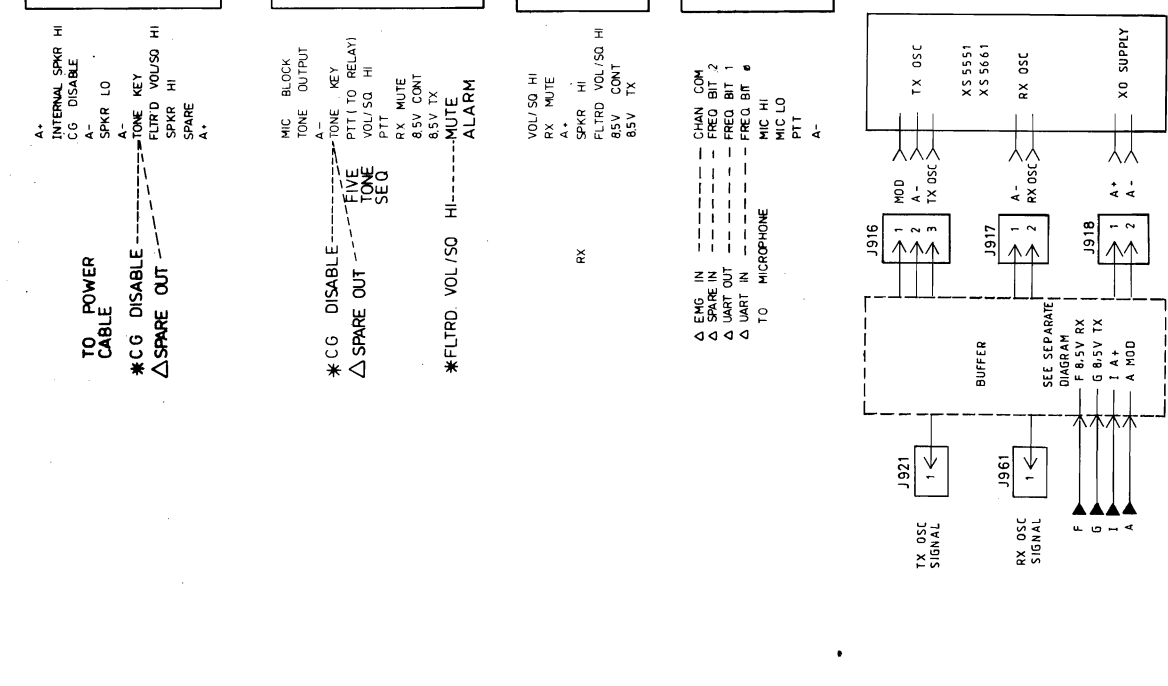


THE TABLE BELOW SHOWS WHICH STRAPS ARE CUTTED WHEN OPTIONAL UNITS ARE INSTALLED COM5006/COM5005

TONE UNIT INSTALLED	ACTION
TQ5001	CUT
TQ5002	W901, W902, W909
TQ5004	W909
TQ5005	CUT
TQ5006	W904, W905, W906, W909
TR5002	CUT
FN5002	W904, W905, W909
TT5002	CUT
CL5001	W901, W902, W907, W910
CL5002	W901, W902, W908, W910

* ALTERNATIVE FUNCTIONS WITH CG UNITS: TQ5003, TR5001, FN5001.
 Δ ALTERNATIVE FUNCTIONS WITH BINARY SIGNALING CONTROL LOGIC (EX. CL5002-CL5005)

WARNING!
 CO THROUGH STRAP INSTRUCTIONS BEFORE ALTERNATIVE FUNCTIONS ARE ASSEMBLED TOGETHER WITH THE XS5006 OR XS5007 BOARD.
 NOTE:
 IF THE PREVIOUSLY USED CG UNITS TQ5003, TR5001 OR FN5001 ARE USED, H20-H33 (W904), H34-H41 (W905) SHALL BE OMITTED AND H20-H50 INSTALLED.

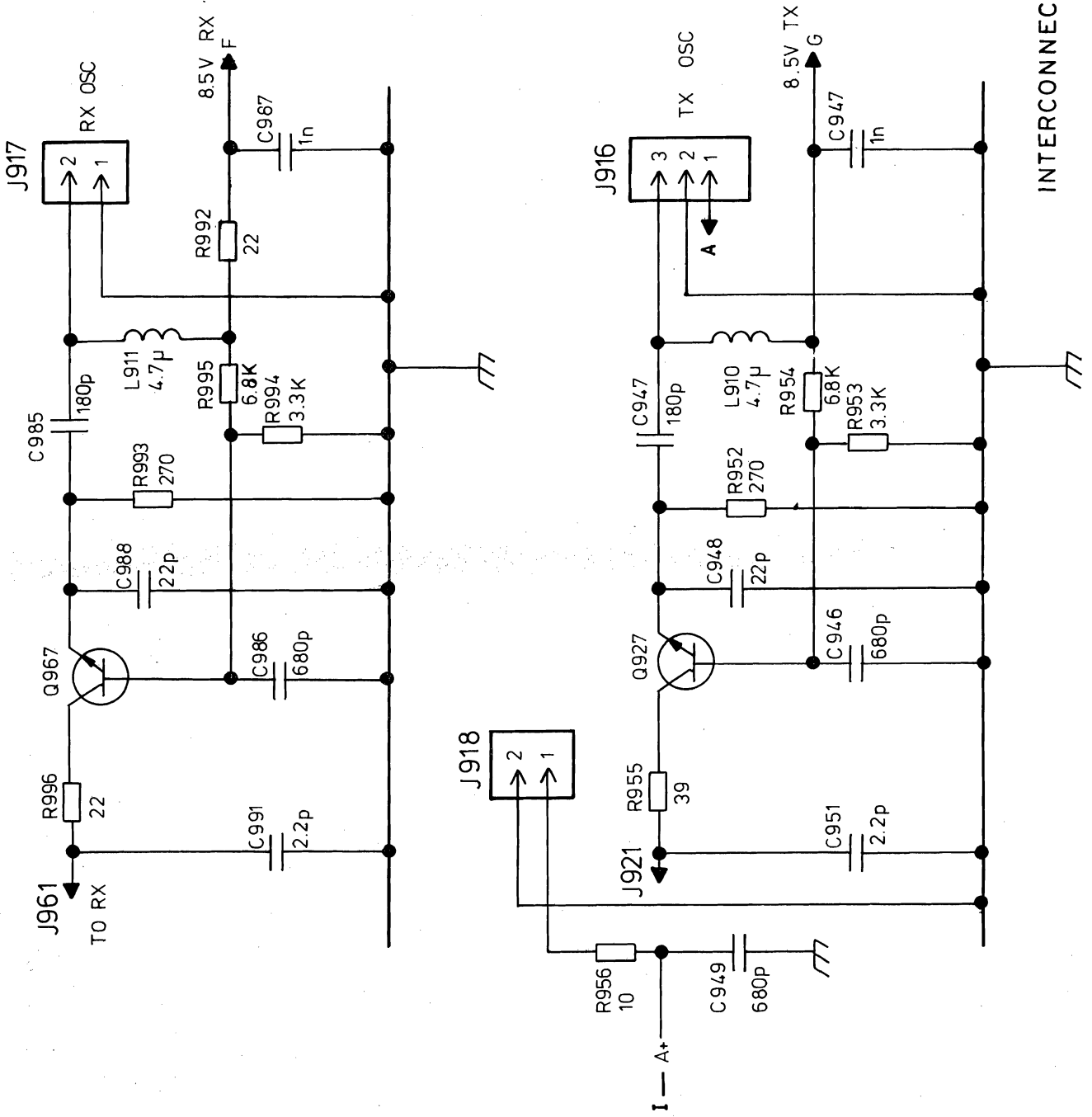


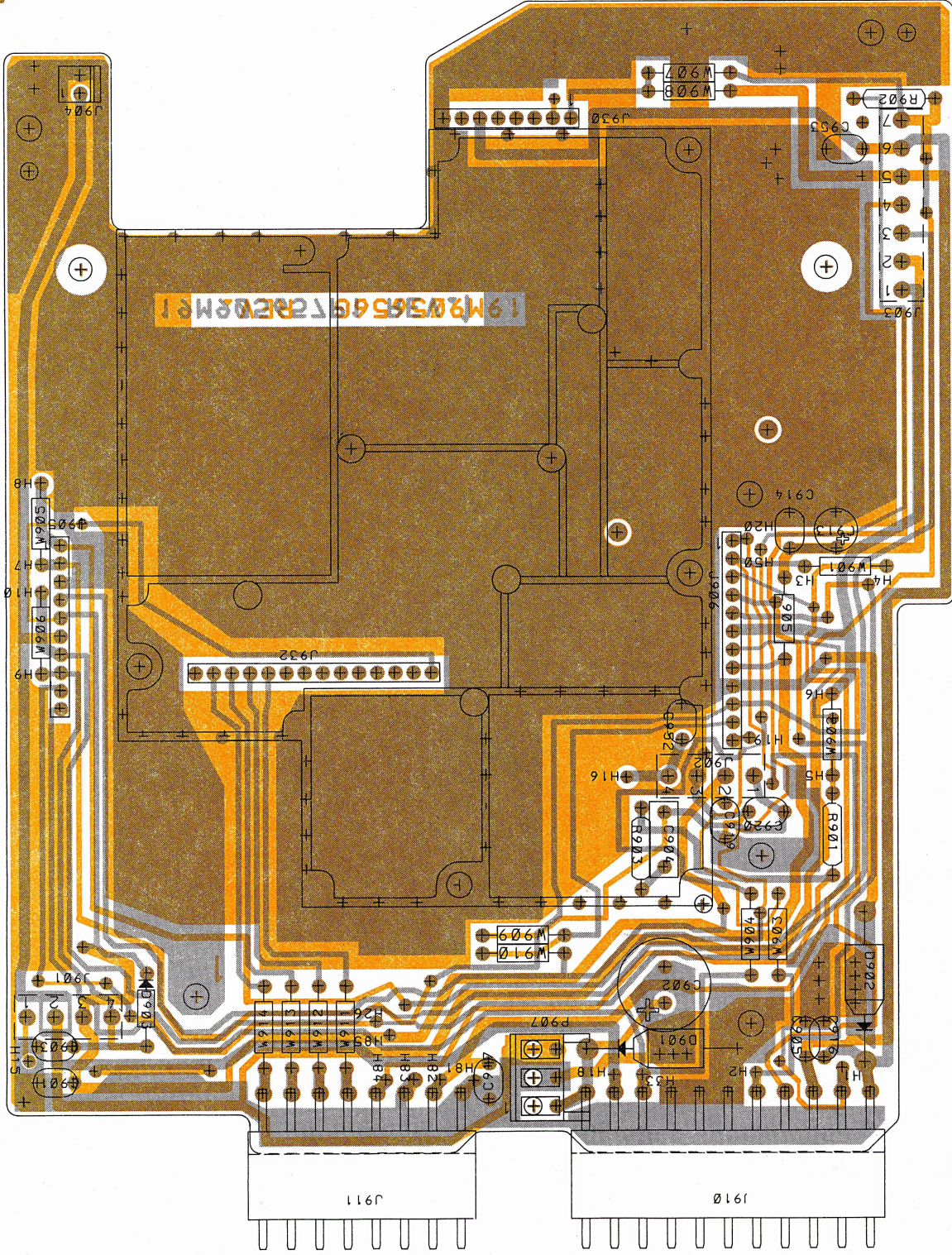
XS 5007 ONLY

INTERCONNECTION BOARD

XS5006/XS5007

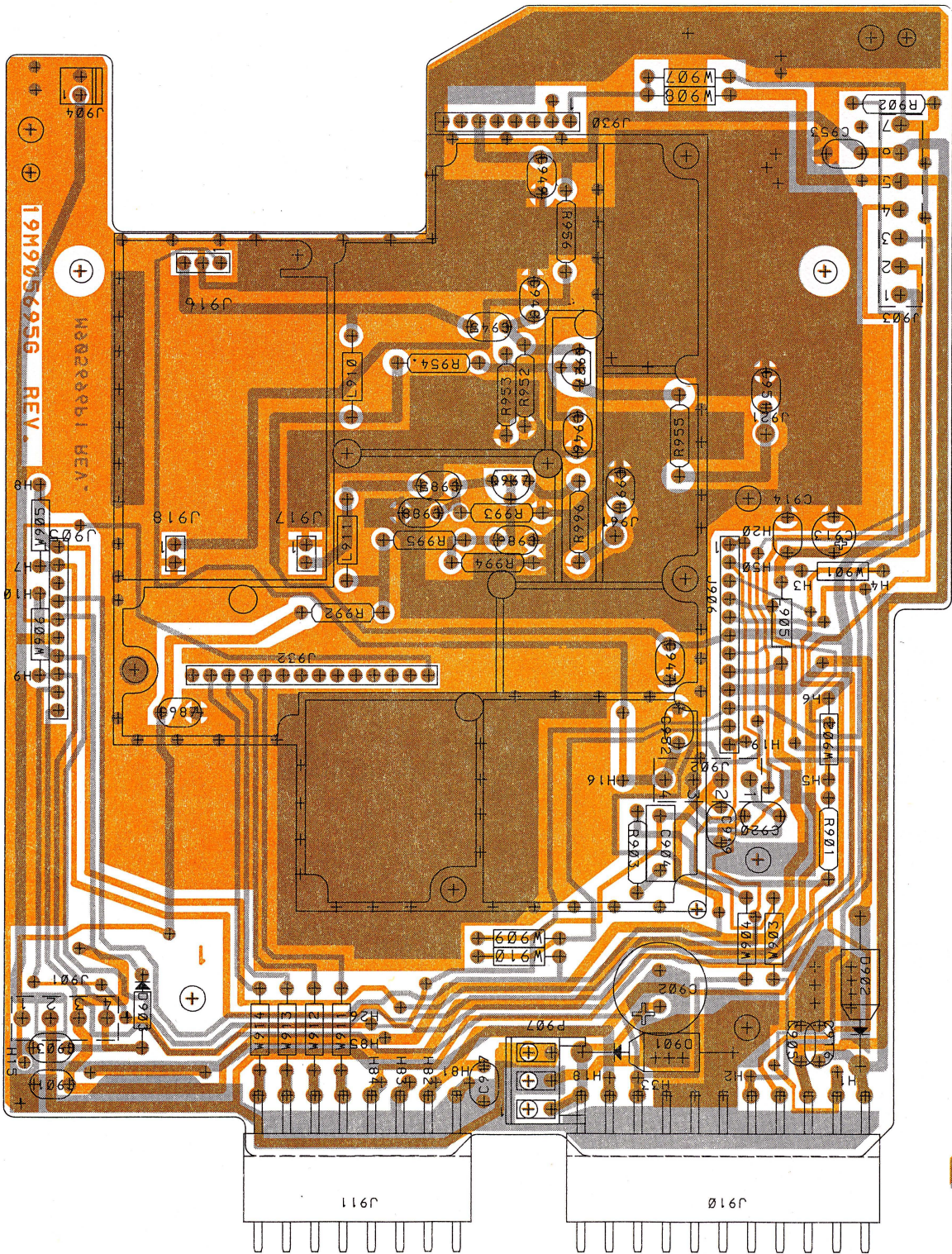
D403.467/2





INTERCONNECTION BOARD
COMPONENT LAYOUT XS 5006

D403.680



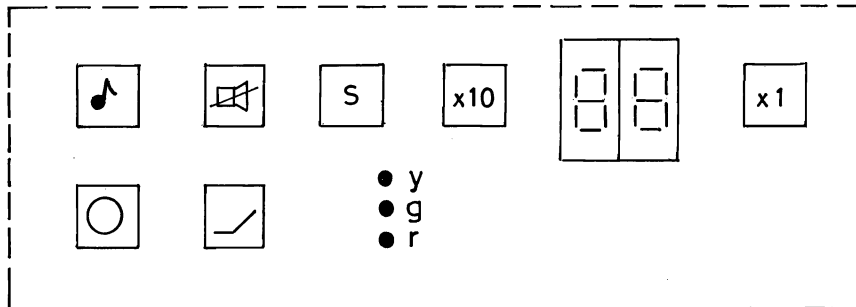
INTERCONNECTION BOARD
 COMPONENT LAYOUT XS5007

D403.679

BINARY SIGNALLING CONTROL PANEL

CP5008

KEY/DISPLAY ARRANGEMENT



OPERATIONAL PROCEDURE

'X1' and 'X10' Buttons

These buttons set the transmit address. Normally the display indicates TX address, if display is used for any other purpose (f. ex. incoming message or status) momentary operation of 'X1' or 'X10' will immediately recall present TX address.

Holding either 'X1' or 'X10' in for more than 2 secs. initiates a stepping procedure for the adjacent display segment at a rate of 2 steps per second.

The stepping start point is from present address value. After stepping has commenced, releasing and reactivating push button within a 2 second time will cause a rapid single step advancement.

When a new address has been selected this will become the new 'permanent' display contents (see 'incoming messages').

'S' Button

This button is used to set the status message. Momentarily pressing the 'S' button will recall the present status and display this for a period of 2 secs.

Holding the 'S' button in for more than 2 seconds initiates stepping of the status content of the message i. e. 0 → 15, 0 → 15 etc.

The new status contents will be displayed for 2 secs. before the display reverts to address. In the same manner as described in 'X1' and 'X10' button the status contents may be rapidly stepped incrementally by releasing and reactivating 'S' button.

The ZVEI system permits status digit values 0-15 (hexadecimal 0-F) these will be handled in the display as follows:

Status 'number'	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Display indication	-0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15

The significance of the bar '-' being that this is a status display.

Call Initiation

After entry of an address the call is initiated by pressing the 'LS' button.

This causes transmission of a single telegram containing address and status information plus a telegram containing own identity and status information. Initiating a call causes the display immediately to revert to address i.e. if status is displayed there is no need to wait for remainder of the 2 sec. time slot.

Incoming Address/Status Readout

Incoming messages - calling part's identity and status - are automatically displayed i.e. display of present transmit address is replaced with incoming message.

The identity and status portions of the message are displayed alternately for 1 second periods as shown below:

Identity 47 - for 1 second

Status -6 - for 1 second

This being repeated continuously until reset.

Re-Setting Incoming Message Display

Momentary depression of the LS in/out button cancels the incoming message display. The display then reverts to the previous TX address/status condition.

Number transfer

For call-back convenience incoming address information may be converted to TX address merely by initiating a call using the call button 'LS' i.e. without resetting the display.

In this case the transmitted status will normally be '00', unless otherwise selected and this address and status will replace any previously entered address/status information.

In connection with this facility 'traffic on air check' - incoming carrier transmitter inhibition still apply. In these cases an alarm will be given if illegal conditions apply.

Address/Status Limits

Normally all address and status values will be selectable i.e.

status 0 - 15

address 0 - 99

These will be 'rolled' forward as described earlier i.e. using 'S' button the status values:

X → 15 / 0 → 15 / 0 → 15 etc.

will pass through the display.

In a similar way using the 'X1' and 'X10' buttons the address digits will be rolled

X → 9 / 0 → 9 / 0 → 9 etc.

For radios with limited requirements for addressing it will be possible to specify, on customer order, upper and lower address limits i.e. as an example 25 - 37. In this case the 'X1' button will roll:

X → 9 / 0 → 9 / 0 → 9 etc.

whilst the 'X10' button will roll:

2 → 3 → 2 → 3 etc.

thus shortening the entering sequence.

Number Allocation


The ZVEI system pre-defines individual addresses as being 3-digit i.e. the telegram contains 3-digit information where, in this application, only the last two are variable.

To avoid interference between common channel systems a 'third' digit must be defined on customer orders i.e. the third digit may not be ignored.

Base Station Address

Normally address '00' will be the base station address. If more than one base station is to be accessed (in different areas f.ex.) the addresses for these must be defined on the customer order. These should preferably be 01, 02, 03 etc.

Transmission of Address/Identity

- Operation of the call button '  ' transmits two telegrams containing:
Address/status + identity/status.
- After operation of call button as above the succeeding operations of the PTT function can be selected - on customer order - to activate the following:
 - a) Speech condition (no further telegram transmission).
 - b) Transmission of telegram with own identity followed by speech condition.
 - c) Transmission of telegrams with: Address - own identity, followed by speech condition.

Choice a) transfers address/status/identity information only during call set-up and the decoder in this case will only accept identity information when immediately preceded by a correctly decoded individual or group call.

Choice b) refreshes identity at every PTT operation. In this case the decoder accepts any identity information (and displays it) after the initial call set-up. Common channel users will in this case reveal themselves if operating "against the rules".

Choice c) refreshes both address and identity at every PTT operation. In this case the decoder only accepts display identity information with correct address information preceding it.

NB! In both case b) and c) each transmission will contain short signalling bursts, at the beginning, which will be audible at the receiving end.

IndicatorsTransmit indicator-red

Red indicator indicates activation of transmitter.

SQ indicator-green

Squelch indicator - 'busy lamp'.

Call indicator - yellow

Yellow indicator flashes as call indicator, the 'LS' opens simultaneously, the indicator is continuously on as indication of 'LS' in, if selected manually.

After reception of a 'cleardown' signal the indicator will continue to flash as call indication even though in this case the 'LS' is out.

Resetting is performed by momentarily pressing the 'LS' in/out button.

If 'LS' is open, a single push on the LS in/out button clears the indicator and closes 'LS'.

If 'LS' is closed the first push on the LS in/out button opens the 'LS' and the flashing indication switches to continuous on. The second push on the 'LS' in/out button closes 'LS' and cancels the indication.

Acoustic Feed-Back

All button activations resulting in change of state are confirmed by a 'beep' tone.

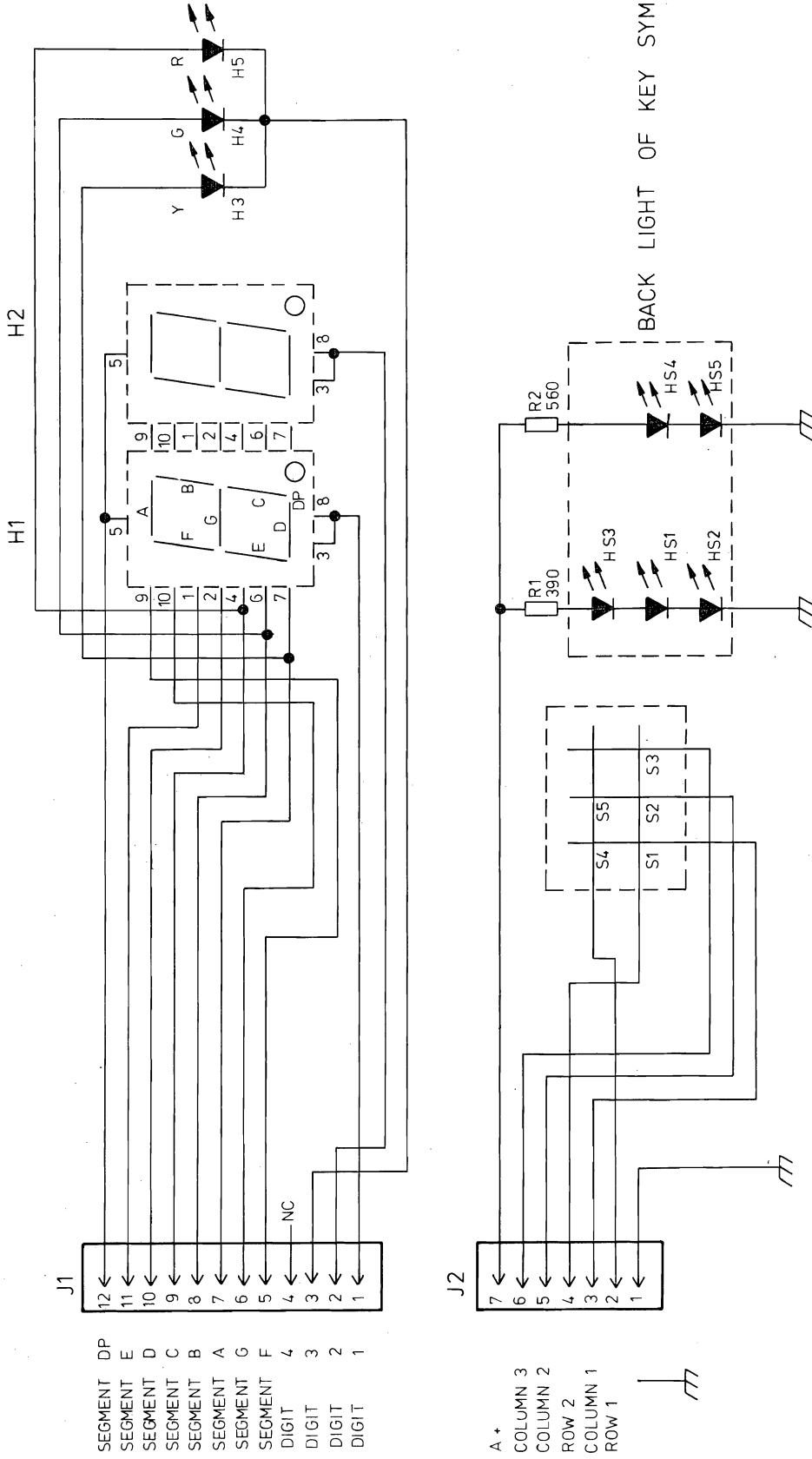
Status Message - Address Dependence






If a new address is entered without a new status message the transmitted telegram will automatically contain status '00'

Memory Retention/Start-Up

The only information retained at switch-off is the last used address, the status message defaults is '00'.

If a power failure has occurred the radio will give an alarm. After this the radio will revert to the lowest legal address and status '00'.



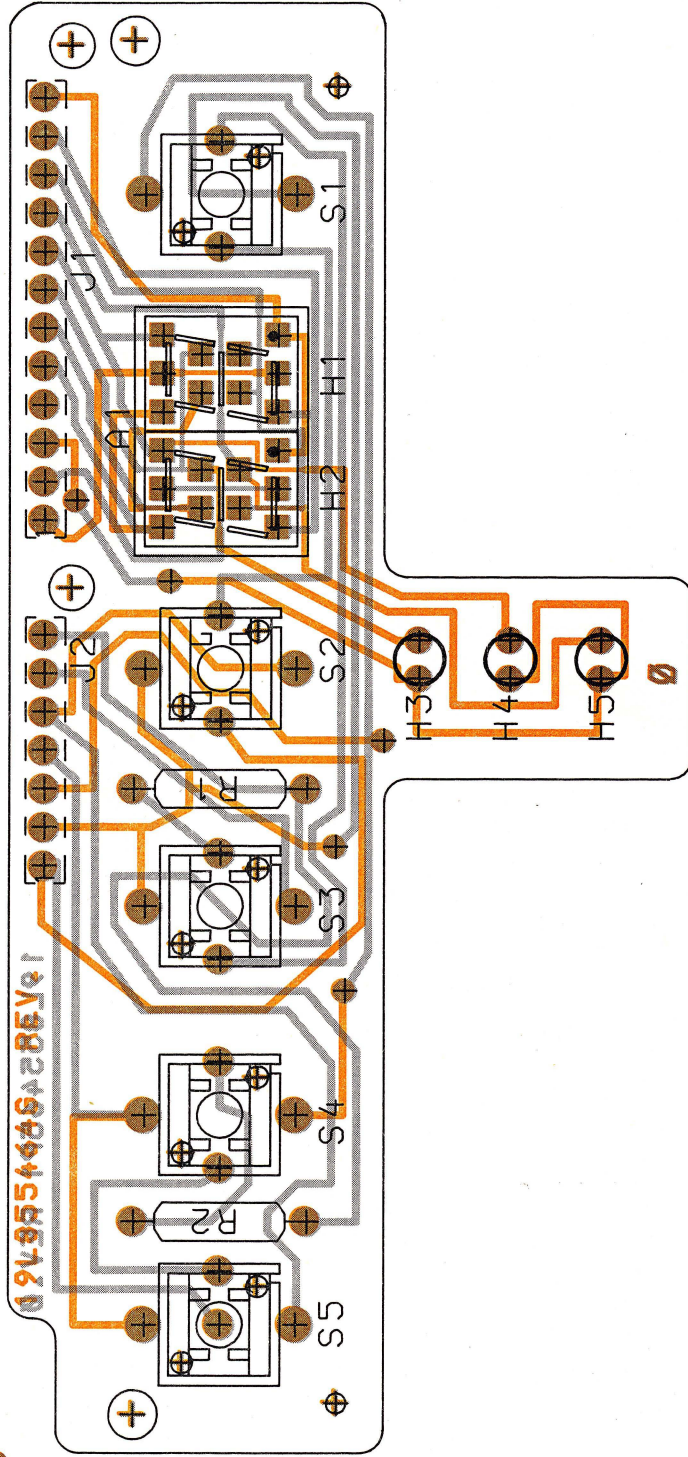
- S1 KEY SYMBOL 
- S2 KEY SYMBOL 
- S3 KEY SYMBOL 
- S4 KEY SYMBOL 
- S5 KEY SYMBOL 

CONTROL PANEL CP 5008

D403.685

Storno

Storno



CONTROL PANEL CP5008
COMPONENT LAYOUT

D403.686

BINARY SIGNALLING PROGRAMMING

CL5002

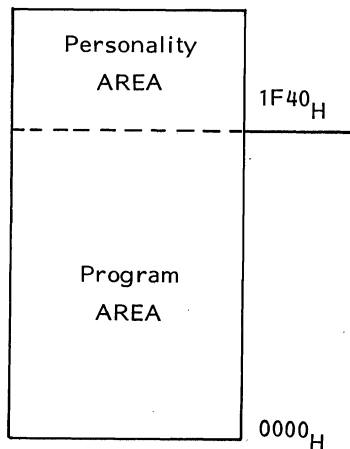
The personality data are programmed into the prom which also contains the microprocessor program. A special area in the prom starting at address 1F40 (HEX) is reserved exclusively for personality data.

A master prom or a prom preprogrammed with the microprocessor program must be available either for copying the program data or for adding the personality data.

The preprogrammed device has part no. J707932G1 and care must be taken not to change the program data.

A prom device without program has part no. J707932P1.

All programmable options, their abbreviations and valid data are listed below.



FUNCTION LIST

ID-Number IDN =

4 first digits identify the system
2 last digits identify the individual radio

Legal range 000000 - 999999

TX Admit TXA =

Indication of free channel

Legal values: 0, 1, 2

0 = Channel free or LS open
1 = Channel free
2 = LS open

Factory default value: 0

Automatic Call on First PTT ACL =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID on Each PTT IDP =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID Time Interval IDT =

Time interval specified in seconds.

Legal range: 0 - 255 (0 - FF HEX)

NO = 0 (definite)

Factory default: 20 sec. = 14_H

ID Includes Call Address IDA =

Legal values: YES = 0, NO = 1

Factory default: 0

Carrier Control Timer CCT =

Time specified in minutes.

Legal values: 0, 1, 2, 3, 4

0 = Definite

1 = 1 min. data = 3C_H

2 = 2 min. data = 78_H

3 = 3 min. data = B4_H

4 = 4 min. data = F0_H

Acknowledge ACK =

Legal values: YES = 0, NO = 1

Factory default value: 0

Privacy PRI =

Legal values: YES = 1, NO = 0

Factory default: 0

Incomming Status Readout INS =

Legal values: YES = 0, NO = 1

Factory default: 0

Address Tens, low limit ALO =

Specifies the lower limit of the address code, see also high limit.

Legal values: 0 - 9

Factory default: 0

Address Tens, high limit AHI =

Specifies the higher limit of the address code.

Legal values: 0 - 9

Factory default: 9

Example: ALO = 3, AHI = 6

The address code can then go from 30 - 69

Status Low Limit SLO =

Specifies the lower limit of the status code.

Legal range 0 - 15 (0 - F_H)

Factory default: 0

Status High Limit SHI =

Specifies the higher limit of the status code.

Legal range 0 - 15 (0 - F_H)

Factory default: 15 (F_H)

Group and All Call GAT =

Legal values: YES = 0, NO = 1

Factory default: 0

Extra Base Station Addressing XBA =

Legal values: 0 - 9

0 = NO

1 - 9 = Number of extra Base Stations.

Base Station Option BSO =

Legal values: YES = 0, NO = 1

Factory default: 0

Test Mode TSM

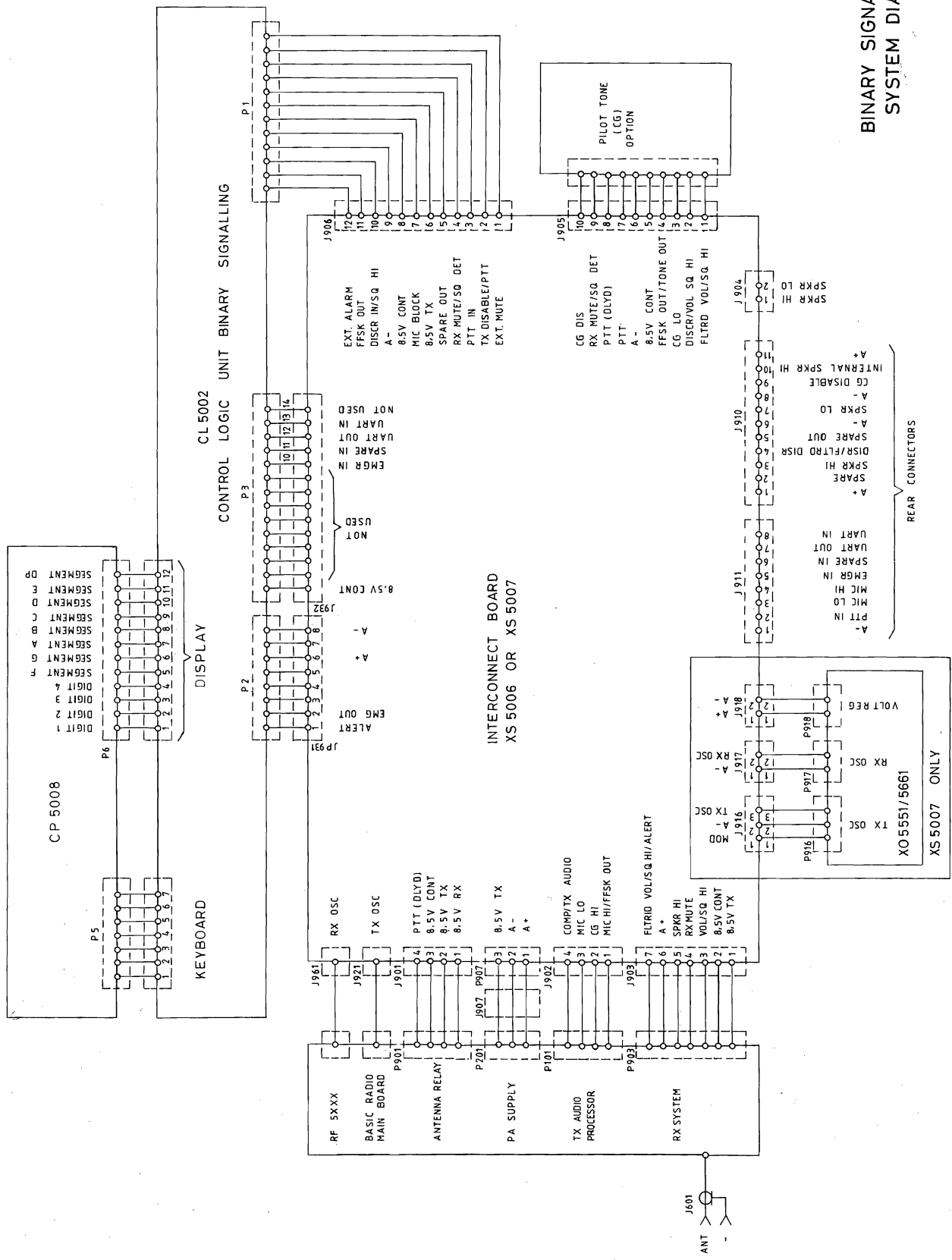
Only available for factory testing.

Legal value: 0

ADDRESS LIST

PROM ADDRESS	FUNCTION	ABBREV	DATA
1F40 1F41 1F42 1F43 1F44 1F45	ID-Number Example: IDN = 123456 System 1234 indiv. 56 Program F1-F2-F3- F4 F5 F6	IDN	1. system digit 2. system digit 3. system digit 4. system digit 1. Individ. digit 2. Individ. digit
1F46	TX Admit	TXA	00 _H = CH free or LS open 01 _H = CH free 02 _H = LS open
1F47	Automatic Call on First PTT	ACL	00 _H = YES FF _H = NO
1F48	ID on Each PTT	IDP	00 _H = YES FF _H = NO
1F49	ID Time Interval	IDT	00 = Definite 1 - 255 seconds 01 _H - FF _H)
1F4A	ID Includes Call Address	IDA	00 _H = YES FF _H = NO

PROM ADDRESS	FUNCTION	ABBREV	DATA
1F4B	Carrier Control Timer	CCT	00 _H = NO (definite) 3C _H = 1 min. 78 _H = 2 min. B4 _H = 3 min. F0 _H = 4 min.
1F4C	Acknowledge	ACK	00 _H = YES FF _H = NO
1F4D	Privacy	PRI	00 _H = NO FF _H = YES
1F4E	Incomming Status Readout	INS	00 _H = YES FF _H = NO
1F4F	Address Tens, Low Limit	ALO	00 - 09 _H Value specified by ALO =
1F50	Address Tens, High Limit	AHI	00 - 09 _H Value specified by AHI =
1F51	Status, Low Limit	SLO	00 - 0F _H (0-15) Value specified by SLO =
1F52	Status, High Limit	SHI	00 - 0F _H (0-15) Value specified by SHI =
1F53	Group and All Call	GAT	00 _H = YES FF _H = NO
1F54	Base Station Option	BSO	00 _H = YES FF _H = NO
1F55	Extra Base Station Addressing	XBA	00 _H = NO 01H - 09 _H specified by XBA
1F56	Test Mode	TSM	00 _H = Fixed data

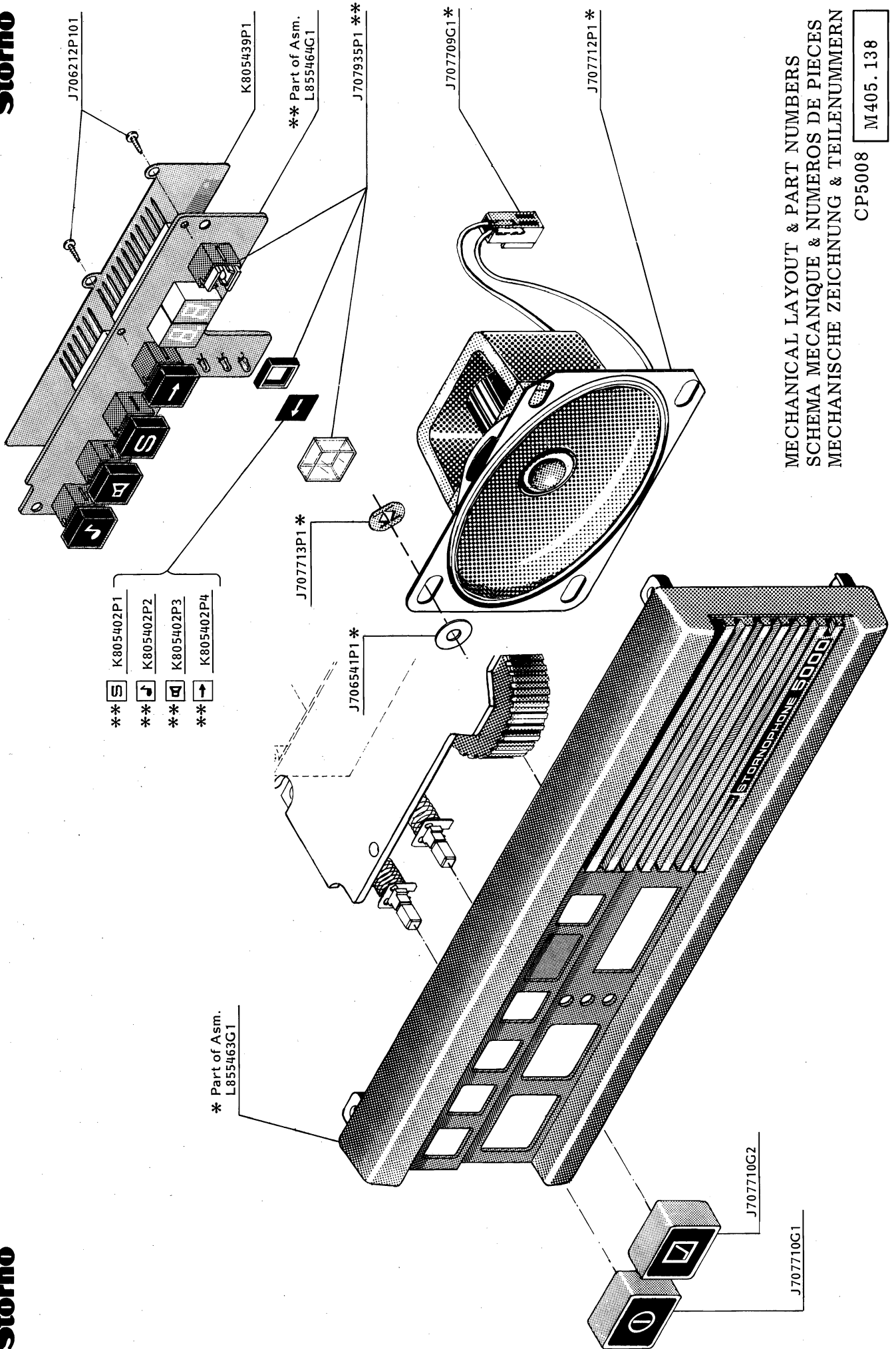


BINARY SIGNALLING CQM 5000 SYSTEM DIAGRAM

D403.466/2

Storno

Storno



MECHANICAL LAYOUT & PART NUMBERS
SCHEMA MECANIQUE & NUMEROS DE PIECES
MECHANISCHE ZEICHNUNG & TEILENUMMERN

CP5008

M405.138

NOTE: 1
TO MODIFY FOR MULTI-FREQUENCY
AND FOR TEMPERATURE COMPENSATED
OSCILLATORS REMOVE R157 (DISABLE TX
OSC.) AND R309 (DISABLE RX OSC.)

NOTE: 2
VALUE OF R636 DEPENDS ON COLOR
MARK ON U602

U602	R636 VALUE Δ
BROWN	OMIT
RED	270
ORANGE	100
YELLOW	47
GREEN	22
BLUE	6,8

CAPACITOR VALUES PICOFARADS (EQUAL
TO MICROMICROFARADS) UNLESS FOLLOWED
BY μ F= MICROFARADS. INDUCTANCE VALUES
IN NANOHENRYS UNLESS FOLLOWED BY μ H=
MICROHENRYS, mH=MILLIHENRYS.

NOTE: *
R109 = 1,8K FOR SWEDEN

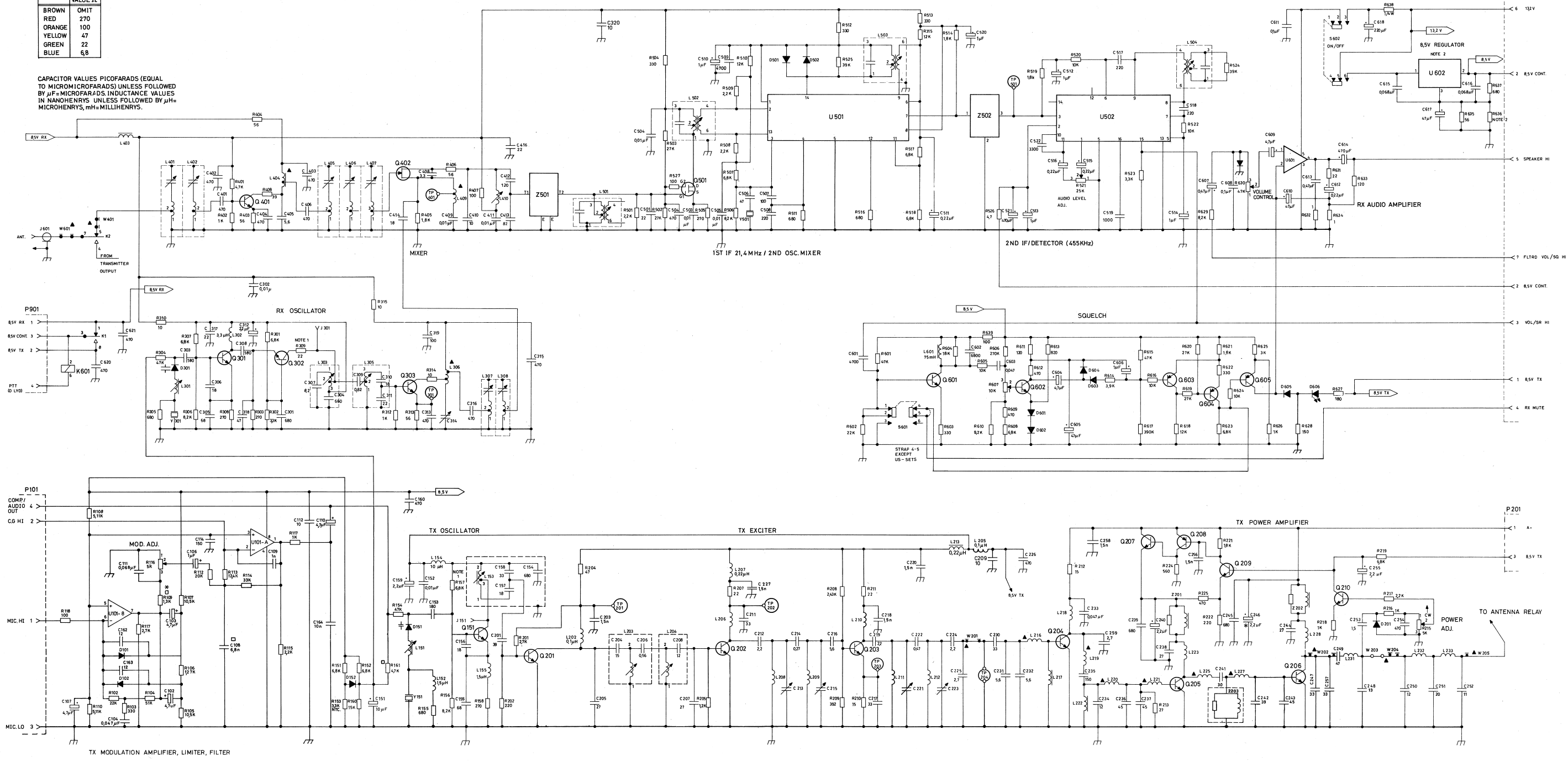
NOTE: \square
12,5 KHz UNITS (RF 5664)

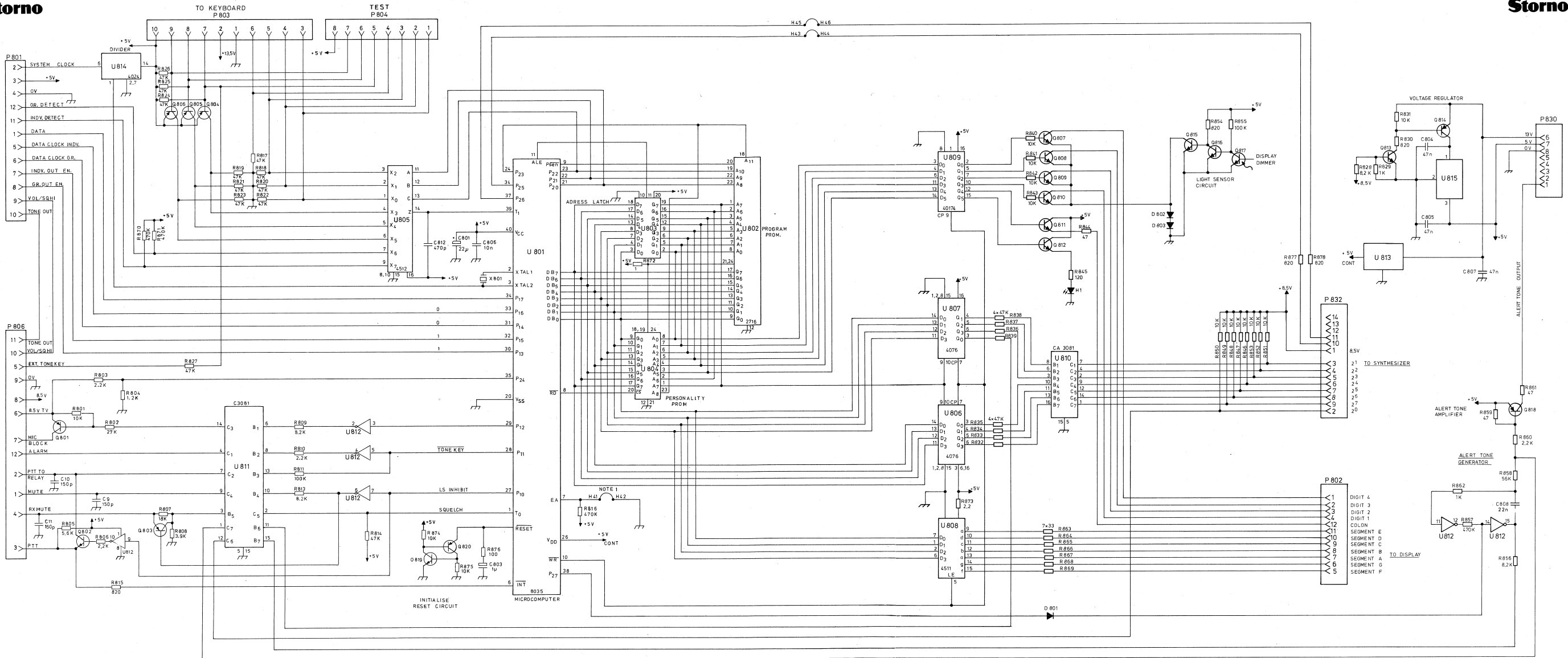
R109 = 1,8K

R161 = REMOVED

C108 = 10nF

NOTE: \blacktriangle
PART OF PRINTED WIREBOARD



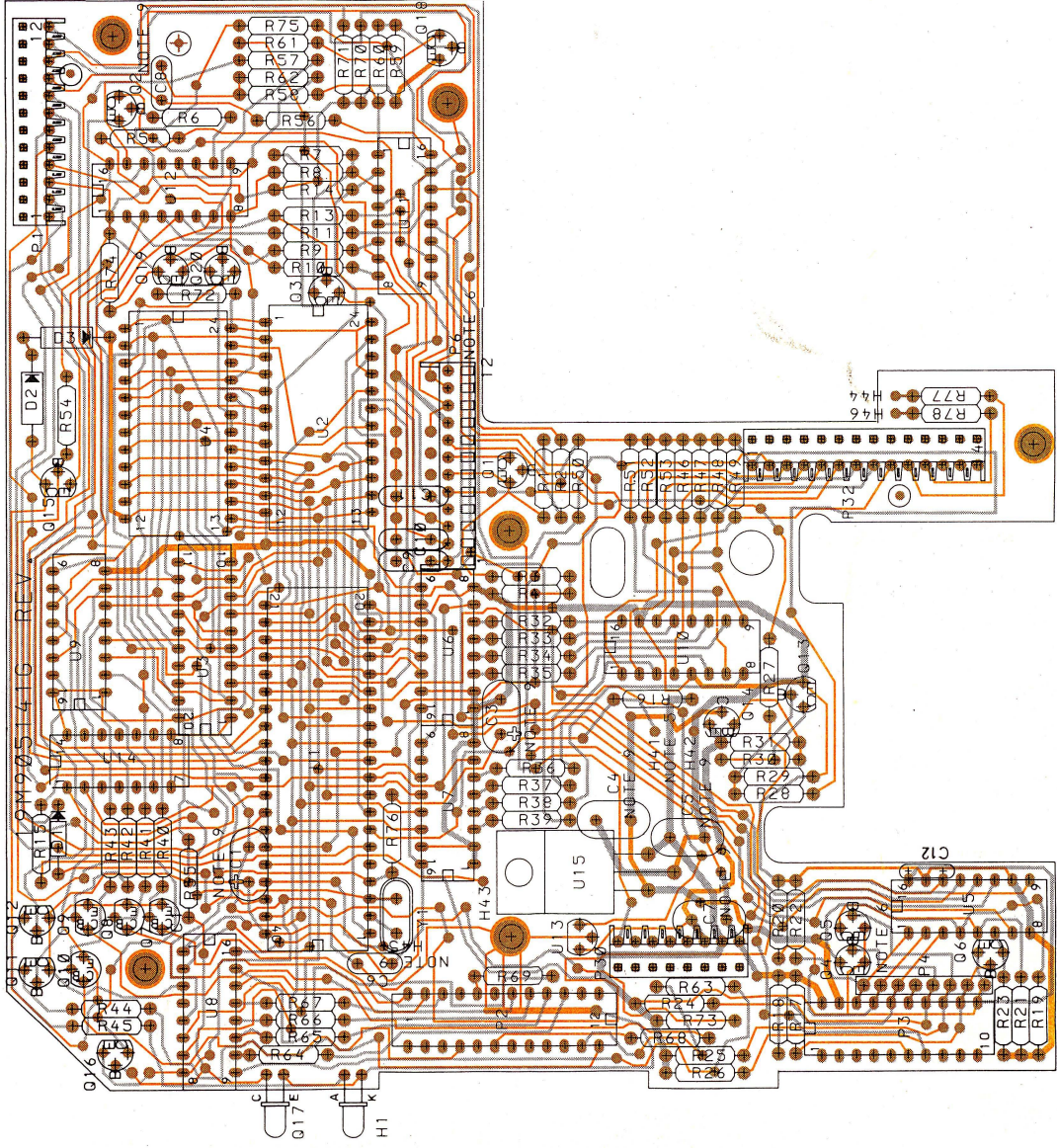


NOTE1: OMIT STRAP FOR E PROM
 INSERT STRAP FOR INTERNAL PROGRAM MEMORY

CONTROL LOGIC CL5001

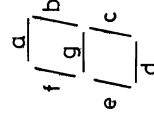
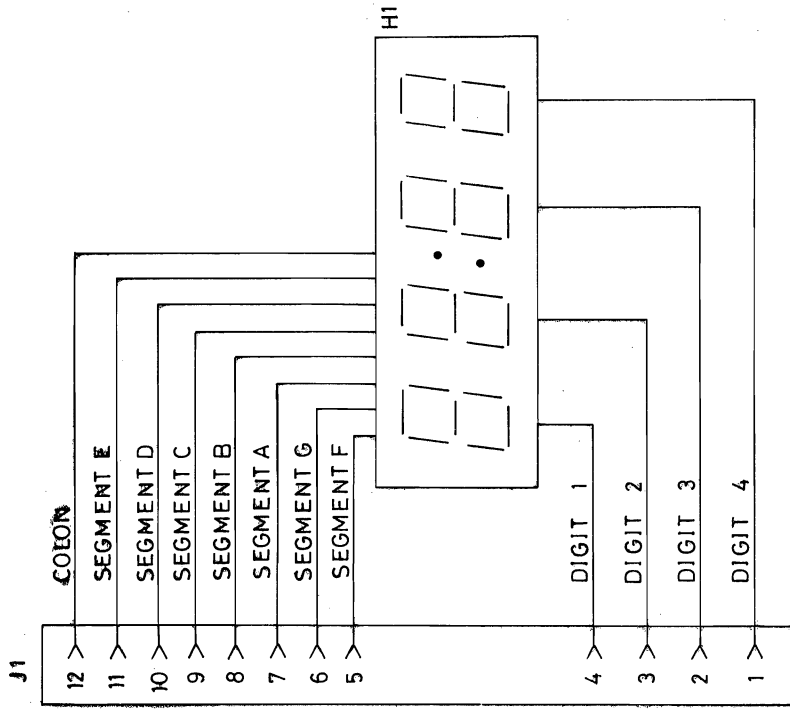
Storno

Storno

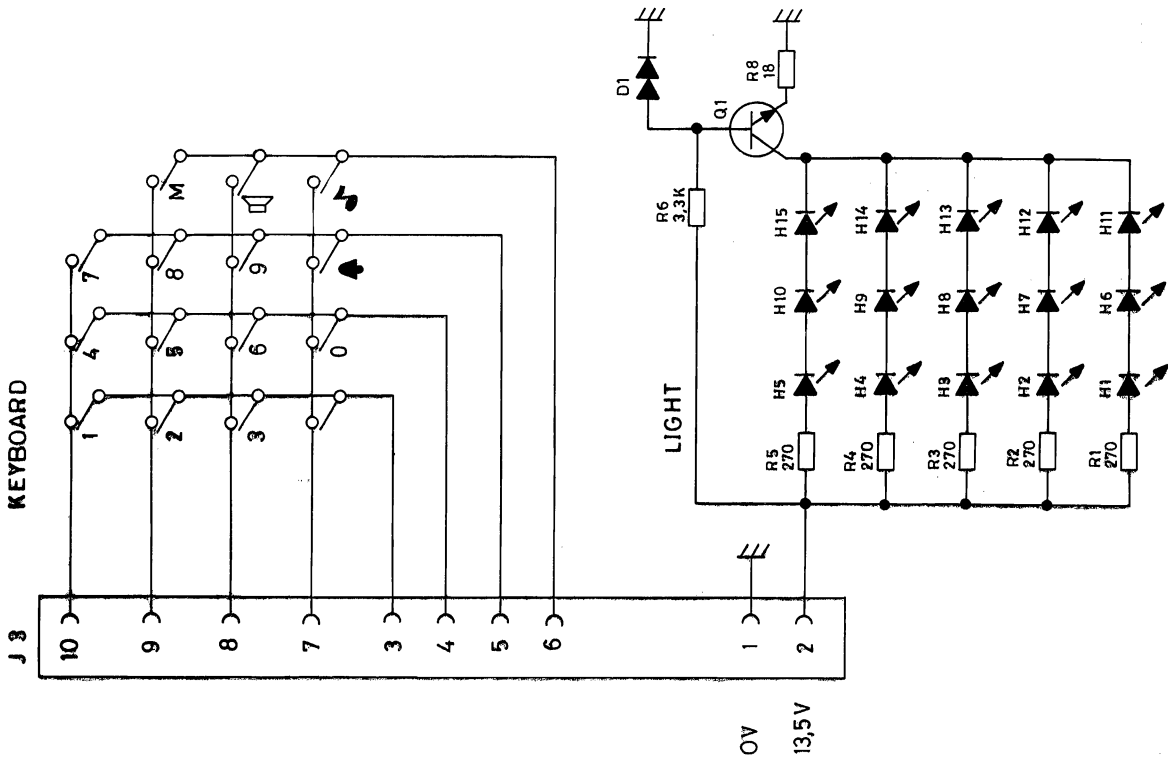


CONTROL LOGIC CL5001

D403.039/2



SEGMENT OF DIGIT



Storno

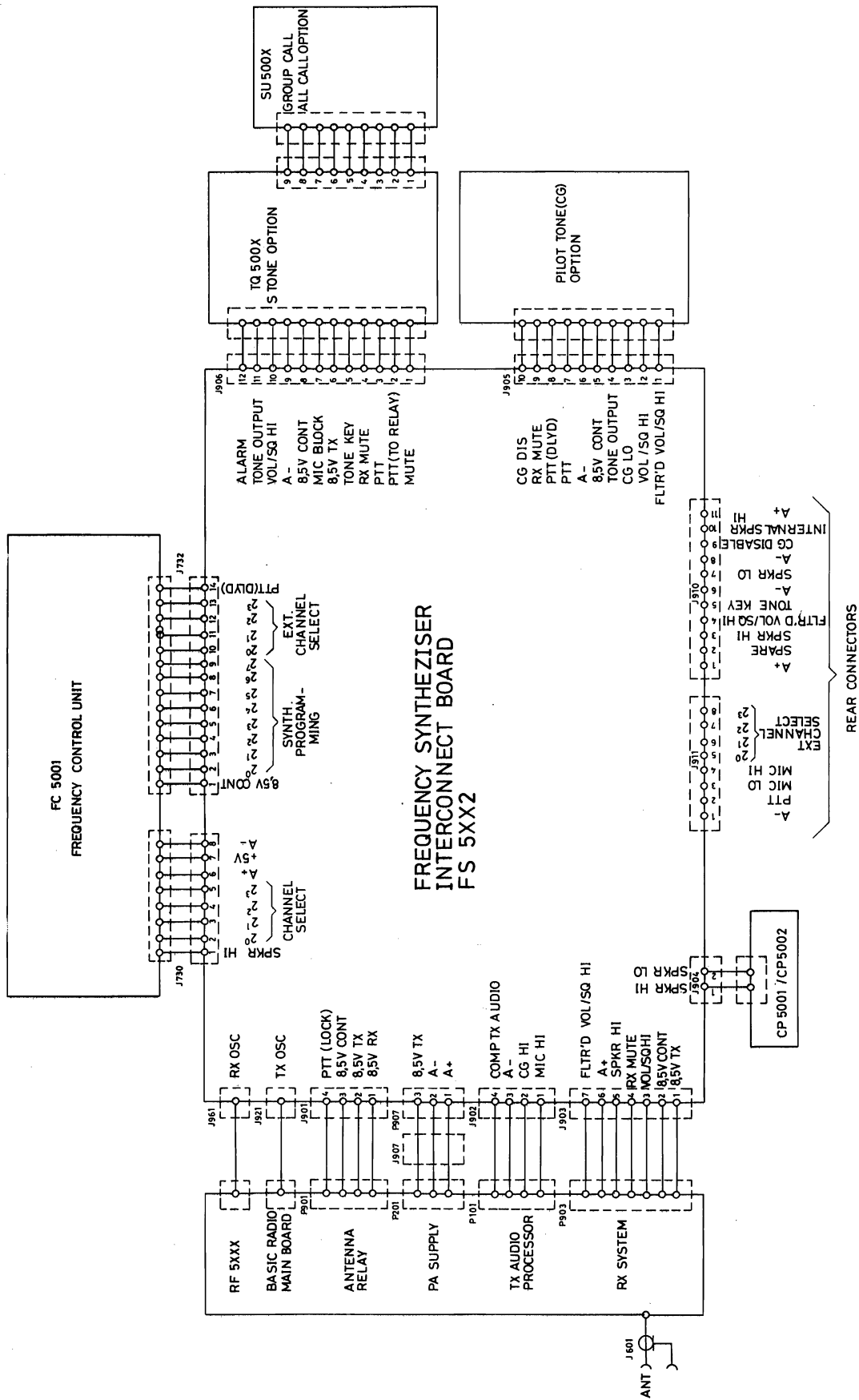
Nº	CODE	DATA
H1-15	L855164P1 L855165G1 L855189G1	Front cap. assembly Keyboard assembly Display assembly
D1	J906022P1	LED
J3	A700053P1	BAV99 diode
Q1	A700072P9 J706718P1	Connector male BCX54 Transistor
R1	B800671P271	270 ohm
R2	B800671P271	270 ohm
R3	B800671P271	270 ohm
R4	B800671P271	270 ohm
R5	B800671P271	270 ohm
R6	B800671P271	270 ohm
R8	B800607P180	18 ohm
H1-4	J706834P1	7-segment display
J2	A700072P11	Connector male
		10 pos
		0.125 W
		0.125 W
		0.125 W
		0.125 W
		0.125 W
		0.125 W
		0.125 W
		12 pos

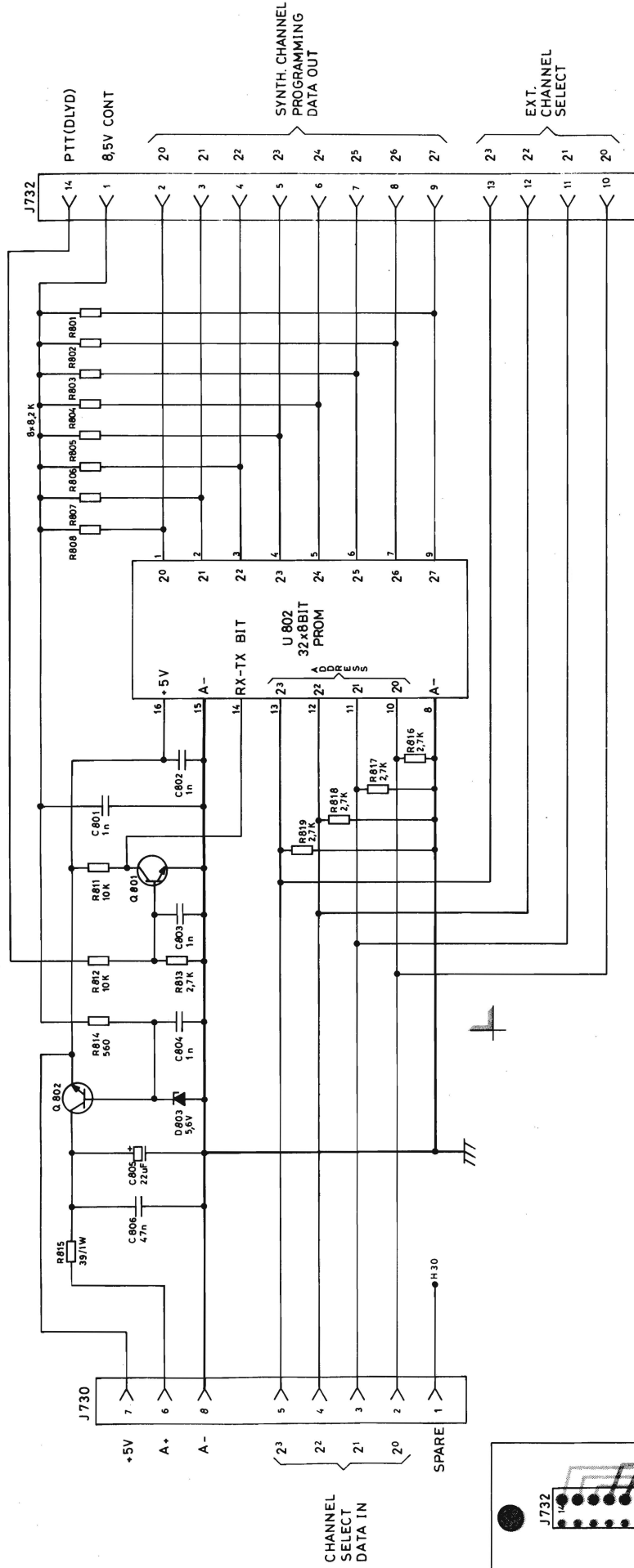
Storno

Nº	CODE	DATA

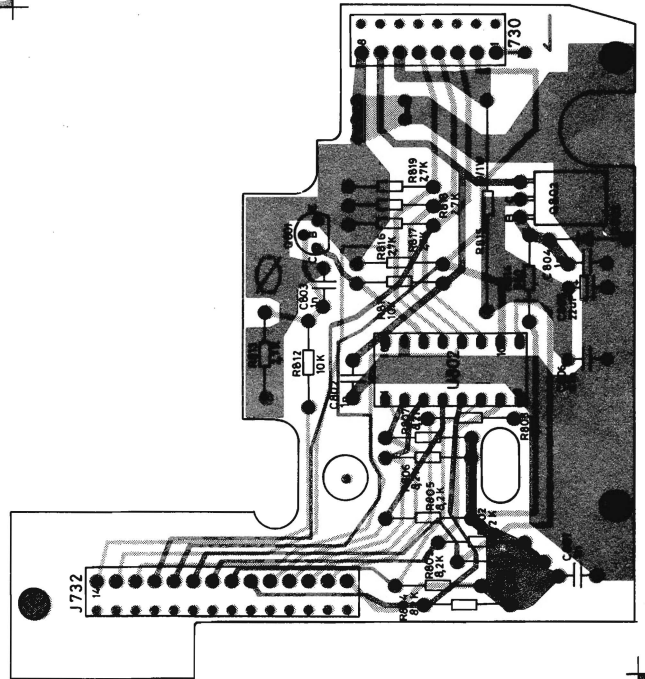
CONTROL PANEL CP5005

X403.053



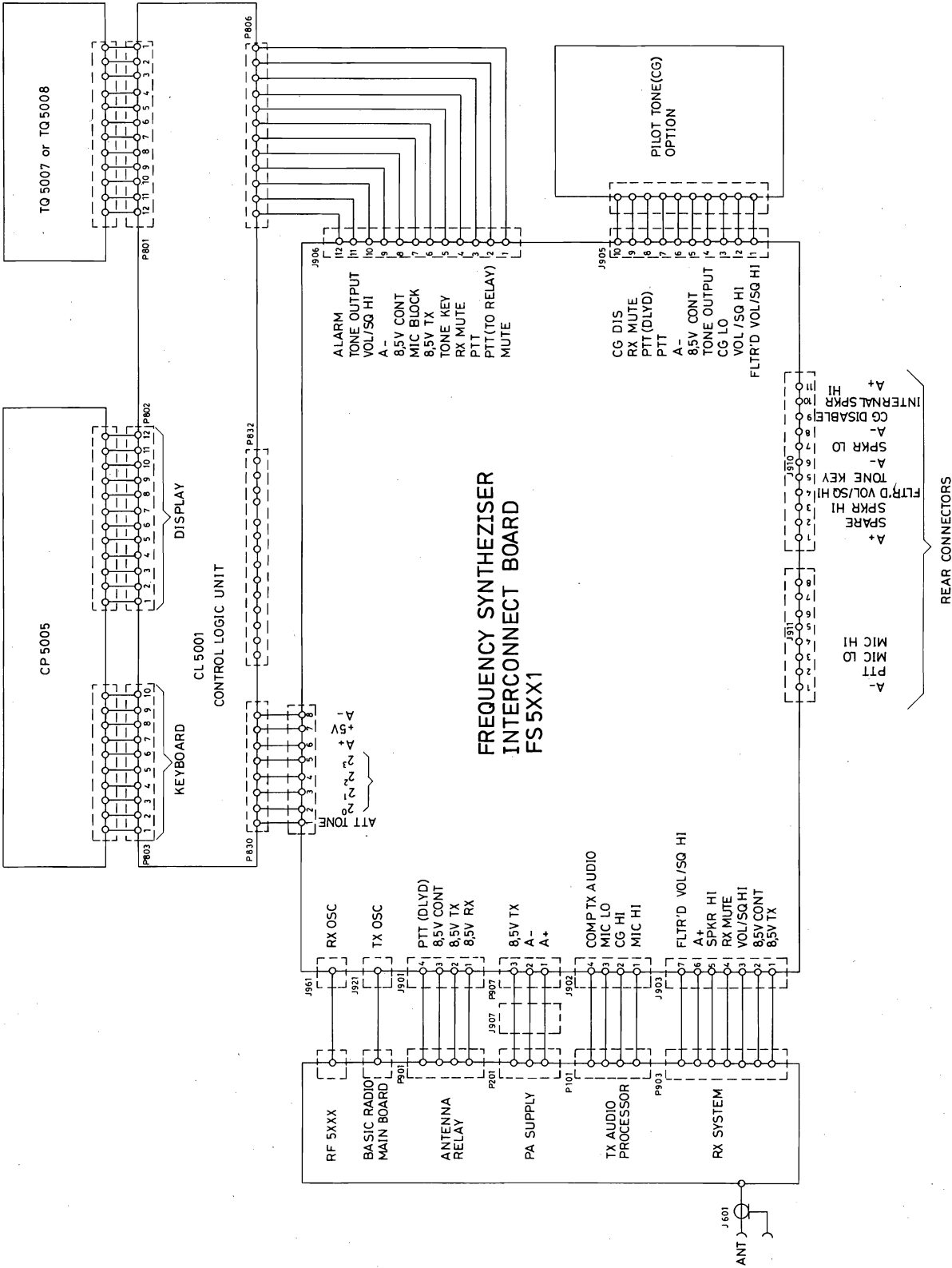


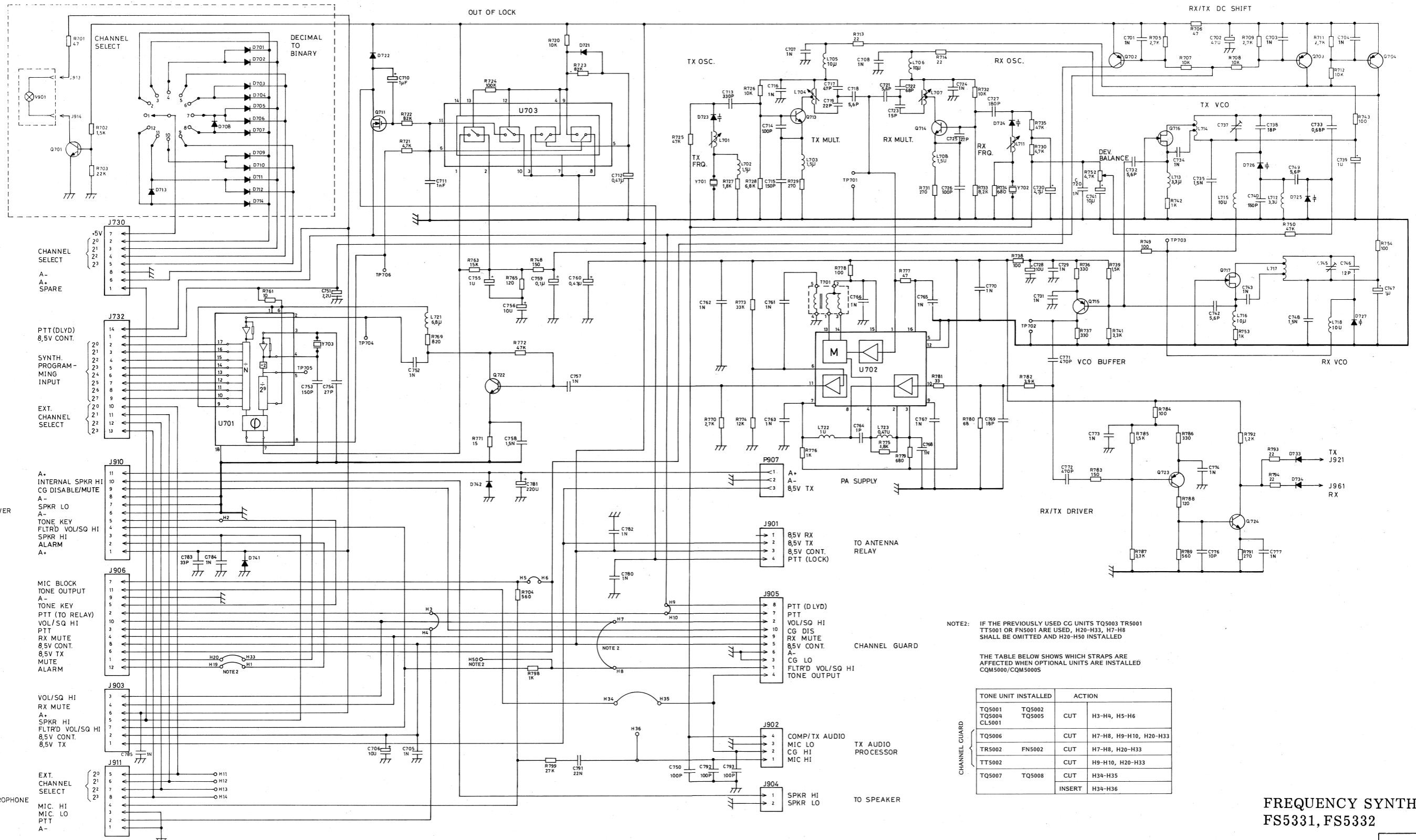
CHAN- NEL	J730			
	23	22	21	20
1	0	0	0	0
2	0	0	0	1
3	0	0	0	0
4	0	0	1	1
5	0	1	0	0
6	0	1	0	1
7	0	1	1	0
8	0	1	1	1
9	1	0	0	0
10	1	0	0	1
11	1	0	1	0
12	1	0	1	1



FREQUENCY CONTROL FC5001

D402. 885



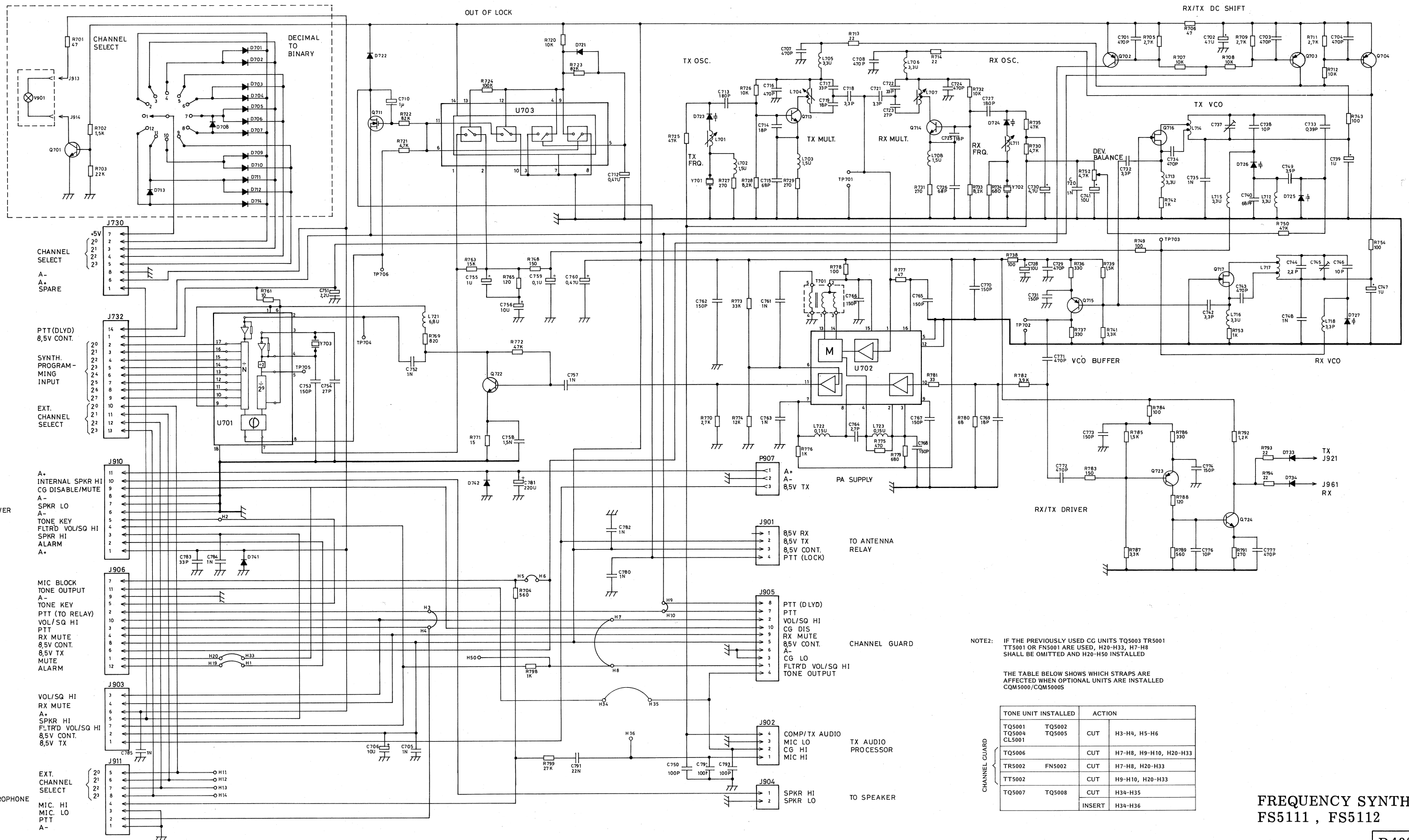


NOTE2: IF THE PREVIOUSLY USED CG UNITS TQ5003 TR5001 TT5001 OR FN5001 ARE USED, H20-H33, H7-H8 SHALL BE OMITTED AND H20-H50 INSTALLED

THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5005

TONE UNIT INSTALLED		ACTION	
TQ5001	TQ5002	CUT	H3-H4, H5-H6
TQ5004	TQ5005		
CL5001			
TQ5006		CUT	H7-H8, H9-H10, H20-H33
TR5002	FN5002	CUT	H7-H8, H20-H33
TT5002		CUT	H9-H10, H20-H33
TQ5007	TQ5008	CUT	H34-H35
		INSERT	H34-H36

FREQUENCY SYNTHESIZER
FS5331, FS5332

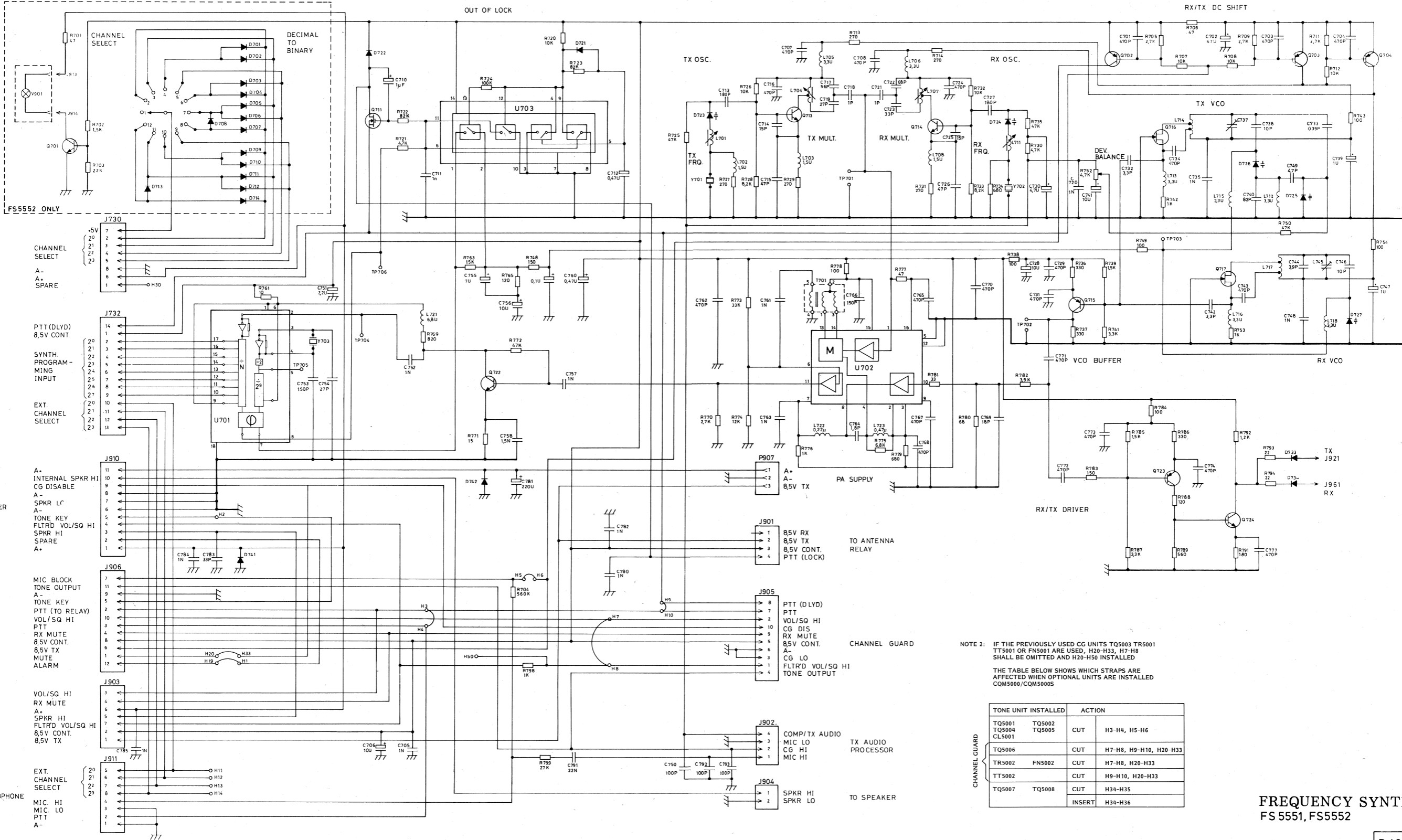


NOTE: IF THE PREVIOUSLY USED CG UNITS TQ5003 TR5001 TT5001 OR FN5001 ARE USED, H20-H33, H7-H18 SHALL BE OMITTED AND H20-H50 INSTALLED

THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5000S

TONE UNIT INSTALLED		ACTION	
TQ5001	TQ5002	CUT	H3-H4, H5-H6
TQ5004	TQ5005		
CL5001			
TQ5006		CUT	H7-H8, H9-H10, H20-H33
TR5002	FN5002	CUT	H7-H8, H20-H33
TT5002		CUT	H9-H10, H20-H33
TQ5007	TQ5008	CUT	H34-H35
		INSERT	H34-H36

FREQUENCY SYNTHESIZER
FS5111, FS5112

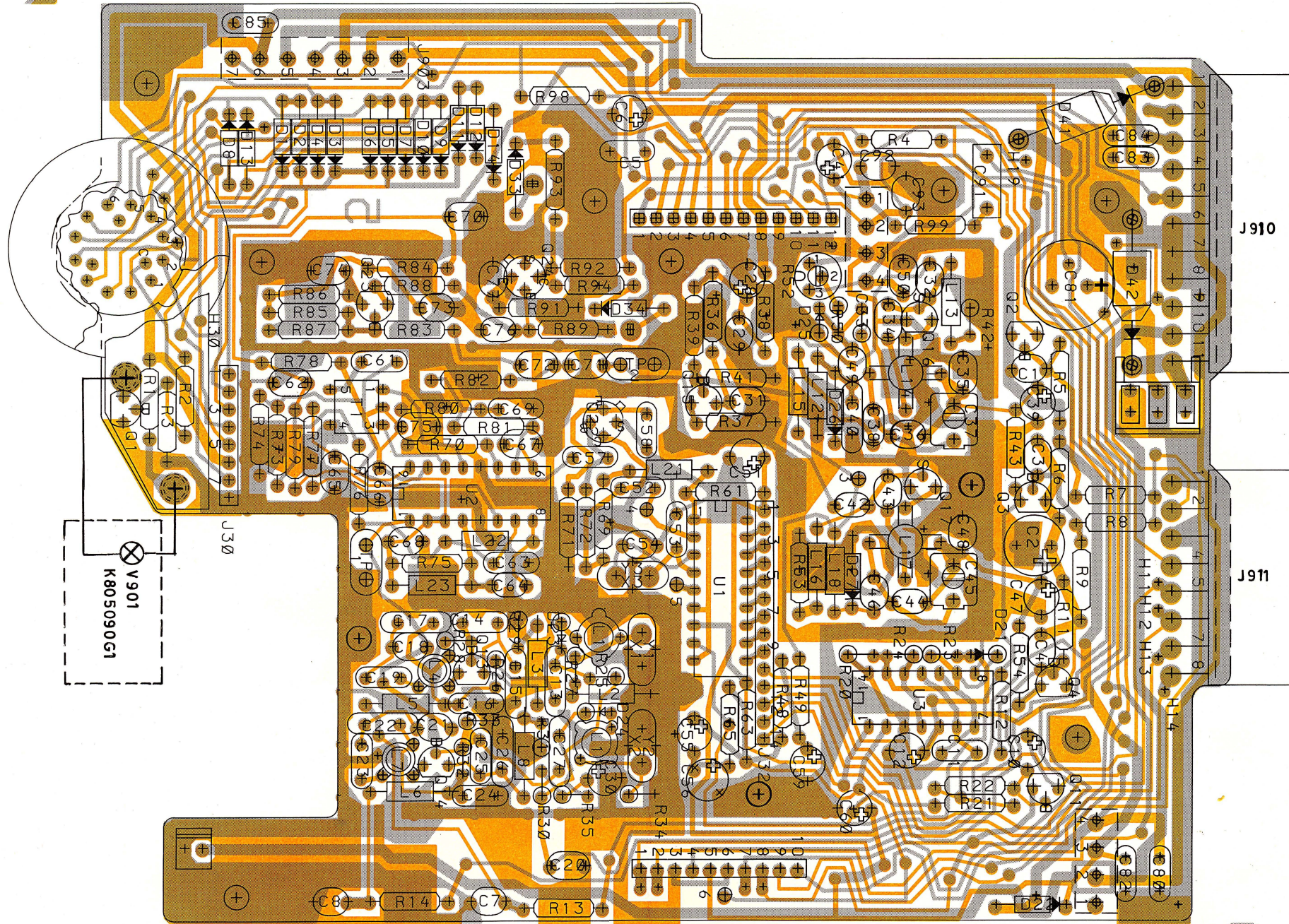


NOTE 2: IF THE PREVIOUSLY USED CG UNITS TQ5003 TR5001 TT5001 OR FN5001 ARE USED, H20-H33, H7-H8 SHALL BE OMITTED AND H20-H50 INSTALLED

THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED

TONE UNIT INSTALLED		ACTION	
TQ5001	TQ5002	CUT	H3-H4, H5-H6
TQ5004	TQ5005	CUT	H7-H8, H9-H10, H20-H33
CL5001		CUT	H7-H8, H20-H33
TQ5006		CUT	H7-H8, H9-H10, H20-H33
TR5002	FN5002	CUT	H7-H8, H20-H33
TT5002		CUT	H9-H10, H20-H33
TQ5007	TQ5008	CUT	H34-H35
		INSERT	H34-H36

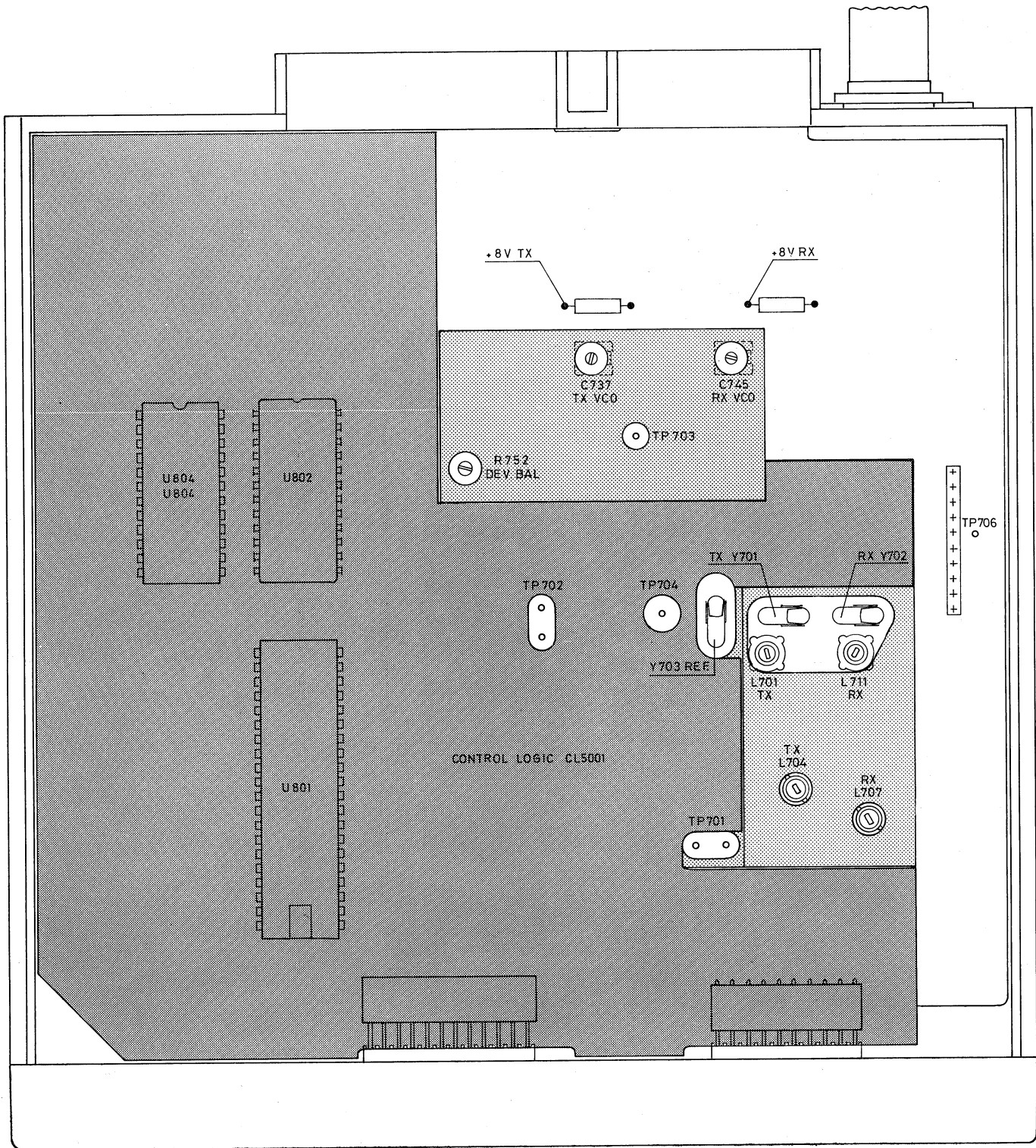
FREQUENCY SYNTHESIZER
FS 5551, FS5552



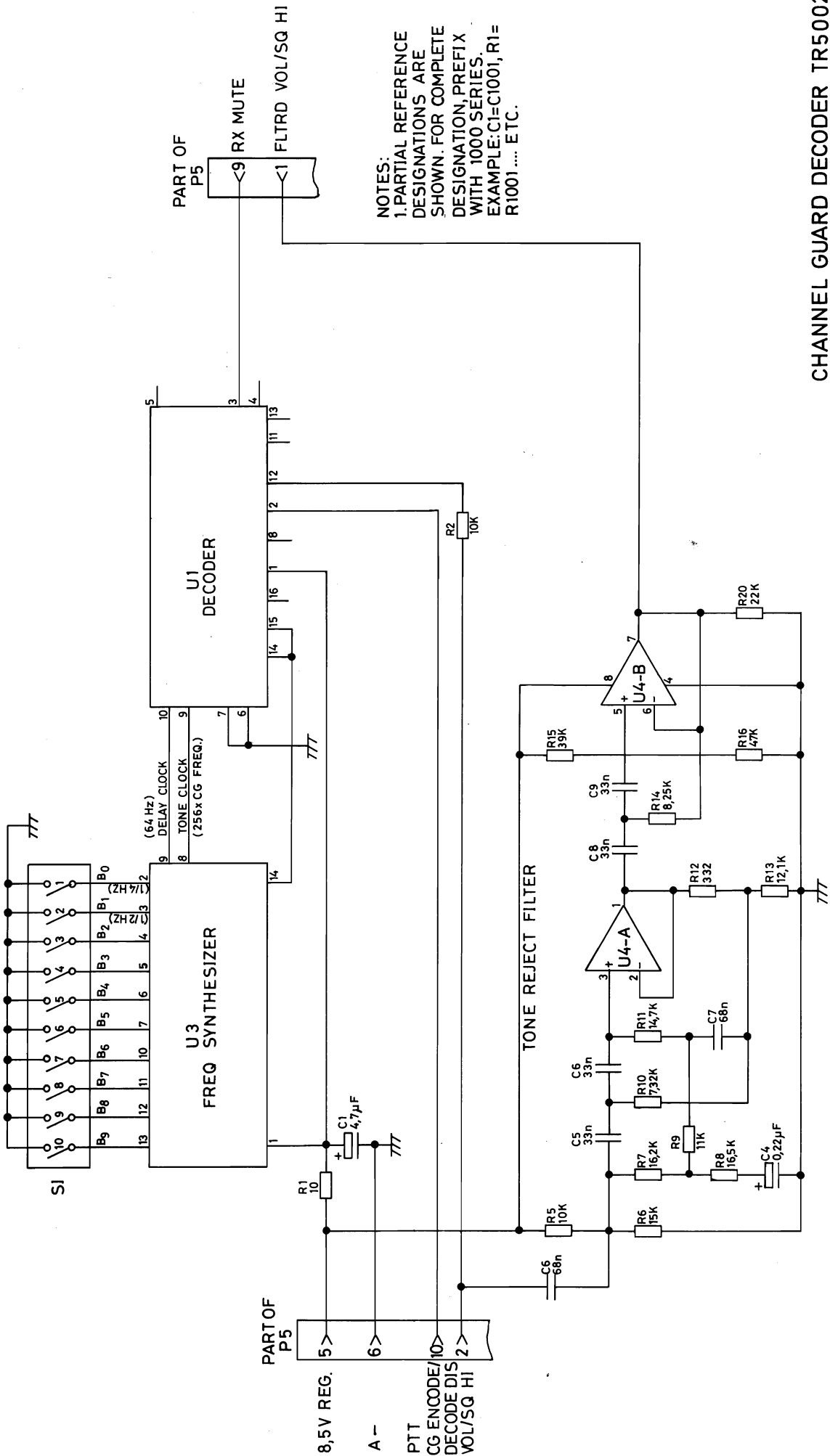
TYPE	CODE NO.
FS5331	M905054G1
FS5332	M905054G2
FS5111	M905054G3
FS5112	M905054G4
FS5661	M905054G5
FS5662	M905054G6
FS5551	M905054G7
FS5552	M905054G8

FREQUENCY SYNTHESIZER
FS5X1, FS5XX2

COMPONENT LAYOUT **D402.886/3**



ADJUSTABLE COMPONENTS AND TEST POINTS ON CQM5000SXXS99

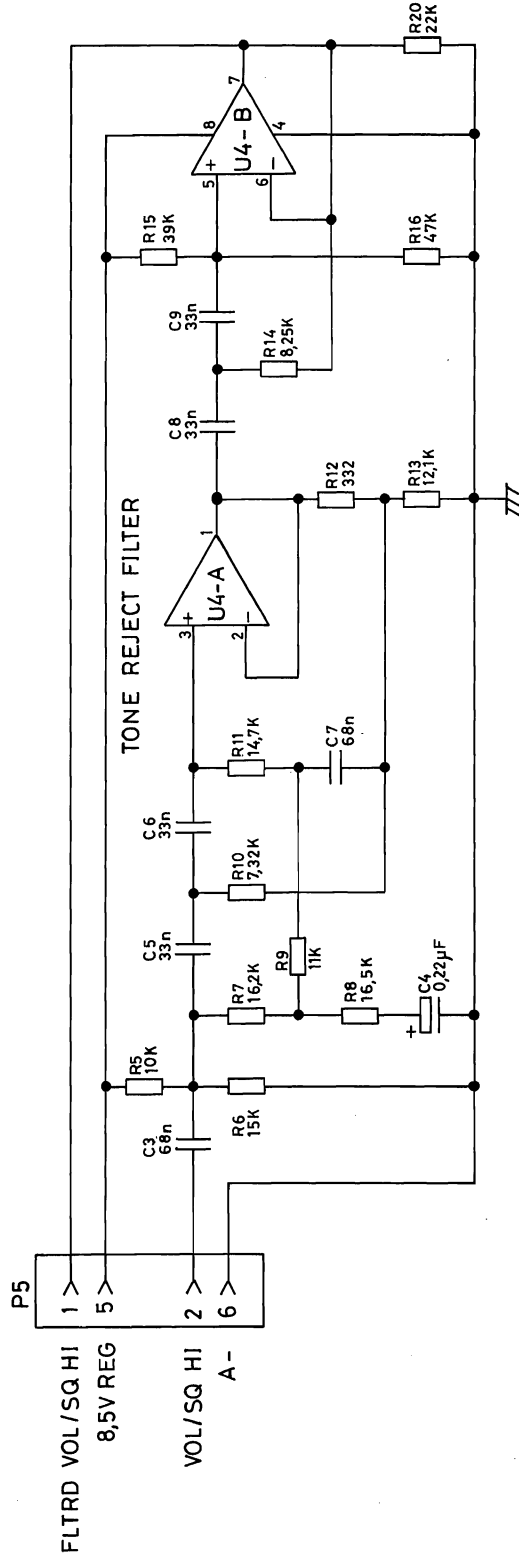


NOTES:
 1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES. EXAMPLE: C1=C1001, R1=R1001 ETC.

CHANNEL GUARD DECODER TR5002

CODE No. : 10. 4224-00
 SUB. ASM. 10. 5020-00 (19C850801G3)

D403.007 / 2



NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
FOR COMPLETE DESIGNATION. PREFIX WITH 1000 SERIES.
EXAMPLE: C1=C1001, R1=R1001..... ETC.

Storno

Nº	CODE	DATA
C1003	19A116080P206	68 nF Polyester
C1004	19A134202P10	0.22 uF Tantal
C1005	19C300075P33001G	33 nF Polyester
C1006	19C300075P33001G	33 nF Polyester
C1007	19C300075P68001G	68 nF Polyester
C1008	19A700005P10	33 nF Polyester
C1009	19A700005P10	33 nF Polyester
P1005	19A134152P35	Connector
R1005	19A700019P49	10 Kohm Resistor
R1006	19A700019P51	15 Kohm Resistor
R1007	19C314256P21622	16.2 Kohm Metal film
R1008	19C314256P21652	16.5 Kohm Metal film
R1009	19C314256P21102	11 Kohm Metal film
R1010	19C314256P27321	7.32 Kohm Metal film
R1011	19A314256P21472	14.7 Kohm Metal film
R1012	19A701250P151	330 ohm Metal film
R1013	19C314256P21212	10 Kohm Metal film
R1014	19C314256P28251	8.2 Kohm Metal film
R1015	19A700019P56	39 Kohm Resistor
R1016	19A700019P57	47 Kohm Resistor
R1020	19A143400P52	20 Kohm Resistor Depos
U1004	19A134511P2	Int. Circuit

50 V
50 V
0.2 W
0.2 W

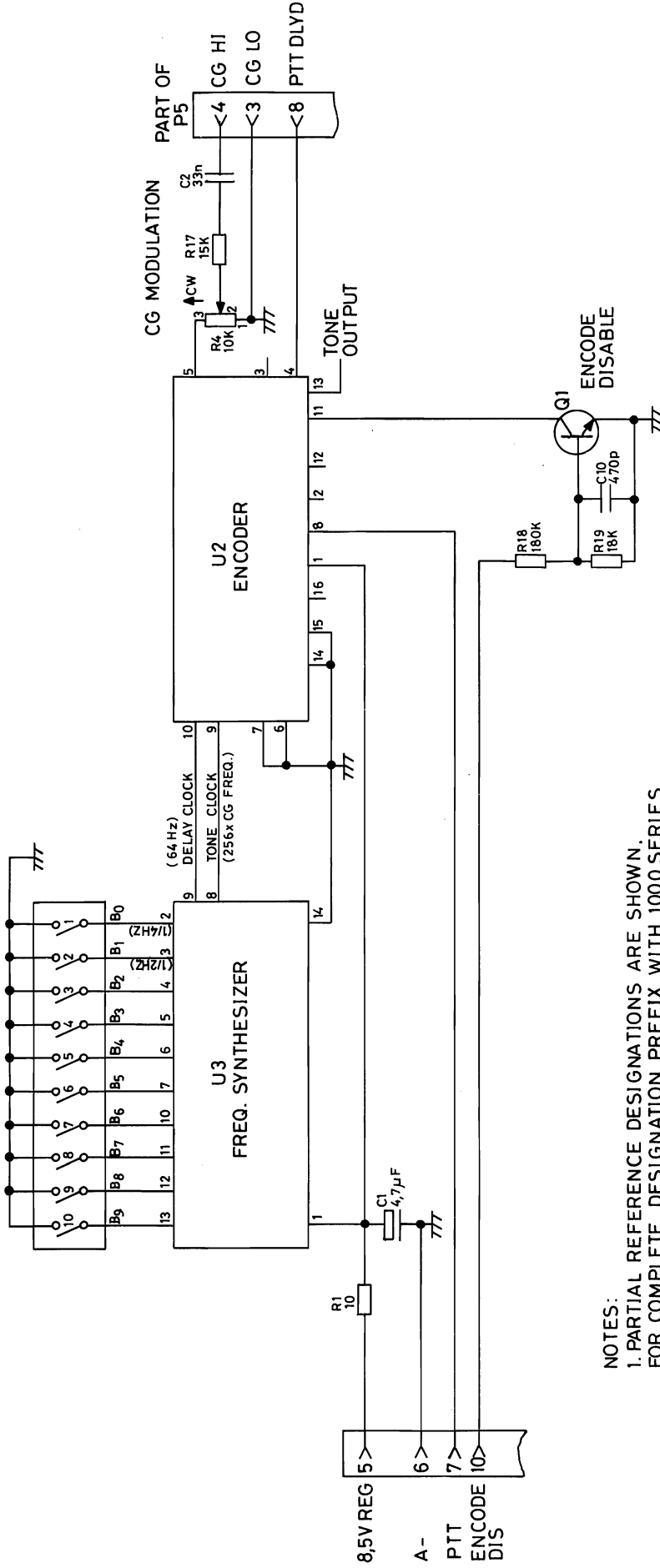
0.2 W
0.2 W

Storno

Nº	CODE	DATA

CHANNEL GUARD TONE REJECT FILTER FN5002

X403.019



NOTES:
 1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
 FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES.
 EXAMPLE: C1 = C1001, R1 = R1001

CHANNEL GUARD ENCODE TT5002

CODE No. : 10.4223-00

SUB. ASM. 10.5019-00 (19C850801G2)

D403.009/2

Storno

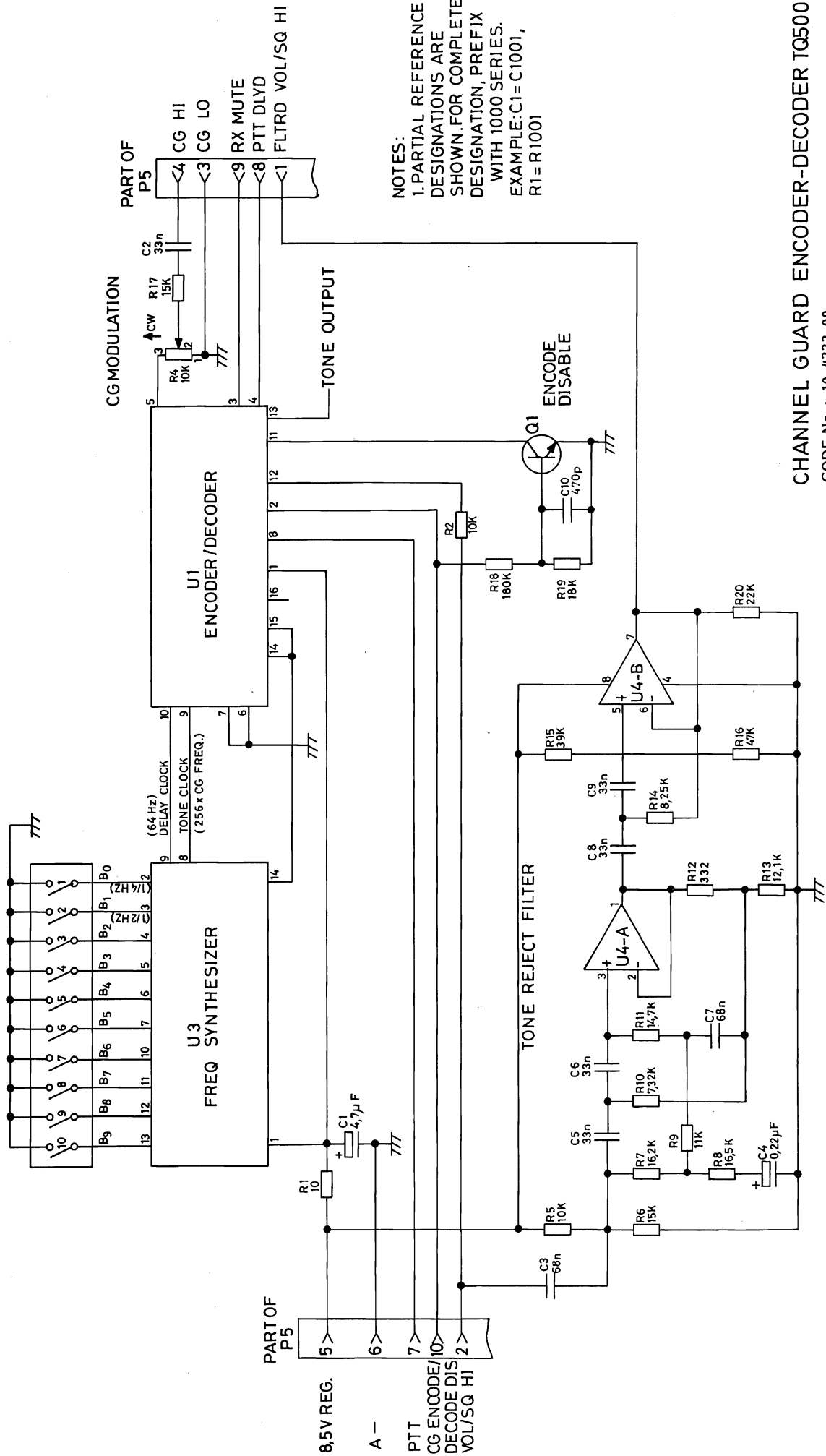
N°	CODE	DATA
C1001	19A134202P5	3.3 uF Tantal
C1002	19A700005P10	33 nF Polyester
C1010	19A116192P2	470 pF Ceram capacitor
P1005	19A134152P35	Connector
Q1001	19A115910P1	Transistor
R1001	19A700019P13	10 ohm Resistor
R1004	19A116559P206	10 Kohm Resistor var.
R1017	19A700019P51	15 Kohm Resistor
R1018	19A700019P61	100 Kohm Resistor
R1019	19A143400P52	20 Kohm Resistor Depos
S1001	19B800010P1	Switch
U1002	19D430412G2	Int. Circuit
U1003	19D430393G1	Int. Circuit

Storno

N°	CODE	DATA

CHANNEL GUARD ENC TT5002

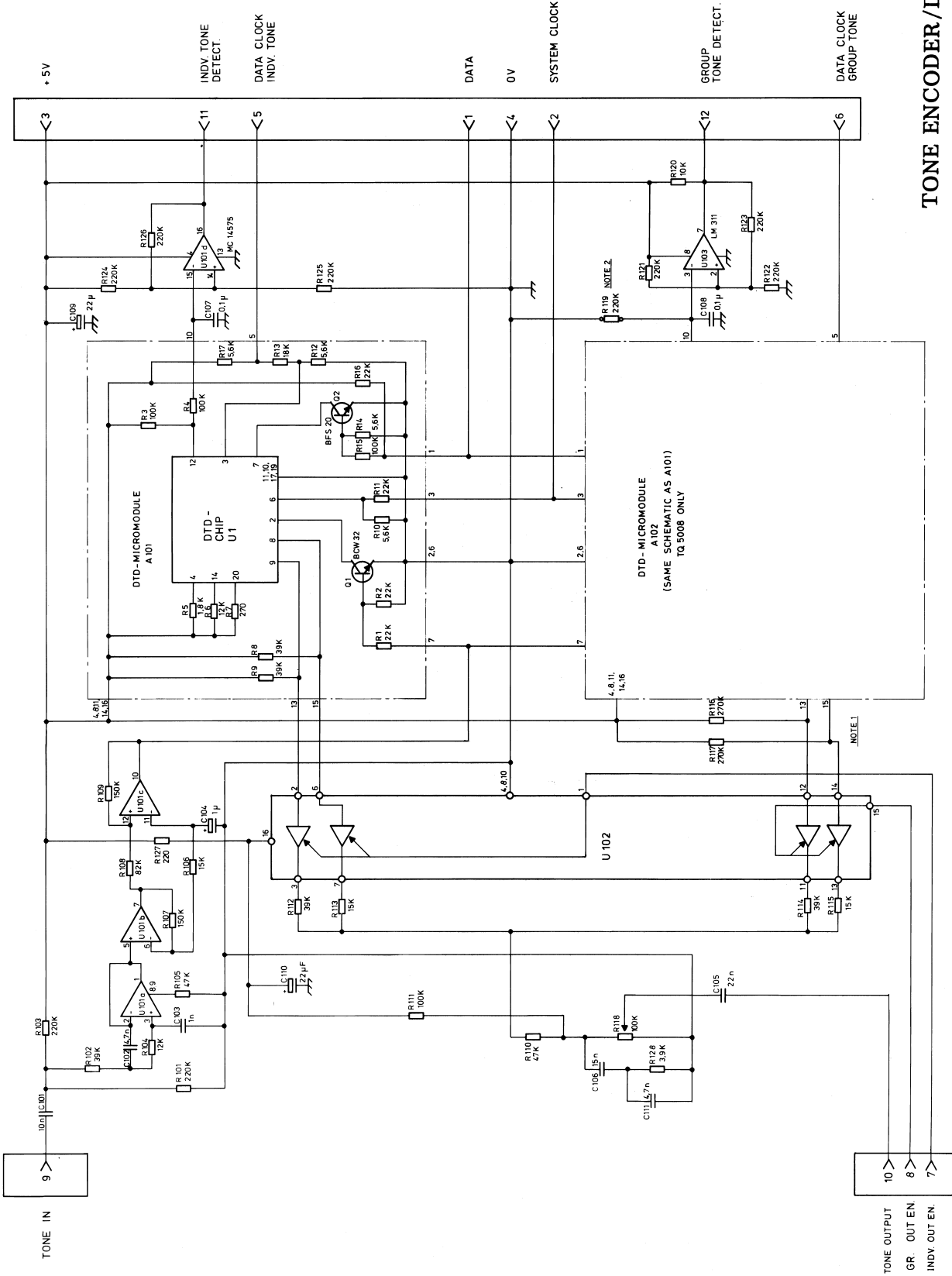
X403.021



NOTES:
 1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION, PREFIX WITH 1000 SERIES. EXAMPLE: C1=C1001, R1=R1001

CHANNEL GUARD ENCODER-DECODER TQ5006
 CODE No. : 10.4222-00
 SUB. ASM. 10.5018-00 (19C850801G1)

D403.010/2



NOTE 1:
FOR TQ 5007 DO NOT MOUNT A102
FOR TQ 5008 MOUNT A102

NOTE 2:
FOR TQ 5007 R119 IS MOUNTED
FOR TQ 5008 R119 IS DISMOUNTED

TONE ENCODER/DECODER TQ5007, TQ5008

D403.012/2

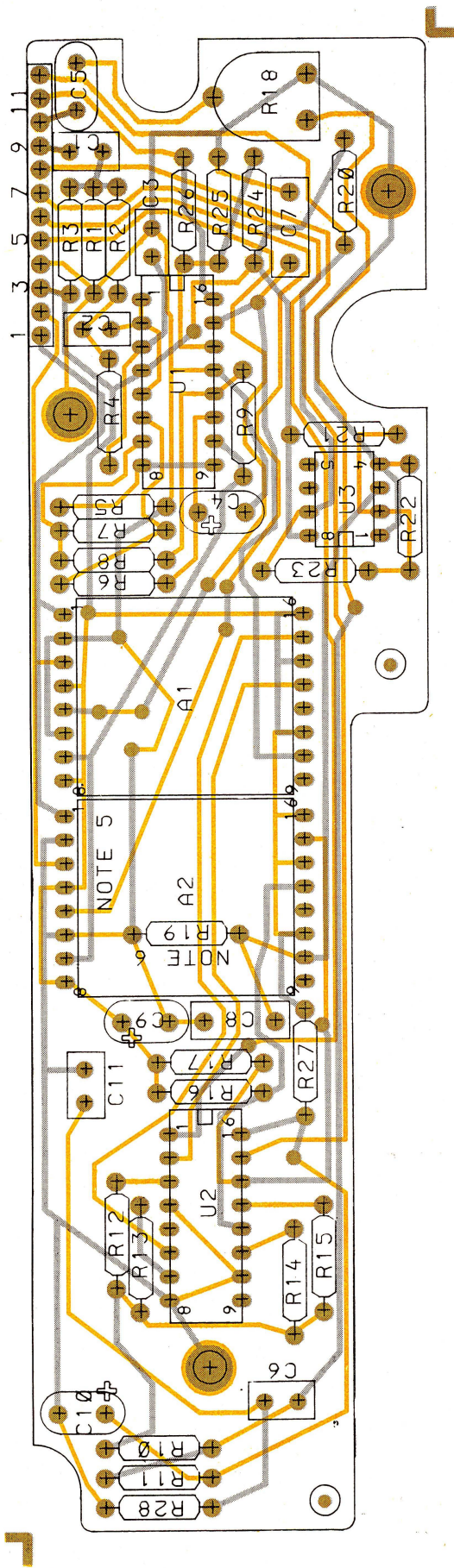
NO	CODE	DATA
	M905144C1	TQ5007
	M905144C2	TQ5008
A101	M905148G1	Assem., Micromodule-incl. Digital Tone Det.
A102 ⁺	M905148G1	Assem., Micromodule-incl. Digital Tone Det.
C101	A700005P7	Capacitor, 10 nF 5%, Polyest. 50 V
C102	A700005P5	Capacitor, 4,7 nF 5%, Polyest. 50 V
C103	A700005P1	Capacitor, 1 nF 5%, Polyest. 50 V
C104	A701352P7	Capacitor, 1 µF -10+100%, Elco 6,3 V
C105	A700005P9	Capacitor, 22 nF 5%, Polyest. 50 V
C106	A700005P8	Capacitor, 15 nF 5%, Polyest. 50 V
C107	A700004P2	Capacitor, 0,1 µF 5%, Polyest. 50 V
C108	A700004P2	Capacitor, 0,1 µF 5%, Polyest. 50 V
C109	J706339P8	Capacitor, 22 µF -10+100%, Elco 50 V
C110	J706339P8	Capacitor, 22 µF -10+100%, Elco 50 V
C111	A700005P5	Capacitor, 4,7 nF 5%, Polyest. 50 V
J101	J706215P112	Connector, 12 Pin, Male.
R101	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R102	A700019P56	39 Kohm 5%, Resistor, carb. film 0,25 W
R103	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R104	A700019P50	12 Kohm 5%, Resistor, carb. film 0,25 W
R105	A700019P57	47 Kohm 5%, Resistor, carb. film 0,25 W
R106	A700019P51	15 Kohm 5%, Resistor, carb. film 0,25 W
R107	A700019P63	150 Kohm 5%, Resistor, carb. film 0,25 W
R108	A700019P60	82 Kohm 5%, Resistor, carb. film 0,25 W
R109	A700019P63	150 Kohm 5%, Resistor, carb. film 0,25 W
R110	A700019P57	47 Kohm 5%, Resistor, carb. film 0,25 W

NO^{RES}: + used in TQ5008 only
o used in TQ5007 only.

NO	CODE	DATA
R111	A700019P61	100 Kohm 5%, Resistor, carb. film 0,25 W
R112	A700019P56	39 Kohm 5%, Resistor, carb. film 0,25 W
R113	A700019P51	15 Kohm 5%, Resistor, carb. film 0,25 W
R114	A700019P56	39 Kohm 5%, Resistor, carb. film 0,25 W
R115	A700019P51	15 Kohm 5%, Resistor, carb. film 0,25 W
R116	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R117	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R118	J706042P1	100 Kohm 10%, Pot. meter-lin. 0,1 W
R119 ^o	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R120	A700019P49	10 Kohm 5%, Resistor, carb. film 0,25 W
R121	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R122	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R123	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R124	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R125	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R126	A700019P65	220 Kohm 5%, Resistor, carb. film 0,25 W
R127	A700019P29	220 ohm 5%, Resistor, carb. film 0,25 W
R128	A700019P44	3,9 Kohm 5%, Resistor, carb. film 0,25 W
U101	J706293P1	MC14575, IC, Dual/Dual Progr. Op. Amp. Comp.
U102	A700029P229	F40097, IC, Hex Tri-State Buffer.
U103	J706579P2	LM311N, IC, Voltage Comparator.

X403.208

STONE ENCODER/-DECODER TQ5007 and TQ5008



TONE MODULE TQ5007-5008

D403.038

STORNOPHONE 5000
Maintenance Manual
Section 8

CONTENTS

TQ5001 and TQ5002	Description	60.393-E1
	Coding and Strapping	60.443-E1
	Schematic Diagram	D402.610
	Component Lay-out	D402.622
	Parts List	X402.645
SU5001 and SU5002	Description	60.415-E1
	Schematic Diagram	D402.620
	Parts List	X402.649

SEQUENTIAL TONE UNIT

TQ5001 AND TQ5002

General

TQ5001 and TQ5002 are combined sequential tone transmitter-tone receiver units, the transmitter and receiver functions being independent of each other, and which can process 3, 4, or 5-tone signals. The units are designed to fit into CQM5000 radiotelephone equipment and the electrical design appears from the block diagram.

The unit is built on a single printed circuit board (p. c. b.) with plated through holes which connects to the radiotelephone circuits via plug-in sockets. The loudspeaker IN/OUT button, the TONE KEY button, and the yellow call indicator is mounted directly on the board and protrude through holes in the front plate. The unit is mechanical secured to the radiotelephone chassis by four screws and spacers. For TQ5001 the tone frequencies are the STORNO series, 885Hz to 2800Hz; for TQ5002 the tone frequencies are the CCIR series, 960Hz to 2110Hz. The tone combinations for the tone receiver and the tone transmitter are selected by soldering colour coded wires to the tone coil, or by establishing the connections on the wiring side of the p. c. b.

In standby, when turning on the equipment, the unit is in the tone receive mode and set to the 1st tone of the combination. Receipt of a sequential tone signal, that matches this combination, will cause the following events to take place.

The key blocking is cancelled (Q127 ON).

The loudspeaker blocking is cancelled (Q130 OFF).

The LED call indicator D107 will start flashing.

When the tone unit is strapped for Auto-Receipt, a correct tone call will automatically trigger the sequential tone transmitter circuit and

after having generated the last tone of the sequential tone signal the unit reverts to the condition described above, i. e. the loudspeaker is on.

Accordingly, when in the LS in mode, the tone transmitter can be manually triggered by pressing the Tone key button.

With 70ms tone length, the time from depressing the Tone key to the generation of the 1st tone is approximate by 220ms for TQ5001, and 320ms for TQ5002.

ms = millisecond = 0,001 second.

When using 3 tones or 4 tones in the sequence this interval may be extended if the unused tone gate wires are left unconnected.

The transmitter remains keyed for approximately 640ms for TQ5001, and 920ms for TQ5002 even if the Tone key button is pressed for a shorter or longer period. Simultaneously with the keying of the transmitter, the microphone amplifier will be blocked. The blocking signal disappears after the last tone has ceased, that is when the unit reverts to standby.

The units can accommodate a Group Call unit, SU5001, when an extension of the call tone system is required, and the unit may also be used as a combined single tone transmitter and sequential tone receiver.

Mode of Operation

In standby the TQ5001/TQ5002 unit is set to the sequential tone receiver mode and when a tone signal having the proper code is applied to the input, the following events take place:

The 1st tone is amplified and limited in the input stage.

The signal is then, via a coupling link, applied to the selective circuit.

In standby the 1st tone gate, Q117, selects the 1st tone of the combination.

The active part of the selective circuit is a Q-multiplier, which also operates as oscillator

when the selective circuit is part of the tone transmitter.

Owing to the high signal voltage across the selective circuit the gate transistors are biased in the nonconductive direction, and simultaneously the tone and oscillator signal amplitude is limited.

If the level of the 1st tone is within the sensitivity range of the tone receiver, the selected signal will switch the comparator output (U101A).

The schmitt-trigger (U101b) will go negative after approximately 17ms which is generated by the Clock Delay circuit. At the same time the schmitt trigger rapidly charges the Clear Delay circuit in order to enable the counter.

At the end of the 1st tone the Schmitt trigger reverts to standby and the positive leading edge is fed to the counter's clock input. The counter steps forward and the next tone gate tunes the selective circuit to the 2nd tone.

Each gate transistor has its collector connected to one of the tone coil terminals. The sequential tone receiver is now set to receive the 2nd tone of the signal, and it remains in this state for approximately 120ms, the time being determined by the Clear-Delay. Except for the requirement of a tone length of approximately 40 ms, the tone receiver is independent of the duration of the signal elements, because the counter switches to the next tone gate at the end of the preceding tone. If the 2nd tone is not accepted within approximately 120ms, the counter is reset to standby, i.e. ready for the 1st tone.

The 2nd, 3rd, 4th, and 5th tone of a sequential signal are received as described for the 1st. When the 5th tone has been accepted information of the counter is read out to Latch U104b, which cancels the key and loudspeaker blockings. At the same time the Call indicator is turned on, and the call may also cause an automatic transmission of receipt to take place, if used. The colour coded wires from the tone generator gates are soldered to the tone coil terminals, but if the same tone code is used for both tone transmitter and tone receiver, the code can be set by arranging the wires on the p.c.b. With the loudspeaker turned on depressing the Tone

key button causes the following to take place:

A positive pulse from the Tone key button toggles the latch U104a whose Q and \bar{Q} outputs control the internal switching from receive to transmit, and U104b controls the Transmitter Key switch and the Microphone Blocking. When the clock generator U101c starts, the comparator U101a and the counter U103, are inhibited by the Q-output of U104a. The Q output enables the tone transmitter counter U102, inhibits the Clock Delay circuit, and turns on Q108 which increases the gain of the Q-multiplier Q107.

The clock generator pulses are applied to the counter U102, the repetition rate being 70ms for TQ5001 and 100ms for TQ5002. Upon arrival of the 3rd clock pulse the 1st tone gate transistor is turned on and the tone oscillator generates the 1st tone of the signal code. The oscillator output is passing an emitter-follower before being applied to the output terminal. The output voltage is adjustable by means of R113.

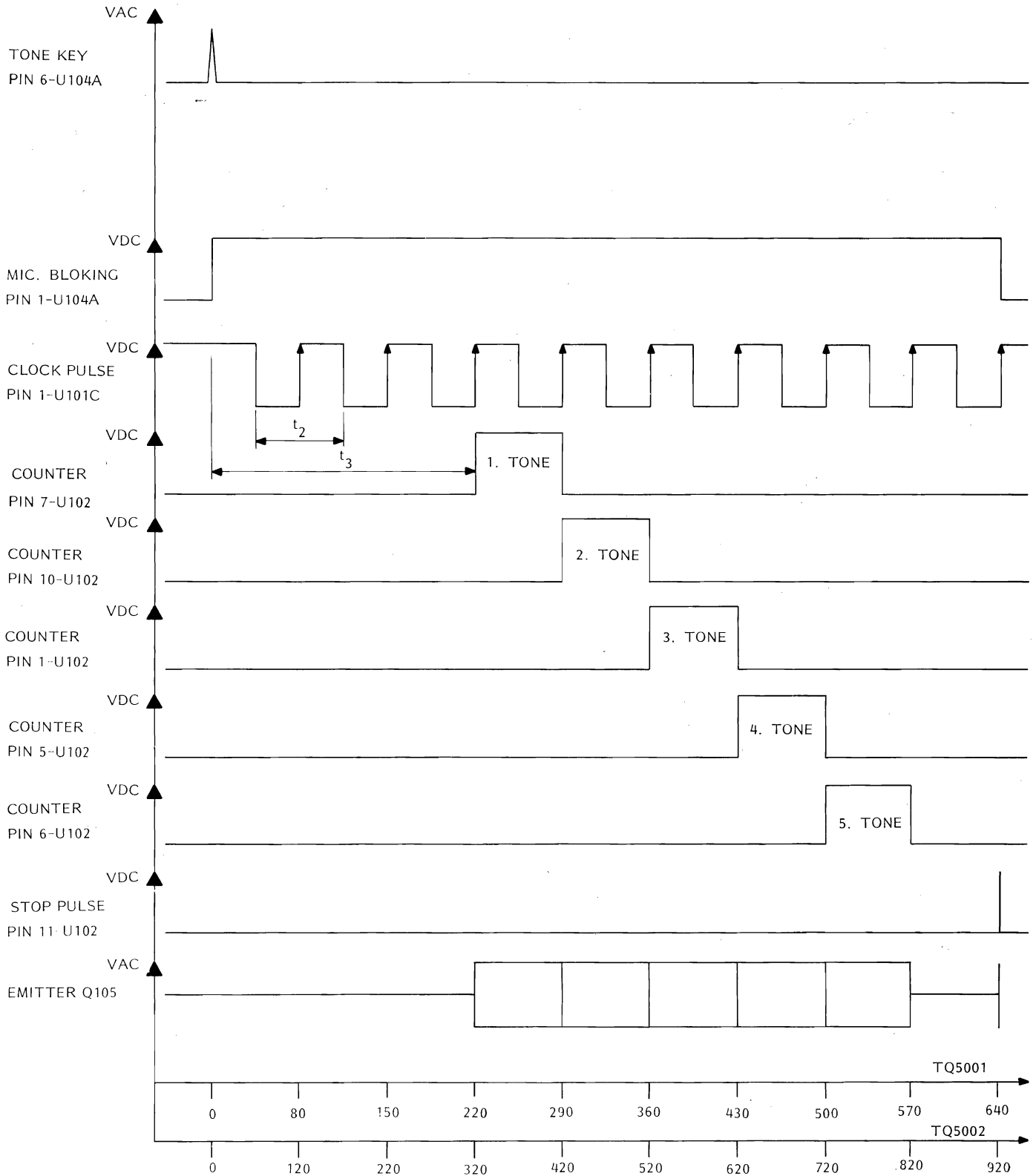
The 4th, 5th, 6th, and the 7th clockpulse successively turn on the remaining gate transistors to accomplish the signal code. The 8th clock pulse is used to introduce an interval before the 9th clock pulse resets the latch, U104a, and the TQ-unit reverts to the tone receive mode with the loudspeaker turned on.

Circuit Description

Input amplifier and limiter

Transistors Q101, Q102, and Q103 form a differential input amplifier/limiter, and Q104 is the resonant circuit driver. The received tone signal is amplified the gain being constant and determined by the ratio of R106 to R107. Signal levels higher than the minimum sensitivity (approx. 85mV) will cause limiting, and the tone signal is then applied to the Group Call Unit SU5001, if any, (terminal 9) and to driver Q104. Transistor Q104 operates as current generator with its collector connected to a separate winding on the tone coil. The sensitivity and thus the sequential tone receiver bandwidth is adjustable with R111.

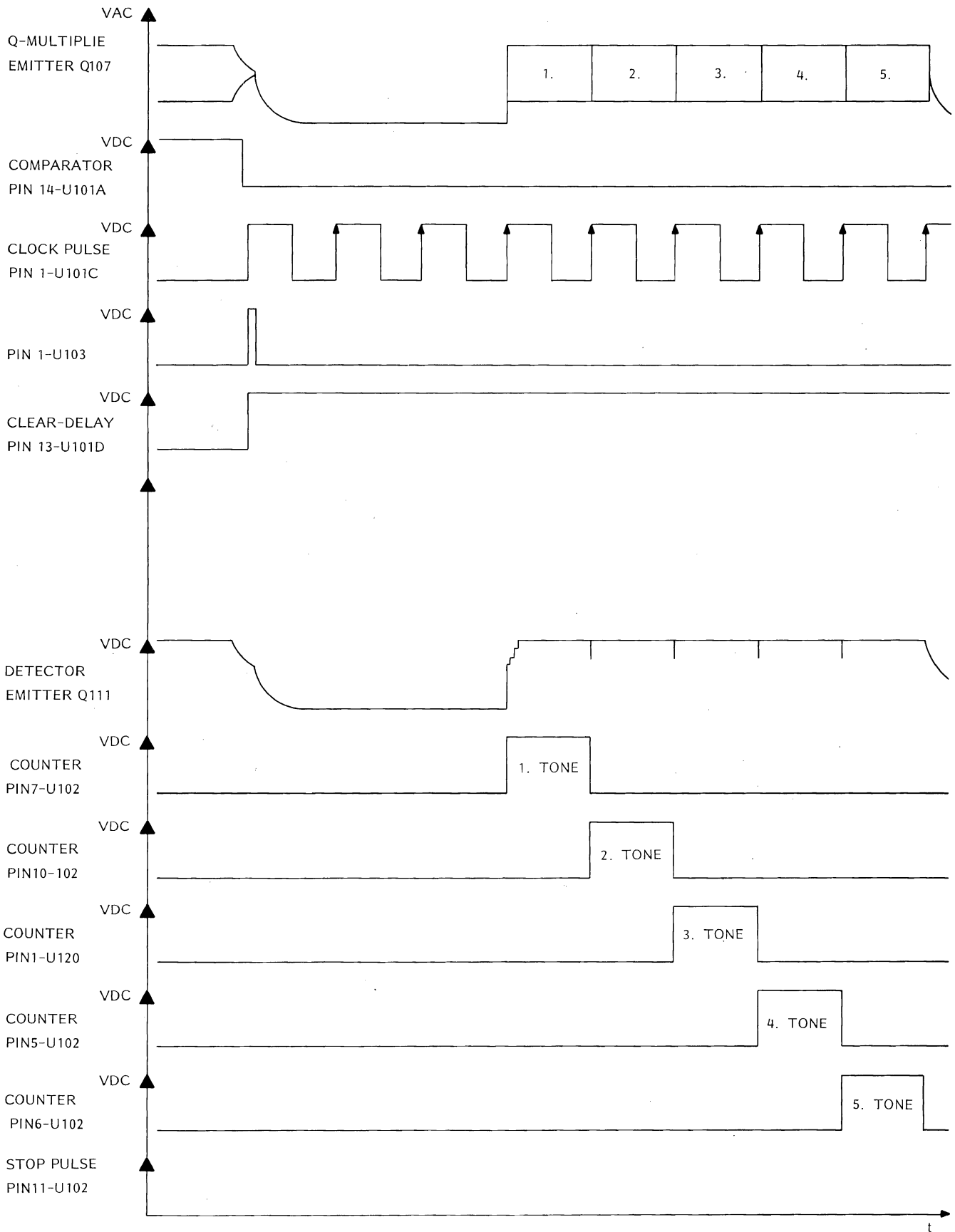
PULSE-TIME DIAGRAM FOR 5-TONE SEQUENTIAL CALL TRANSMITTING IN TQ5001 AND TQ5002



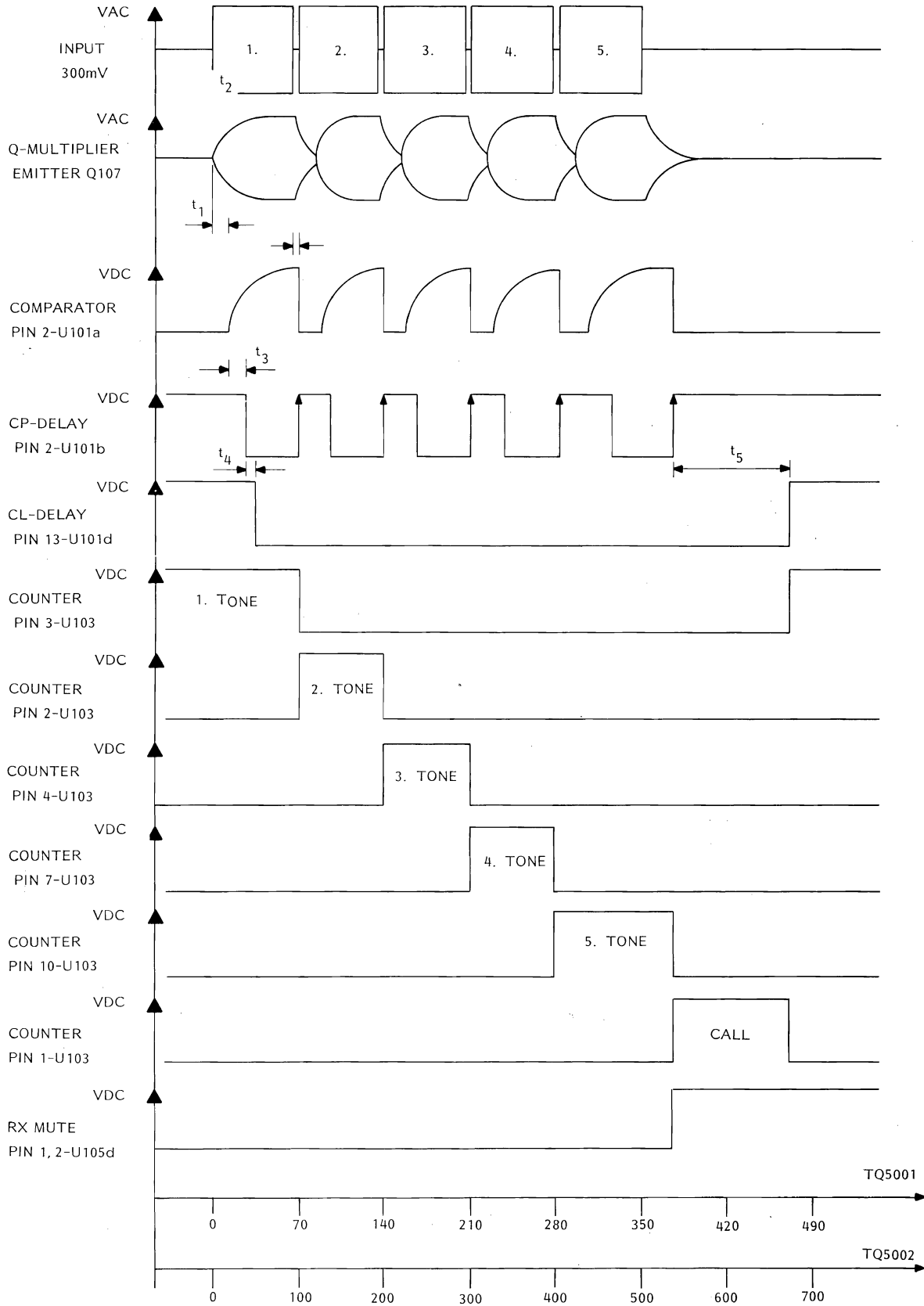
LOUDSPEAKER MANUALLY TURNED ON

- t_1 CHARGING TIME FOR CLOCK GENERATOR
- t_2 CLOCK PULSE PERIOD (TONE LENGTH)
- t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

PULSE-TIME DIAGRAM FOR 5-TONE AUTOMATIC RECEIPT

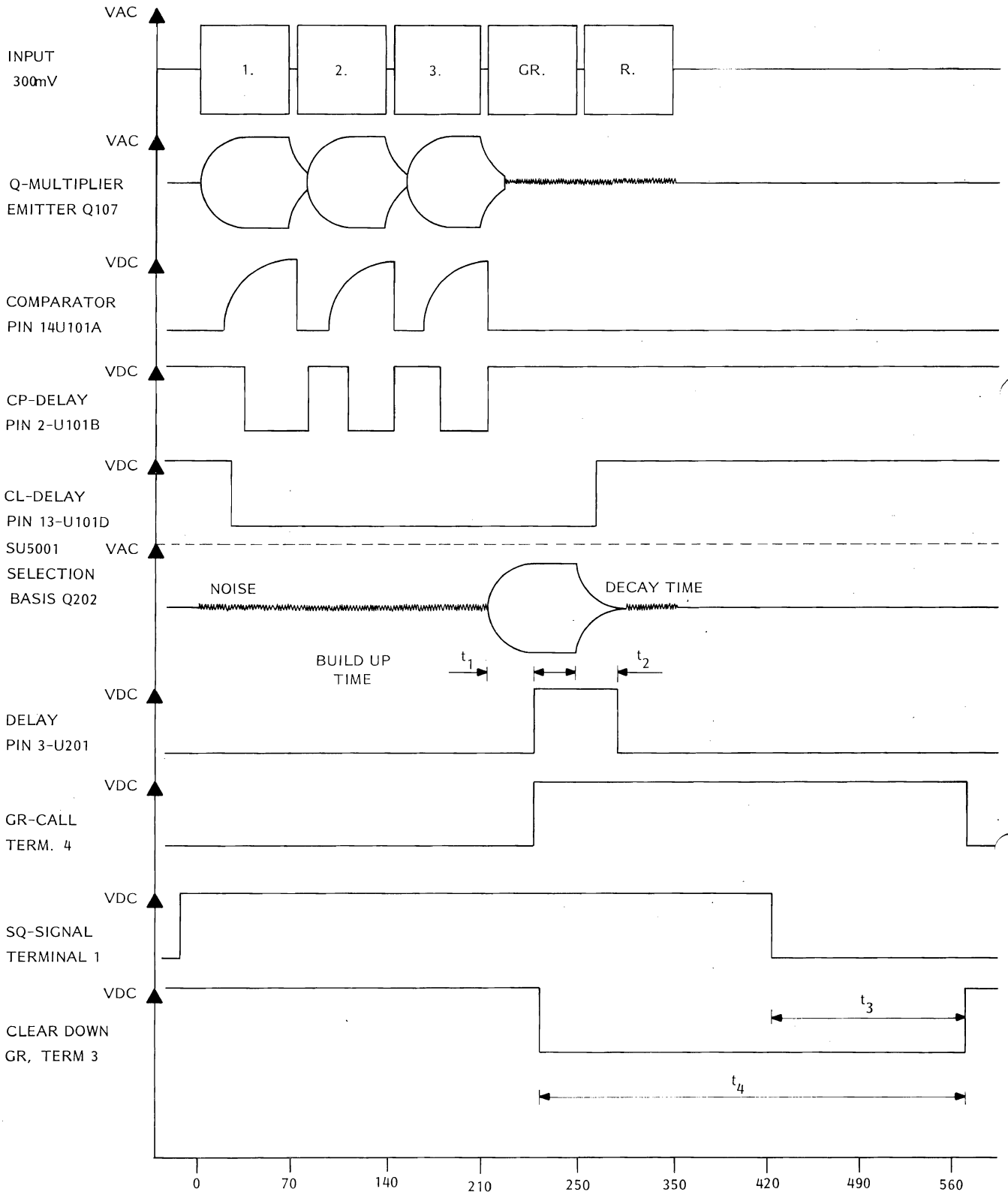


PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5001 AND TQ5002



- t_1 . SELECTIVE CIRCUIT BUILD-UP TIME
- t_2 . DELAYTIME
- t_3 . CLOCK-DELAY
- t_4 . DELAY CHARGING TIME
- t_5 . CLEAR-DELAY

PULSE-TIME DIAGRAM FOR 5-TONE SEQUENTIAL CALL WITH GROUP CALL



t_1 BUILD-UP TIME DELAY
 t_2 DELAY TIME HANGE TIME
 t_3 SQ-DELAY
 IN PERIOD t_4 THE AUTOMATIC RECEIPT TONE KEY AND LS IN OUT ARE INHIBITED.

The amplifier is inhibited when depressing the Tone Key (and the normal Key) causing the 8.5V TX to be applied to the base of Q101 through D101. Less than 100ms after reverting from the tone transmitting mode the unit is ready to receive a call.

Resonant circuit

The band pass filter consists of tone coil L101 and capacitor C113.

The signal from the input amplifier is coupled to the parallel resonant circuit via the coupling link. The colour coded wires from the tone gates switch the tone coil taps into the circuit in parallel with capacitor C113.

Q-multiplier, limiter, reference voltage, and detector

These circuits consist of Q107, Q108, Q109, Q110, Q111, and their associated components. A part of the selected tone signal is fed via the Q-multiplier Q107 back to the coupling link and in phase with the input signal. This increases the bandpass filter Q-factor to approx. 30.

Resistors R123-R148 linearize this factor throughout the band, and the NTC resistor in the Q107 emitter compensates the Q-factor variations with ambient temperature.

The tone signal is rectified by transistor Q111 and the resultant d.c. voltage is applied to comparator U101a. Q108 is turned on by U104a when depressing the Tone Key, which increases the feedback so that the resonant circuit and Q107, which is the active component, form an oscillator. The signal voltage across the resonant circuit is amplitude limited by Q109 in order to obtain a constant signal output level from the oscillator and to reduce the decay time for strong signals. The gate transistor bias and the detector bias voltages are derived from Q110.

Output emitter follower and clipper

The desired frequency characteristic is flat because the tone signal is connected directly

to the splatter-filter. The output stage consists of the emitter follower Q105, and R113 is generator impedance for the OP-Amp of the splatterfilter. Due the DC-shift in the oscillator a peak will appear at the start, and the end of the tone signal, but this peak will be limited by Q106.

Comparator

The comparator is build around U101a, whose trigger reference level is determined by voltage divider R130-R131/R181 and controlled by the Q-output of latch U104a. The rectified tone signal increases the d.c. voltage to the non-inverting input of the comparator and when the level exceeds the reference voltage, the output of U101a will change from being a short to ground, to be the off state.

This state persists for a time determined by the length of the tone. After the tone period the output will revert to form a ground path. When depressing the Tone Key, U101a is inhibited in its standby state by the Q-output of U104a.

Clock-delay and clock generator

The Clock-delay is terminated by R132 and C107. In standby the charge of capacitor C107 is neutral due to the discharge through the output of U104a, and the clock generator U101c is inhibited in its off position. The reference voltage, which is common to U101b and U101c, is, via voltage divider R133, R134, R135, applied to their non-inverting inputs. When the comparator U101a is activated, the voltage across C107 will start to go positive. After 17ms (Clock-delay) the Schmitt trigger U101b will be activated and the output voltage will drop to 0V. At the end of the tone C107 again discharges via U101a.

This produces a positive going voltage edge at the U101b output which is applied to the clock inputs of counters U102 and U103 whose outputs switch the circuits to the next tone gate. If the comparator detects a new tone the procedure is repeated as previously described.

The comparator will, in its inhibited state (TONE KEY activated), keep U101b off. On the

other hand, the clock generator U101c is released by biasing D104 off. C108 is charged through resistors R136, R137, and R138 until reaching the common reference voltage, and the output of U101c drops to 0V. This d. c. voltage transition is via R134 fed back to the non-inverting input and thus causes a hysteresis. C108 is discharged to the lower voltage level and the positive edge so created is used as clock input to counter U102. The period time is adjusted by means of resistor, R137, to 70ms (TQ5001) or 100ms for TQ5002.

Clear delay

Comparator U101d is controlled by the Schmitt trigger U101b. In standby the charge of C109 is neutral because D103 is reverse biased. The output level of U101d corresponds to the supply voltage, 8.5V, and counter U103 is cleared and set to the 1st tone gate. Triggering U101b enables C109 to be charged of via D103 and R140, and when the voltage of C109 has fallen to the reference level, U101d changes its output to 0V and releases counter 103 which now is ready to receive the clock pulses.

The U101d reference level is controlled by U104a's Q-output which in standby is approximately 8.5V. Depressing the Tone Key button causes the reference level to fall to 0V and U101d is blocked in its standby position, and hence counter U103 is blocked accordingly. As long as the Schmitt trigger, U101b, is active, D103 will maintain the charge of C109. When the last tone ceases, U101b reverts to standby and D103 is reverse biased. The discharge of C109 is determined by R139 and R140 which within approximately 120ms reduces the charge of the capacitor until it corresponds to the reference level.

The U101d output voltage returns to 8.5V and clears the counter, U103, after which the 1st tone gate is reengaged, and the tone receiver is ready to receive a new call. As the intervals between the individual tones in sequential tone call are far less than the above mentioned 120ms, the clear delay will retain its state for this period.

Counter and tone gates

Two decimal counters are employed as tone generator pulse counter (U102) and tone receiver pulse counter, (U103). The counter output control the tone gates, Q112-121.

Determined by the clock generator period counter U102's outputs will, consequently, open gate transistors Q112 to Q116 the collectors of which are tied to the tone coil taps and so producing the tones of the sequential tone signal. The first gate transistor is connected to the third counter output for which reason a period of 220ms, for TQ5001 and 320ms for TQ5002 elapses -corresponding to the three first clock pulses- before generation of the 1st tone is started.

The time following the 9th clock pulse is utilized to discharge detector Q111, and the 10th clock pulse is fed, via R154, to latch U104a as a "stop" information. In order to hold the gate transistors effectively cut off their emitters are biased at 4.1V.

The clear input of U102 is controlled by U104a's Q-output, and therefore the counter is inhibited in standby and is not released until the Tone Key button is depressed.

Counter U103 opens the tone receiver gate transistors, Q117-Q121.

The control signals for the counter is derived from U101b and the clear delay U101d, respectively.

In standby the counter is inhibited by U101d and the 1st tone gate is opened by the "0" output. The mode of operation for counter U103 is similar to that of U102 the clock pulse period corresponding to the received tone pulse lengths.

Approximately 120ms after the cessation of the last tone the counter is reset to standby by U101d. All counter outputs of U103 are accessible on the p. c. b. for setting the individual and the group call combinations (see instructions for coding and strapping).

Transistor Q122 is, together with the counter enable input, controlled by U104a's Q-output, which in standby is 0V. Depressing the Tone Key button blocks the U103 clock input, and at the same time the 1st tone gate is blocked by Q122. The elapse of time to transmit, or receive, a 5-tone sequential signal appears from the time-pulse diagrams.

Latch, LS IN/OUT, TONE KEY and flashing circuit

As latch for the tone receiver and tone transmitter functions, a dual-D-flip-flop U104 is employed of which U104a is directly controlled by U104b via diodes D105 and D106. An R-S flip-flop, U105a-U105b, prevents contact bounce in the LS in/out button from operating the latch.

After a tone call, or after having opened the loudspeaker manually the flashing circuit, U106 with its associated components will start flashing the yellow LED Call indicator (D107).

When applying the supply voltage, 8.5RX, U104b is forced into state "LS out" by the positive pulse fed to the latch reset input via C115. The call pulse is derived from one of counter U103's outputs and applied to U104b's set input and, according to note 6 on the diagram, to U104a as a receipt pulse.

After a received tone call, U104b remains in state "LS in" until manually reset by depressing the LS in/out button. The tone transmitter latch, U104a, is inhibited in standby via diode D106 and, accordingly, the information from the Tone Key input terminal is short circuited via D105.

To perform a tone call U104b must be toggled manually to reverse bias D105 and D106.

Mute and Alarm

The mute function takes the information from the Q output of U104b and turns Q124 ON after a call or a manual opening of the loudspeaker.

The Alarm (Q123) is ON for a short time (70ms) immediately after the 5th tone.

PTT (To Relay) and PTT (Push To Talk)

When pressing the Tone Key, Q126 will go on and operate the transmitter relay. Q125 is controlled by the Q output of U104a which is triggered by U105c.

The normal keying of the RF transmitter is achieved by shorting terminal 3 to ground, but if the tone receiver is not opened, Q127 is off, and hence it prevents the transmitter from being keyed.

Microphone blocking and RX mute

When the transmitter is keyed, the microphone amplifier supply comes via Q129.

When "Tone Key" is activated, U104a blocks Q129, the microphone is deprived of its supply, and the amplifier blocked.

After reception of a correct call, or manual opening, Q130 switches off and cancels the clamping of the RX mute lead, so that only the noise controlled squelch circuit decides whether the sets audio channel should be open or not.

TECHICAL SPECIFICATIONS TQ5001.

Supply Voltage

8.5 ± 0.25V (Cont. and TX)

Current Drain

Standby

<20mA

Engaged

20mA +25mA peak when call indicator is on

Temperature Range

-30°C to +60°C

SEQUENTIAL TONE TRANSMITTER

Output Impedance

50Kohm max.

Output Signal

3.4 or 5 tones in burst of 70ms \pm 15ms.

The interval between triggering and emission of the 1st tone is min. 200ms.

Signal output level

600mV emf. max.

Frequency response

Flat. \pm 1dB

Distortion

max. 5%

Tone frequencies

885, 970, 1060, 1160, 1270, 1400, 1530, 1670,
1830, 2000, 2200, 2400, 2600, 2800Hz.

Frequency accuracy

Typical deviation (2 σ)

1%

Maximum deviation

1.4%

Relative frequency accuracy

0.3%

Adjustment accuracy

0.1%

Frequency stability

1%

CONTROL FUNCTIONSReceipt

TQ5001 can be strapped to automatic transmission of receipt after a received sequential call.

Automatic Keying

TQ5001 energizes the transmitter for approx. 640ms.

Microphone inhibit

The voltage supply to the microphone amplifier is inhibited during the tone key.

SEQUENTIAL TONE RECEIVERInput impedance

>30Kohm, DC isolation

Input Response

De-emphasis according to an RC-function with Fc=2900Hz.

Signalling code

3.4 or 5 tone burst of min 55ms duration.

Activating Level

300mV \pm 6dB

Distortion

The TQ5001 can process tone signals having less than 20% distortion.

Tone Frequencies

885, 970, 1060, 1160, 1270, 1400, 1530, 1670,
1830, 2000, 2200, 2400, 2600, 2800Hz.

Frequency Accuracy

\pm 0.3%

Selectivity

The tone receiver responds to tones with a frequency deviation less than 1.4%. The tone receiver is not sensitive to adjacent tones or other tones of the same standard series.

Reset Time

minimum 90ms

maximum 140ms

Reaction Time

minimum 20ms

maximum 45ms

Signal to Noise Conditions

The tone receiver will accept a noise level corresponding to SINAD = 5dB as measured in the speech channel of the CQM5000.

TECHICAL TQ5002 SPECIFICATIONS.

Supply Voltage

8.5 ± 0.25V (Cont and TX)

Current Drain

Standby

<20mA

Engaged

20mA +25mA peak when call indicator is on.

Temperature Range

-30°C to +60°C

SEQUENTIAL TONE TRANSMITTEROutput Impedance

50Kohm max.

Output Signal

3.4 or 5 tones in burst of 100ms ± 15ms.

The interval between triggering and emission of the 1st tone is min 300ms.

Signal output level

600mV emf. max.

Frequency response

Flat. ± 1dB

Distortion

max. 5%

Tone frequencies

(960, 1022), 1124, 1197, 1275, 1358, 1446, 1540, 1640, 1747, 1860, 1981, 2110Hz.

Frequency accuracy

Typical deviation (28)

1%

Maximum deviation

1.4%

Relative frequency accuracy

0.3%

Adjustment accuracy

0.1%

Frequency stability

1%

CONTROL FUNCTIONSReceipt

TQ5002 can be strapped to automatic transmission of receipt after a received sequential call.

Automatic Keying

TQ5002 energizes the transmitter for approx. 900ms.

Microphone inhibit

The voltage supply to the microphone amplifier is inhibited during the tone key.

SEQUENTIAL TONE RECEIVERInput impedance

>30Kohm, DC isolation

Input Response

De-emphasis according to an RC-function with Fc= 2900Hz.

Signalling code

3.4 or 5 tone burst of min. 55ms duration.

Activating Level

300mV ± 6dB

Distortion

The TQ5002 can process tone signals having less than 20% distortion.

Tone Frequencies

(960, 1022), 1124, 1197, 1275, 1358, 1446, 1540, 1640, 1747, 1860, 1981, 2110Hz.

Frequency Accuracy

± 0.3%

Selectivity

The tone receiver responds to tones with a frequency deviation less than 1.4%. The tone receiver is not sensitive to adjacent tones or other tones of the same standard series.

Reset Time

minimum 90ms

maximum 140ms

Reaction Time

minimum 20ms

maximum 45ms

Signal to Noise Conditions

The tone receiver will accept a noise level corresponding to SINAD = 5dB as measured in the speech channel of the CQM5000.

OUTPUT FUNCTIONS

A sequence call produces the following output signals.

Yellow L.E.D. will start flashing, cancel the short-circuit of terminal 4, and short-circuit 2-3.

Manual activation of LS in/out

establishes the output functions as above.

Switching the LS off

produces the following output signals.

The L.E.D. will stop flashing.

Key Blocking:

The connection between terminal 2 and 3 will be cancelled.

Audio Blocking:

Short-circuits terminal 4 to ground.

Length

159.8mm.

Width

69mm

Weight

86g.

CODING AND STRAPPING OF TQ5001 AND TQ5002

The sequential tone transmitter and sequential tone receiver codes are independent of each other for which reason examples are given separately. See notes on the schematic diagram.

The sequential tone receiver is capable of receiving 3, 4 or 5 tones in a decadic system in which each digit is represented by a specific tone. Group call codings are described later, refer to SU5001 and SU5002.

Sequential Tone receiver, individual call.

Strapping for 3, 4 or 5 tone sequential call

For receiving and transmitting 3, 4 or 5 tones connect a wire from Note 4 to the terminal with the desired number. (Note 4 = INDV)

See fig. 1

The wire colors indicate the order of the tonegates, BN, RD, OR, YW, and GN for the sequential tone transmitter code, BL, VT, GY, WH and BK for the sequential tone receiver code. Each wire soldered to the tone coil represents one digit of the call number. If

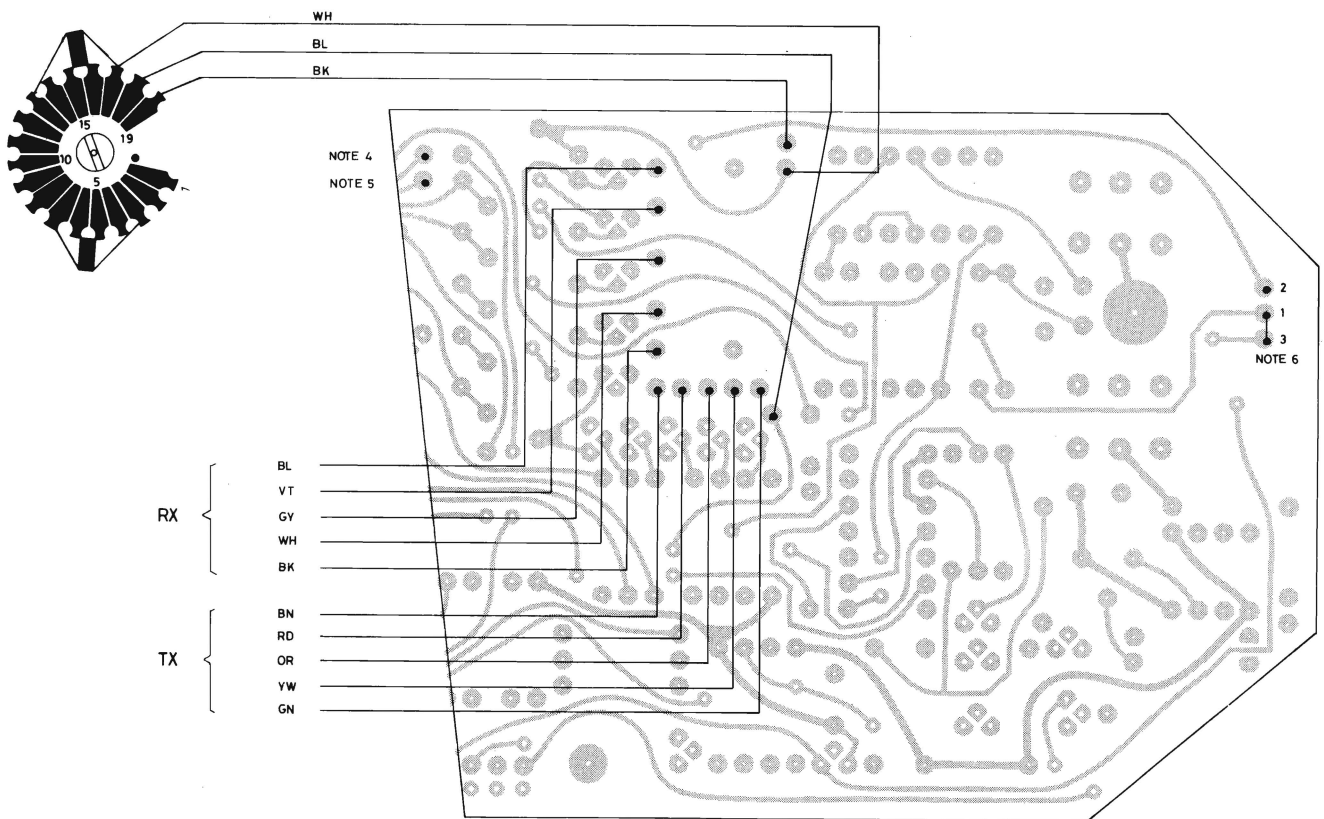


Fig. 1

Viewed from component side

Note 6: 1-2 = return.

the actual call number contains two identical digits following each other, a repeat tone is used for the latter. The procedure is repeated if more than 2 identical digits are used.

As an example the number 33333 is coded 3R3R3.

		5-tone call	4-tone call	3-tone call
Blue wire	1st tone	1st digit	1st digit	1st digit
Violet wire	2nd tone	2nd digit	2nd digit	2nd digit
Gray wire	3rd tone	3rd digit	3rd digit	3rd digit
White wire	4th tone	4th digit	4th digit	3rd digit
Black wire	5th tone	5th digit	4th digit	3rd digit

When coding 3-tone calls and 4-tone calls the remaining wires are, on the p.c.b., connected, to the last digit.

If the tone transmitter code and the tone receiver code are identical, the tone

gate wires may be interconnected on the p.c.b. as shown:

Tone transmitter code: 23354 (23R54)

Tone receiver code: 23354

See Fig. 2.

Part of printed circuit

Coil on component side

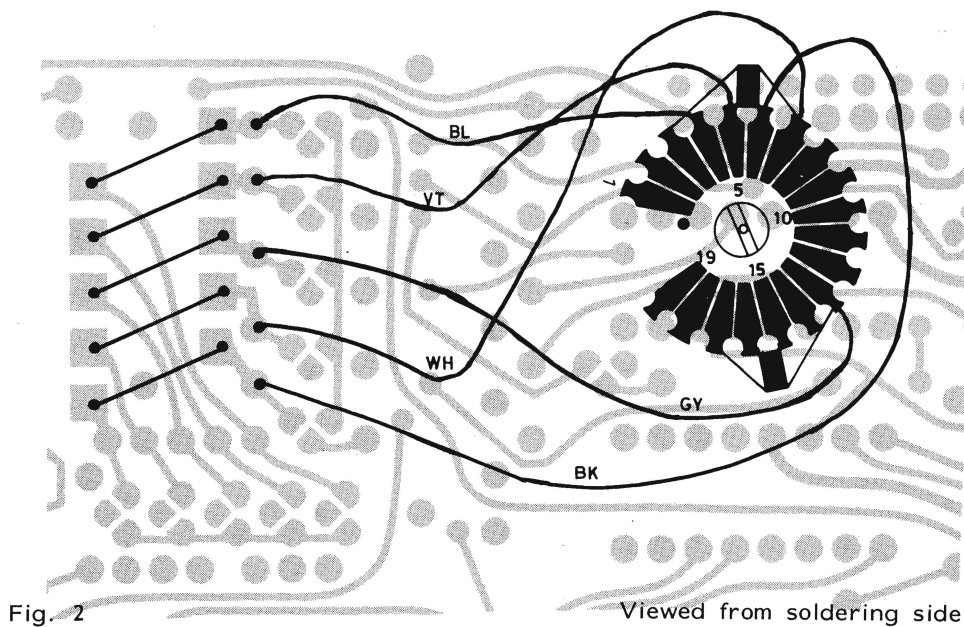


Fig. 2

Viewed from soldering side

Group digit coding

The TQ-unit can be installed together with a group call unit SU5001 or an all-call unit SU5002, designed for group calls or all-calls with 1 digit. A connection between terminal GR (NOTES) and terminal 2, 3, or 4 are for group calls with 1 group call tone on the 3rd tone, the 4th tone, or the 5th tone.

A connection between terminal GR (NOTE5) and terminal 0 are for All-Call.

For code combinations and their limitations see coding of SU5001 and SU5002.

Auto Receipt

See NOTE 6 and Fig. 1.

Tone coil

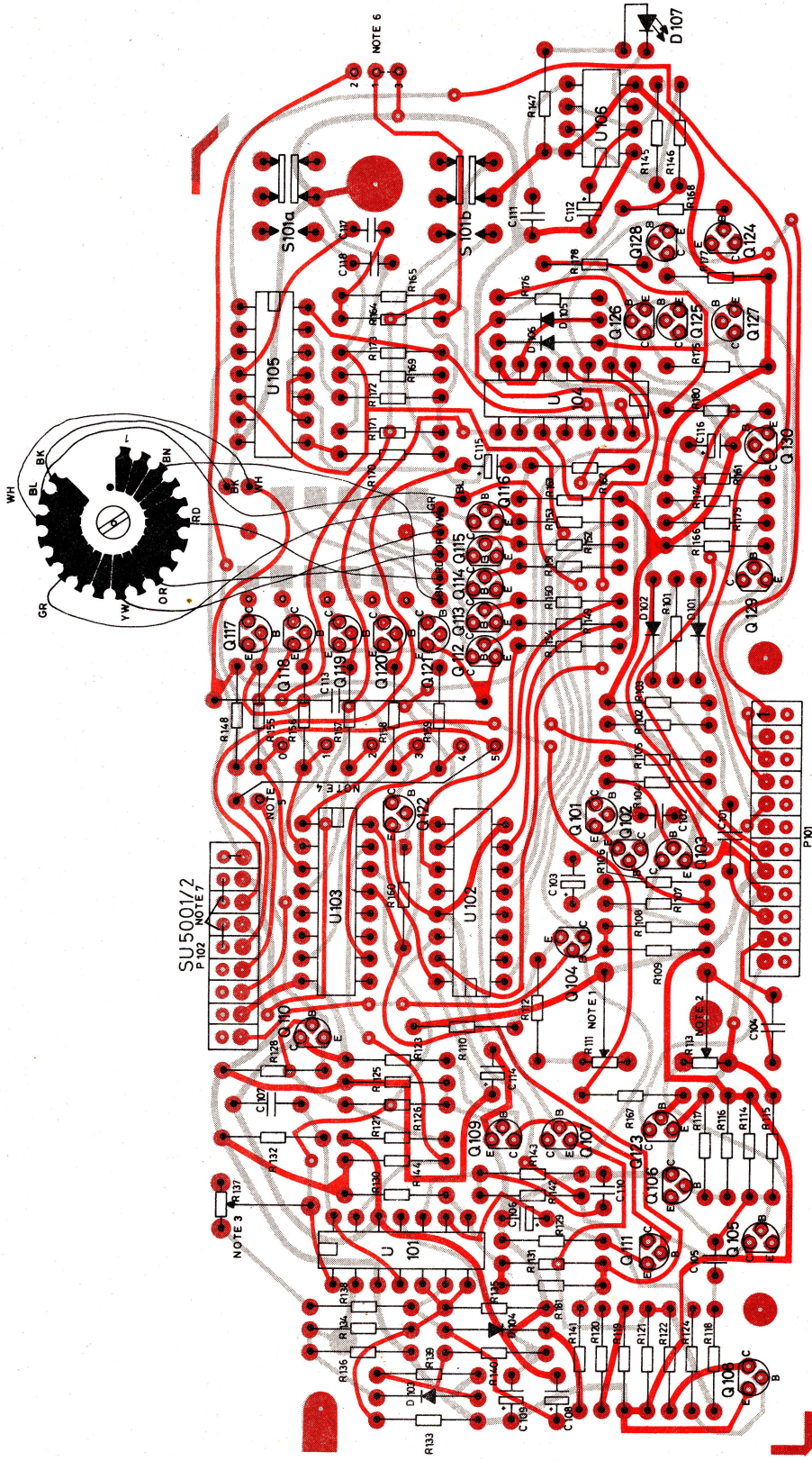
Terminal numbers on the tone coil tags and their relating digits and frequencies appear from the table.

Terminal	Digit	STORNO. ZVEI Frequency, Hz	CCIR Frequency Hz
1	X	885	960
2	Y	970	1062
3	1	1060	1124
4	2	1160	1197
5	3	1270	1275
6	4	1400	1358
7	5	1530	1446
8	6	1670	1540
9	7	1830	1640
10	8	2000	1747
11	9	2200	1860
12	0	2400	1981
13	R	2600	2110
14	A	2800	

R =Repeat tone

A = Alarm tone

X and Y: Special tones, used for A and R in 12,5kHz channel spacing equipment.



COIL TERM	DIGIT	TQ5001 STORNO FREQ	TQ5002 CCIR FREQ
1	X	885 Hz	960 Hz
2	Y	970 Hz	1062 Hz
3	1	1060 Hz	1124 Hz
4	2	1160 Hz	1197 Hz
5	3	1270 Hz	1275 Hz
6	4	1400 Hz	1358 Hz
7	5	1530 Hz	1446 Hz
8	6	1670 Hz	1540 Hz
9	7	1830 Hz	1640 Hz
10	8	2000 Hz	1747 Hz
11	9	2200 Hz	1860 Hz
12	0	2400 Hz	1981 Hz
13	R	2600 Hz	2110 Hz
14	A	2800 Hz	-

SEQUENTIAL TONE UNIT
 COMPONENT LAYOUT
 TQ 5001, TQ5002

D402.622

TONE OUTPUT

VOL./SO HI

-85V CONT

+85V TX

ALARM

-A

MUTE

LS IN/OUT

TONE KEY

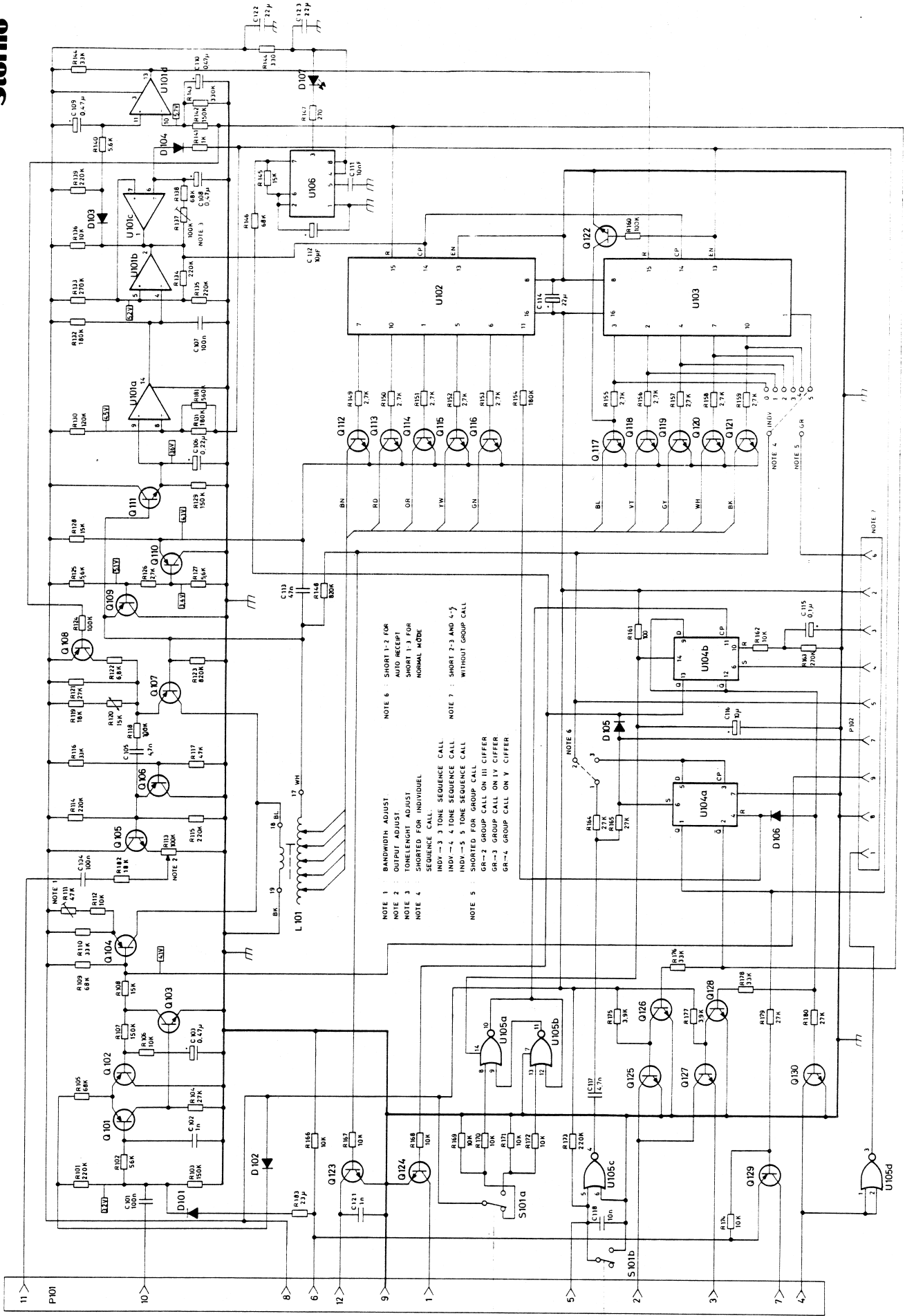
TONE KEY

PTT(TO RELAY)

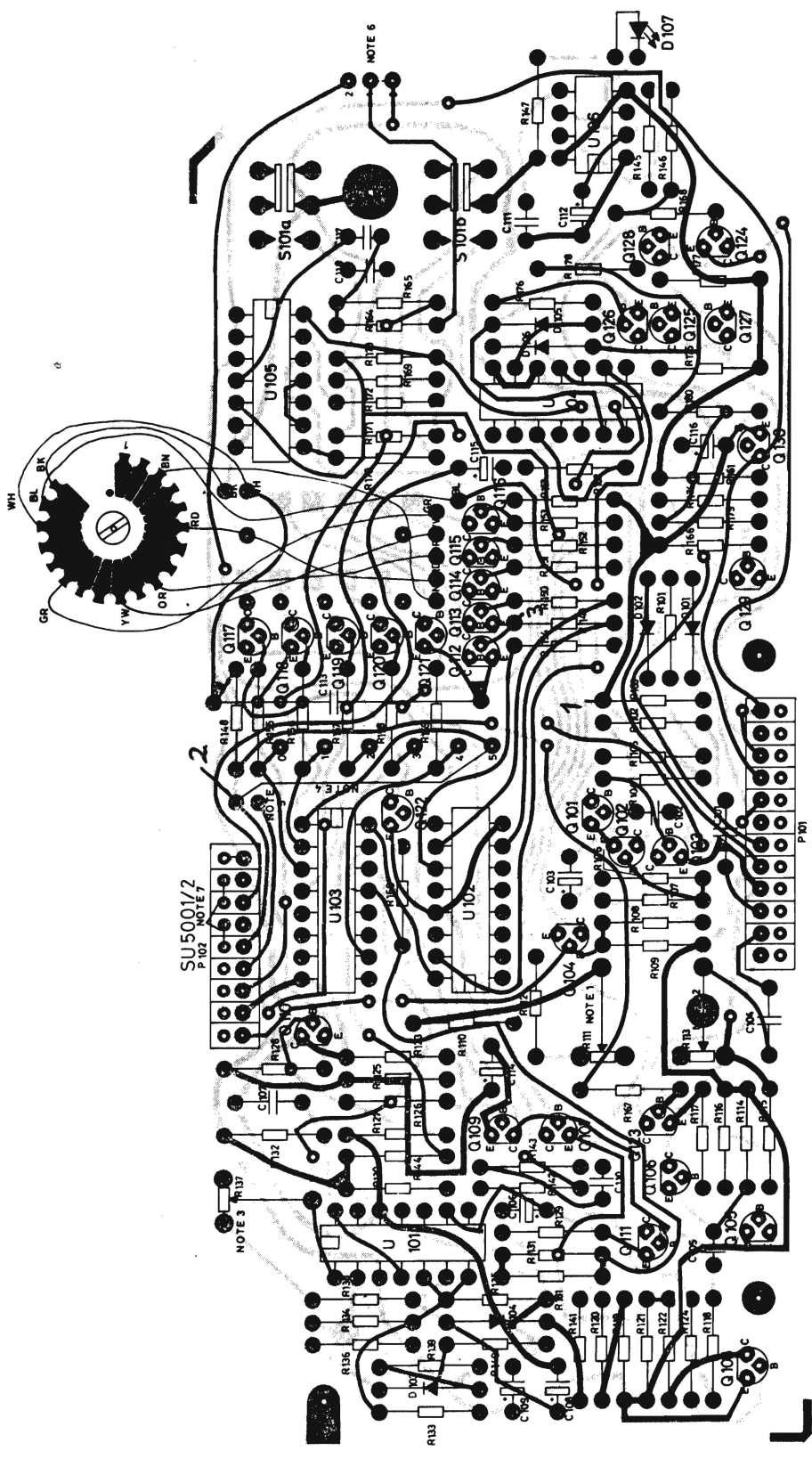
PTT

MIC BLOCK

RX MUTE



COIL TERM	DIGIT	TQ5001 STORNO FREQ	TQ5002 CCIR FREQ
1	X	885 Hz	960 Hz
2	Y	970 Hz	1062 Hz
3	1	1060 Hz	1124 Hz
4	2	1160 Hz	1197 Hz
5	3	1270 Hz	1275 Hz
6	4	1400 Hz	1358 Hz
7	5	1530 Hz	1446 Hz
8	6	1670 Hz	1540 Hz
9	7	1830 Hz	1640 Hz
10	8	2000 Hz	1747 Hz
11	9	2200 Hz	1860 Hz
12	0	2400 Hz	1981 Hz
13	R	2600 Hz	2110 Hz
14	A	2800 Hz	-



SEQUENTIAL TONE UNIT
 COMPONENT LAYOUT
 TQ 5001, TQ5002

D402.622

TYPE	NO	CODE	DATA
	C101	A700004P2	0.1 uF 10% Polyester. FL
	C102	A700234P1	1 nF 10% Polyester. FL
	C103	A701534P3	0.47 uF 20% Tantal
	C104	A700004P2	0.1 uF 10% Polyester. FL
	C105	A700234P5	4.7 nF 10% Polyester. FL
	C106	A700003P2	0.22 uF 20% Tantal
	C107	A700004P2	0.1 uF 10% Polyester. FL
	C108	A700003P3	0.47 uF 20% Tantal
	C109	A700003P3	0.47 uF 20% Tantal
	C110	A701534P3	0.47 uF 20% Tantal
	C111	A700234P7	10 nF 10% Polyester. FL
	C112	A701534P7	10 uF 20% Tantal
	C113	J707156P1	47 nF 25% Polyester. TB
	C114	A701534P8	22 uF 20% Tantal
	C115	A701534P1	0.1 uF 20% Tantal
	C116	A701534P7	10 uF 20% Tantal
	C117	A700234P5	4.7 nF 10% Polyester. FL
	C118	A700234P7	10 nF 10% Polyester. FL
	C121	A700233P7	1 nF 10% Polyester
	C122	A701534P8	22 uF 20% Tantal
	C123	A701534P8	22 uF 20% Tantal
	D101	A700028P1	1N4148 Diode
	D102	A700028P1	1N4148 Diode
	D103	A700028P1	1N4148 Diode
	D104	A700028P1	1N4148 Diode
	D105	A700028P1	1N4148 Diode
	D106	A700028P1	1N4148 Diode
	D107	99.5325	LED Yellow
TQ5001	L101	K805299G1	Tone coil
TQ5002	L101	K805299G2	Tone coil
	P101	41.5549	Fem. Connector
	P102	41.5548	Fem. Connector
	Q101	99.5230	BC308 Transistor
	Q102	99.5230	BC308 Transistor
	Q103	99.5143	BC238 Transistor
	Q104	99.5230	BC308 Transistor
	Q105	99.5143	BC238 Transistor
	Q106	99.5230	BC308 Transistor
	Q107	99.5115	BC309 Transistor
	Q108	99.5230	BC308 Transistor
	Q109	99.5230	BC308 Transistor
	Q110	99.5230	BC308 Transistor

12 pos
9 pos

TYPE	NO	CODE	DATA
	Q111	99.5143	BC238 Transistor
	Q112	99.5324	BC338-25 Transistor
	Q113	99.5324	BC338-25 Transistor
	Q114	99.5324	BC338-25 Transistor
	Q115	99.5324	BC338-25 Transistor
	Q116	99.5324	BC338-25 Transistor
	Q117	99.5324	BC338-25 Transistor
	Q118	99.5324	BC338-25 Transistor
	Q119	99.5324	BC338-25 Transistor
	Q120	99.5324	BC338-25 Transistor
	Q121	99.5324	BC338-25 Transistor
	Q122	99.5143	BC238 Transistor
	Q123	99.5143	BC238 Transistor
	Q124	99.5143	BC238 Transistor
	Q125	99.5143	BC238 Transistor
	Q126	99.5143	BC238 Transistor
	Q127	99.5143	BC238 Transistor
	Q128	99.5143	BC238 Transistor
	Q129	99.5230	BC308 Transistor
	Q130	99.5143	BC238 Transistor
	R101	A700019P65	220 Kohm 5% Carbon film
	R102	A700019P58	56 Kohm 5% Carbon film
	R103	A700019P63	150 Kohm 5% Carbon film
	R104	A700019P54	27 Kohm 5% Carbon film
	R105	A700019P59	68 Kohm 5% Carbon film
	R106	A700019P49	10Kohm 5% Carbon film
	R107	A700019P63	150 Kohm 5% Carbon film
	R108	A700019P51	15 Kohm 5% Carbon film
	R109	A700019P59	68 Kohm 5% Carbon film
	R110	A700019P55	33 Kohm 5% Carbon film
	R111	J708394P30	47 Kohm 20% RES. VAR. CE1M.
	R112	A700019P49	10 Kohm 5% Carbon film
	R113	J708394P31	100 Kohm 20% Trin Cemset
	R114	A700019P65	220 Kohm 5% Carbon film
	R115	A700019P65	220 Kohm 5% Carbon film
	R116	A700019P55	33 Kohm 5% Carbon film
	R117	A700019P57	47 Kohm 5% Carbon film
	R118	A700019P61	100 Kohm 5% Carbon film
	R119	A700019P52	18 Kohm 5% Carbon film
	R120	89.5010	15 Kohm 20% ITC
	R121	A700019P54	27 Kohm 5% Carbon film
	R122	A700019P47	6.8 Kohm 5% Carbon film

SEQUENTIAL TONE UNIT TQ5001
SEQUENTIAL TONE UNIT TQ5002

X402.645/4

TYPE	Nº	CODE	DATA
	R123	A700019P72	820 Kohm 5% Carbon film
	R124	A700019P61	100 Kohm 5% Carbon film
	R125	A700019P46	5.6 Kohm 5% Carbon film
	R126	A700019P42	2.7 Kohm 5% Carbon film
	R127	A700019P46	5.6 Kohm 5% Carbon film
	R128	A700019P51	15 Kohm 5% Carbon film
	R129	A700019P63	150 Kohm 5% Carbon film
	R130	A700019P62	120 Kohm 5% Carbon film
	R131	A700019P64	180 Kohm 5% Carbon film
	R132	A700019P64	180 Kohm 5% Carbon film
	R133	A700019P66	270 Kohm 5% Carbon film
	R134	A700019P65	220 Kohm 5% Carbon film
	R135	A700019P65	220 Kohm 5% Carbon film
	R136	A700019P49	10 Kohm 5% Carbon film
	R137	J708394P31	100 Kohm 20% Trim cemet lin
	R138	A700019P59	68 Kohm 5% Carbon film
	R139	A700019P65	220 Kohm 5% Carbon film
	R140	A700019P46	5.6 Kohm 5% Carbon film
	R141	A700019P37	1 Kohm 5% Carbon film
	R142	A700019P63	150 Kohm 5% Carbon film
	R143	A700019P67	330 Kohm 5% Carbon film
	R144	A700019P55	33 Kohm 5% Carbon film
	R145	A700019P51	15 Kohm 5% Carbon film
	R146	A700019P59	68 Kohm 5% Carbon film
	R147	A700019P25	100 ohm 5% Carbon film
	R148	A700019P25	820 Kohm 5% Carbon film
	R149	A700019P42	2.7 Kohm 5% Carbon film
	R150	A700019P42	2.7 Kohm 5% Carbon film
	R151	A700019P42	2.7 Kohm 5% Carbon film
	R152	A700019P42	2.7 Kohm 5% Carbon film
	R153	A700019P42	2.7 Kohm 5% Carbon film
	R154	A700019P64	180 Kohm 5% Carbon film
	R155	A700019P42	2.7 Kohm 5% Carbon film
	R156	A700019P42	2.7 Kohm 5% Carbon film
	R157	A700019P42	2.7 Kohm 5% Carbon film
	R158	A700019P42	2.7 Kohm 5% Carbon film
	R159	A700019P42	2.7 Kohm 5% Carbon film
	R160	A700019P61	100 Kohm 5% Carbon film
	R161	A700019P25	100 ohm 5% Carbon film
	R162	A700019P49	10 Kohm 5% Carbon film
	R163	A700019P66	270 Kohm 5% Carbon film
	R164	A700019P54	27 Kohm 5% Carbon film

TYPE	Nº	CODE	DATA
	R165	A700019P54	27 Kohm 5% Carbon film
	R166	A700019P49	10 Kohm 5% Carbon film
	R167	A700019P49	10 Kohm 5% Carbon film
	R168	A700019P49	10 Kohm 5% Carbon film
	R169	A700019P49	10 Kohm 5% Carbon film
	R170	A700019P49	10 Kohm 5% Carbon film
	R171	A700019P49	10 Kohm 5% Carbon film
	R172	A700019P49	10 Kohm 5% Carbon film
	R173	A700019P65	220 Kohm 5% Carbon film
	R174	A700019P49	10 Kohm 5% Carbon film
	R175	A700019P44	3.9 Kohm 5% Carbon film
	R176	A700019P55	33 Kohm 5% Carbon film
	R177	A700019P44	3.9 Kohm 5% Carbon film
	R178	A700019P55	33 Kohm 5% Carbon film
	R179	A700019P54	27 Kohm 5% Carbon film
	R180	A700019P54	27 Kohm 5% Carbon film
	R181	A700019P70	560 Kohm 5% Carbon film
	R182	A700019P52	18 Kohm 5% Carbon film
	R183	A700019P43	3.3 Kohm 5% Carbon film
	R184	A700019P31	330 ohm 5% Carbon film
	S101a	B800563P3	Switch
	S101b	B800563P3	Switch
	U101	J706018P1	MC3302 Quad. Comparat.
	U102	A700029P12	4017 Johnson Counter
	U103	A700029P12	4017 Johnson Counter
	U104	14.5098	4013 Dual D-FF
	U105	A700029P2	4001 Quad. 2-imp. NOR
	U106	14.5134	555 Timer

SEQUENTIAL TONE UNIT TQ5001
SEQUENTIAL TONE UNIT TQ5002

X402.645/3

GROUP CALL UNIT SU5001

ALL CALL UNIT SU5002

The All-Call unit, SU5002, and Group Call unit, SU5001, are identical except for some few points. The following description will therefore apply to both SU5001 and SU5002, and their differences will be described in an appendix. All notes in this description refer to the schematic diagram.

General

The call unit is a single tone receiving module designed for application in TQ5001/2 and extend the selective calls to comprise group calls with one group tone. The module is a printed board with plug-in pins fitting sockets on the TQ5001/2. When fitted with a SU5000, TQ5001/2 is capable of receiving calls with a group call tone as the 3rd, 4th, or 5th tone of the sequential tone signal corresponding to the selected group division. Functionally the SU5000 is in parallel with the selection circuit of the individual call channel and the two circuits share the input amplifier/limiter. Two tones may be selected as the group tone, 2400Hz or 2800Hz, corresponding to individual digit 0 and alarm tone G, respectively.

A receiver group call is read out like an individual call with the following exceptions:

- 1: The audio channel can not be blocked with LS in/out.
- 2: The Automatic Receipt is blocked and Tone Keying is not possible.

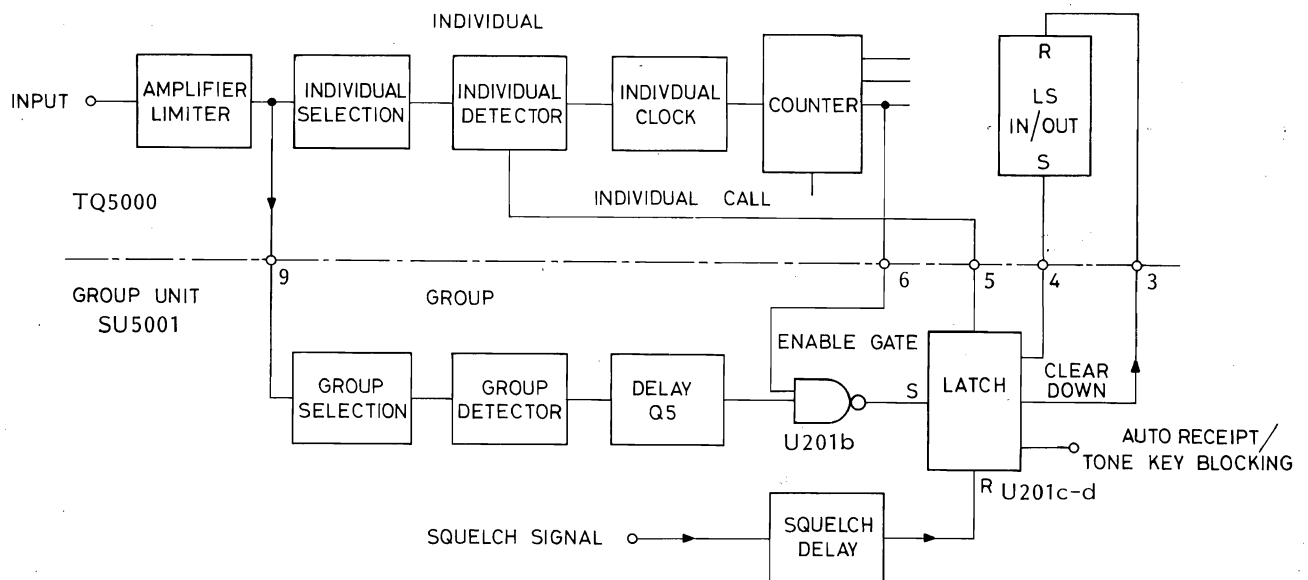
The blockings are all cancelled approximately 500 milliseconds (ms) after the group call is terminated. Also see notes on TQ5001/2 schematic.

Mode of Operation

Upon reception of a sequential tone signal matching the tone combinations of TQ5001/2 and SU5001 the operation is as follows:

The r. f. carrier opens the squelch circuit which energizes the SQ-delay.

The sequential tone signal is amplified and limited in the input stage after which the



signal is applied to the resonant circuits of TQ5001/2 and SU5000. When the individual counter of TQ5001/2 has registered the first tones of the signal it releases the SU5000 to read out the group digit. The group tone is selected by the bandpass filter and applied to the detector. If the group tone level is within the sensitivity range of SU5000 the signal activates the detector circuit. The rectified signal from the detector is delayed approx. 25ms before the latch read out the call to TQ5001/2 along with establishing the blocking functions. Approximately 15 to 20ms after the end of the group tone the detector and delay circuits revert to standby. Approximately 500ms after the squelch closes, all blocking signals are cancelled and the loudspeaker is turned off.

Circuit Description:

Resonant Circuit

Transistor Q201 operates as a current generator and drives the resonant circuit L201-C201. The sensitivity and thus the bandwidth of SU5000 can be adjusted with resistor R201. (Note 3).

The resonant circuit is a bandpass configuration and drives the detector circuit directly. The unit can be set to one of two tones, 2400Hz and 2800Hz. (NOTE 1 and 2)

Detector

The transistors Q202 and Q203 are arranged to form a differential detector circuit. In standby transistor Q202 is off, Q203 is on, and C202 is charged up to the potential determined by voltage divider R206-207. If the peak value of the selected signal exceeds the bias of Q202 (Q203's base voltage) Q202 turns on and charges C202 to a higher potential by which Q203 is biased off. At the cessation of the group tone C202 discharges via R204 and after approximately 10-20ms Q203 again turns on and holds the voltage on C202.

Delay and Enable Gate

Transistor Q204 operates as a switch and is controlled directly by the detector. In standby Q204 is on and the charge of C203 is neutral. When the detector is energized by a call Q204 goes off and C203 charges through R208// R209. After approximately 25ms (adjustable with R209) the voltage across C203 reaches the trigger level of U201a which relays the call information (+ 8, 5V) to enable Gate U201b.

If U201b has received a signal indicating that the first tones of a signal is accepted and counted by the individual Counter the call is applied directly to the Latch. At the end of the group tone C203 discharges through R210 and U210a-b reverts to standby.

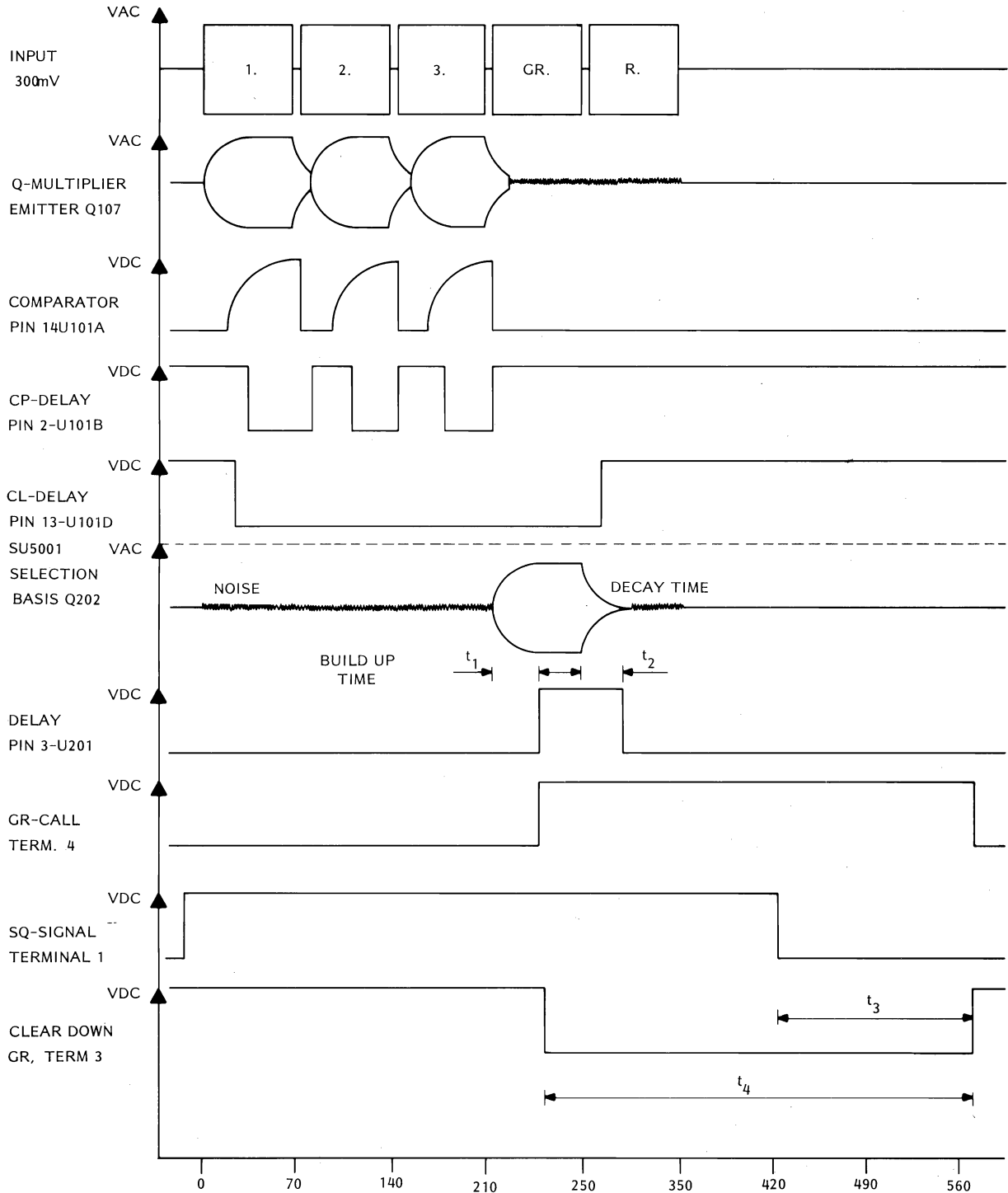
Latch and Squelch Delay

The latch is constructed as an R-S flip-flop employing gates U201c and U201d.

The latch reads out the group call to the individual tone receiver TQ5001/2 and, simultaneously, establishes the blocking functions:

- Pin 4: common terminal for individual and group call blocking of the LS in/out. Diode D203 is forward biased.
- Pin 7: Blocking of Automatic Receipt and Tone Key. Diode D201 tied to chassis through U201d.
- Pin 3: Tied to chassis through U201d.

The R-input of the Latch is controlled by the squelch via the Squelch Delay which cancels the blocking functions 500ms after the squelch closes. C205 charges through R214 and Q205 which is driven by the squelch buffer inverter of TQ5001/2. The voltage across the capacitor is maintained until the squelch closes after



t_1 BUILD-UP TIME DELAY
 t_2 DELAY TIME HANG TIME
 t_3 SQ-DELAY
 IN PERIOD t_4 THE AUTOMATIC RECEIPT TONE KEY AND LS IN OUT ARE INHIBITED.

which C205 is discharged by R214 and R215. At the end of the group tone Enable Gate U201b reverts to standby.

The latch information is held by the Squelch Delay for approximately 500ms after the squelch has closed and then the blockings are cancelled.

- Pin 4: 0V, R = R212
- Pin 7: D201 submits a positive pulse to turn off the loudspeaker.

Coding Sequential Tone Call Signals

With One Group Tone

If digit 0 (2400Hz) is used (group call according to ZVEI), there are limitations to the number of individual call combinations, as the SU5001 responds to individual tone combinations containing the digit 0. Likewise a sequential tone signal must not contain two identical, consecutive tones for which reason digit 0 cannot be used as the last digit of a group number.

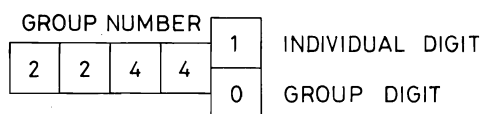
Note

The tone ahead of the group tone and the following tones must not be coded to 0. If tone G is used (2800Hz), which is outside the tone series employed (0-9), there are no limitations in the number of individual and group combinations.

The Group Digit Location

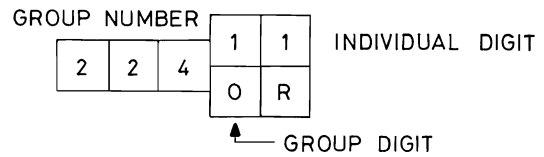
a: SU5001 strapped to 2400Hz (=digit 0).

5-digit sequential tone signal with group call on 5th digit



9 individual numbers from 22441 to 22449

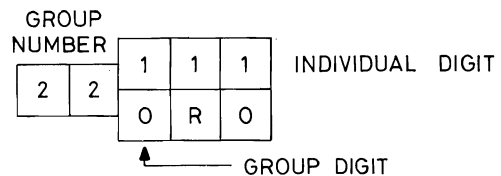
5-digit sequential tone signal with group call on 4th digit



81 individual numbers from 22411 to 22499.

5-digit sequential tone signal with group call on the 3rd digit

(non standard according to ZVEI)

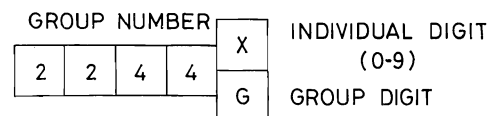


729 individual numbers from 22111 to 22999

The group call combination is emitted as shown above, but the digits following the group digit (0) have no functions in the call configuration.

b: SU5001 strapped to 2800Hz (=digit G)

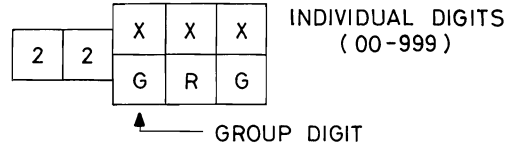
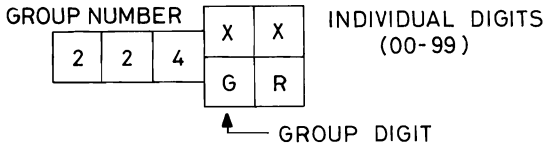
5 digit sequential tone signal with group call on 5th digit



10 individual numbers from 22440 to 22449.

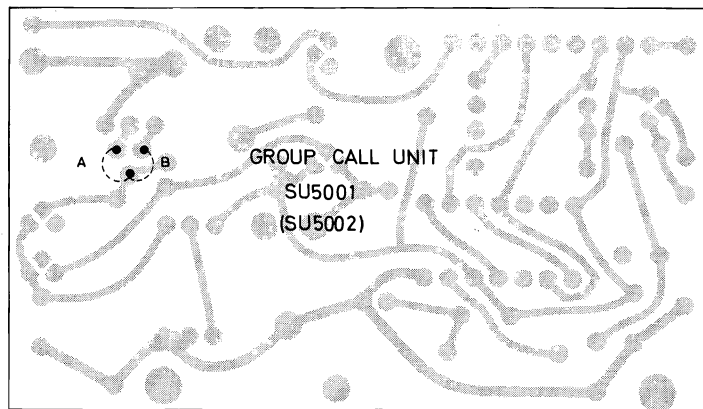
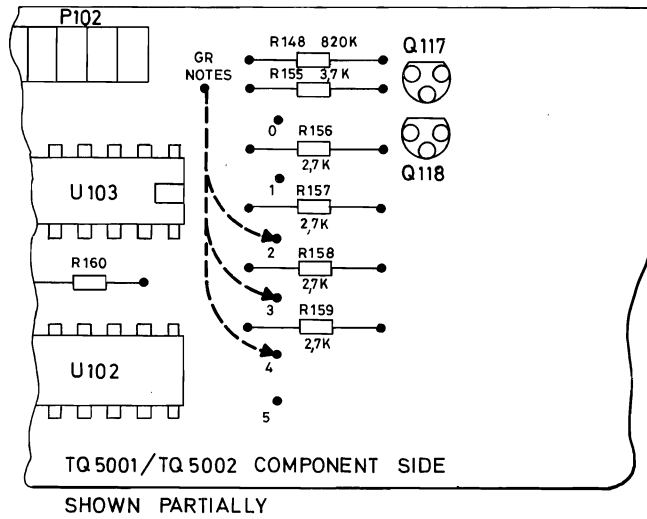
5-digit sequential tone call with group call on the 4th digit

5-digit sequential tone call with group call on the 3rd digit



100 individual numbers from 22400 to 22499

1000 individual numbers from 22000 to 22999



A = 2800 Hz (DIGIT G)
B = 2600 Hz (DIGIT O)

Part of component side TQ5001/2. See drawing and notes on the TQ diagram.

- NOTE 5 → 2: Group-Call on 3rd tone
- NOTE 5 → 3: Group-Call on 4th tone.
- NOTE 5 → 4: Group-Call on 5th tone.

Installation

The SU5000 is equipped with plug-in pins and can be inserted directly in the TQ5001/2. When inserted the straps in the connector P102 (on TQ5001/2) must be removed. See drawing and notes on the TQ diagram.

GROUP CALL UNIT

SU5001

Technical Specifications

Supply Voltage8.5V \pm 0.25VCurrent Drain

Standby: 0,5 mA (no external load)

Engaged: approx. 0,65 mA (with SQ signal)

Temperature Range

30°C to +60°C

Input Specifications

See input specifications of TQ5001/TQ5002.

Activating Signal

Single tone signal of 55 ms duration. The location of the group tone is coded on the TQ5001/TQ5002.

Tone Frequencies

2400Hz, 2800Hz.

Frequency Accuracy \pm 0.3%SelectivitySU5001 responds to frequency deviations \pm 1.4%.

SU5001 is insensitive to adjacent tones of the same standard series.

Reaction Time30ms \pm 5ms (adjustable).Signal to Noise Conditions

SU5001 can, in conjunction with TQ5001/TQ5002, process signals having a noise level corresponding to SINAD = 5dB as measured in the speech channel of the CQM5000.

Clear Down Time

< 30ms.

Output Functions

The TQ5001/TQ5002 output functions corresponds to an individual call with the following exceptions:

LS in/out Latch Blocking:	After a group call the loudspeaker cannot be turned off manually.
Auto Receipt Blocking:	After a group call the automatic receipt function is inhibited.
Tone Key Blocking:	After a group call the tone key function is blocked.
Group Call Clear Down:	Approx. 500ms after the receiver squelch closes, the blocked functions are released and the loudspeaker is turned off.

Dimensions

Width: 41 mm

Length: 72.5 mm

Weight

20 g

GROUP CALL UNIT SU5002

Technical Specifications

Supply Voltage

8.5V \pm 0.25V

Current Drain

Standby: 0.5 mA (no external load)

Engaged: approx. 0.65 mA (with SQ signal)

Temperature Range

-30°C to +60°C.

Input Specifications

See input specifications of TQ5001/TQ5002.

Activating Signal

Single tone signal of minimum 2 seconds duration.

The location of the 'all call tone' is coded on the TQ5001/TQ5002.

Tone Frequencies

2400Hz, 2800Hz

Frequency Accuracy

\pm 0.3%

Selectivity

SU5002 responds to frequency deviations \pm 1.4%.

SU5002 is insensitive to adjacent tones of the same standard series.

Reaction Time

2 seconds \pm 0.25 sec. (adjustable).

Signal to Noise Conditions

SU5002 can, in conjunction with TQ5001/5002, process signals having a noise level corresponding to SINAD = 5 dB as measured in the speech channel of CQM5000.

Clear Down Time

< 30ms.

Output Functions

The TQ5001/TQ5002 output functions corresponds to an individual call with the following exceptions:

LS in/out Latch Blocking: After an all-call the loudspeaker cannot be turned off manually.

Auto Receipt Blocking: After an all-call the automatic receipt function is inhibited.

Tone Key Blocking: After an all-call the tone key function is blocked.

All Call Clear Down: Approx. 500ms after the receiver squelch closes, the blocked functions are released and the loudspeaker is turned off.

Dimensions

Width: 41 mm

Length: 72.5 mm

Weight

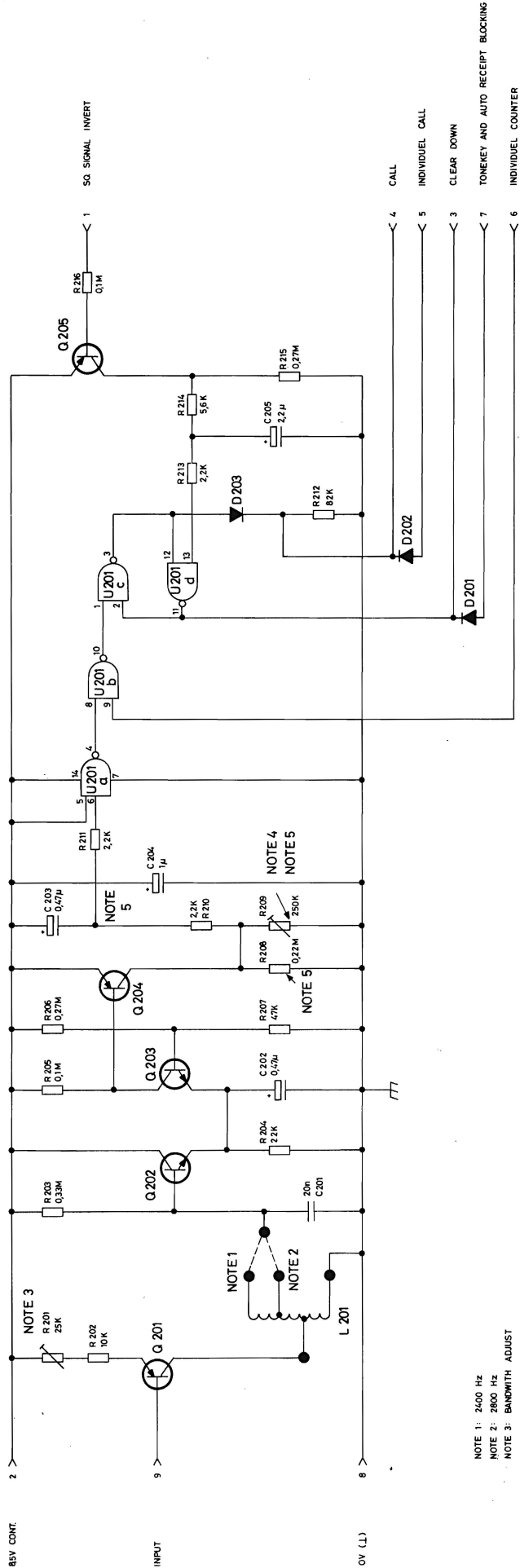
20 g

AppendixSU5002

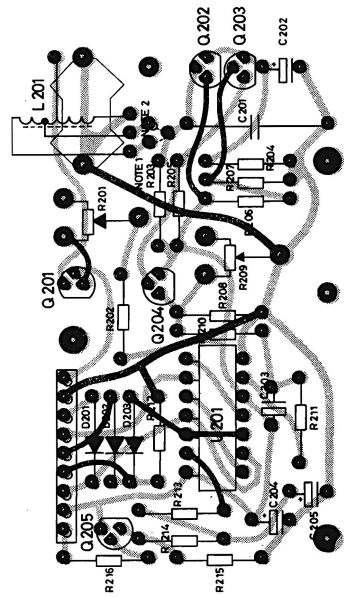
An "All-Call" is emitted as a single tone of more than two seconds duration. In SU5002 both tones, 2400Hz or 2800Hz, may be used (digit 0 or digit G) The only difference between SU5001 and SU5002 is the time delay that determines the reaction time (C203, R208, R209). With a reaction time of two seconds it is possible to transmit a normal sequence call including the All-Call tone without activating the unit.

Coding

For Coding TQ5001/2 to correspond with SU5002:
Strap NOTE5 O.
See coding for Group Call.



- NOTE 1: 2400 Hz
- NOTE 2: 2800 Hz
- NOTE 3: BANDWIDTH ADJUST
- NOTE 4: SET UP TIME ADJUST
- NOTE 5: FOR SU 5002
- R 208 = 056 M
- R 209 = 500 K
- C 203 = 10uF/16V



GROUP CALL - ALL CALL UNIT
SU 5001, SU 5002

D402.620

SEQUENTIAL TONE UNITS

TQ5004 AND TQ5005

GENERAL

The sequential tone units TQ5004 and TQ5005 are combined tone transmitter-tone receiver units with the transmitter and receiver functions being independent of each other. They can process 3, 4, or 5-tone signals, one sequence for tone reception and two sequences for transmission.

The units are built on two printed circuit boards, a TONE BOARD and a LOGIC BOARD, which mount together to a sandwich unit with the soldering sides facing each other. The unit fits mechanically into the CQM5000 radiotelephone on the interconnect board side, and the electrical design appears from the block diagram, see fig. 1. and fig. 2.

For TQ5004 the tone frequencies are the ZVEI (Storno) series, 885 Hz to 2800 Hz, and for TQ5005 the tone frequencies are the CCIR series, 960 Hz to 2110 Hz.

The combinations for the tone receiver and transmitter sequences are selected by coding a PROM (Programmable Read Only Memory). Before placing it on the logic board, see coding and strapping. For the tone transmitter sequences up to 4 tones may be coded to be selected from a keyboard on the control panel CP5003.

The following description applies to both TQ5004 and TQ5005 unless otherwise noted.

STANDBY CONDITIONS

When the radio equipment is turned on it will be in standby condition, and the tone unit, TQ5004/TQ5005, is in the tone receive mode and set to the 1st tone of the receive code.

TONE RECEPTION

Reception of a sequential tone signal that matches the combination of the code will cause the following events to take place:

The KEY BLOCKING is cancelled (Q127 ON).
The LOUDSPEAKER BLOCKING is cancelled (Q130 OFF).

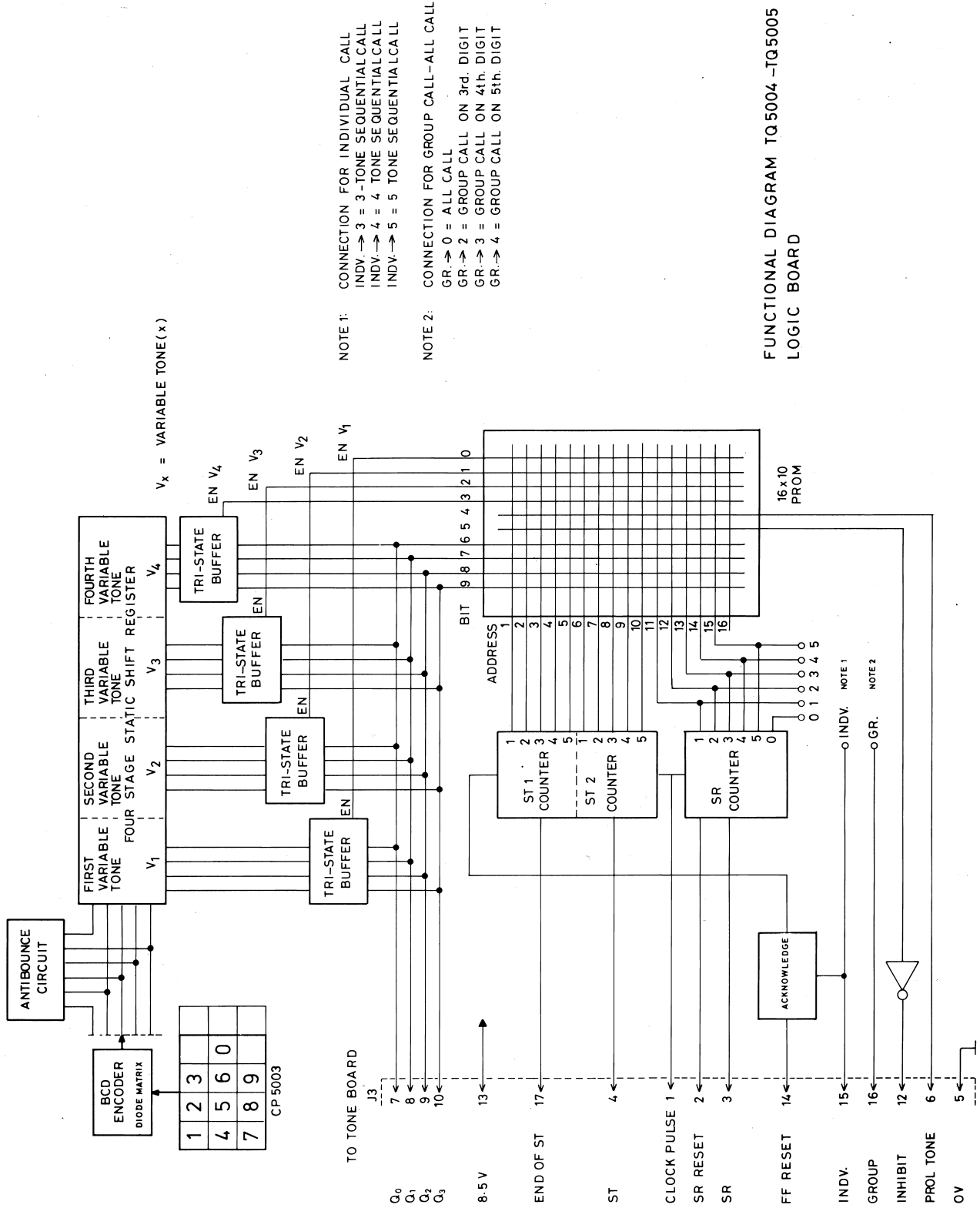
The visual LED CALL INDICATOR will start flashing.

If the unit is connected for AUTO RECEIPT/ACKNOWLEDGE a correctly received tone call will automatically key the sequential tone transmitter and transmit its own ID, and after having generated the last tone of a sequential tone signal, the unit reverts to the condition described above, i. e. the loudspeaker is on.

TONE TRANSMISSION

When the loudspeaker is turned on, either by a tone call or by pressing the LS IN button, the tone transmitter can be keyed and will generate the sequential tone signal.

With a tone length of 70 ms (milliseconds) for the ZVEI and 100 ms for the CCIR tone series the interval from pressing the TONE KEY button to the start of the 1st tone is approximately 220 ms for the TQ5004 (ZVEI) and 320 ms for the TQ5005 (CCIR). When using 3 or 4 tones in the transmitter sequence this interval may be extended if the PROM is programmed to give INHIBIT to the 4-to-16 Bit Decoder.



FUNCTIONAL DIAGRAM TQ5004 -TQ5005 LOGIC BOARD

FIG. 1. LOGIC BOARD FUNCTIONS

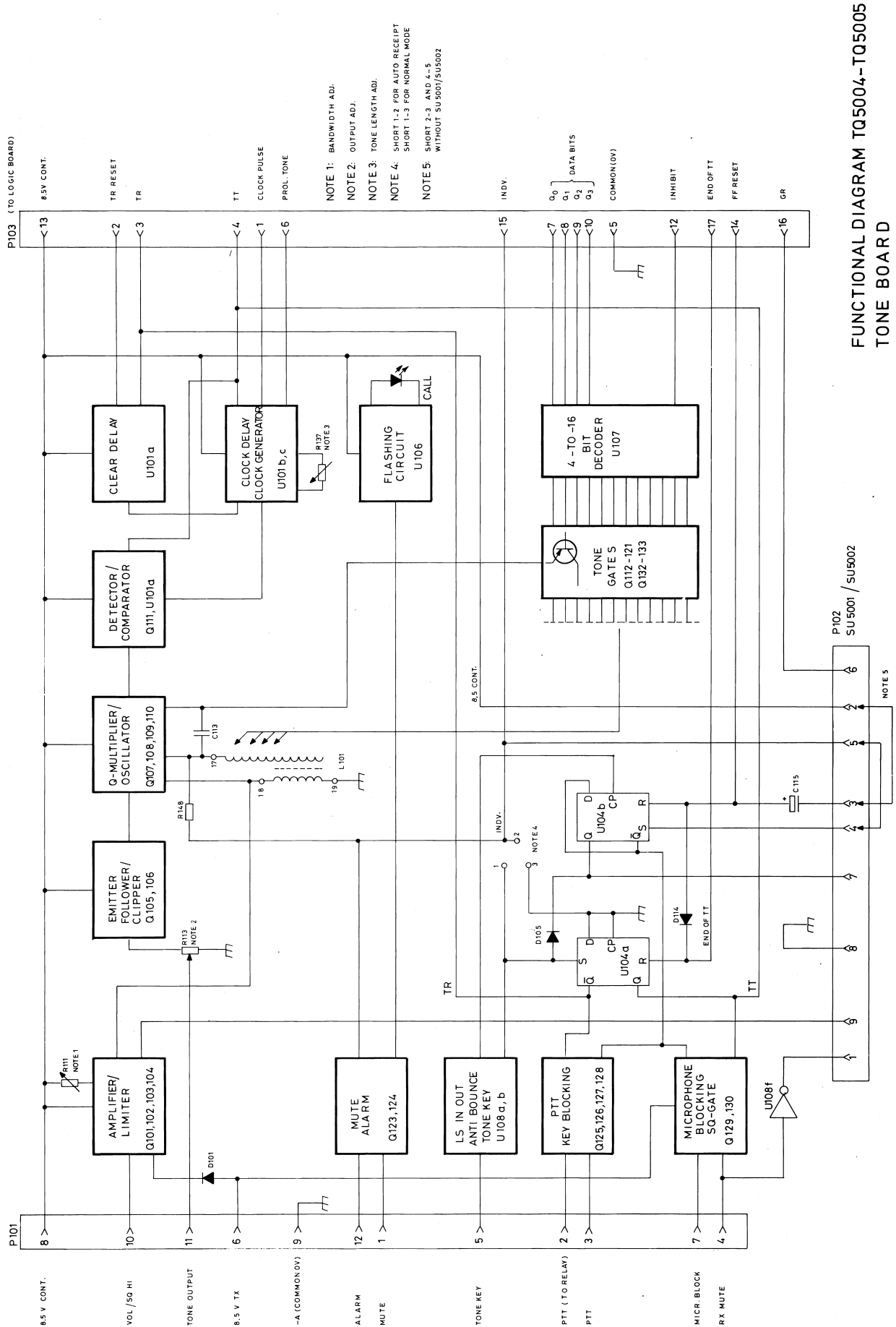


FIG. 2. TONE BOARD FUNCTIONS

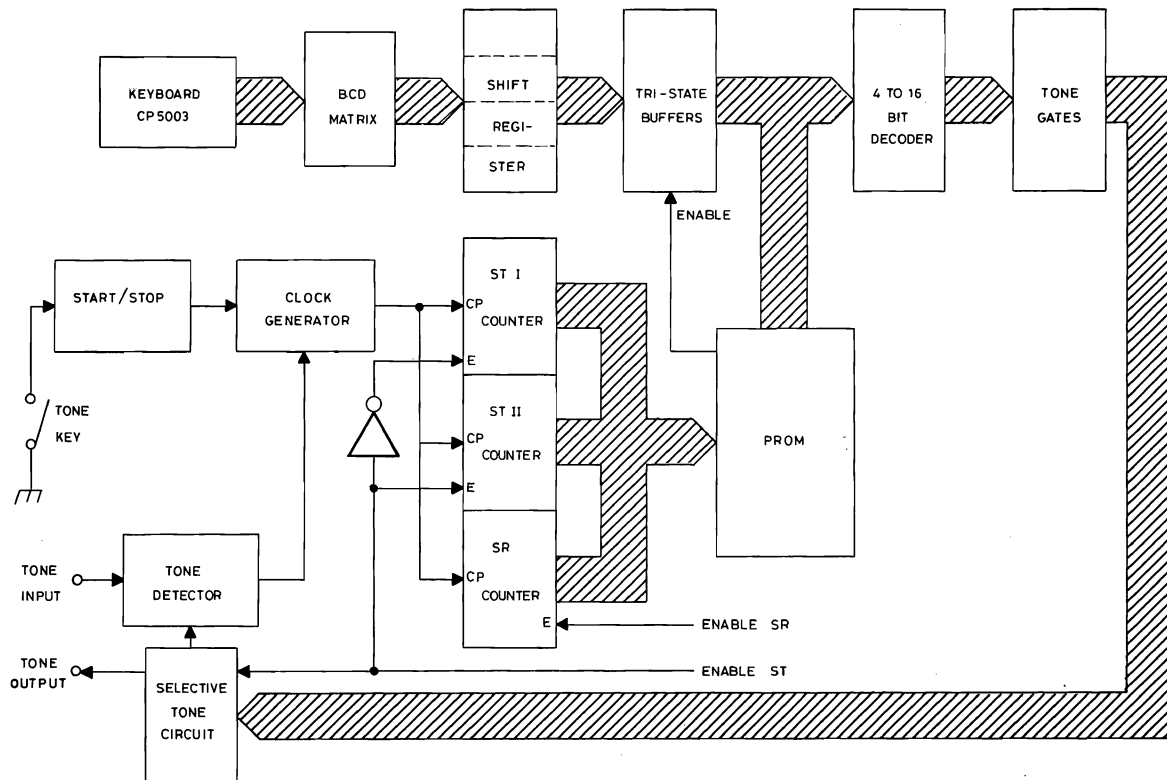


FIG. 3. DATA FLOW CHART

The RF transmitter remains keyed for approximately 600 ms with coding and strapping for one-sequence transmission, and 1100 ms for two-sequence transmission in TQ5004, and 850 ms for one-sequence transmission, and 1550 ms for two-sequence transmission in TQ5005, even if the TONE KEY is depressed for a shorter or longer period.

During the keying of the transmitter the microphone amplifier will be blocked and the blocking signal will disappear after the last tone, i. e. when the unit reverts to standby.

Before transmitting commences it is possible to select up to 4 tones by entering them on the keyboard. The tones are then inserted in the transmitted code in accordance with the coding of the PROM.

The selected tones may be 0-9, and on each side (in the code) a repeat tone must be inserted, refer to Coding and Strapping.

The strapping is performed on the p. c. b. and it is possible to select the "X" tone in place of the "A" tone (Alarm) and the "Y" tone in place of the "R" tone (Repeat). It is impossible to select the A, R, X, and Y tones from the keyboard.

MODE OF OPERATION

Logic levels are as follows:

"1" = ~ 8.5 V

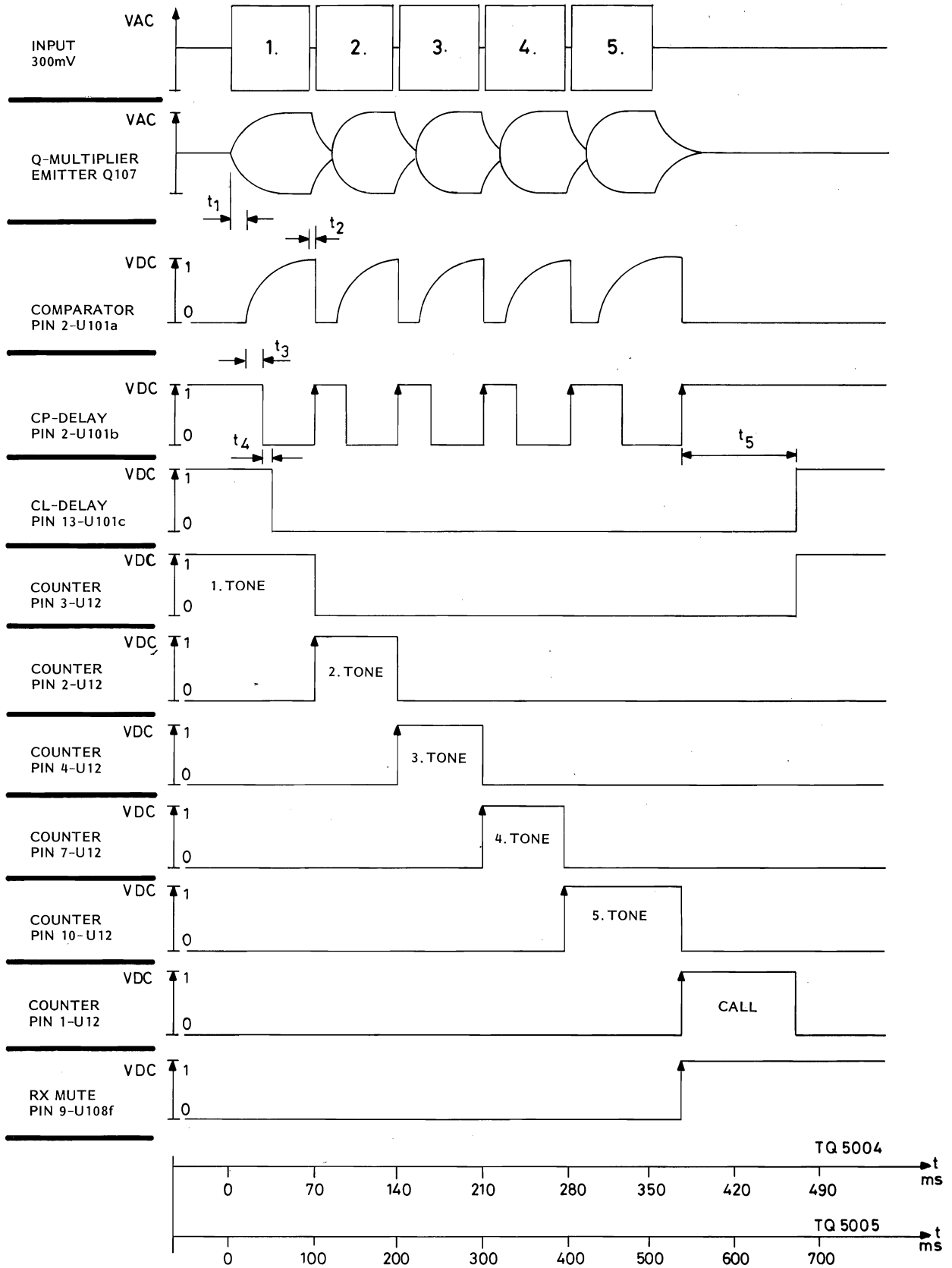
"0" = ~ 0 V

TONE RECEPTION

In standby the 1st tone receiver code in the PROM is applied to the 4-to-16 BIT DECODER which selects the proper tone gate.

The unit is set to the sequential tone reception mode awaiting a call, and when a tone

PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5004 AND TQ5005

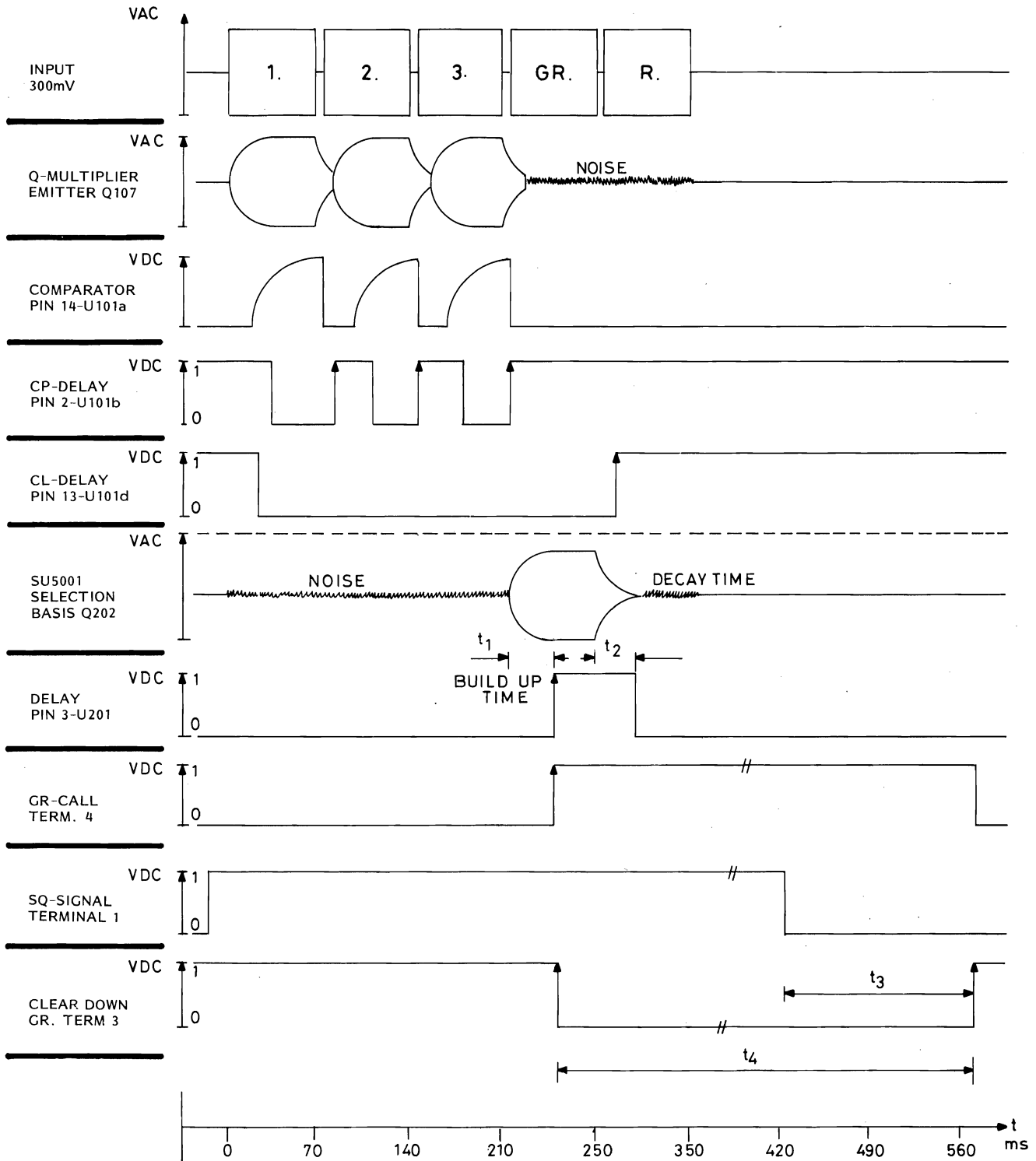


t_1 = SELECTIVE CIRCUIT BUILD-UP TIME
 t_2 = DECAY TIME
 t_3 = CLOCK-DELAY

t_4 = DELAY CHARGING TIME
 t_5 = CLEAR DELAY

FIG. 4. 5-TONE SEQUENTIAL RECEPTION

PULSE-TIME DIAGRAM FOR 5-TONE SEQUENTIAL CALL TQ5004



t_1 BUILD-UP TIME + DELAY
 t_2 DELAY TIME + HANGTIME
 t_3 SQ-DELAY
 IN PERIOD t_4 THE AUTOMATIC RECEIPT, TONE KEY,
 AND LS IN/OUT ARE INHIBITED.

FIG. 5. 5-TONE CALL WITH GROUP CALL

signal having the proper code is applied to the input it is processed as follows:

The 1st tone is amplified and limited in the input stage. The tone is then, via the coupling link, applied to the selective circuit.

The active part of the selective circuit is a Q-multiplier which also operates as an oscillator when the circuit is working as part of the tone transmitter.

If the level of the 1st tone is within the sensitivity range of the tone receiver the detected signal will switch the output of the comparator U101a. Approximately 17 ms later, caused by the CLOCK DELAY circuit, the Schmitt trigger output, U101b goes logic "0". At the same time the Schmitt trigger circuit rapidly sets up the CLEAR DELAY circuit, U101d, in order to remove the reset on the tone receiver counter, U12.

When the first tone ceases the Schmitt trigger reverts to standby condition, output logic "1", and the positive leading edge is fed to the clock input of the counters. As only the tone receiver counter is enabled this steps forward and the code corresponding to the 2nd tone is applied to the 4-to-16 BIT DECODER. The proper tone gate for the 2nd tone is now open.

The transistor collectors of the tone gates are all tied to one of the tone coil terminals. The tone receiver is now set up to receive the 2nd tone of the signal and remain in this state for approximately 120 ms, provided that the 2nd tone is not accepted. The time elapsing is determined by the CLEAR DELAY circuit.

Except for the requirement of a tone length of approximately 40 ms the tone receiver is independent of the duration of the tone bursts, because the counter switches to the next PROM input at the end of the preceding tone. If the 2nd tone is not accepted within approximately 120 ms the counter is reset to standby, i. e. ready for the 1st tone.

The 2nd, 3rd, 4th, and 5th tone of the sequential signal is received as described for the 1st tone.

When the last tone has been accepted, the counter information is read out to latch U104b, which is set and cancels the key and loudspeaker blockings. At the same time the CALL indicator is turned on and LED D107 starts to blink.

The ALARM relay driver Q123 goes on during the last tone period and turns off approximately 70 ms later.

An accepted call may also release an automatic receipt transmission, ACKNOWLEDGE, if this option is used.

TONE TRANSMISSION

All tones used in the tone transmitter codes are programmed in the PROM.

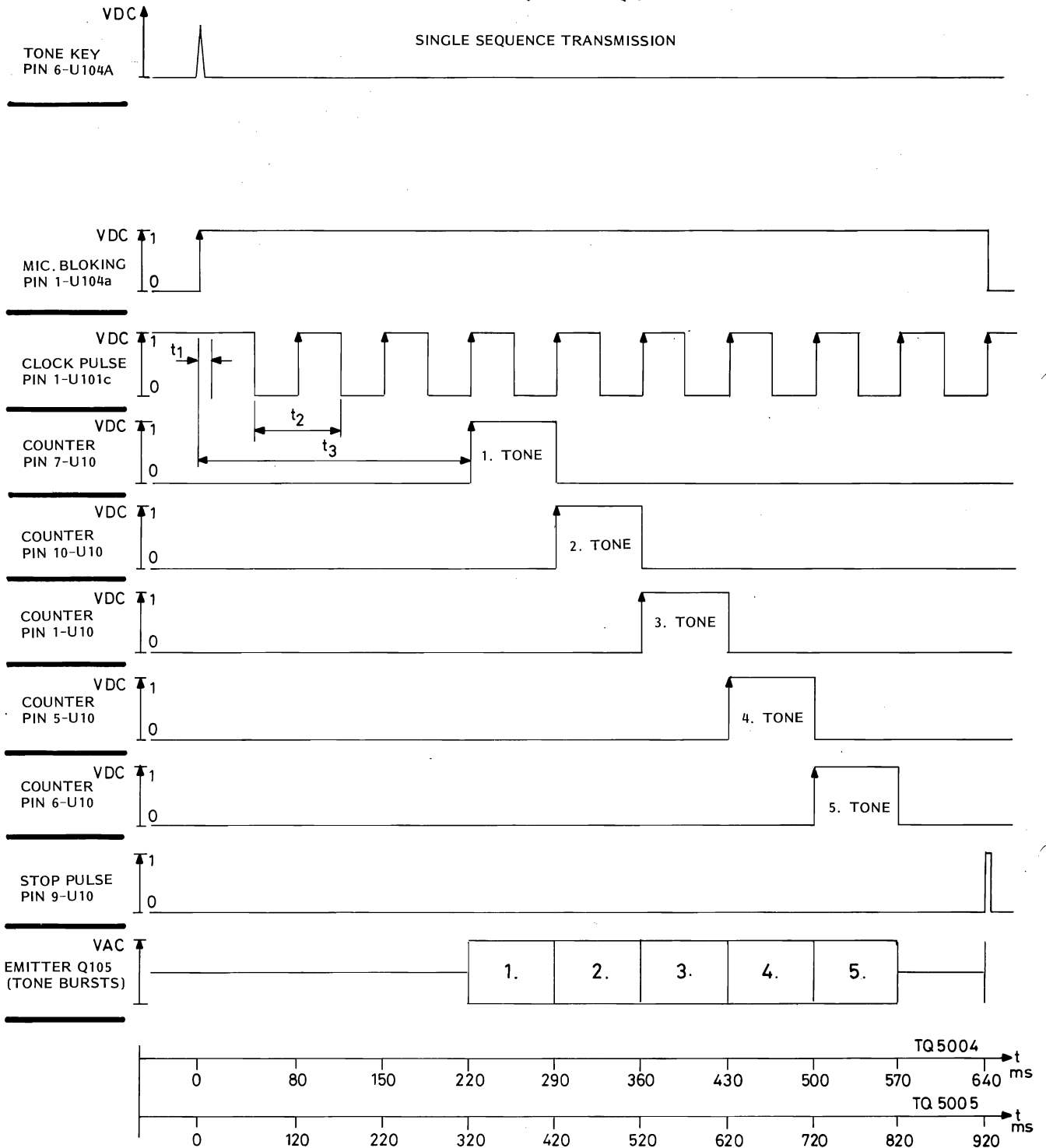
With the loudspeaker turned on, either by a call or by manually pressing the LS in/out button, pressing the TONE KEY button initiates the following series of events:

The positive pulse from the TONE KEY button sets latch U104a whose Q and \bar{Q} outputs control the internal switching from receive mode to transmit mode. U104a also controls the Transmitter Key Switch, Q126-Q125, and the Microphone Blocking transistor Q129.

When the Clock Generator U101c starts to run, the comparator U101a and the counter U12 are both inhibited by the Q-output of U104a. The \bar{Q} -output keys the RF transmitter, inhibits the Clock Delay circuit, and turns Q108 on which increases the gain of Q-multiplier Q107 to make it oscillate when the tone gates are opened.

The clock generator pulses from U101c are applied to the counters, U10 and U11, the repetition rate being 70 ms for TQ5004 and

PULSE-TIME DIAGRAM FOR 5-TONE SEQUENTIAL CALL TRANSMITTING IN TQ5004 AND TQ5005



LOUDSPEAKER MANUALLY TURNED ON
 t_1 CHARGING TIME FOR CLOCK GENERATOR
 t_2 CLOCK PULSE PERIOD (TONE LENGTH)
 t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

FIG. 6. 5-TONE SEQUENTIAL TRANSMISSION

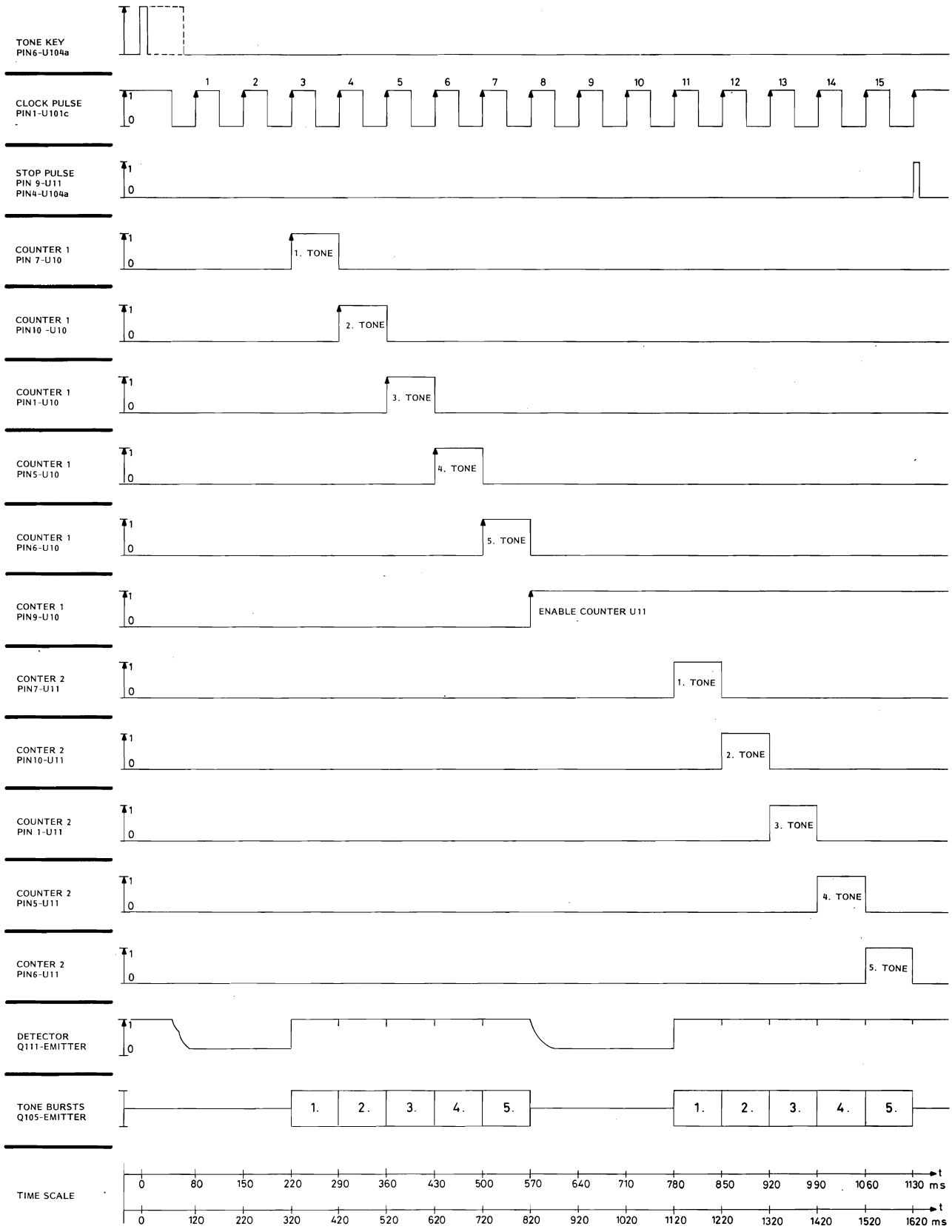


FIG. 7. DUAL SEQUENCE TRANSMISSION

100 ms for TQ5005. This repetition rate is set by R137.

When the 3rd clock pulse reach counter U10 the 1st tone transmitter code of the PROM is selected and through the 4-to-16 BIT DECODER the 1st tone transmitter gate is opened and the tone oscillator, Q107, generates the 1st tone of the transmitter code. The oscillator output passes an emitter follower, Q105, before reaching the output terminal. The output is set with potentiometer R113.

The 4th, 5th, 6th, and the 7th clock pulse consecutively selects the proper codes in the PROM for the 4-to-16 BIT DECODER and accomplish the sequential tone signal.

If only one sequence is required the 8th clock pulse will reset the latch U104a and the unit

reverts to the tone receive mode with the loudspeaker still being on.

However, if a 2nd sequence is required the next counter U11 is enabled. The following two clock pulses will not produce an input to the PROM and therefore no tones are generated. The following 5 clock pulses will, through the PROM and the 4-to-16 BIT DECODER produce a proper 2nd tone sequence, and thereafter the unit reverts to standby with the loudspeaker on.

As an option the PROM may be coded to accept up to 4 tones being variable and selectable from the Key Board. The position of these tones in the tone transmitter sequences are coded into the PROM.

TONE BOARD CIRCUIT DESCRIPTION

INPUT AMPLIFIER AND LIMITER

The transistors Q101, Q102, and Q103 form a differential input amplifier/limiter followed by the resonant circuit driver Q104.

The received tone signals are amplified, the amplifier gain being constant and determined by the ratio of R106 to R107, and signal levels higher than the minimum sensitivity (approx. 85 mV) will cause limiting to occur. The tone signal is then applied to the Group Call unit SU5001 or All Call unit SU5002, if used (terminal 9), and to the resonant circuit driver Q104 which operates as a current generator with its collector connected to a separate winding on the tone coil.

The sensitivity and thus also the tone receiver bandwidth is adjustable and set with potentiometer R111.

The input amplifier is blocked when the TONE KEY button is depressed (and the TRANSMIT key) which applies 8.5 V TX to the base of Q101 through D101.

Less than 100 ms after the unit reverts from the tone transmit mode it is ready to receive a call.

RESONANT CIRCUIT

The bandpass filter consists of tone coil L101 and capacitor C113. The signal from the input amplifier is coupled to the parallel resonant circuit via the coupling link. The circuit is tuned to the tone frequencies by the tone gates which switch the coil taps into the circuit in parallel with capacitor C113.

Q-MULTIPLIER, LIMITER, REFERENCE VOLTAGE, AND TONE DETECTOR

The Q-multiplier consists of Q107, the limiter of Q109; the reference voltage is derived from Q110, and Q111 is the tone detector.

A portion of the selected tone signal is fed, via the Q-multiplier Q107, back to the coupling link and in phase with the input signal. This increases the bandpass filter Q-factor to approx. 30. The resistors R123-R148 linearize this factor throughout the band, and the NTC resistor, R120, in the Q107 emitter compensates the Q-factor variations with ambient temperature.

The tone signal is rectified by transistor Q111 and the resultant d. c. voltage is applied to comparator U101a. Q108 is turned on by U104a when depressing the TONE KEY, and this increases the feedback so much that the resonant circuit and Q107, which is the active component, form an oscillator. The signal voltage across the resonant circuit is amplitude limited by Q109 in order to obtain a constant signal output level from the oscillator and to reduce the decay time for strong signals.

The gate transistor bias and the detector bias voltages are derived from Q110.

TONE OUTPUT EMITTER FOLLOWER AND CLIPPER

The output stage consists of the emitter follower Q105 and its frequency characteristic is flat because the tone signal is connected directly to the splatter filter. Potentiometer R113 is the generator impedance for the operational amplifier in the splatter filter.

Because of the d. c. shifts in the oscillator circuit a peak will appear at the start and end of the tone signals. These peaks will be limited by Q106.

COMPARATOR

The comparator is built around U101a and its trigger level is determined by the voltage divider R130-R131//R181 and controlled by the Q-output of Latch U104a.

The rectified tone signal increases the d. c. voltage to the non-inverting input of the comparator, and when the level exceeds the reference voltage the output of U101a will change from being a short to ground (logic "0") to the off state (logic "1"). The time of this state is determined by the length of the tone and when the tone ceases the output reverts to a short to ground, i. e. standby condition. When depressing the TONE KEY button U101a is inhibited in its standby state by the Q-output of U104a.

CLOCK DELAY CLOCK GENERATOR

The Clock Delay time is determined by R132 and C107, and Schmitt Trigger U101b. In standby the charge of capacitor C107 is neutral due to the discharge through the output of U101a. The Clock Generator U101c is inhibited in its off position.

The reference voltage, which is common to U101b and U101c, is via voltage divider R133, R134, R135 applied to the non-inverting inputs. When the comparator U101a is activated by the tone, the voltage across C107 will begin to go positive.

After 17 ms (Clock Delay) the Schmitt Trigger U101b will be activated and its output voltage will drop to zero (logic "0"). After the end of the tone C107 again discharges via U101a's output and Schmitt Trigger U101b changes its state.

This produces a positive going voltage edge at the U101b output which is applied to the clock inputs (CP) of the counters U10, U11, and U12 whose outputs switch the circuitry to the next tone gate.

If the Comparator detects a new tone before the Clear Delay reverts to standby the procedure is repeated.

The Comparator will, in its inhibited state (TONE KEY activated), keep U101b off. Simultaneously the Clock Generator U101c is released by biasing D104 off. This enables C108 to charge through the resistors R136, R137, and R138 until reaching the common reference voltage, and the output of U101c drops to 0 V. This voltage transition is, via R134, feed back to the non-inverting input of U101b and thus causes a hysteresis. C108 now discharges to the lower voltage level and this cycle keeps repeating itself.

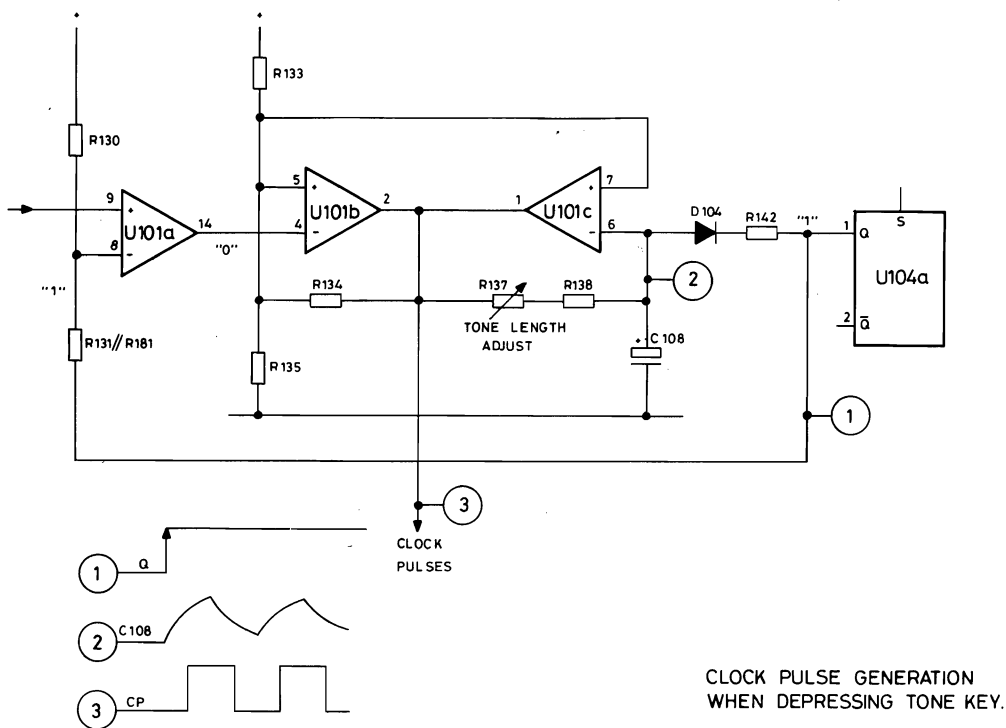
The positive pulses so appearing of the outputs of U101b and U101c are used as clock input to the counters U10 and U11. The period time is adjusted by means of resistor R137 to 70 ms for TQ5004 or 100 ms for TQ5005.

A tone can be prolonged by applying a logic "0" through D109 to the base of Q131, which then turns off and R202 is switched into the circuit.

CLEAR DELAY

Comparator U101d is controlled by the Schmitt Trigger U101b. In standby the charge of C109 is neutral because D103 is reverse biased. The output level of U101d corresponds to the supply voltage 8.5 V, i. e. logic "1" and counter U12 is cleared and set to the 1st tone gate.

Triggering U101b enables C109 to be charged via D103 and R140, and when the voltage at C109's negative pole has fallen to the reference level, U101d changes its output to 0 V (logic "0") and releases the counter U12, which now is ready to receive the clock pulses.



CLOCK PULSE GENERATION WHEN DEPRESSING TONE KEY.

FIG. 8. CLOCK PULSE CIRCUITRY

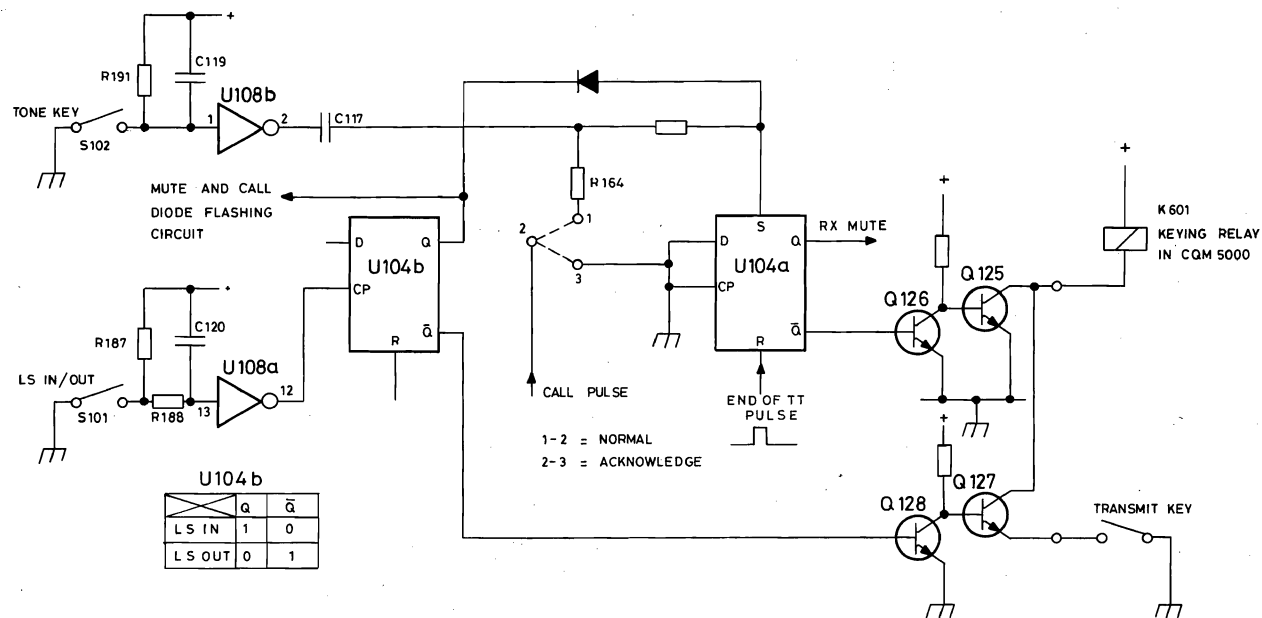


FIG. 10. LS IN/OUT AND TONE CIRCUITRY

employed, of which U104a's set input is controlled by U104b via diode D105. A Schmitt Trigger, U108a prevents that contact-bounce in the LS IN/OUT switch operates the latch.

After a received tone call, or after having manually opened the loudspeaker, the Flashing Circuit U106, with its associated components, will start flashing the CALL LED (D107).

When applying the supply voltage, 8.5 V, U104b is forced into position 'LS OUT' by the positive pulse fed to the latch reset input via C115. The call pulse is derived from one of Counter U12's outputs on the Logic Board, and applied to U104b's set input, and according to NOTE 4 on the diagram, to U104a as a receipt pulse (Acknowledge). After a received tone call, U104b will be in position "LS in" until manually reset by pressing the "LS IN/OUT" button. The information from the Tone key input terminal to the 'set' terminal of U104a is shortcircuited by the Q-output of U104b via diode D105 when the loudspeaker is off. To perform a tone

call, U104b must be set manually by pushing the LS IN/OUT button in order to reverse bias D105.

MUTE AND ALARM FUNCTIONS

The Mute function takes the information from the Q-output of U104b, and Q124 is on after a call or manual opening of the loudspeaker. The Alarm transistor Q123 is on for a short time after the 5th tone (70 ms) for triggering the Alarm Relay unit SU5003.

PUSH-TO-TALK TO RELAY AND PUSH TO TALK FUNCTIONS

When the TONE KEY button is depressed Q125 will go on and operate the relay. Q125 is controlled by the information on the \bar{Q} -output of U104a.

The normal keying of the RF transmitter is achieved by shorting terminal 3 to ground. If the tone receiver is not open, Q127 is off and prevents keying of the transmitter.

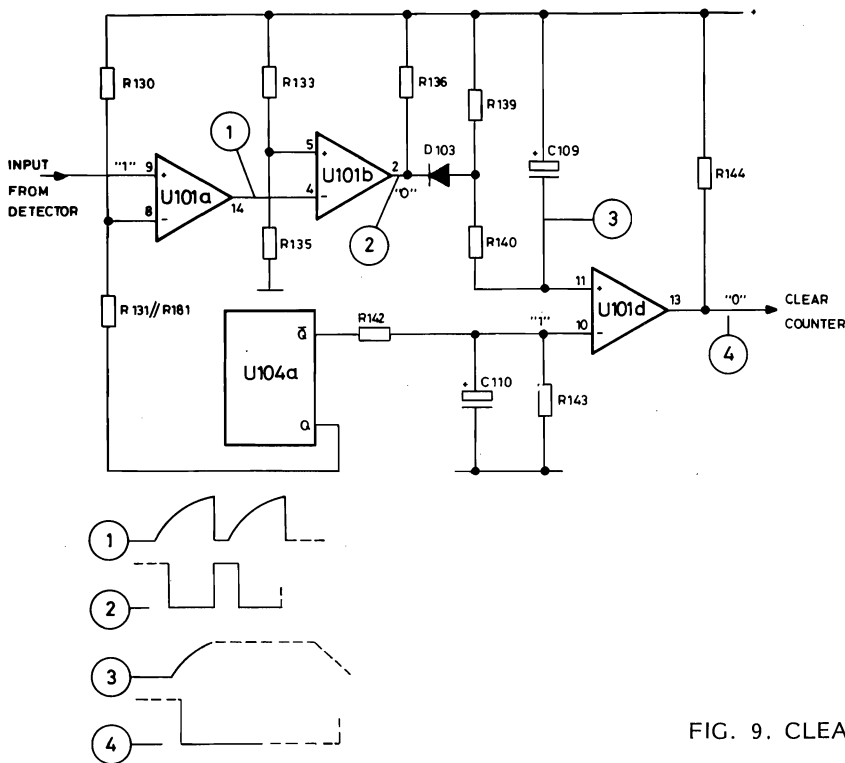


FIG. 9. CLEAR DELAY CIRCUITRY

The U101d reference level is controlled by U104a's \bar{Q} -output which in standby is approximately 8.5 V, i. e. logic "1".

Depressing the TONE KEY button causes the reference voltage to fall to 0 V and U101d is blocked in its standby position, and hence Counter U12 is disabled accordingly. As long as the Schmitt Trigger U101b is active, D103 will maintain the charge of C109 and, when the last tone ceases, U101b reverts to standby and D103 is reverse biased. The discharge time of C109 is determined by R139 and R140 which within approx. 120 ms reduces the capacitor voltage until it corresponds to the reference level.

The U101d output voltage now returns to 8.5 V and clears the Counter U12, after which the 1st tone gate is reengaged and the tone receiver is ready to receiver a new call. As the intervals between the individual tones in a sequential tone call are far less than the above mentioned 120 ms, the Clear Delay will retain its state during the call plus the 120 ms.

4-TO-16-BIT DECODER AND TONE GATES

In order to select the correct tones the taps on the tone coil are each connected to the collector of a tone gate transistor (Q112-Q121, Q132 and Q133).

When a tone gate input is logic "1", the corresponding tap on the coil is connected in parallel to capacitor C113 in order to establish the resonant circuit of the Q-multiplier/Tone generator.

The 4-to-16-Bit Decoder will, if the Inhibit input is logic "0", open a tone gate corresponding to the data inputs ($Q_0-Q_1-Q_2-Q_3$) from the Logic Board.

ANTIBOUNCE, LOUDSPEAKER IN/OUT, TONE KEY, AND CALL INDICATOR FLASHING CIRCUIT

As latch for the tone receiver and tone transmitter functions a dual D-Flip-Flop, U104, is

MICROPHONE BLOCKING AND RX MUTE

When the transmitter is keyed in normal transmit mode, the microphone amplifier is supplied via Q129. When the TONE KEY button is pressed, U104a turns Q129 off and the microphone amplifier is blocked.

After reception of a correct tone call, or manual opening of the loudspeaker (LS IN/OUT), Q130 switches off and cancels the clamping of the RX Mute lead, so that only the noise squelch decides whether the audio channel is open or not.

LOGIC BOARD CIRCUIT DESCRIPTION

KEY BOARD, DECIMAL TO BCD ENCODING AND ANTIBOUNCE

From the Key Board pulses enter the circuit and are encoded to BCD format in a diode matrix. All pulses from the Key Board pass the antibounce circuit (Q1 and U6d) which forms the clock pulses for the Shift Registers.

pulses from the antibounce circuit. When 4 clock pulses have entered the Shift Registers, i. e. 4 digits have been keyed into the circuit, the registers are full. Digits further keyed in will shift out the digits keyed in 4 positions earlier so the Shift Registers will only contain the last 4 key board entries. The Shift Registers work in the serial input - parallel output mode.

SHIFT REGISTERS AND DATA BUFFERS

The data from the BCD encoder are shifted into the Shift Registers, U1 and U2 by clock

The parallel outputs of the Shift Registers connect to the input of Tri-state Buffers whose output states are controlled by the PROM via U6a, U6b, U6c, and U6e. According

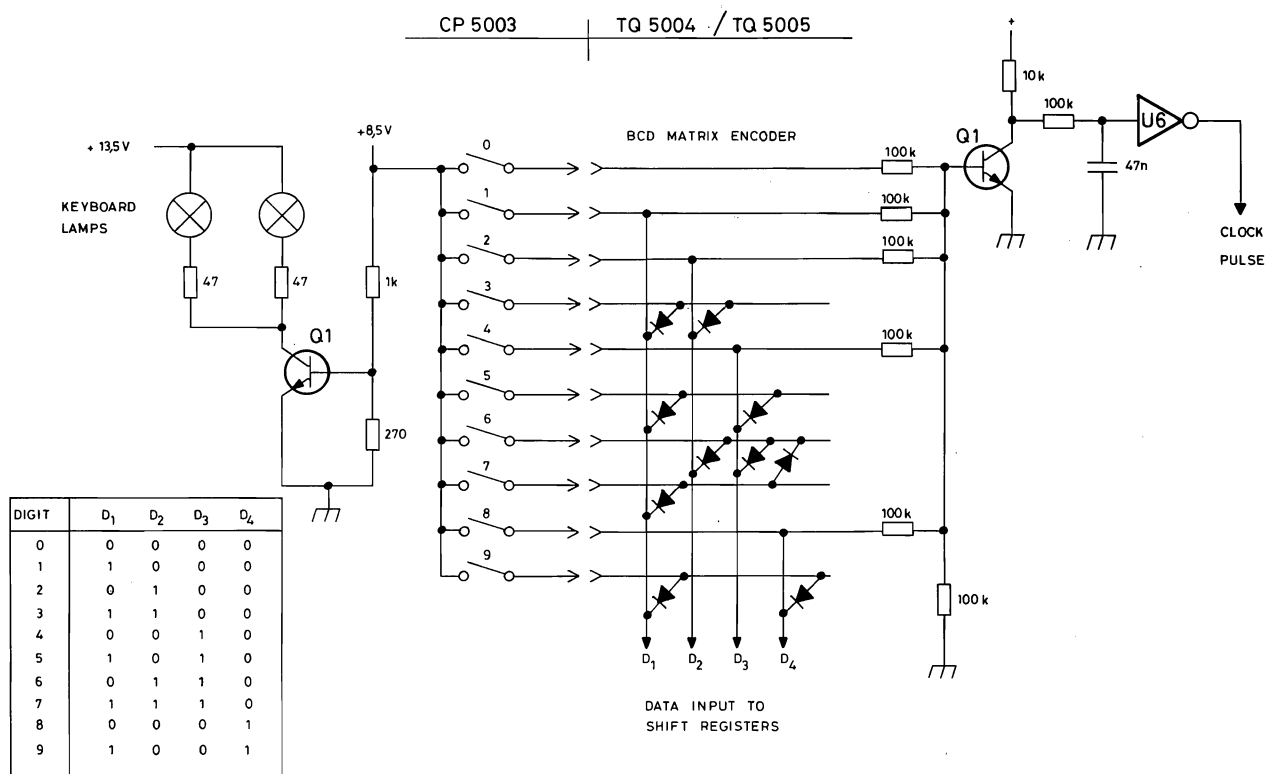


FIG. 11. BCD ENCODER - CLOCK PULSE CIRCUITRY

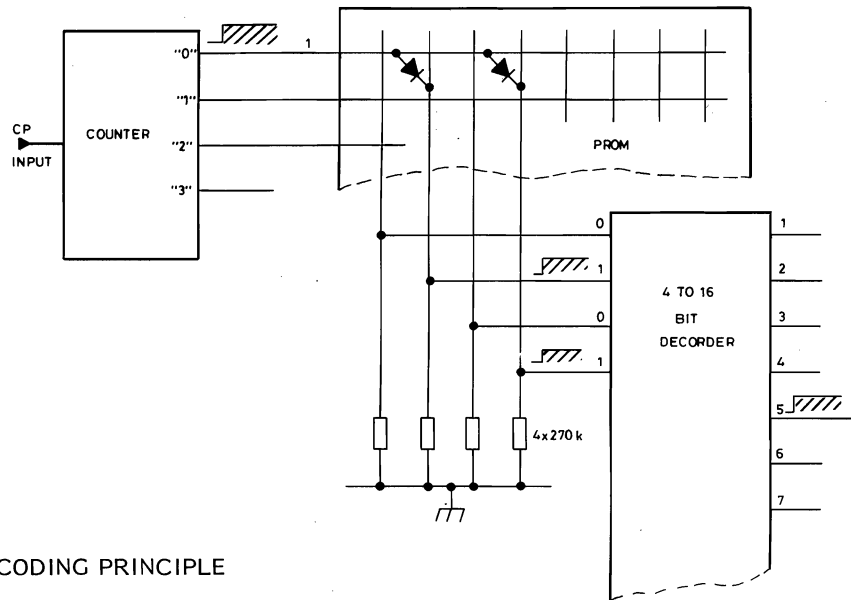


FIG. 12. PROM DECODING PRINCIPLE

to the codes programmed into the PROM the Tri-state Buffers, U3, U4, and U5 will place the data for the variable tones on the data bus to the 4-to-16 Bit Decoder.

COUNTERS AND PROM CONTROL CIRCUIT

Three decimal counters are employed as pulse counters, two counting the tone generator pulses (U10 and U11) and one counting the tone receiver pulses (U12). The counter outputs connect to the PROM inputs and control its output.

Determined by the clock generator period the counter outputs of U10 and U11 will be applied to the PROM inputs causing the PROM to feed the following information to the Tone Board.

$Q_0-Q_1-Q_2-Q_3$ - data to the 4-to-16 Bit Decoder

Inhibit to the 4-to-16 Bit Decoder

Prolonged tone control signal

Tri-state Buffer control data
(variable tones)

For details on coding of the PROM refer to Coding and Strapping.

The 1st PROM input is connected to the 3rd output on the 1st tone transmitter pulse counter, U10, and the result is that a period of 220 ms for the TQ5004, or 320 ms for the TQ5005, elapses before generation of the 1st tone is started. This period corresponds to the length of the three leading clocks pulses. The following five clockpulses generate the tone sequence and on the 8th pulse one of the following events happens:

- 1) A TT reset pulse to the Tone Board will be sent through b (D25) if the unit is strapped to only one sequence; the Q8 output of Counter U10 is logic "1".
- 2) A second sequence with 3 leading clock pulses without tone generation and 5 tones will be generated if the unit is strapped to transmit two sequences; the Q8 output of U10 will enable the 2nd tone transmitter counter U11. A TT reset pulse will be sent to the Tone Board by the Q8 output of U11 when the 16th clock pulse appears.

The Reset inputs of the Counters U10 and U11 are controlled by the \bar{Q} -output of U104a and therefore the Counters are inhibited in standby and not released until the TONE KEY button is depressed.

Counter U12 controls the receiver inputs of the PROM. The counter's control signals are derived from the Clock Delay U101b and the Clear Delay U101d respectively.

In standby the counter is inhibited by the Clear Delay U101d and the counter's "0" output is logic "1". This selects the code of the 1st receiver tone in the PROM.

The operation of the Counter U12 is similar to that of U10 and U11, the clock pulse period being linked to the length of the received tones.

Approximately 120 ms after the last tone has ended the tone receiver counter is reset to standby by the Clear Delay U101d.

All outputs (Q_0 - Q_5) on Counter U12 are accessible on the p. c. b. for setting the individual combination and the Group Call/All Call combination. Refer to Coding and Strapping for details.

Inverter U7b is, together with the counter's enable input, controlled by the U104a's Q-output which in standby is logic "0". When the TONE KEY is depressed a logic 1 is placed on the enable input of U12 and at the same time at the inverter U7b. The inverter output then shorts the counter's "0" output to ground through diode D18.

The times elapsing to transmit or receive a 5-tone sequential signal appear from the Time-Pulse diagrams.

If only one transmitter sequence is required diode b (D25) causes "TT reset" after the first transmitter code has been generated and the TQ5004/TQ5005 reverts to standby in the receive mode.

In the transmission mode is input TT= "1" and input TR= "0", and this ensures that the Receiver Counter U12 is disabled and the reset signals on the Transmitter counters U10

and U11 are removed. The opposite conditions occur when the TQ5004/TQ5005 is in the receive mode.

ACKNOWLEDGE TRANSMISSION

When acknowledge transmission is required, the diodes c, d, and e are inserted. In the receive mode the D-Flip-Flop U9 is "reset" and the diodes are off (reverse biased). After a tone call has been accepted output Q_5 on U12 goes logic "1", turns the loudspeaker on, sets Latch U104a which keys the transmitter, and provides a clock pulse for Flip-Flop U9. This toggles U9 and its Q-output goes logic "1" and \bar{Q} logic "0", and the diodes c, d, and e are turned on. Diode c resets the two Transmitter Counters U10 and U11, diode d enables the Receiver Counter U12, and diode e prevents the "TR-reset" level from resetting the Receiver Counter.

When Latch U104a is "set", the TT input to the Logic Board is logic "1" and input TR is logic "0", but due to the diodes this has no influence on the status of the transmitter and receiver counters. Three clock pulses after the Q_5 output of U12 has been logic "1" the Receiver Counter is reset by diode D22 and the counter is now acting as a tone transmitter counter, transmitting the receiver tone code.

After the last tone has been transmitted a clockpulse toggles Flip-Flop U9 and sets Q logic "0" and \bar{Q} logic "1". This causes an "End of TT" pulse to be sent through diode D21 to reset Latch U104a, and at the same time the diodes c, d, and e are turned off (reverse biased).

Now the TT input is logic "0" and the TR input is logic "1" ensuring that the transmitter Counters U10 and U11 are reset and the Receiver Counter U12 is enabled and reset by the "TR reset".

The TQ5004/TQ5005 is now back in the normal tone receive mode.

AUTO RECEIPT (ACKNOWLEDGE) TRANSMISSION TQ5004 AND TQ5005

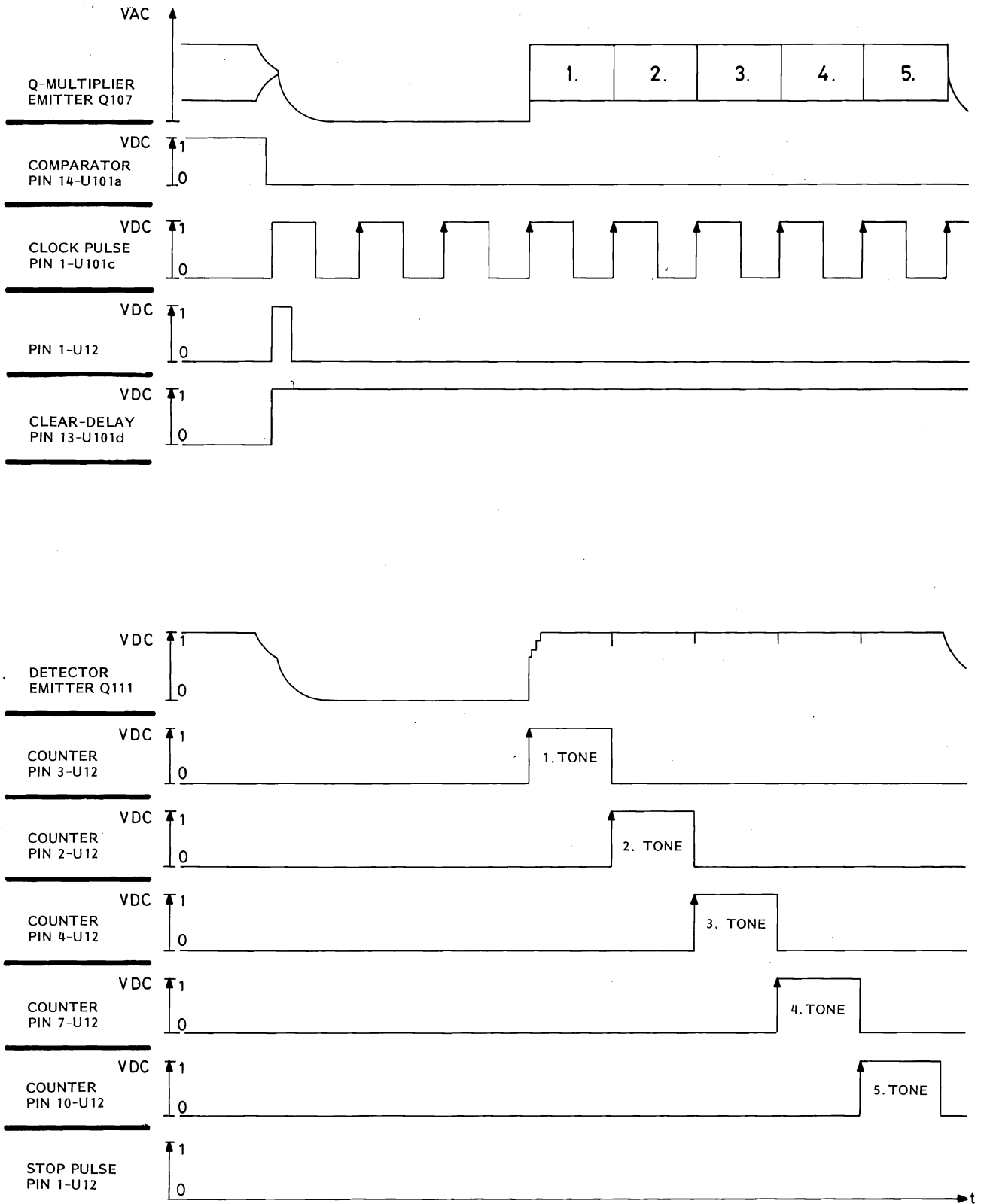


FIG. 13. ACKNOWLEDGE TRANSMISSION

TECHNICAL SPECIFICATIONS

SPECIFICATIONS COMMON TO TQ5004 AND TQ5005

Supply Voltage

8.5 V \pm 0.25 V (8.5 V Cont. and 8.5 V TX)

Current Drain

Standby: <20 mA

Engaged: 20 mA +25 mA peak
when the CALL indicator is on.

Temperature Range

-30°C to +60°C

SEQUENTIAL TONE TRANSMITTER

Signal Output Level

Max. 600 mV EMF (Adjustable)

Frequency Response

Flat \pm 1 dB

Signal Distortion

<5%

Tone Frequency Accuracy

Max. deviation: 1.4%

Rel. freq. accuracy: 0.3%

Adj. accuracy: 0.1%

Freq. stability: 1%

Control Functions

Acknowledge: Can be strapped to automatic transmission of "Acknowledge" after a CALL.

Microphone inhibit

The supply voltage to the microphone amplifier is inhibited when transmitting a tone call.

SEQUENTIAL TONE RECEIVER

Input Impedance

>30 Kohm, DC isolation

Reset Time (T)

90 ms < T < 140 ms

Reaction Time (T)

20 ms < T < 45 ms

Signal to Noise Conditions

Signal tone receiver will accept signals with a noise level corresponding to SINAD= 5 dB as measured in the speech channel of the CQM5000.

Input Frequency Response

Deemphasis according to an RC function with $F_c = 2900$ Hz

Activating Input Level

300 mV \pm 6 dB

Input Signal Distortion

The unit can process tone signals containing up to 20% distortion.

Tone Frequency Accuracy

\pm 0.3%

Tone Frequency Selectivity

The tone receiver is not sensitive to adjacent tones or other tones of the same standard series.

Output Functions

A call produces the following output signals:

- 1) The green LED (D107) will start flashing
- 2) Cancel the short circuit of terminal 4
- 3) Short circuit terminals 2-3

Manual activation of the LS IN/OUT button establishes the same functions.

Switching the loudspeaker off produces the following output signals:

- 1) The green LED (D107) will stop flashing
- 2) RX mute on; short circuit terminal 4 to ground.
- 3) Key blocking on; the connections between terminal 2 and 3 is cancelled.

Dimensions

159.8 mm x 69 mm x 22.5 mm (L x W x H)

Weight

150 g

SPECIFICATIONS UNIQUE TO TQ5004

SEQUENTIAL TONE TRANSMITTER

Output Signal

3, 4, or 5 tones in bursts of 70 ms \pm 15 ms.
The interval between triggering and emission of the 1st tone is min. 200 ms.
Up to 4 tones can be variable and selected from the Key Board.

Tone Frequencies

The ZVEI series:

885 Hz, 970 Hz, 1060 Hz, 1160 Hz, 1270 Hz,
1400 Hz, 1530 Hz, 1670 Hz, 1830 Hz, 2000 Hz,
2200 Hz, 2400 Hz, 2600 Hz, 2800 Hz.

Automatic RF Transmitter Keying

The TQ5004 energizes the RF transmitter for approximately 570 ms.

SEQUENTIAL TONE RECEIVER

Signalling Code

3, 4, or 5 tone bursts of min. 55 ms duration.

Tone Frequencies

The ZVEI series (refer to Sequential Tone Transmitter).

SPECIFICATIONS UNIQUE TO TQ5005

SEQUENTIAL TONE TRANSMITTER

Output Signal

3, 4, or 5 tones in bursts of 100 ms \pm 15 ms.
The interval between triggering and emission of the 1st tone is min. 300 ms.
Up to 4 tones can be variable and selected from the Key Board.

Tone Frequencies

The CCIR series:

(960 Hz, 1022 Hz), 1124 Hz, 1197 Hz, 1275 Hz,
1358 Hz, 1446 Hz, 1540 Hz, 1640 Hz, 1747 Hz,
1860 Hz, 1981 Hz, 2110 Hz.

Automatic RF Transmitter Keying

The TQ5005 energizes the transmitter for approximately 800 ms.

SEQUENTIAL TONE RECEIVER

Signalling Code

3, 4, or 5 tone bursts of min 55 ms duration

Tone Frequencies

The CCIR series (refer to sequential Tone Transmitter).

CODING AND STRAPPING INSTRUCTION

TQ5004 AND TQ5005

GENERAL

When coding and strapping a TQ5004 or TQ5005 module, and programming its PROM circuit, the following decisions must be made:

1. One or two transmitter sequences (Logic Board).
2. First transmitter sequence (PROM).
 - a. Number of tones (3, 4, or 5).
 - b. Frequencies of fixed tones (Table 1).
 - c. Variable tones.
 - d. Prolongation of first tone.
3. Second transmitter sequence (PROM).
 - a. Number of tones (3, 4, or 5).
 - b. Frequencies of fixed tones (Table 1).
 - c. Variable tones.
 - d. Prolongation of first tone.
4. The tone receiver sequence (PROM).
 - a. Number of tones (3, 4, or 5).
 - b. Frequencies of the tones.
5. Group Call (Logic Board).
 - a. Group tone format.
 - b. Frequency of group call tone (SU5001).
6. All Call (Logic Board).
 - a. Frequency of all call tone (SU5002).
7. Auto Receipt (Acknowledge) (Tone Board).
 - a. Transmitter sequence acknowledge (Logic Board).
 - b. Receiver sequence acknowledge (Logic Board).

These data are used to complete the words of addresses 1 to 5 on the PROM Code Specification Chart, fig. 1.

3. Second transmitter sequence (PROM).
 - a. Number of tones (3, 4, or 5).
 - b. Frequencies of fixed tones (Table 1).
 - c. Variable tones.
 - d. Prolongation of first tone.

These data are used to complete the words of addresses 6 to 10 on the PROM Code Specification Chart, fig. 1.

NOTE: Maximum 4 variable tones can be inserted in the two transmitter sequences. See also Tone Format.

4. The tone receiver sequence (PROM).
 - a. Number of tones (3, 4, or 5).
 - b. Frequencies of the tones.

These data are used to complete the words of addresses 11 to 15 on the Code Specification Chart, fig. 1.

The tone transmitter codes and the tone receiver code are independent of each other and examples are given separately.

The tone format, 1 or 2 tone transmitter codes, automatic receipt (acknowledge), and group call options are all coded by a strapping and diode arrangement on the printed wiring board.

TONE FORMATS

The need for insertion of repeat tones will in some applications limit the number of selectable calls, but anyhow, the R-tone (repeat) can be used as a fixed tone in a code. The coding possibilities and their limitations are shown below.

TONE FORMATS FOR TRANSMITTED TONE CALLS

FORMAT 1.

- Transmission of one sequential tone signal.

1	2	3	4	5
---	---	---	---	---

Standard 5 tone sequence.

* Total number of variables in system												
A D D R E S S	BIT	9	8	7	6	5	4	3	2	1	0	Total number of variables in system
		TONE FREQUENCY BIT Q ₃	TONE FREQUENCY BIT Q ₂	TONE FREQUENCY BIT Q ₁	TONE FREQUENCY BIT Q ₀	INHIBIT BIT	PROLONGED TONE BIT	VARIABLE TONE V ₄	VARIABLE TONE V ₃	VARIABLE TONE V ₂	VARIABLE TONE V ₁	
	TQ5004							V ₁				1 Variable
	TQ5005							V ₂	V ₁			2 Variables
	PROM CODE SPECIFICATION							V ₃	V ₂	V ₁		3 Variables
								V ₄	V ₃	V ₂	V ₁	4 Variables
1	ST1-1. TONE											
2	ST1-2. TONE											
3	ST1-3. TONE											
4	ST1-4. TONE											
5	ST1-5. TONE											
6	ST2-1. TONE											
7	ST2-2. TONE											
8	ST2-3. TONE											
9	ST2-4. TONE											
10	ST2-5. TONE											
11	SR-1. TONE											
12	SR-2. TONE											
13	SR-3. TONE											
14	SR-4. TONE											
15	SR-5. TONE											
16	SPARE											

FIG. 1
PROM Code Specification Chart

Prolonged tone: Bit 4 = 1
Tone inhibit: Bit 5 = 0

Fused diode = 0

PROM Code Specification Chart.

R= Repeat tone.

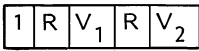
V_x = Variable tone (x).

ST1= Sequential Tone Transmit 1.

ST2= Sequential Tone Transmit 2.

SR= Sequential Tone Receive.

EX. A

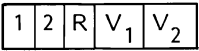


No limitation in the variable digits V₁ and V₂.

R= repeat tone.

100 CALLS.

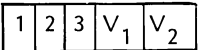
EX. B



Limitation, V₁ cannot be selected equal to V₂.

90 CALLS.

EX. C

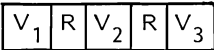


Limitation, V₁ cannot be selected equal to

V₂ and V₁ cannot be selected equal to 3.

81 CALLS.

EX. D

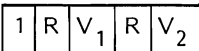


No limitations in the variable digits, V₁, V₂

and V₃. R= repeat tone.

1000 CALLS.

EX. E

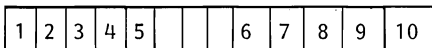


No limitation in the variable digits V₁ and V₂.

Prolonged 1st-tone max 1.2 sec.

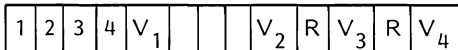
FORMAT 2.

- Transmission of two consecutive sequential tone signals.



Same possibilities and limitations rules as for format 1. There is no limitation in selection of last digit in first tone signal and first digit in 2nd tone signal.

EX. A



V₁= V₂ is valid.

STRAPPING FOR 3, 4, or 5 TONES

See fig. 2.

Connect a wire from the INDV-terminal as follows:

INDV to 3 for 3-tone sequential call

INDV to 4 for 4-tone sequential call

INDV to 5 for 5-tone sequential call

STRAPPING FOR GROUP CALL OR ALL CALL

The TQ5004/TQ5005 can accommodate a SU5001 (group call) or SU5002 (all call) module designed for receiving one group call or all call tone.

Connect a wire from the GR-terminal as follows:

GR to 2 for group call on the 3rd tone.

GR to 3 for group call on the 4th tone.

GR to 4 for group call on the 5th tone.

GR to 0 for all call.

For code combinations and their limitations see coding for SU5001 and SU5002.

STRAPPING FOR AUTOMATIC RECEIPT (ACKNOWLEDGE)

Tone Board

Short terminal 1-3 for NORMAL mode.

Short terminal 1-2 for AUTO RECEIPT mode.

Logic Board

Insert diodes c (D26), d (D27) and e (D28) for Auto Receipt (acknowledge) with the tone receiver code.

If none of the diodes are inserted the generated Auto Receipt code will be the tone transmitter code(s).

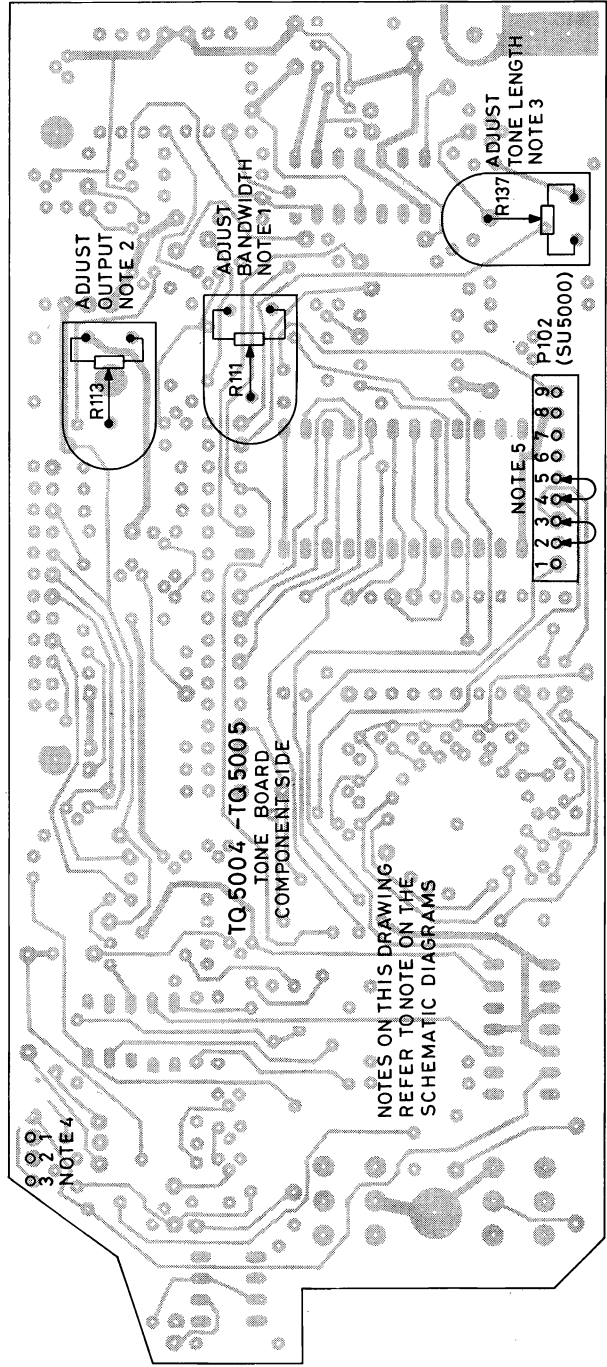
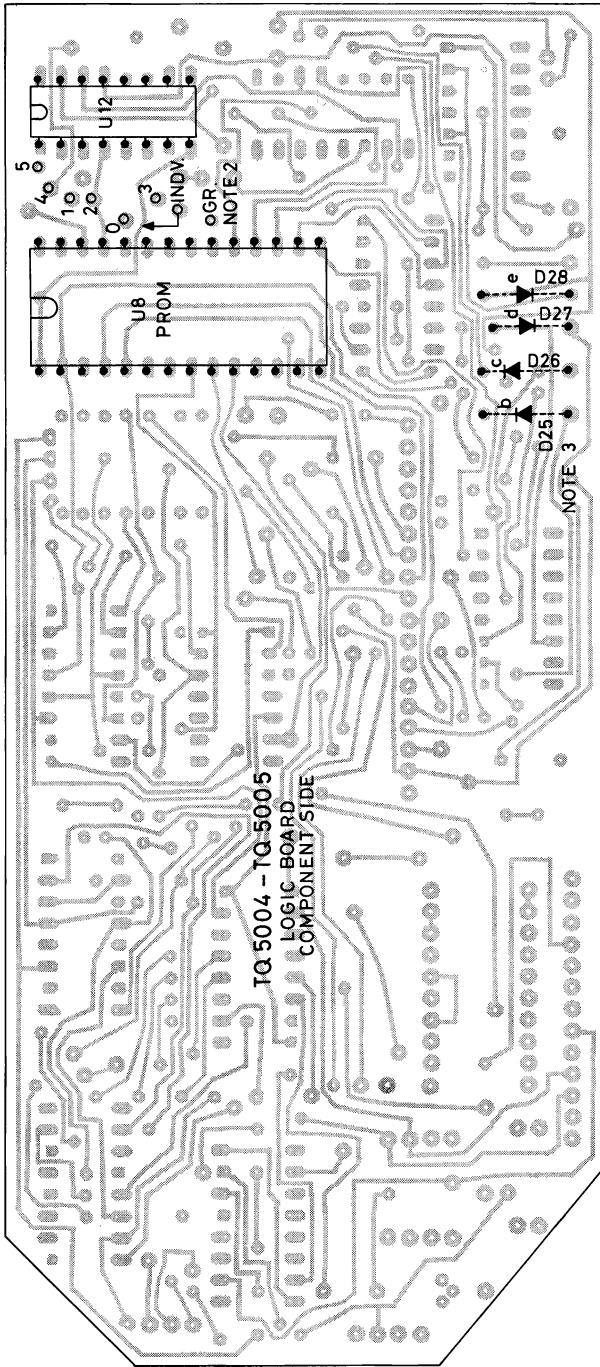


FIG 2. CIRCUIT BOARD LAYOUT TQ5004-TQ5005.

STRAPPING FOR 1-SEQUENCE TRANSMISSION

Logic Board

Insert diode b (D25).

STRAPPING FOR 2-SEQUENCE TRANSMISSION

Logic Board

Omit diode b (D25).

PROM CODE SPECIFICATION

The following list gives the information contained in the PROM circuit:

1. Data for each tone frequency to be transmitted (4 bits).
2. Data for selectable tones (1 of 4 bits).
3. Data for each tone frequency to be received (4 bits).
4. Inhibit to the 4-of-16 bit decoder for each address not used (1 bit).
5. Prolonged length of first tone (1 bit).

The PROM is a diode matrix with 16 addresses each forming a 10 bit word as shown on the PROM Code Specification Chart, fig. 1.

Addresses 1 to 5 are controlled by the first tone transmitter counter (U10).

Addresses 6 to 10 are controlled by the second tone transmitter counter (U11).

Addresses 11 to 15 are controlled by the tone receiver counter (U12).

Address 16 is spare

Bits 6 to 9 are bit data for the 4 to 16 bit decoder.

A fused diode gives bit= "0", otherwise bit= "1".

TONE	Frequency Hz		BIT			
	TQ5004	TQ5005	9	8	7	6
X	885	960	1	0	1	0
Y	970	1022	1	0	1	1
1	1060	1124	0	0	0	1
2	1160	1197	0	0	1	0
3	1270	1275	0	0	1	1
4	1400	1380	0	1	0	0
5	1530	1446	0	1	0	1
6	1670	1540	0	1	1	0
7	1830	1640	0	1	1	1
8	2000	1747	1	0	0	0
9	2200	1860	1	0	0	1
0	2400	1981	0	0	0	0
R	2600	2110	1	0	1	0
A	2800	-	1	0	1	1

Table 1. Tone Frequencies

The X and Y tones replaces the R and A tones in 12.5 kHz channel spacing equipment.

Bit 5 is inhibit data bit for the 4 to 16 bit decoder; a fused diode gives bit= "0", otherwise bit= "1".

To ensure stable operation all diodes on inhibit addresses are blown, i. e. bit= "0". The decoder is inhibited, i. e. the tone not used, if the corresponding inhibit bit is "0".

Bit 4 is prolonged tone data bit for the Clock Pulse Generator. A fused diode gives bit= "0", otherwise bit= "1".

The tone is prolonged, 1.2 second, if the corresponding data bit is "1".

Bit 3 is the fourth variable tone, V_4 .

Bit 2 is the third variable tone, V_3 .

Bit 1 is the second variable tone, V_2 .

Bit 0 is the first variable tone, V_1

A tone is variable when the corresponding data bit= "1".

A fused diode gives data bit= "0", otherwise bit= "1".

BIT	3	2	1	0
4 Variables	V ₄	V ₃	V ₂	V ₁
3 Variables	V ₃	V ₂	V ₁	
2 Variables	V ₂	V ₁		
1 Variables	V ₁			

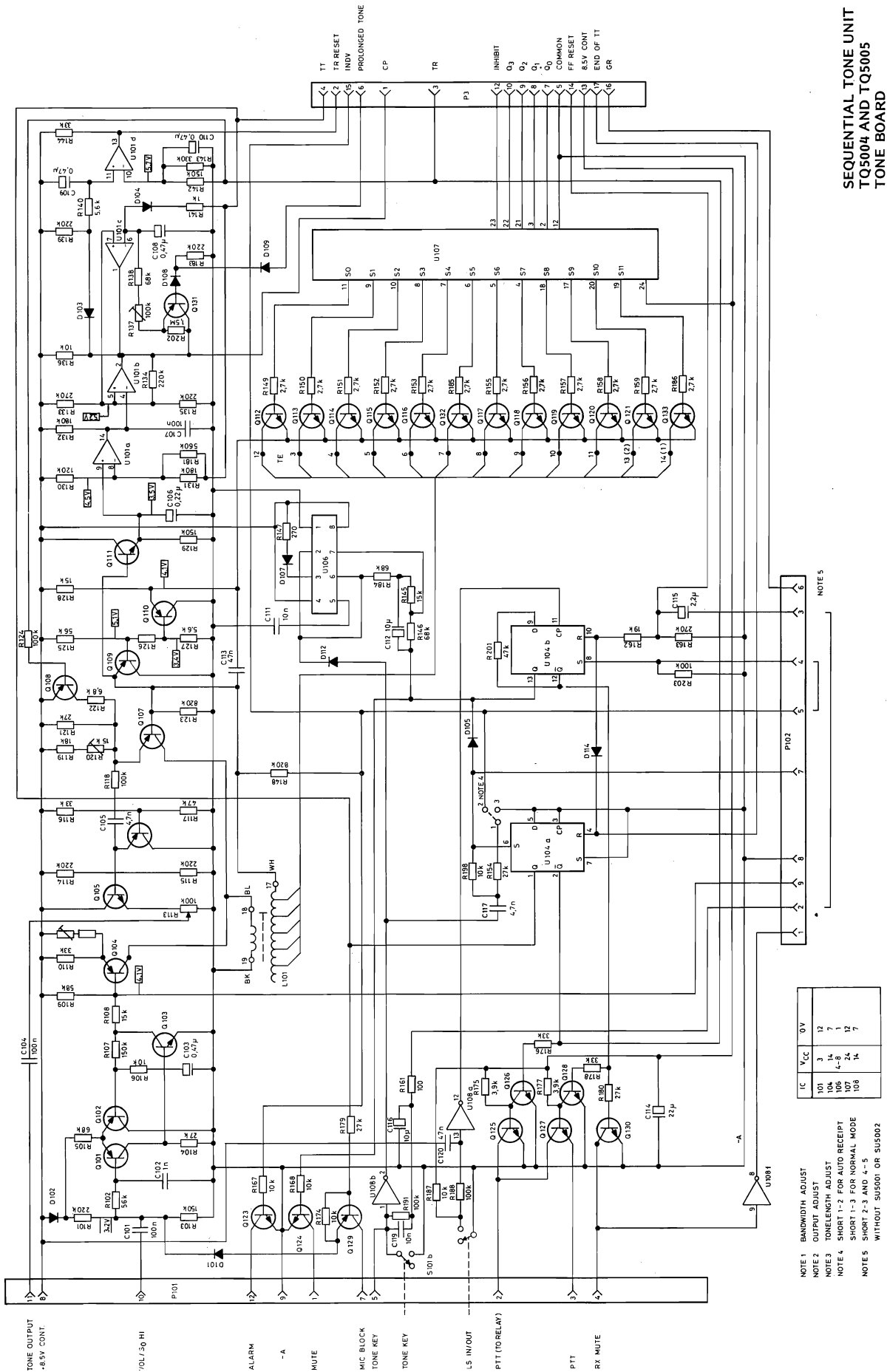
V_x = Variable tone x

A variable tone is inserted in the code when the bit= 1.

TONE RECEIVER FREQUENCY CODING

The bit pattern of the tone frequencies are programmed on addresses A11 to A15 as shown in table 1.

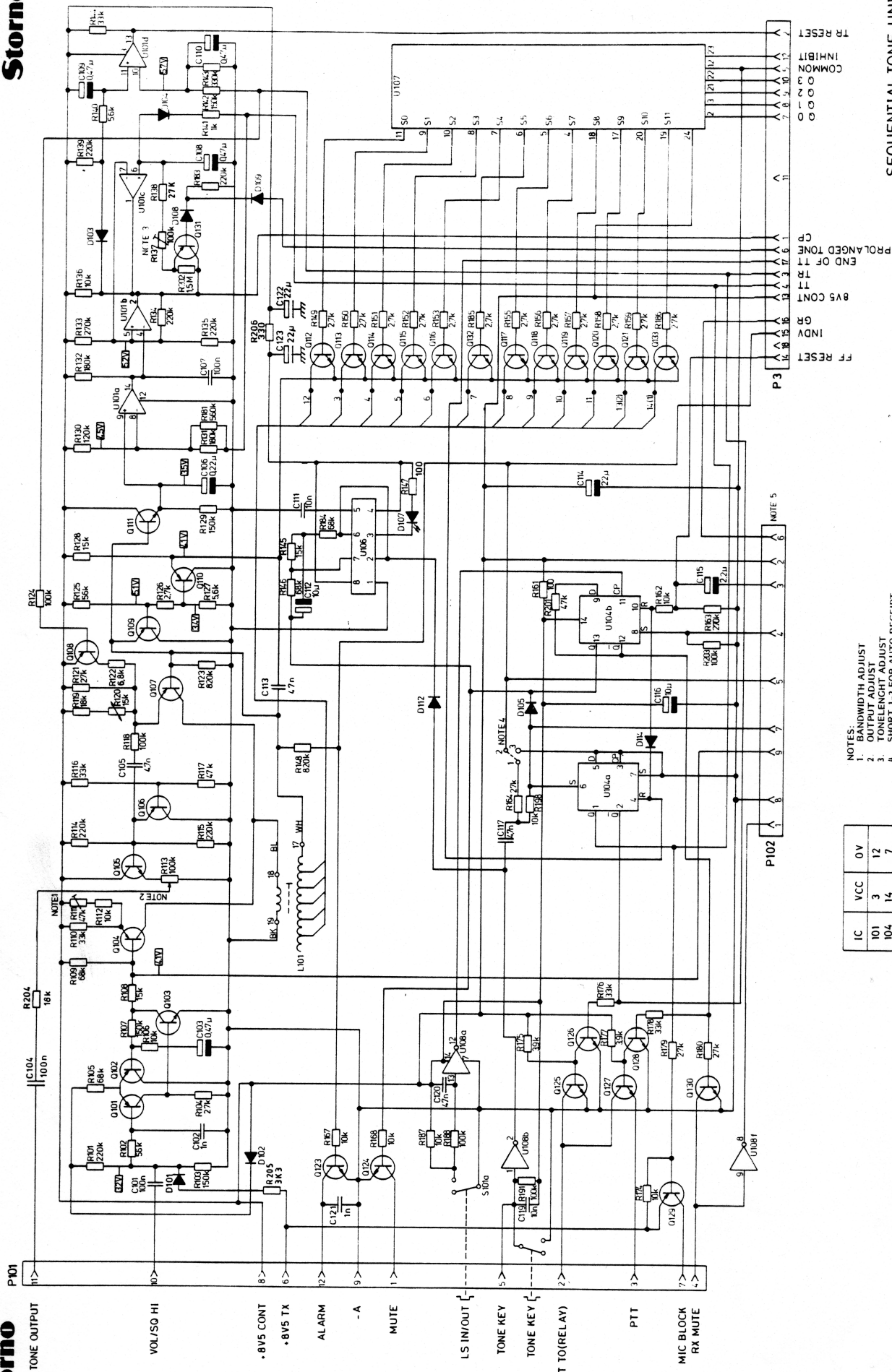
PROM ADDRESS			5-TONE	4 TONE	3-TONE
A1	A6	A11	1. digit	1. digit	1. digit
A2	A7	A12	2. digit	2. digit	2. digit
A3	A8	A13	3. digit	3. digit	3. digit
A4	A9	A14	4. digit	4. digit	INHIBIT
A5	A10	A15	5. digit	INHIBIT	INHIBIT



NOTE 1 BANDWIDTH ADJUST
 NOTE 2 OUTPUT ADJUST
 NOTE 3 TONELENGTH ADJUST
 NOTE 4 SHORT 1-2 FOR AUTO RECEIPT
 NOTE 5 SHORT 1-3 FOR NORMAL MODE
 WITHOUT SUS001 OR SUS002

SEQUENTIAL TONE UNIT
 TQ5004 AND TQ5005
 TONE BOARD

D402. 848



- NOTES:
1. BANDWIDTH ADJUST
 2. OUTPUT ADJUST
 3. TONELENGTH ADJUST
 4. SHORT 1-2 FOR AUTO RECEIPT
 5. SHORT 1-3 FOR NORMAL MODE
 6. SHORT 2-4 AND 4-5 WITHOUT GROUP CALL

IC	VCC	0V
101	3	12
104	14	7
106	4-18	1
107	24	12
108	14	7

SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402.848/3

TR RESET
INHIBIT
COMMON
0000
0000
0000
0000

CP
PROLONGED TONE
END OF T1
14
15
8V5 CONT
0R
INV
FF RESET
4 8 15 16 17 18 19 20 21 22 23 24

NOTE 5

P102

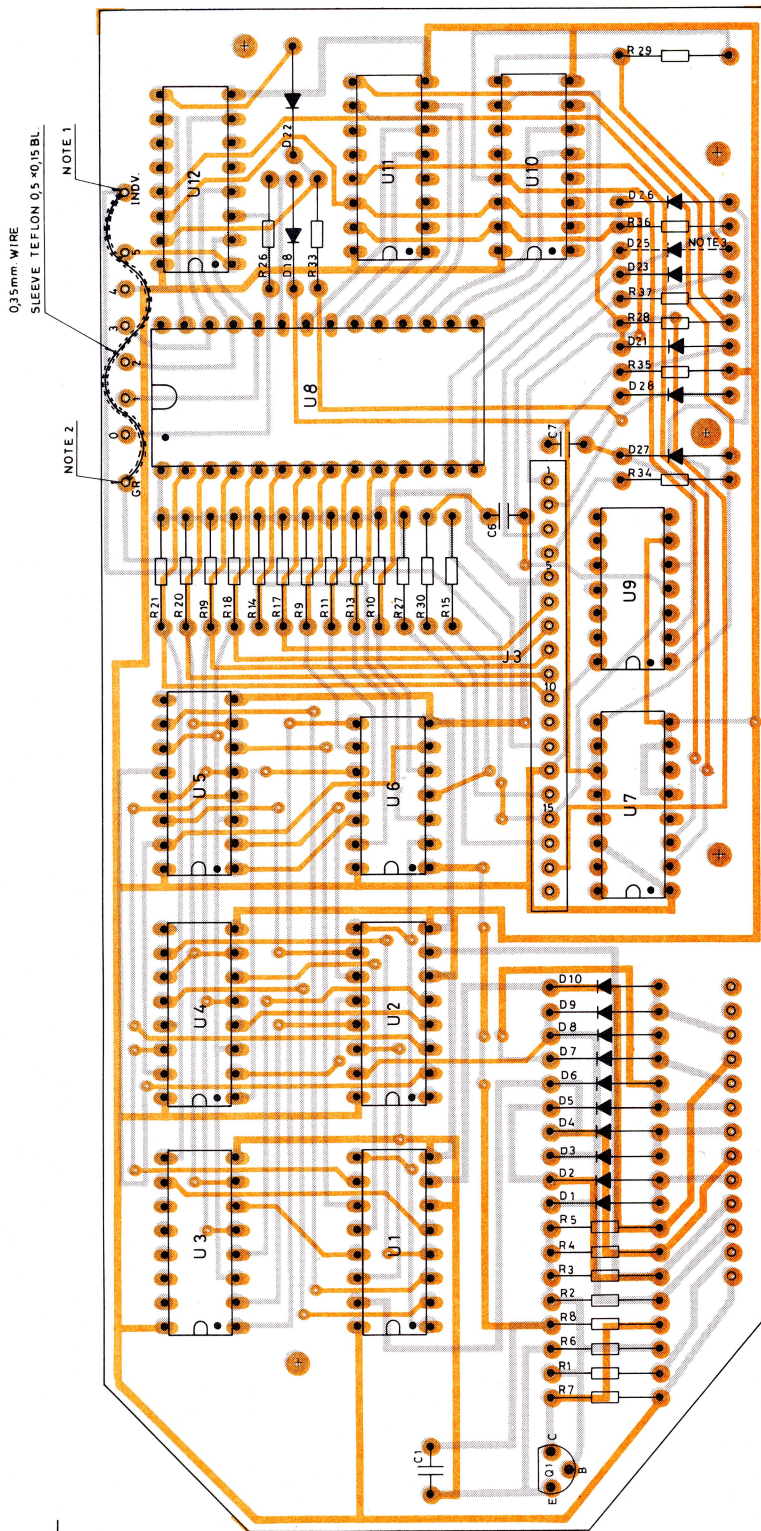
U1081

U1081

U1081

Storno

Storno

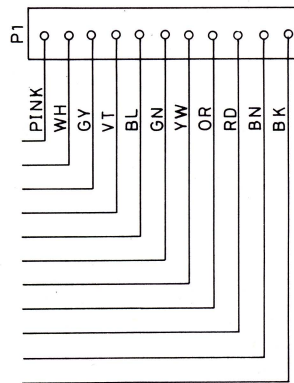


NOTE 1: Shorted for individual call:
 INDV. -3 : 3 Tone sequence call
 INDV. -4 : 4 Tone sequence call
 INDV. -5 : 5 Tone sequence call

NOTE 2: Shorted for group call
 GR. -2 : Group call on III ciffer
 GR. -3 : Group call on IV ciffer
 GR. -4 : Group call on V ciffer

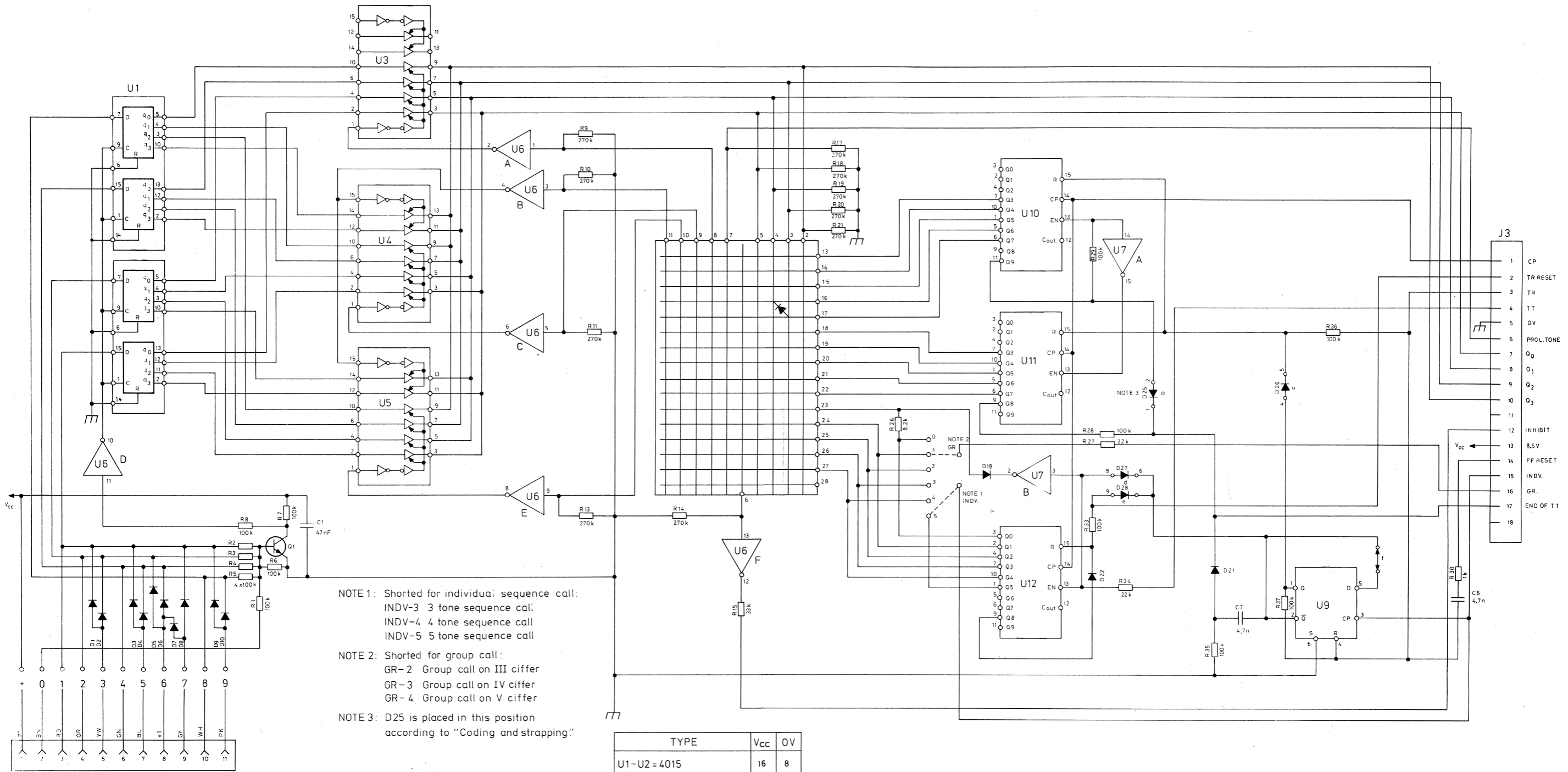
3. digit
4. "
5. "

NOTE 3: D25 IS mounted in this position according to "coding and strapping"



**SEQUENTIAL TONE UNIT
 TQ5004 AND TQ5005
 LOGIC BOARD**

D402. 832/2

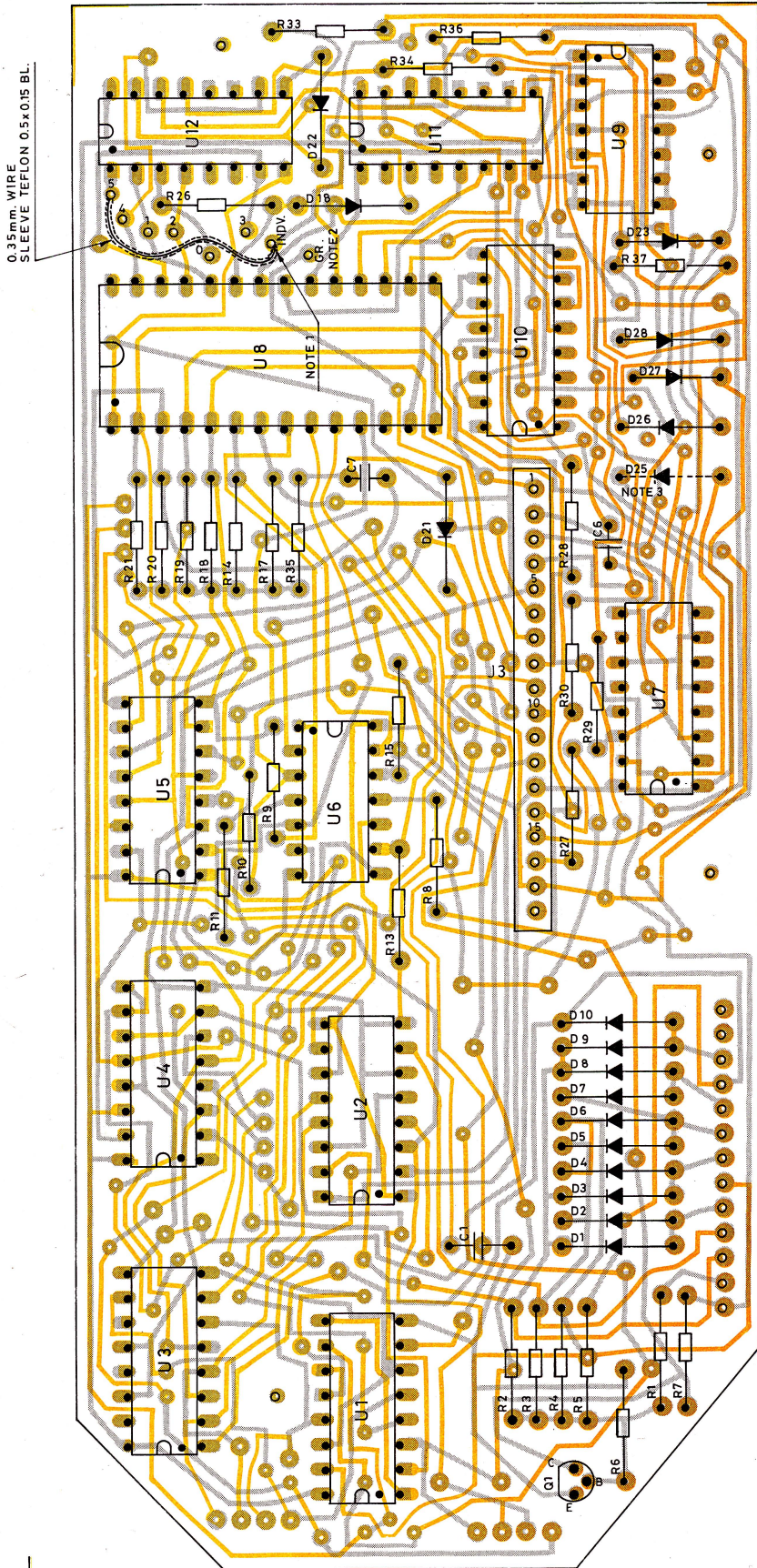


NOTE 1: Shorted for individual sequence call:
 INDV-3 3 tone sequence call
 INDV-4 4 tone sequence call
 INDV-5 5 tone sequence call

NOTE 2: Shorted for group call:
 GR-2 Group call on III cipher
 GR-3 Group call on IV cipher
 GR-4 Group call on V cipher

NOTE 3: D25 is placed in this position according to "Coding and strapping"

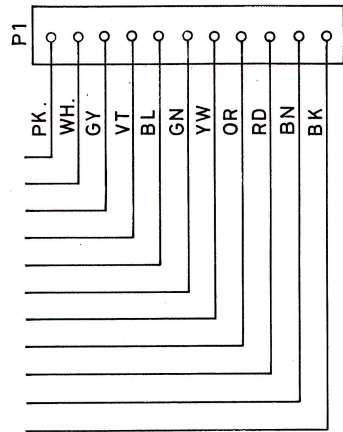
TYPE	Vcc	0V
U1-U2 = 4015	16	8
U3-U4-U5 = 40097	16	8
U6 = 40106	14	7
U7 = 4049	1	8
U8 = PROM	-	1
U9 = 4013	14	7
U10 } U11 } U12 }	16	8



NOTE 1: Shorted for individual call:
 INDV.-3 : 3 Tone sequence call
 INDV.-4 : 4 Tone sequence call
 INDV.-5 : 5 Tone sequence call

NOTE 2: Shorted for group call:
 GR.-2 : Group call on III ciffer
 GR.-3 : Group call on IV ciffer
 GR.-4 : Group call on V ciffer

NOTE 3: D25 IS mounted in this position according to "coding and strapping"

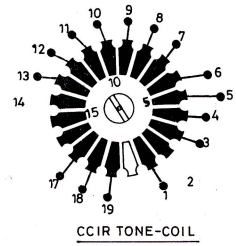
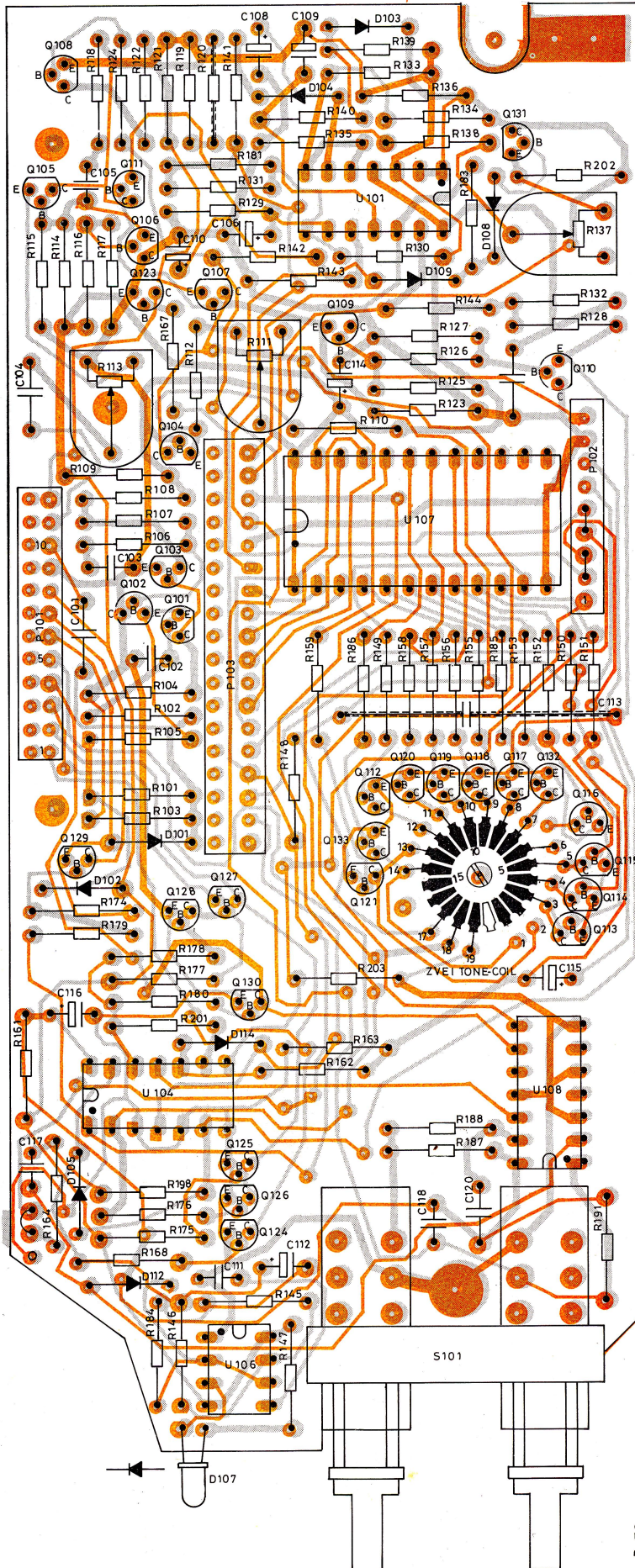
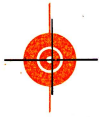


SEQUENTIAL TONE UNIT
 TQ5004 AND TQ5005
 LOGIC BOARD

D402.832

Storno

Storno



SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402.831

TYPE	NO	CODE	DATA
	C 1	76.5139	47 nF 10% Polyester FL
	C 6	76.5133	4.7 nF 10% Polyester FL
	C 7	76.5133	4.7 nF 10% Polyester FL
	C101	A700004P2	0.1 uF 10% Polyest. FL
	C102	A700005P1	1 nF 10% Polyester FL
	C103	A700003P3	0.47 uF 20% Tantal
	C104	A700004P2	0.1 uF 10% Polyest. FL
	C105	A700005P5	4.7 nF 10% Polyester FL
	C106	A700003P2	0.22 uF 20% Tantal
	C107	A700004P2	0.1 uF 10% Polyest. FL
	C108	76.5144	0.1 uF 10% Polyester FL
	C109	A700003P4	1.0 uF 20% Tantal
	C110	A700003P3	0.47 uF 20% Tantal
	C111	A700005P7	0.47 uF 20% Tantal
	C112	A700003P7	10 nF 10% Polyester FL
	C113	A707272P1	10 uF 20% Tantal
	C114	A700003P8	47 nF 2.5% Polyester TB
	C115	A700003P5	22 uF 20% Tantal
	C116	A700003P7	10 uF 20% Tantal
	C117	A700005P5	4.7 nF 10% Polyester FL
	C118	A700005P7	10 nF 10% Polyester FL
	C120	A700005P11	47 nF 10% Polyester FL
	C121	A700233P7	1 nF 10% Polyester
	C122	A700003P8	22 uF 20% Tantal
	C123	A700003P8	22 uF 20% Tantal
	D 1	99.5237	1N4148 Diode
	D 2	99.5237	1N4148 Diode
	D 3	99.5237	1N4148 Diode
	D 4	99.5237	1N4148 Diode
	D 5	99.5237	1N4148 Diode
	D 6	99.5237	1N4148 Diode
	D 7	99.5237	1N4148 Diode
	D 8	99.5237	1N4148 Diode
	D 9	99.5237	1N4148 Diode
	D 10	99.5237	1N4148 Diode
	D 18	99.5137	1N4148 Diode
	D 21	99.5237	1N4148 Diode
	D 22	99.5237	1N4148 Diode
	D 23	99.5237	1N4148 Diode
	D 25	99.5237	1N4148 Diode
	D 26	99.5237	1N4148 Diode

TYPE	NO	CODE	DATA
	D 27	99.5237	1N4148 Diode
	D 28	99.5237	1N4148 Diode
	D101	A700028P1	1N4148 Diode
	D102	A700028P1	1N4148 Diode
	D103	A700028P1	1N4148 Diode
	D104	A700028P1	1N4148 Diode
	D105	A700028P1	1N4148 Diode
	D107	99.5325	LED Yellow
	D108	99.5237	1N4148 Diode
	D109	99.5237	1N4148 Diode
	D112	99.5237	1N4148 Diode
	D114	99.5237	1N4148 Diode
	J 3	41.5568	Male Connector
	L101	61.1421	Tone coil ZVEI
	L101	61.1422	Tone coil CCIR
	P 1	41.5570	PCOM socket
	P101	41.5549	Fem. Connector
	P102	41.5548	Fem. Connector
	P103	41.5569	Fem. Connector
	Q 1	99.5121	BC237 Transistor
	Q101	99.5230	BC308 Transistor
	Q102	99.5230	BC308 Transistor
	Q103	99.5143	BC238 Transistor
	Q104	99.5230	BC308 Transistor
	Q105	99.5143	BC238 Transistor
	Q106	99.5230	BC308 Transistor
	Q107	99.5115	BC309 Transistor
	Q108	99.5230	BC308 Transistor
	Q109	99.5230	BC308 Transistor
	Q110	99.5230	BC308 Transistor
	Q111	99.5143	BC238 Transistor
	Q112	99.5324	BC338-25 Transistor
	Q113	99.5324	BC338-25 Transistor
	Q114	99.5324	BC338-25 Transistor
	Q115	99.5324	BC338-25 Transistor
	Q116	99.5324	BC338-25 Transistor
	Q117	99.5324	BC338-25 Transistor
	Q118	99.5324	BC338-25 Transistor
	Q119	99.5324	BC338-25 Transistor
	Q120	99.5324	BC338-25 Transistor
	Q121	99.5324	BC338-25 Transistor
	Q123	99.5143	BC238 Transistor

TQ5004
TQ5005

18 pos

12 pos
9 pos
18 pos.

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810/2

TYPE	Nº	CODE	DATA
	Q124	99.5143	BC238 Transistor
	Q125	99.5143	BC238 Transistor
	Q126	99.5143	BC238 Transistor
	Q127	99.5143	BC238 Transistor
	Q128	99.5143	BC238 Transistor
	Q129	99.5230	BC308 Transistor
	Q130	99.5143	BC238 Transistor
	Q131	99.5115	BC309 Transistor
	Q132	99.5324	BC338 Transistor
	Q133	99.5324	BC338 Transistor
	R 1	80.5273	100 Kohm 5% Carbon film
	R 2	80.5273	100 Kohm 5% Carbon film
	R 3	80.5273	100 Kohm 5% Carbon film
	R 4	80.5273	100 Kohm 5% Carbon film
	R 5	80.5273	100 Kohm 5% Carbon film
	R 6	80.5273	100 Kohm 5% Carbon film
	R 7	80.5261	10 Kohm 5% Carbon film
	R 8	80.5273	100 Kohm 5% Carbon film
	R 9	80.5278	270 Kohm 5% Carbon film
	R 10	80.5278	270 Kohm 5% Carbon film
	R 11	80.5278	270 Kohm 5% Carbon film
	R 13	80.5278	270 Kohm 5% Carbon film
	R 14	80.5278	270 Kohm 5% Carbon film
	R 15	80.5267	33 Kohm 5% Carbon film
	R 17	80.5278	270 Kohm 5% Carbon film
	R 18	80.5278	270 Kohm 5% Carbon film
	R 19	80.5278	270 Kohm 5% Carbon film
	R 20	80.5278	270 Kohm 5% Carbon film
	R 21	80.5278	270 Kohm 5% Carbon film
	R 26	80.5260	8.2 Kohm 5% Carbon film
	R 27	80.5265	22 Kohm 5% Carbon film
	R 28	80.5273	100 Kohm 5% Carbon film
	R 29	80.5273	100 Kohm 5% Carbon film
	R 30	80.5249	1 Kohm 5% Carbon film
	R 33	80.5273	100 Kohm 5% Carbon film
	R 34	80.5265	22 Kohm 5% Carbon film
	R 35	80.5273	100 Kohm 5% Carbon film
	R 36	80.5273	100 Kohm 5% Carbon film
	R 37	80.5273	100 Kohm 5% Carbon film
	R101	A700019P65	220 Kohm 5% Carbon film
	R102	A700019P58	56 Kohm 5% Carbon film
	R103	A700019P63	150 Kohm 5% Carbon film

TYPE	Nº	CODE	DATA
	R104	A700019P54	27 Kohm 5% Carbon film
	R105	A700019P59	68 Kohm 5% Carbon film
	R106	A700019P49	10Kohm 5% Carbon film
	R107	A700019P63	150 Kohm 5% Carbon film
	R108	A700019P51	15 Kohm 5% Carbon film
	R109	A700019P59	68 Kohm 5% Carbon film
	R110	A700019P55	33 Kohm 5% Carbon film
	R111	J708394P30	47 Kohm 20% RES. VAR. CERM.
	R112	A700019P49	10 Kohm 5% Carbon film
	R113	J708394P31	100 Kohm 20% Trim Cermet
	R114	A700019P65	220 Kohm 5% Carbon film
	R115	A700019P65	220 Kohm 5% Carbon film
	R116	A700019P55	33 Kohm 5% Carbon film
	R117	A700019P57	47 Kohm 5% Carbon film
	R118	A700019P61	100 Kohm 5% Carbon film
	R119	A700019P52	18 Kohm 5% Carbon film
	R120	89.5010	15 Kohm 20% HTC
	R121	A700019P54	27 Kohm 5% Carbon film
	R122	A700019P47	6.8 Kohm 5% Carbon film
	R123	A700019P72	820 Kohm 5% Carbon film
	R124	A700019P61	100 Kohm 5% Carbon film
	R125	A700019P46	5.6 Kohm 5% Carbon film
	R126	A700019P42	2.7 Kohm 5% Carbon film
	R127	A700019P46	5.6 Kohm 5% Carbon film
	R128	A700019P51	15 Kohm 5% Carbon film
	R129	A700019P63	150 Kohm 5% Carbon film
	R130	A700019P62	120 Kohm 5% Carbon film
	R131	A700019P64	180 Kohm 5% Carbon film
	R132	A700019P64	180 Kohm 5% Carbon film
	R133	A700019P66	270 Kohm 5% Carbon film
	R134	A700019P65	220 Kohm 5% Carbon film
	R135	A700019P65	220 Kohm 5% Carbon film
	R136	A700019P49	10 Kohm 5% Carbon film
	R137	J708394P31	100 Kohm 20% Trim cermet film
	R138	A700019P54	27 Kohm 5% Carbon film
	R139	A700019P65	220 Kohm 5% Carbon film
	R140	A700019P46	5.6 Kohm 5% Carbon film
	R141	A700019P37	1 Kohm 5% Carbon film
	R142	A700019P63	150 Kohm 5% Carbon film
	R143	A700019P67	330 Kohm 5% Carbon film
	R144	A700019P55	33 Kohm 5% Carbon film
	R145	A700019P51	15 Kohm 5% Carbon film

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402. 810/2

Stereo

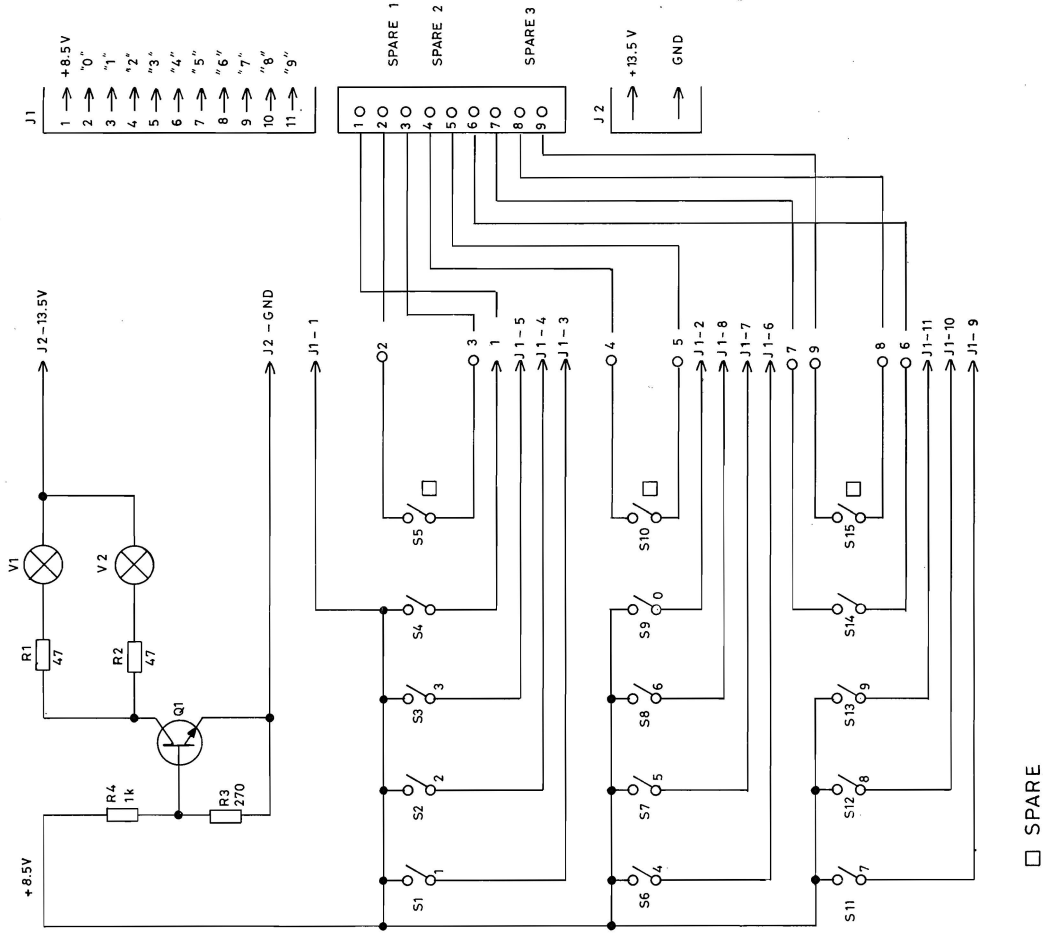
TYPE	NO	CODE	DATA
	U 1	14.5091	CD4015 Shift reg.
	U 2	14.5091	CD4015 Shift reg.
	U 3	14.5117	CD40097 Hex buffer F
	U 4	14.5117	CD40097 Hex buffer F
	U 5	14.5117	CD40097 Hex buffer F
	U 6	14.5146	CD40106 Hex inverter
	U 7	14.5049	CD4049 Hex inverter
	U 8	14.5147	SO353 RCM
	U 9	14.5098-01	CD4013 Dual D-FF
	U 10	14.5052-01	CD4017B Johnson Counter
	U 11	14.5052-01	CD4017B Johnson Counter
	U 12	14.5052-01	CD4017B Johnson Counter
	U101	J706018P1	IC3302 Quad. Comparat.
	U104	14.5098-01	CD4013B Dual D-FF
	U106	14.5134	555 Timer
	U107	A700029P206	4514B Encoder 4-16 bit
	U108	14.5146	CD40106B Hex Schmitt trigger

Stereo

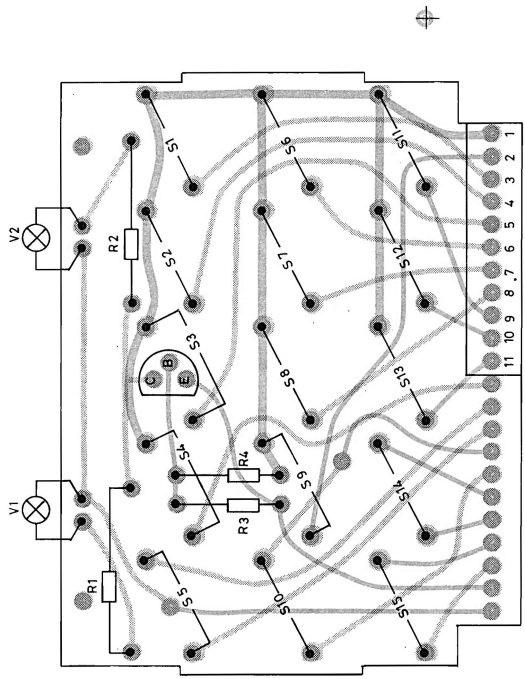
TYPE	NO	CODE	DATA
	R146	A700019P59	68 Kohm 5% Carbon film
	R147	A700019P25	100 ohm 5% Carbon film
	R148	A700019P25	820 Kohm 5% Carbon film
	R149	A700019P42	2.7 Kohm 5% Carbon film
	R150	A700019P42	2.7 Kohm 5% Carbon film
	R151	A700019P42	2.7 Kohm 5% Carbon film
	R152	A700019P42	2.7 Kohm 5% Carbon film
	R153	A700019P42	2.7 Kohm 5% Carbon film
	R155	A700019P42	2.7 Kohm 5% Carbon film
	R156	A700019P42	2.7 Kohm 5% Carbon film
	R157	A700019P42	2.7 Kohm 5% Carbon film
	R158	A700019P42	2.7 Kohm 5% Carbon film
	R159	A700019P42	2.7 Kohm 5% Carbon film
	R161	A700019P25	100 ohm 5% Carbon film
	R162	A700019P49	10 Kohm 5% Carbon film
	R163	A700019P66	270 Kohm 5% Carbon film
	R164	A700019P54	27 Kohm 5% Carbon film
	R167	A700019P49	10 Kohm 5% Carbon film
	R168	A700019P49	10 Kohm 5% Carbon film
	R174	A700019P49	10 Kohm 5% Carbon film
	R175	A700019P44	3.9 Kohm 5% Carbon film
	R176	A700019P55	33 Kohm 5% Carbon film
	R177	A700019P44	3.9 Kohm 5% Carbon film
	R178	A700019P55	33 Kohm 5% Carbon film
	R179	A700019P54	27 Kohm 5% Carbon film
	R180	A700019P54	27 Kohm 5% Carbon film
	R181	A700019P70	560 Kohm 5% Carbon film
	R183	A700019P65	220 Kohm 5% Carbon film
	R184	A700019P59	68 Kohm 5% Carbon film
	R185	A700019P42	2.7 Kohm 5% Carbon film
	R186	A700019P42	2.7 Kohm 5% Carbon film
	R187	A700019P49	10 Kohm 5% Carbon film
	R188	A700019P61	100 Kohm 5% Carbon film
	R191	A700019P61	100 Kohm 5% Carbon film
	R198	A700019P49	10 Kohm 5% Carbon film
	R201	A700019P57	47 Kohm 5% Carbon film
	R202	A700019P75	1.5 Mohm 5% Carbon film
	R203	A700019P61	100 Kohm 5% Carbon film
	R204	A700019P52	18 Kohm 5% Carbon film
	R205	A700019P43	3.3 Kohm 5% Carbon film
	R206	A700019P67	330 Kohm 5% Carbon film
	S101	47.0642	Switch assembly

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402, 810/2



PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE (BACK)



NOTE: PUSHBUTTON S1-S15 MOUNTED ON FRONT

Nº	CODE	DATA
J01	41.5573	Male Connector
J02	41.5566	Male Connector
Q01	99.5333	BC337 Transistor
R01	80.5433	47 ohm 5% Carbon film
R02	80.5433	47 ohm 5% Carbon film
R03	80.5242	270 ohm 5% Carbon film
R04	80.5249	1 Kohm 5% Carbon film
Sxa	12.0378-00	Button dummy
S01	47.5105	Switch
S01a	12.0386-01	Button 1
S02	47.5105	Switch
S02a	12.0386-02	Button 2
S03	47.5105	Switch
S03a	12.0386-03	Button 3
S04	47.5105	Switch
S04a	12.0386-04	Button 4
S05	47.5105	Switch
S05a	12.0386-05	Button 5
S06	47.5105	Switch
S06a	12.0386-06	Button 6
S07	47.5105	Switch
S07a	12.0386-07	Button 7
S08	47.5105	Switch
S08a	12.0386-08	Button 8
S09	47.5105	Switch
S09a	12.0386-09	Button 9
S10	47.5105	Switch
S10a	12.0386-10	Button 0
S11	47.5105	Switch
S12	47.5105	Switch
S13	47.5105	Switch
S14	47.5105	Switch
S15	47.5105	Switch
V01	92.5120	12 V Lamp
V02	92.5120	12 V Lamp

11 pos
2 pos
0.25 W
0.25 W
0.125 W
0.125 W

DATA

CODE

Nº

CONTROL PANEL CP5003

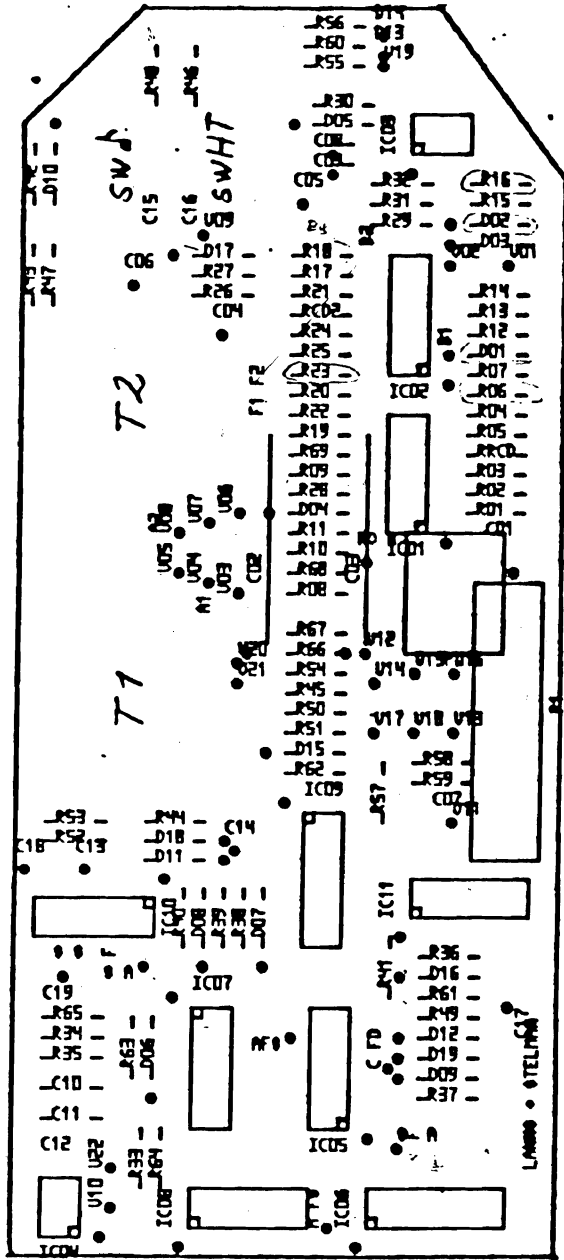
X403.000

LANNG & STELMAN aps

Havnegade 16 F, DK-8000 Århus C, Denmark Tlf. (06) 193500

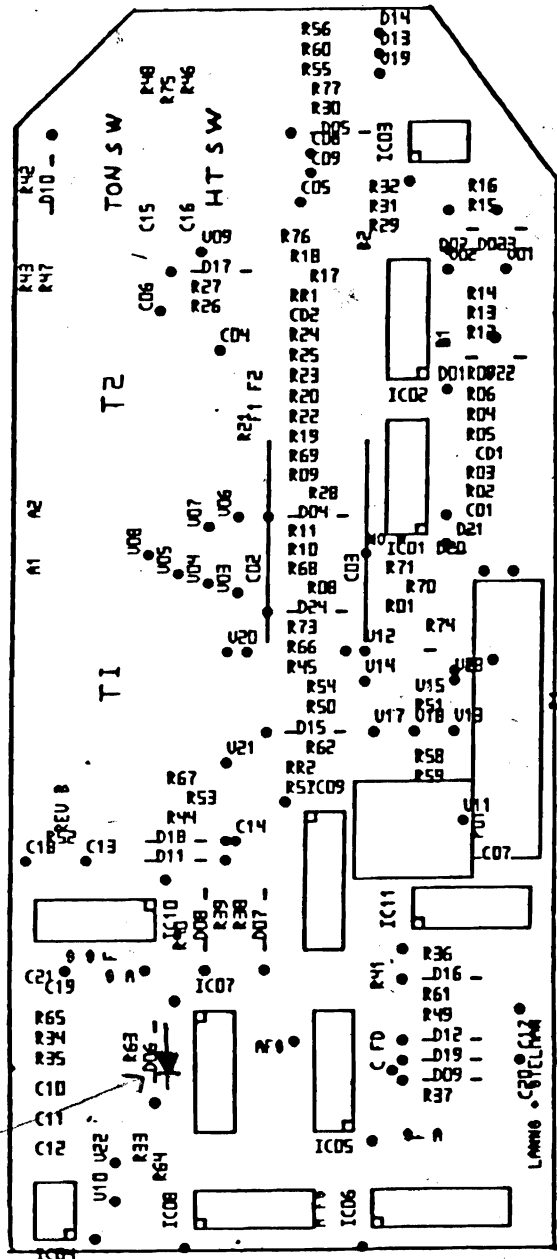
To-tone transceiver til CQM 5000

280380/BJ

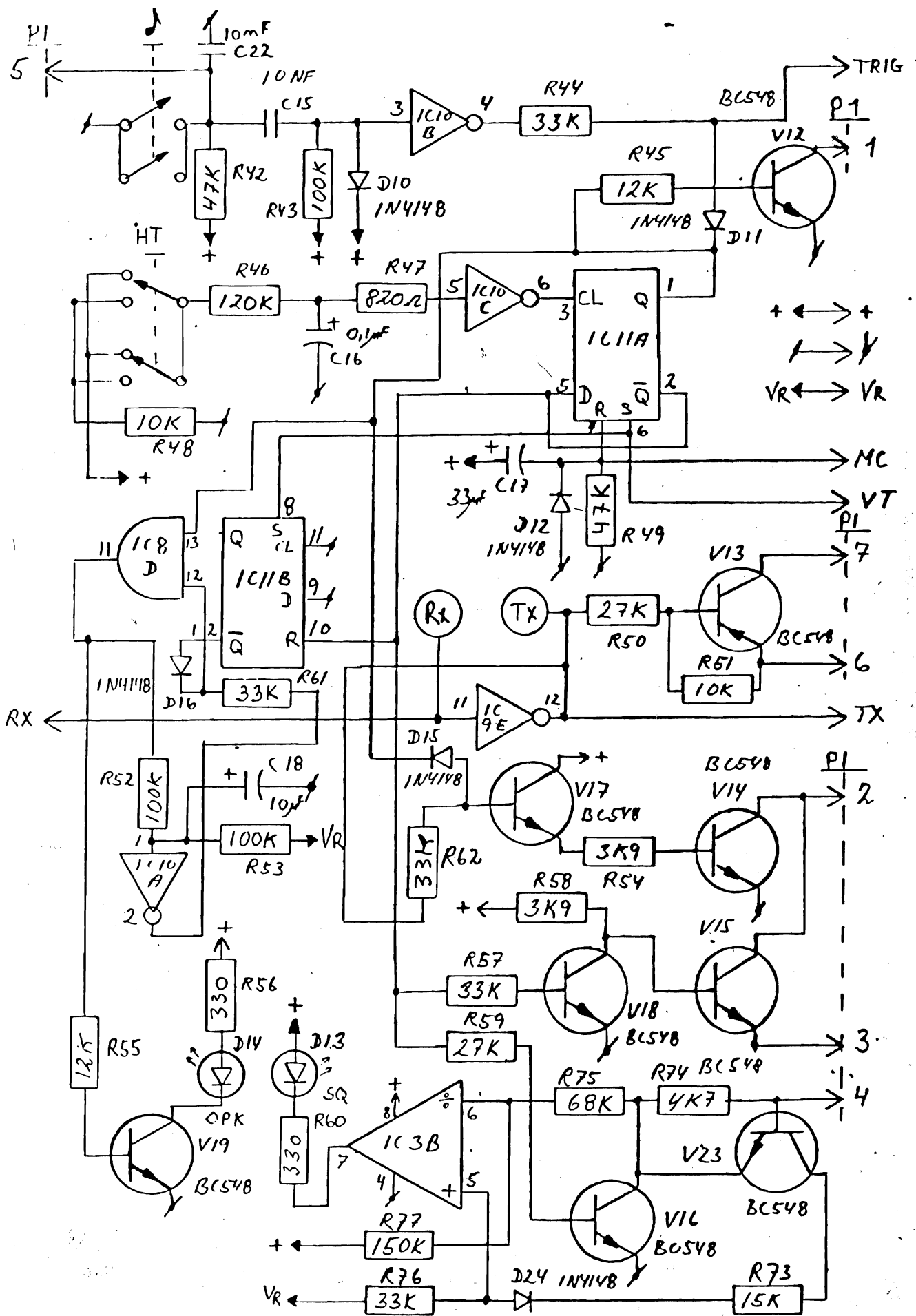


TONE TRANCEIVER
 KOMPONENT PLACERING
 86/801 BJ

Doğ kun ved tilføjes var

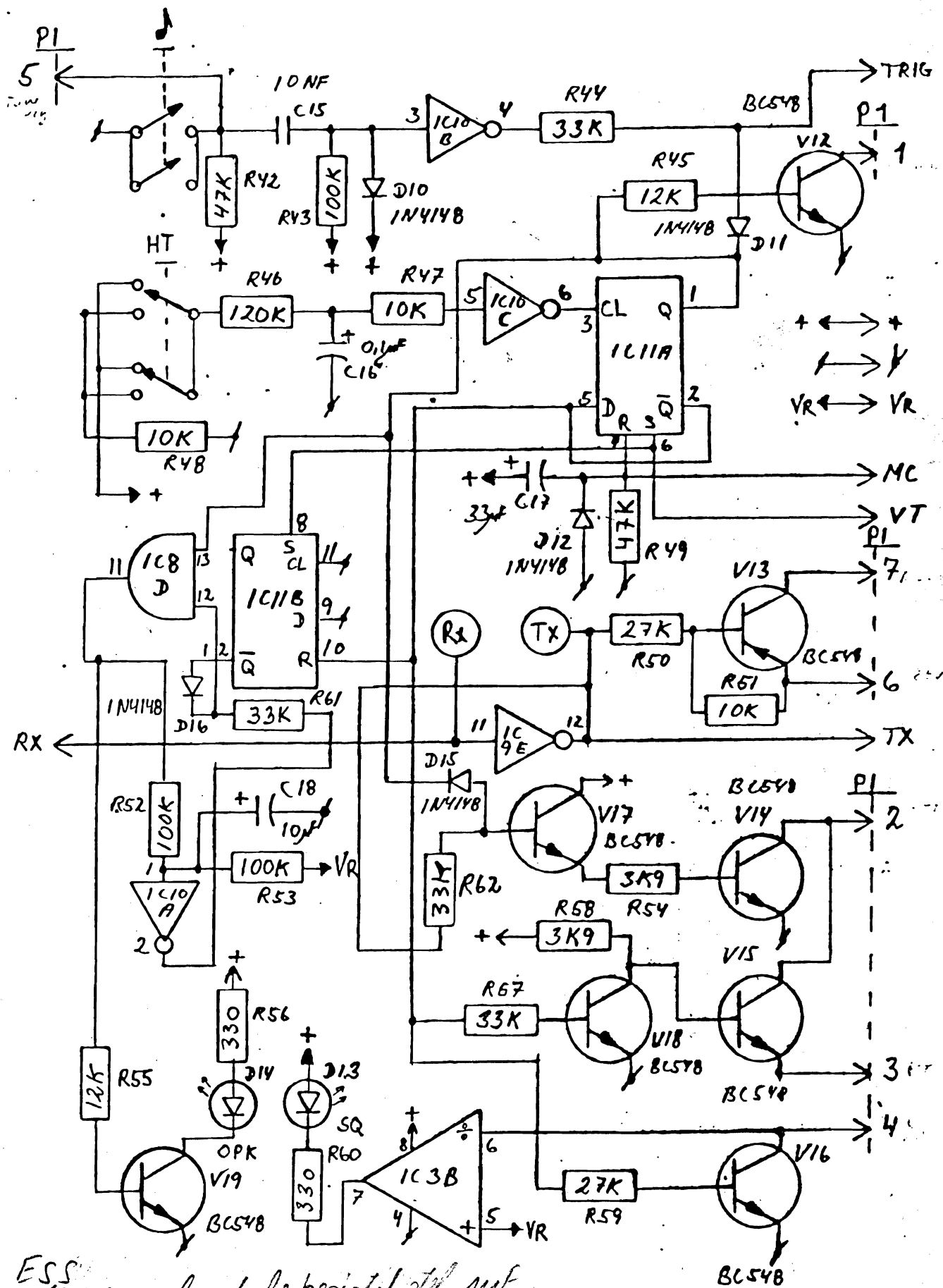


TONE TRANCEIVER	
COMPONENT PLACING	
8/1801 BJ	REV. B.



... NG & S...
 ...
 ...

TONE TRANCEIVER
 2 TONER
 INTERFACE
 REV. B. 15/2/81



ESS rettet V11 hoved fra berøstet stål puf
 Paral-hoved på C17 (68µF)

LANG & STELMAN

Havneparken 16, 3.
 DK-8000 Århus C. Tlf. 06 12 75 00

TONETRANCIVER

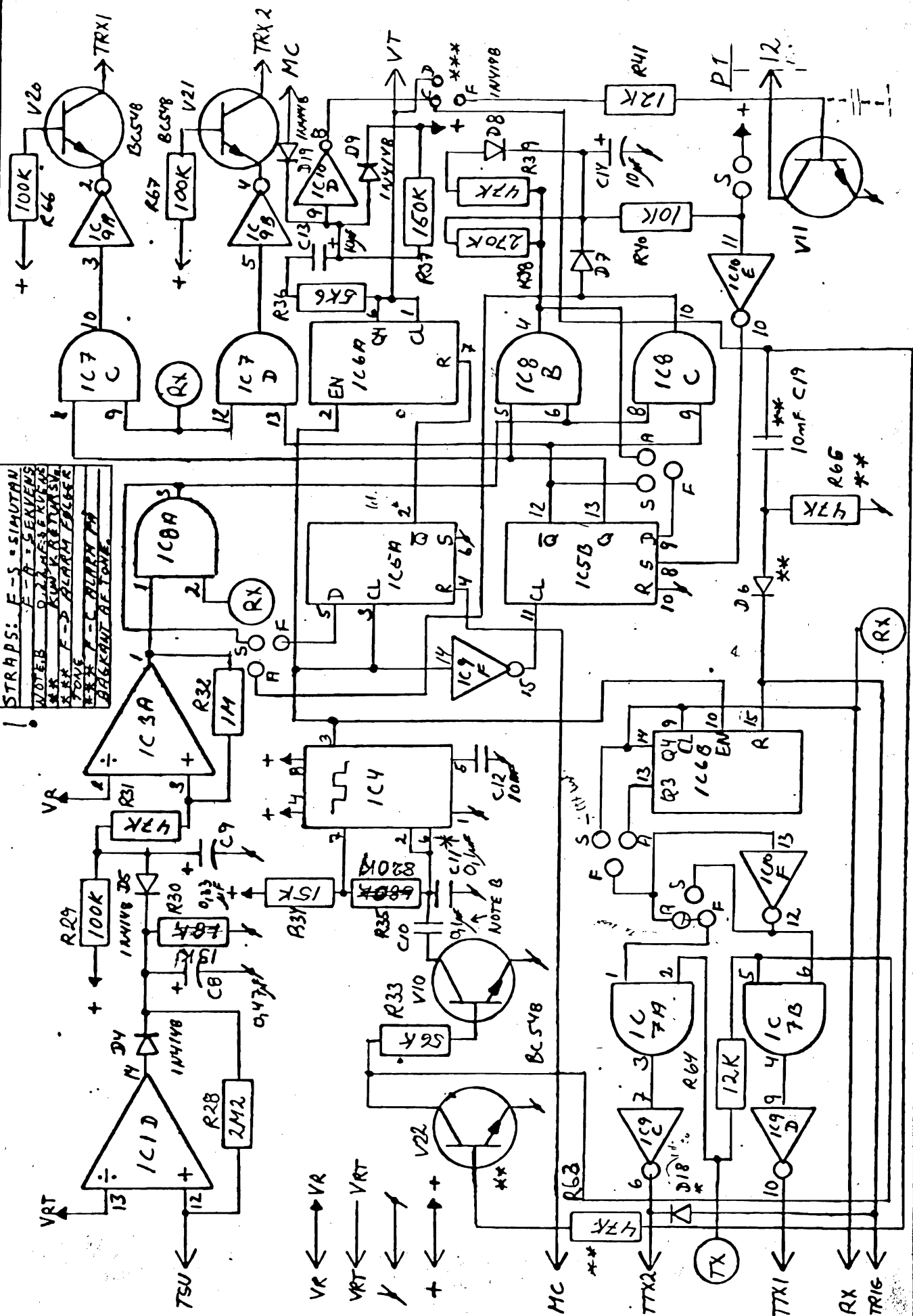
2 TONER

INTERFACE

REV. A. 150280 BJ

20ndringer ind (1/4) 23/4-1
 PER ASI LOK 266

STRAPS: F-S-SIMULTAN
 WDT/B - A-SERVEN
 0-23-4-5-6-7-8-9-10-11-12-13-14-15
 * * * F - D-ALARM FOLBER
 * * * F - C-ALARM PA
 BALKANT AF TONE



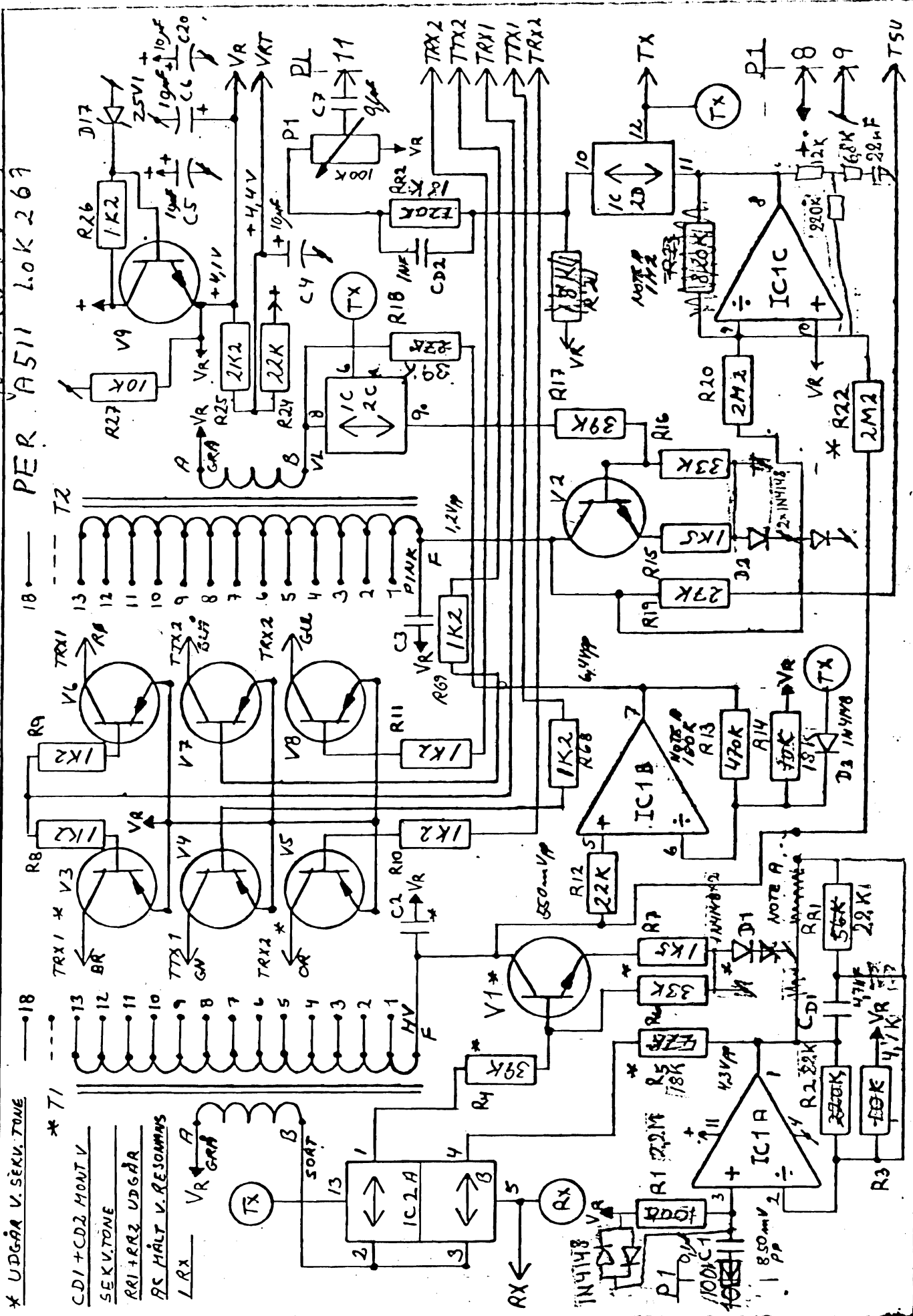
LANG & STELMAN
 Havnegade 16, 3.
 DK-8000 Århus C, tlf. 06-193500

Denfer C11 = 0,2μF

TONETRANCEIVER
 2 TONER
 LOGIKDEL
 REV. A. 150280 BJ

sendringer indlæst 22/11-80

PER A511 LOK 267



- * UDGAAR V. SEK. TONE
- * 71
- CD1 + CD2 MONT V
- SEK. TONE
- RR1 + RR2 UDGAAR
- RS HÅLT V. RESONANS
- L RX VR GAAR A B

LANNG & STELMAN

Havnegade 16, 3.

DK-8000 Artus v. 111. OG 193500

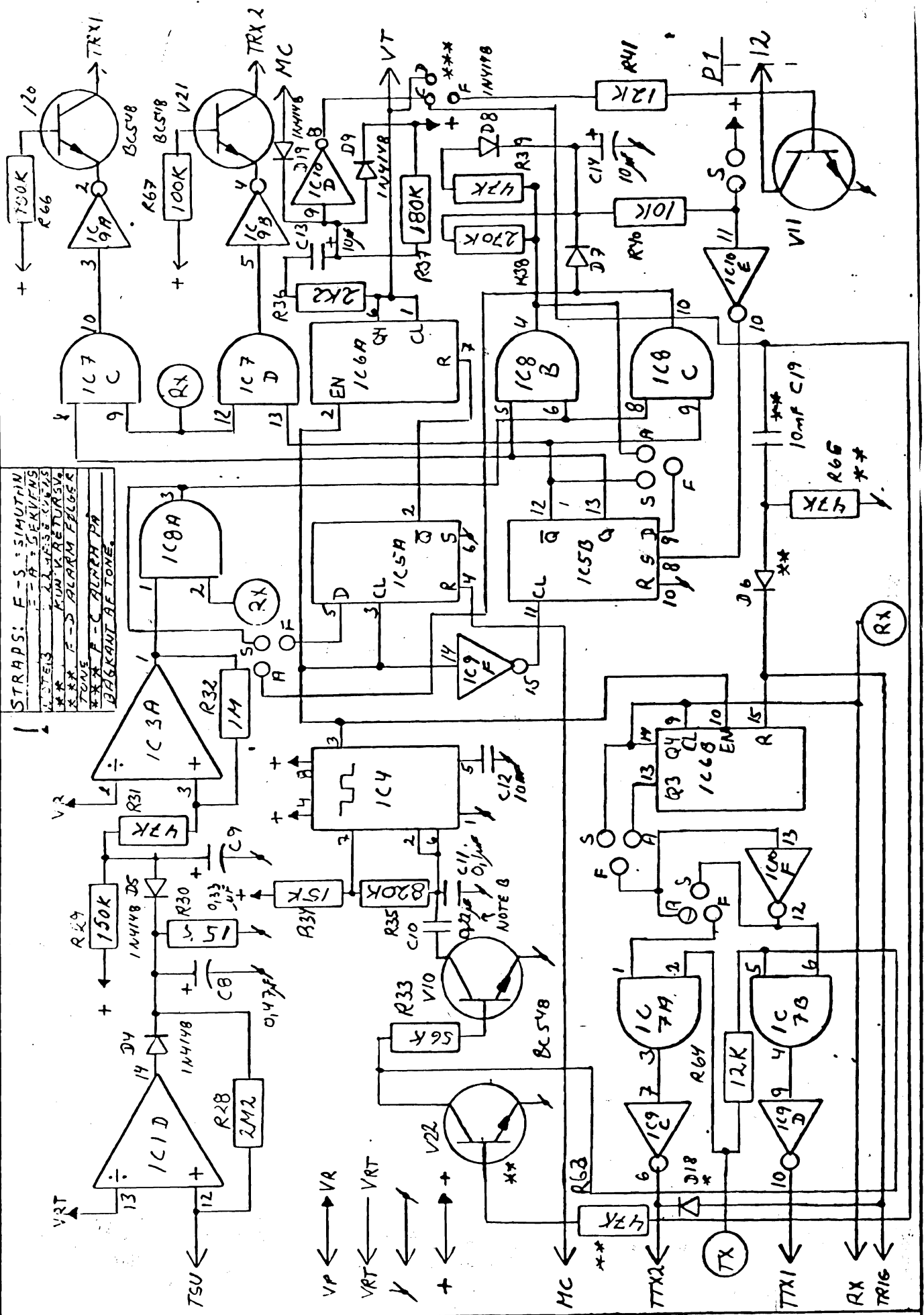
TONETRANCEIVER

2 TONER

ANALOG DEL

REV. A. 150280 BJ

STRAPS: F-S : SIMUTAN
 F-A : SEKVENSI
 A-STEIS : 22.453.82.75
 ** F-KUN VARETURSA
 ** F-D ALARM FELGER
 TONE
 ** F-C ALARM PA
 BAKKANT BE TONE.

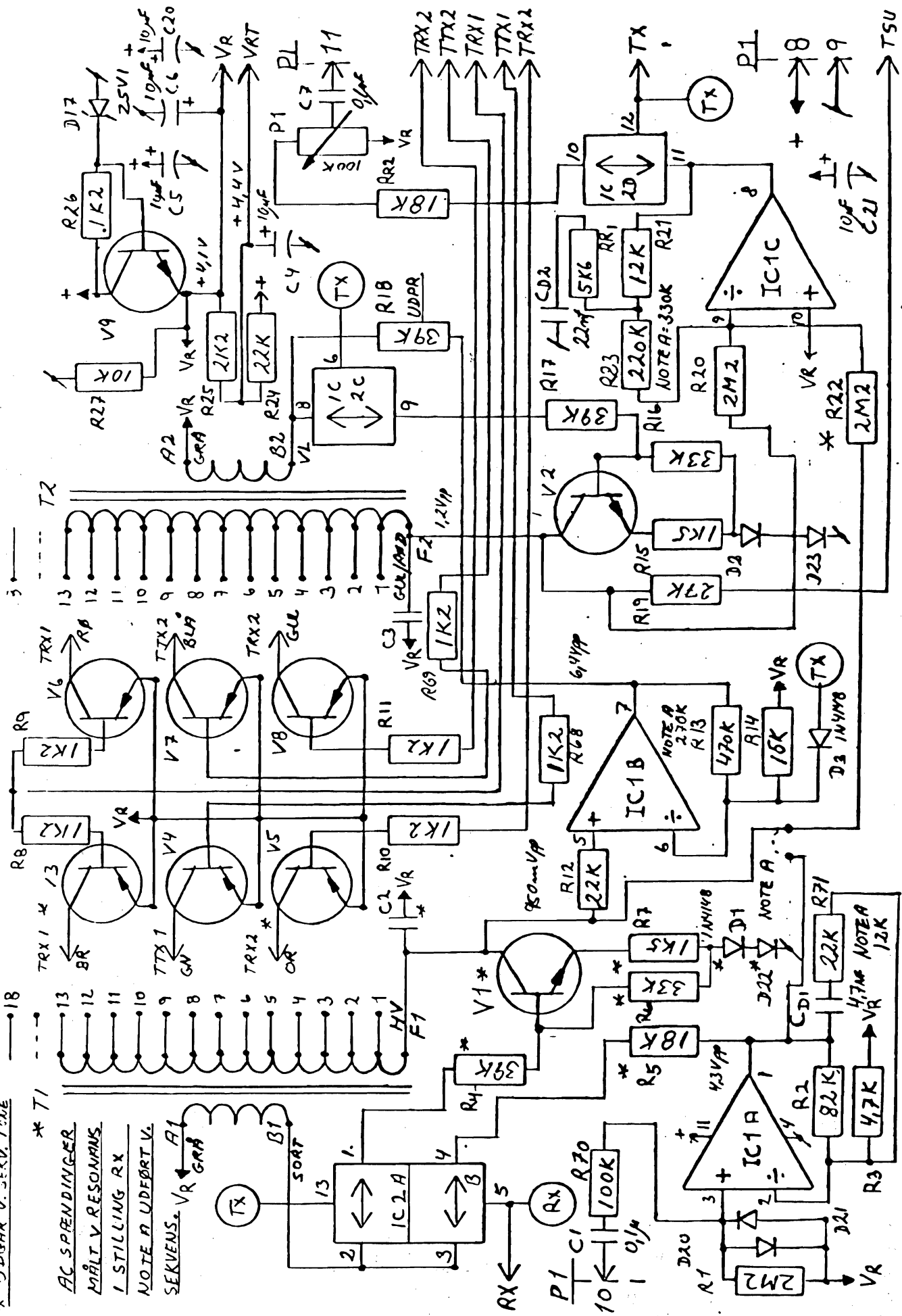


... & STE...
 ...
 ...

TONETRANCEIVER
 2 TONER
 LOGIKDEL
 REV.B. 150280 RJ 1

* UDGÅR V. SEK. TONE

* T1
 AC SPENDINGER
 MÅLT V. RESONANS
 I STILLING RX
 NOTE A UDFØRT V.
 SEKVEN. VR



ANIL & STELAIN

Elektronik

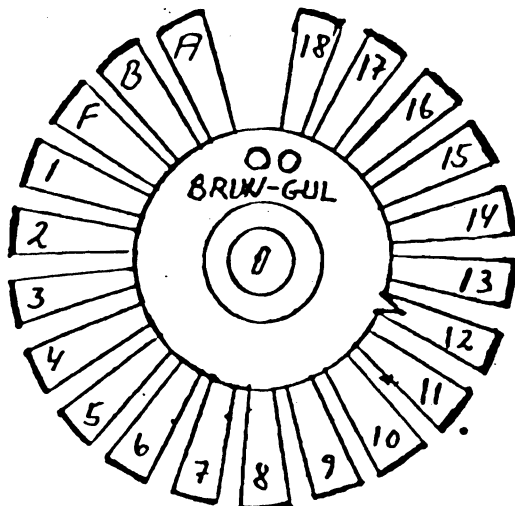
TONETRANCEIVER

2 TONER

ANALOG DEL

REV. 0. 150280 BJ

T1 OG T2



		T1	T2
TRX1 BRUN	V3	S	
TRX1 RØD	V6		SA
TRX2 ORANGE	V5	S	
TRX2 GUL	V8		SA
TTX1 GRØN	V4	S	A
TTX2 BLÅ	V7		SA

S = SIMULTAN (STANO/SRA)
 A = SEKVENB (AP) KUNT2
 MONTERET.

LME

SPOLE KODE:		BRUN-GUL		GUL-RØD		HVID-RØD	
UDTAG	FREKV	STANO	NR	SRA	NR	FREKV.	AP. NR
1	2900	12	2580	0		2960	R
2	2600	11	2367	1		2820	9
3	2400	10	2172	2		2590	8
4	2200	9	1993	3		2410	7
5	2000	8	1828	4		2220	6
6	1830	7	1677	5		2010	5
7	1670	6	1539	6	G	1800	4
8	1530	5	1412	7	H	1600	3
9	1400	4	1295	8	I	1380	2
10	1270	3	1188	9	J	1190	1
11	1160	2	1090	10	K	980	0
12	1060	1	1000	11	L		
13	970	+3	917		A		
14	885	+4	842		B		
15	805	+5	772		C		
16	735	+6	708		D		
17	675	+7	650		E		
18	615	+8	596		F		
F	0	—	0	—	—	0	—

Red. JG. djl. v. BJ.

NB: VERKODNING BØR HØJ OG LAV TONERÆKKE
 HOLDES PÅ HVER SPOLE SIN SPOLE, EKS T1=LAV OG T2=HØJ

I ANNG & STELMAN

Havnegade 16,3.

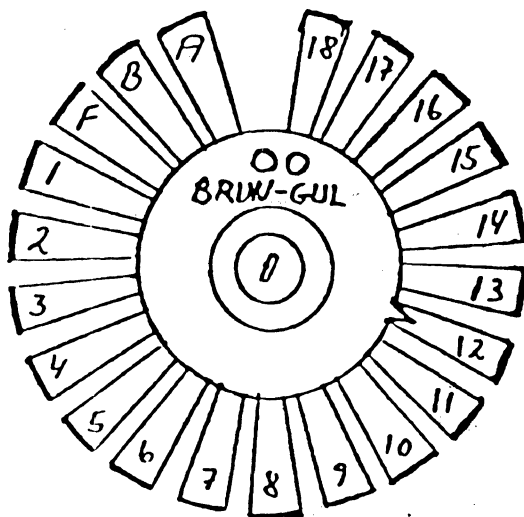
TELEFON: Arthur C. 01 08-103500

TONETRANKEIVER

KODE VEJLEDNING

801201 BJ

T1 06 T2



	T1	T2	SW
TRX1 BRUN	S		V3
TRX1 RØD		SA	V6
TRX2 ORANGE	S		V5
TRX2 GUL		SA	V8
TTX1 GRØN	S	A	V4
TTX2 BLÅ		SA	V7

S = SIMULTAN STORNO OG SRA.
 A = SEKVEN S AP. KUNT 2.
 MONTERET.

SPOLE KODE:		BRUN-GUL		GUL-RØD		HVID-RØD	
LIDTAG	FREKV	STORNO N ^o	FREKV	SRA. N ^o	SRA. N ^o	FREKV.	AP. N ^o
1	2900	12	2580	0		2960	R
2	2600	11	2367	1		2820	9
3	2400	10	2172	2		2590	8
4	2200	9	1993	3		2410	7
5	2000	8	1828	4		2220	6
6	1830	7	1677	5		2010	5
7	1670	6	1539	6	G	1800	4
8	1530	5	1412	7	H	1600	3
9	1400	4	1295	8	I	1380	2
10	1270	3	1188	9	J	1190	1
11	1160	2	1090	10	K	980	0
12	1060	1	1000	11	L		
13	970	18	917		A		
14	885	17	842		B		
15	805	16	772		C		
16	735	15	708		D		
17	675	14	650		E		
18	615	13	596		F		
F	0	—	0	—	—	0	—

R X : tone 1 brun + rød. tone 2 orange + gul.
 T X : blå + grøn

1210

295700
 06 VASSTON skænk

ANNG & STELMAN Industrivej 18.3 2100 København Ø Tlf. 22367	TONETRANCEIVER	
	KODE VEJLEDNING 801201 03	

LANNING & STELHAN
Ingenierfirma

Emne: Telefonapparat

Kunde	Storno	Korr.	A	B	C	Tegning nr	
Projekt	5000 toneudstyr		X			Udført af	Date
						Godkendt	

Position	Artikel	Type	Antal	Leverandør	L. nr	Pris 1	Pris 2
R 1	100K	1/8W					
- 2	220K						
- 3	10K						
- 4	39K	Simultan					
- 5	47K	Simultan					
- 6	33K	Simultan					
- 7	1K5	Simultan					
- 8	1K2	Simultan					
- 9	1K2						
- 10	1K2	Simultan					
- 11	1K2						
- 12	22K						
- 13	470K/180-	Sim.470K/AP 180K					
- 14	10K						
- 15	1K5						
- 16	33K						
- 17	39K						
- 18	27K						
- 19	27K						
- 20	2M2						
- 21	18K						
- 22	2M2						
- 23	820K/1M2-	Sim 820K/AP 1M2					
- 24	22K						
- 25	2K2						
- 26	1K2						
- 27	10K						
- 28	2M2						
- 29	100K						
- 30	18K						
- 31	47K						
- 32	1M						
- 33	56K						
- 34	15K						
- 35	680K						
- 36	5K6						
- 37	150K						
- 38	27CK						
- 39	47K						
- 40	10K						
- 41	12K						
- 42	47K						
- 43	100K						
- 44	33K						
- 45	12K						
- 46	120K						
- 47	10K						
- 48	10K						
- 49	47K						
- 50	27K						
- 51	10K						
- 52	100K						

Kunde	Storno	Korr.	A	B	C	Tegning nr
			X			
Projekt	5000 toneudstyr					Udført af Date Godkendt

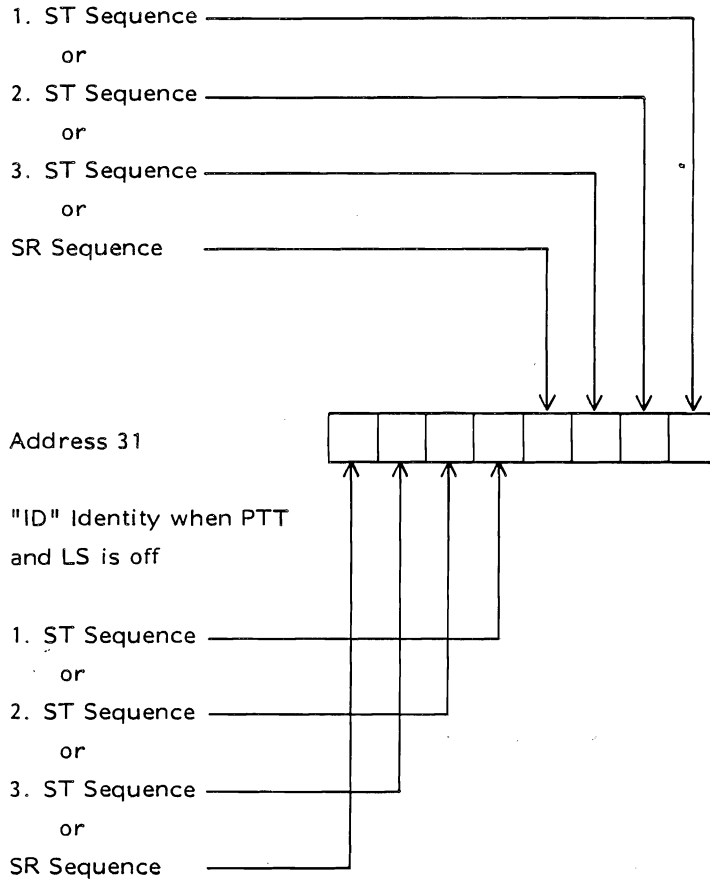
Position	Artikel	Type	Antal	Leverandør	L. nr	Pris 1	Pris 2
R 53	100K 1/8W						
- 54	3K9						
- 55	12K						
- 56	330E						
- 57	33K						
- 58	3K9						
- 59	27K						
- 60	330E						
- 61	33K						
- 62	33K						
- 63	47K	Retursvar					
- 64	12K						
- 65	47K	Retursvar					
- 66	100K						
- 67	100K						
- 68	1K2						
- 69	1K2						
RR 1	56K	Simultan					
- 2	120K	Simultan					
P 1	100K trimmer	Liggende					
CD 1	4n7 3M	AP					
CD 2	1n 3M	AP					
C 1	u1/100 3M	poly					
- 2	u1/100 3M	- Simultan					
- 3	u1/100 1%						
- 4	10u/16	lyt, rød					
- 5	10u/16	- -					
- 6	10u/16	- -					
- 7	u1/100 3M	poly					
- 8	u47/16	tantal					
- 9	u33/16	-					
- 10	u1 (u22) 3/4M	poly		Sim-u1 AP-u22			
- 11	u1/100 3M	-					
- 12	10n/100 3M	-					
- 13	10u/16	lyt, rød					
- 14	10u/16	- -					
- 15	10n/100 3M	poly					
- 16	u1/100 3M	-					
- 17	33u/16	lyt, blå					
- 18	10u/16	- rød					
- 19	10n/100 3M	poly		retursvar			
- 20	10u/16	rød lyt/tantal					
T 1	tonespole var. sp.	Simultan					
- 2	tonespole var. sp.						
J 1	12-pol	molex hun		5x30,4xH8,5			
S 1	omskifter Storno						
K 1+2	knapper Storno						

Kunde	Storno	Korr.	A	B	C	Tegning nr
Projekt	500C toneudstyr					Udført af Dato Godkendt

Position	Artikel	Type	Antal	Leverander	L. nr	Pris 1	Pris 2
D 1-12	1N4148		12				
- 13	LED LD /II	kun ved busy					
- 14	-						
- 15	1N4148						
- 16	1N4148						
- 17	Z5V1	zener 400 mW					
- 18	1N4148						
- 19	1N4148						
V 1	BC 548	Simultan					
V 2	BC 548						
- 3	BC 558	Simultan					
- 4	BC 558						
- 5	BC 558	Simultan					
- 6-8	BC 558		3				
- 9-12	BC 548		4				
- 13	BC 558						
- 14-22	BC 548		10				
IC 1	TL 084						
- 2	4016/4066						
- 3	MC 4558						
- 4	555						
- 5	4013 B						
- 6	14520 B						
- 7	4081 B						
- 8	4081 B						
- 9	4049 B						
- 10	14584/40106 B						
- 11	4013 B						

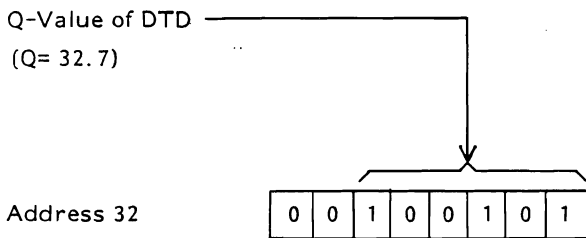
ID/ACK Address 31

"Acknowledge" when SR is activated

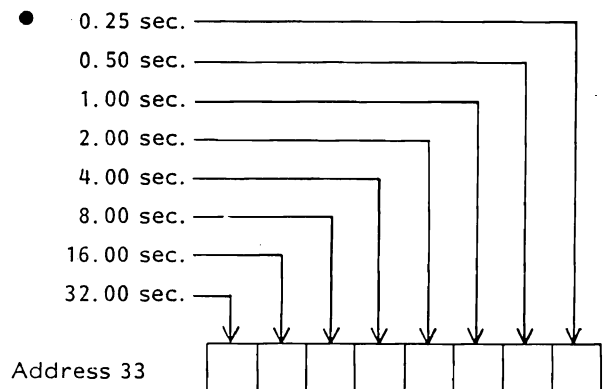


PRIVACY ADDRESS 33

DTD (TONESYSTEM/Q - VALUE) ADDRESS 32



- The operator cannot open LS manually
- Keying and tone keying is not possible if the channel is busy - (true also without Privacy if LS is closed).
- LS will close automatically 0.25s - 1 min after last transmission or reception of carrier.



100 x RX - CODES ADDRESS 35/98

100 x TX - CODES ADDRESS 99/FC

For channel 00-99 use the formula

$$V_{DEC} = \frac{(A-10.7)-(Cx3)}{F}$$

Refer to CQM5110's handbook.

Convert then V_{DEC} - Data Hex code and insert the Hex code from address 35 channel 00 to address 98= channel 99

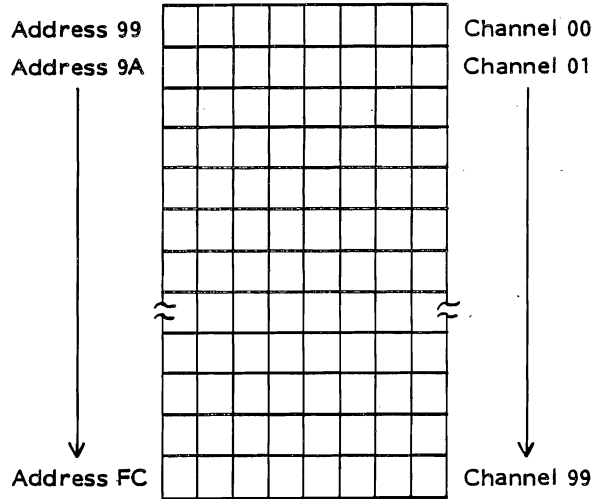
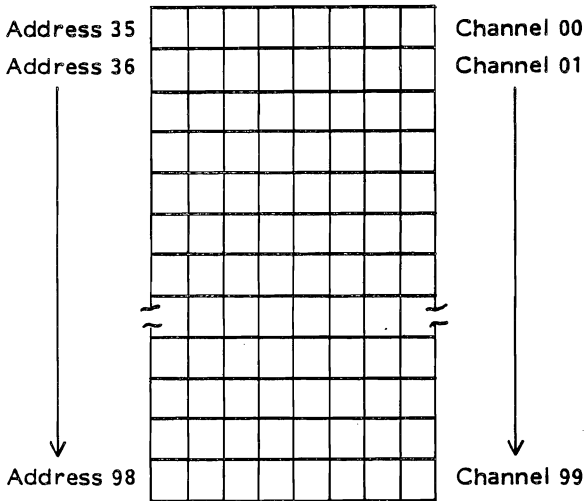
For channel 00-99 use the formula

$$V_{DEC} = \frac{B - (Dx3)}{F}$$

Refer to CQM5110's handbook.

Convert then V_{DEC} - Data Hex code and insert the Hex code from address 99= channel 00 to address FC= channel 99

8 Bits



NOTE: ALL UNUSED/NOT CALCULATED CHANNELS SHALL BE PROGRAMMED FF/FREE.

Ex. for RX: (ADDRESS 35/98)

If ADDRESS 95 - 98 are unused:

THEN PROGRAMM:	ADR	BIT S
95 F F	95	1 1 1 1 1 1 1 1
96 F F	96	1 1 1 1 1 1 1 1
97 F F	97	1 1 1 1 1 1 1 1
98 F F	98	1 1 1 1 1 1 1 1

INSTALLATION, PROGRAMMING AND ADJUSTMENT

TQ5006, TR5002, TT5002, FN5002

INSTALLATION

The TQ5006 module is inserted and connected to the XS/FS board on the J905 connector.

The following jumper wires on the XS/FS board are cut:

- For TQ5006 - cut H7-H8 and H9-H10-H20-H33
- For TT5002 - cut H9-H10
- For TR5002 - cut H7-H8
- For FN5002 - cut H7-H8

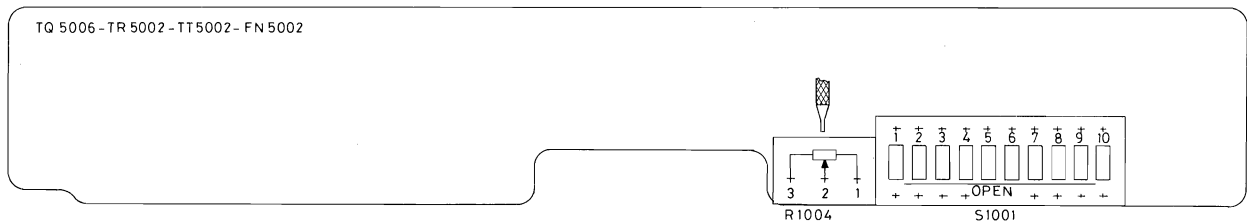
PROGRAMMING

The Channel Guard module is programmed to a specific tone of the CTCSS series by setting a 10 position binary switch.

The switch positions have the following weights (Hz).

The programmed frequency is the sum of the open switches.

SW position	1	2	3	4	5	6	7	8	9	10
Freq. Hz	0.25	0.5	1	2	4	8	16	32	64	128



PROGRAMMING AND ADJUSTMENT TQ5006

D403.044

STANDARD TONE FREQUENCIES, Hz (CTCSS)

67.0				
71.9	88.5	107.2	131.8	162.2
74.4	91.5	110.9	136.5	167.9
77.0	94.8	114.8	141.3	173.8
79.7	97.4	118.8	146.2	179.9
82.5	100.0	123.0	151.4	189.2
85.4	103.5	127.3	156.7	192.8
				203.5
				210.7

EXAMPLE

Channel Guard tone= 103.5 Hz

$$103.5 = 64 + 32 + 4 + 2 + 1 + 0.5$$

Switch	1	2	3	4	5	6	7	8	9	10
Position	0	1	1	1	1	0	0	1	1	0

1= OPEN 0= CLOSED

Channel Guard tone= 156.7 Hz (round off to 156.75 Hz)

$$156.75 = 128 + 16 + 8 + 4 + 1 + 0.5 + 0.25$$

Switch	1	2	3	4	5	6	7	8	9	10
Position	1	1	1	0	1	1	1	0	0	1

1= OPEN 0= CLOSED

ADJUSTMENT OF FREQUENCY DEVIATION

Disable the Channel Guard modulation by applying +8.5 V DC to pin 9 on the rear connector J910 (CG disable). This pin is floating during normal operation and if pulsed "low" the Channel Guard receiver function is disabled.

Adjust, as described in the CQM5000 Adjustment Procedure, the modulation frequency deviation such that the frequency deviation is equal to the maximum permissible frequency deviation minus the Channel Guard frequency deviation.

The channel guard modulation is as follows, or as specified by the customer:

25 kHz	channel spacing	± 750 Hz
20 kHz	channel spacing	± 600 Hz
12.5 kHz	channel spacing	± 375 Hz

Remove the AF modulation.
 Remove the 8.5 V DC to pin 9 on the rear connector J910.
 Key the transmitter.

Adjust potentiometer R1004 for correct Channel Guard frequency deviation.

Connect a frequency counter to the AF output on the deviation meter.

Check the accuracy of the channel guard tone.

Requirement: $f_{nom} \pm 0.2\%$

CHANNEL GUARD DECODING CHECK

Use receiver test setup.

Modulate the RF generator with the channel guard tone to specified frequency deviation.

Check that the decoder opens the AF channel if and only if the channel guard tone is present.

Connect an AF voltmeter to the AF output load.

Measure the channel guard tone level.

Requirement: -17 dB below the level produced by a signal which is modulated with 1 kHz to 60% of maximum frequency deviation.

INSTALLATION, PROGRAMMING AND ADJUSTMENT

TQ5006, TR5002, TT5002, FN5002

INSTALLATION

The TQ5006 module is inserted and connected to the XS/FS board on the J905 connector.

The following jumper wires on the XS/FS board are cut:

- For TQ5006 - cut H7-H8 and H9-H10-H20-H33
- For TT5002 - cut H9-H10
- For TR5002 - cut H7-H8
- For FN5002 - cut H7-H8

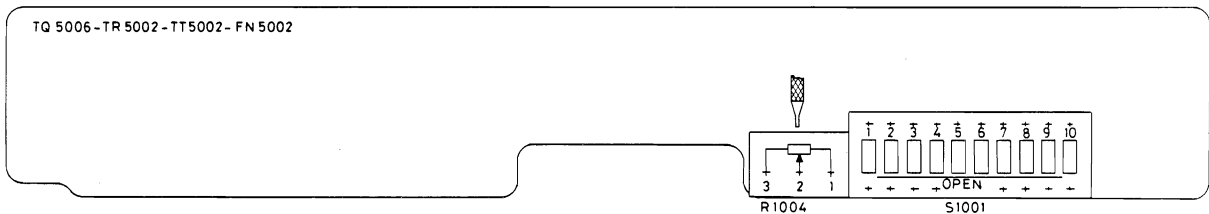
PROGRAMMING

The Channel Guard module is programmed to a specific tone of the CTCSS series by setting a 10 position binary switch.

The switch positions have the following weights (Hz).

The programmed frequency is the sum of the open switches.

SW position	1	2	3	4	5	6	7	8	9	10
Freq. Hz	0.25	0.5	1	2	4	8	16	32	64	128



PROGRAMMING AND ADJUSTMENT TQ5006

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79.7	97.4	118.8	146.2	179.9
82.5	100.0	123.0	151.4	186.2
85.4	103.5	127.3	156.7	192.8
				203.5
				210.7

EXAMPLE

Channel Guard tone= 103.5 Hz

$$103.5 = 64 + 32 + 4 + 2 + 1 + 0.5$$

Switch	1	2	3	4	5	6	7	8	9	10
Position	0	1	1	1	1	0	0	1	1	0

1= OPEN 0= CLOSED

Channel Guard tone= 156.7 Hz (round off to 156.75 Hz)

$$156.75 = 128 + 16 + 8 + 4 + 1 + 0.5 + 0.25$$

Switch	1	2	3	4	5	6	7	8	9	10
Position	1	1	1	0	1	1	1	0	0	1

1= OPEN 0= CLOSED

ADJUSTMENT OF FREQUENCY DEVIATION

Disable the Channel Guard modulation by applying +8.5 V DC to pin 9 on the rear connector J910 (CG disable). This pin is floating during normal operation and if pulsed "low" the Channel Guard receiver function is disabled.

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25 kHz	channel spacing	± 750 Hz
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 Key the transmitter.

Adjust potentiometer R1004 for correct Channel Guard frequency deviation.

Connect a frequency counter to the AF output on the deviation meter.

Check the accuracy of the channel guard tone.

Requirement: $f_{nom} \pm 0.2\%$

CHANNEL GUARD DECODING CHECK

Use receiver test setup.

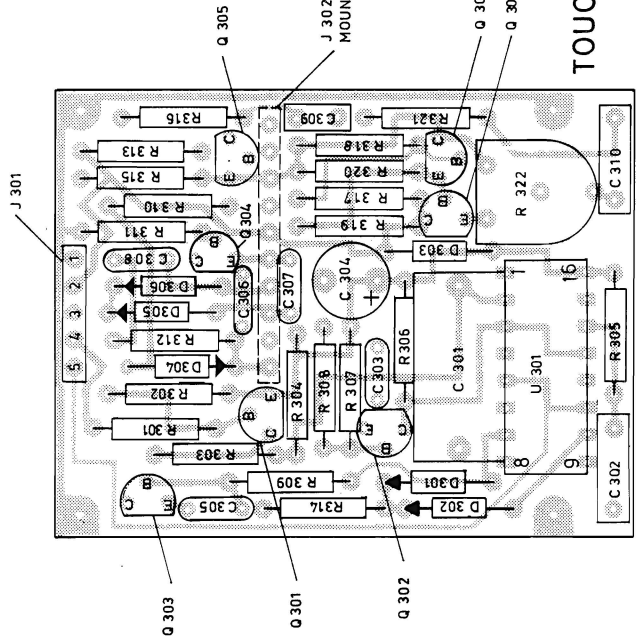
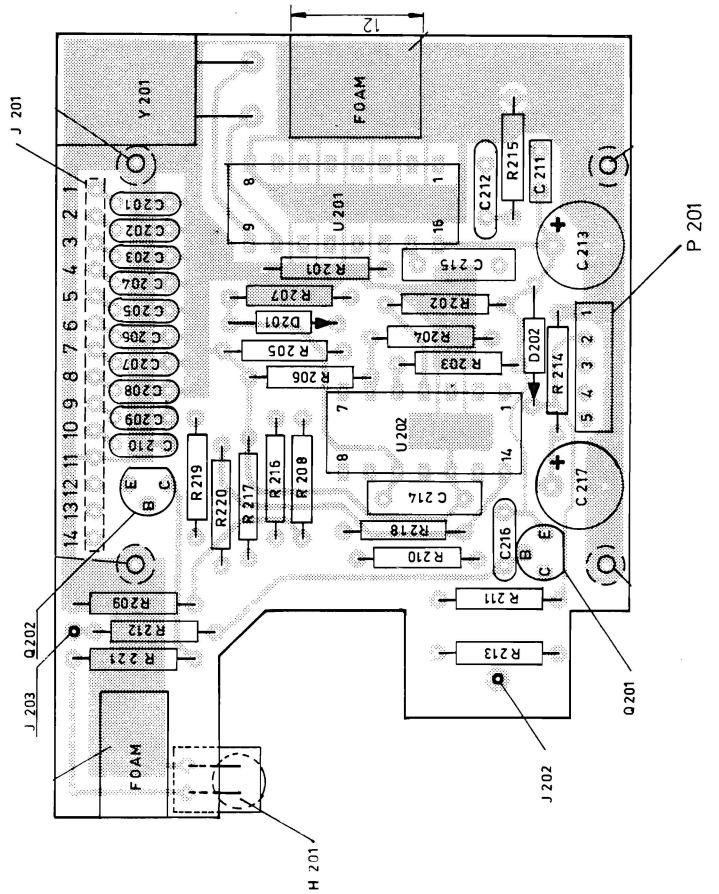
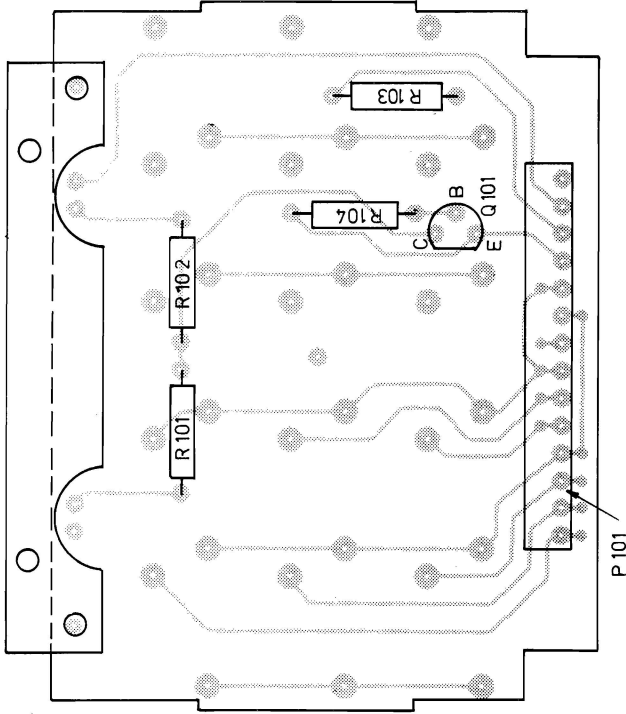
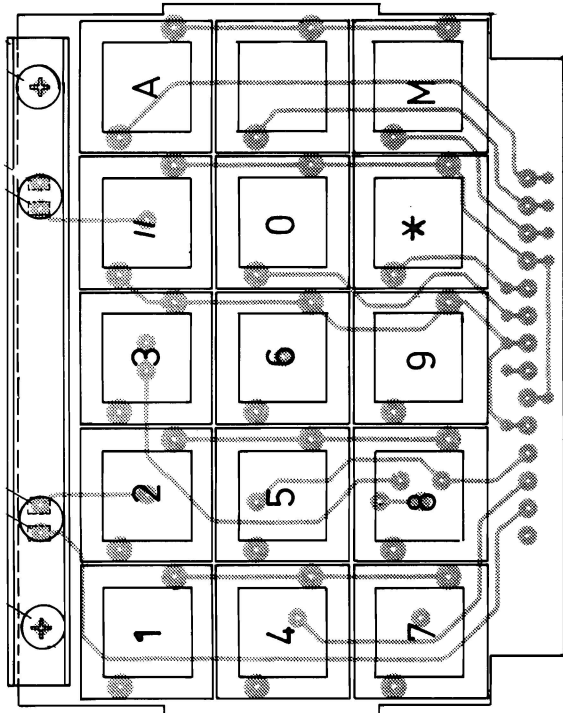
Modulate the RF generator with the channel guard tone to specified frequency deviation.

Check that the decoder opens the AF channel if and only if the channel guard tone is present.

Connect an AF voltmeter to the AF output load.

Measure the channel guard tone level.

Requirement: -17 dB below the level produced by a signal which is modulated with 1 kHz to 60% of maximum frequency deviation.



**TOUCH TONE GENERATOR TT5003
COMPONENT LAYOUT**

D 404.084

BINARY SIGNALLING PROGRAMMING

(BINARY PROGRAM VERSION A) CL5002

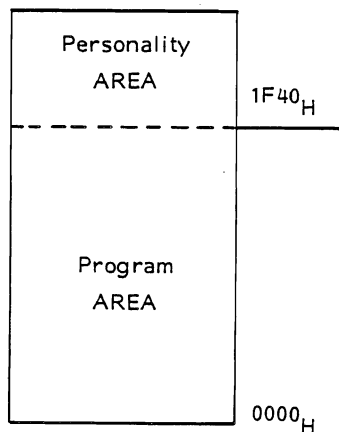
The personality data are programmed into the prom which also contains the microprocessor program. A special area in the prom starting at address 1F40 (HEX) is reserved exclusively for personality data.

The preprogrammed device has part no. J707932G1 and care must be taken not to change the program data.

A prom device without program has part no. J707932P1.

A master prom or a prom preprogrammed with the microprocessor program must be available either for copying the program data or for adding the personality data.

All programmable options, their abbreviations and valid data are listed below.



FUNCTION LIST

ID-Number IDN =

4 first digits identify the system
2 last digits identify the individual radio

Legal range 000000 - 999999

0 = Channel free or LS open
1 = Channel free
2 = LS open

Factory default value: 0

TX Admit TXA =

Indication of free channel

Legal values: 0, 1, 2

Automatic Call on First PTT ACL =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID on Each PTT IDP =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID Time Interval IDT =

Time interval specified in seconds.

Legal range: 0 - 255 (0 - FF HEX)

NO = 0 (definite)

Factory default: 20 sec. = 14_H

ID Includes Call Address IDA =

Legal values: YES = 0, NO = 1

Factory default: 0

Carrier Control Timer CCT =

Time specified in minutes.

Legal values: 0, 1, 2, 3, 4

0 = Definite

1 = 1 min. data = 3C_H

2 = 2 min. data = 78_H

3 = 3 min. data = B4_H

4 = 4 min. data = F0_H

Acknowledge ACK =

Legal values: YES = 0, NO = 1

Factory default value: 0

Privacy PRI =

Legal values: YES = 1, NO = 0

Factory default: 0

Incomming Status Readout INS =

Legal values: YES = 0, NO = 1

Factory default: 0

Address Tens, low limit ALO =

Specifies the lower limit of the address code, see also high limit.

Legal values: 0 - 9

Factory default: 0

Address Tens, high limit AHI =

Specifies the higher limit of the address code.

Legal values: 0 - 9

Factory default: 9

Example: ALO = 3, AHI = 6

The address code can then go from 30 - 69

Status Low Limit SLO =

Specifies the lower limit of the status code.

Legal range 0 - 15 (0 - F_H)

Factory default: 0

Status High Limit SHI =

Specifies the higher limit of the status code.

Legal range 0 - 15 (0 - F_H)

Factory default: 15 (F_H)

BINARY SIGNALLING PROGRAMMING

(BINARY PROGRAM VERSION B)

CL5002

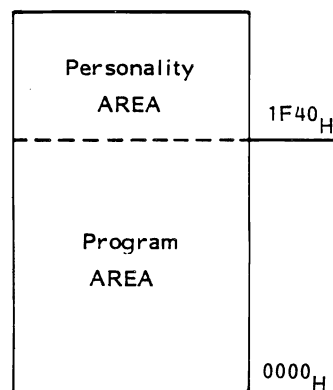
The personality data are programmed into the prom which also contains the microprocessor program. A special area in the prom starting at address 1F40 (HEX) is reserved exclusively for personality data.

A master prom or a prom preprogrammed with the microprocessor program must be available either for copying the program data or for adding the personality data.

The preprogrammed device has part no. J709412G1 and care must be taken not to change the program data.

A prom device without program has part no. J707923P1.

All programmable options, their abbreviations and valid data are listed below.



FUNCTION LIST

ID-Number IDN =

4 first digits identify the system
2 last digits identify the individual radio

Legal range 000000 - 999999

TX Admit TXA =

Indication of free channel

Legal values: 0, 1, 2

- 0 = Channel free or LS open
- 1 = Channel free
- 2 = LS open

Factory default value: 0

Automatic Call on First PTT ACL =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID on Each PTT IDP =

Legal values: YES = 0, NO = 1

Factory default value: 0

ID Time Interval IDT =

Time interval specified in seconds.

Legal range: 0 - 255 (0 - FF HEX)

NO = 0 (definite)

Factory default: 20 sec. = 14_H

ID Includes Call Address IDA =

Legal values: YES = 0, NO = 1

Factory default: 0

Carrier Control Timer CCT =

Time specified in minutes.

Legal values: 0, 1, 2, 3, 4

0 = Definite

1 = 1 min. data = 3C_H

2 = 2 min. data = 78_H

3 = 3 min. data = B4_H

4 = 4 min. data = F0_H

Acknowledge ACK =

Legal values: YES = 0, NO = 1

Factory default value: 0

Privacy PRI =

Legal values: YES = 1, NO = 0

Factory default: 0

Incomming Status Readout INS =

Legal values: YES = 0, NO = 1

Factory default: 0

Address Tens, low limit ALO =

Specifies the lower limit of the address code, see also high limit.

Legal values: 0 - 9

Factory default: 0

Address Tens, high limit AHI =

Specifies the higher limit of the address code.

Legal values: 0 - 9

Factory default: 9

Example: ALO = 3, AHI = 6

The address code can then go from 30 - 69

Mobile Cross Group, low limit MXL=

Specifies the lower limit of the mobile cross group.

Legal values: 0 - 9

0 = Option not selected

Factory default: 0

Mobile Cross Group, high limit MXH=

Specifies the higher limit of the mobile cross group.

Legal values: 0 - 9

0 = Option not selected

Factory default: 0

Group call, low limit CGL =

Specifies the lower limit of the group call.

Legal values: 0 - 9

0 = No lower limit

0 = Factory default

0 = NO

1 - 9 = Number of extra Base Stations.

Factory default: 0

Base Station Option BSO =

Legal values: YES = 0, NO = 1

Factory default: 0

Group call, high limit CGH =

Specifies the higher limit of the group call.

Legal values: 0 - 9

0 = No higher limit

Factory default: 0

Base Address, low limit BAL =

Specifies the lower limit of the base station address.

Legal range: 0 - 9

0 = No lower limit

Factory default: 0

Status Low Limit SLO =

Specifies the lower limit of the status code.

Legal range 0 - 15 (0 - F_H)

Factory default: 0

Base Address, high limit BAH =

Specifies the higher limit of the base station address.

Legal range: 0 - 9

0 = NO higher limit

Factory default: 0

Status High Limit SHI =

Specifies the higher limit of the status code.

Legal range 0 - 15 (0 - F_H)Factory default: 15 (F_H)Group and All Call GAT =

Legal values: YES = 0, NO = 1

Factory default: 0

Base Cross Group, low limit BXL =

Specifies the lower limit of the base station cross group.

Legal range: 0 - 9

0 = NO lower limit

Factory default: 0

Extra Base Station Addressing XBA =

Legal values: 0 - 9

Base Cross Group, high limit BXM =

Test Mode TSM =

Specifies the higher limit of the base station cross group.

Legal range: 0 - 9

0 = NO higher limit

Factory default: 0

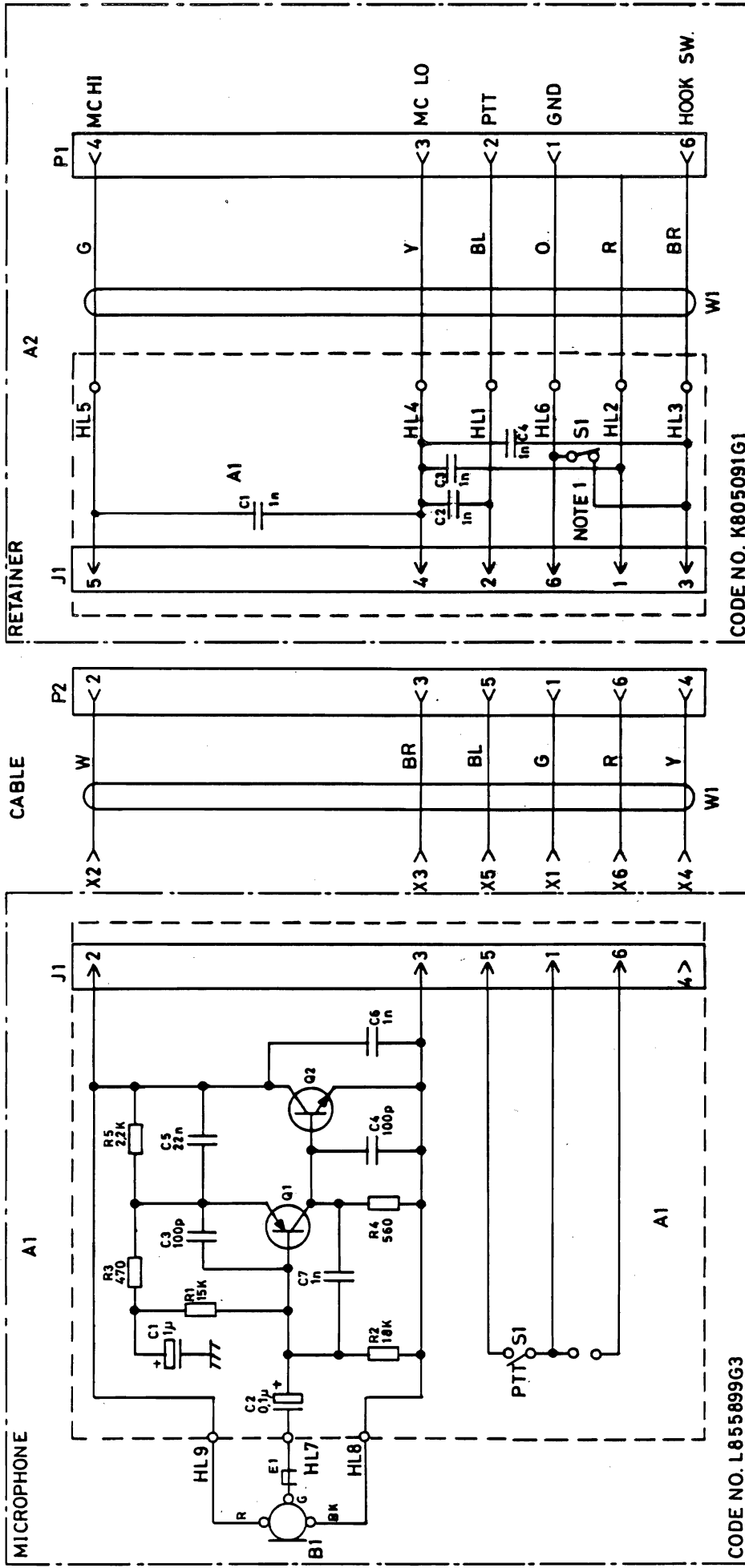
Only available for factory testing.

Legal value: 0

ADDRESS LIST

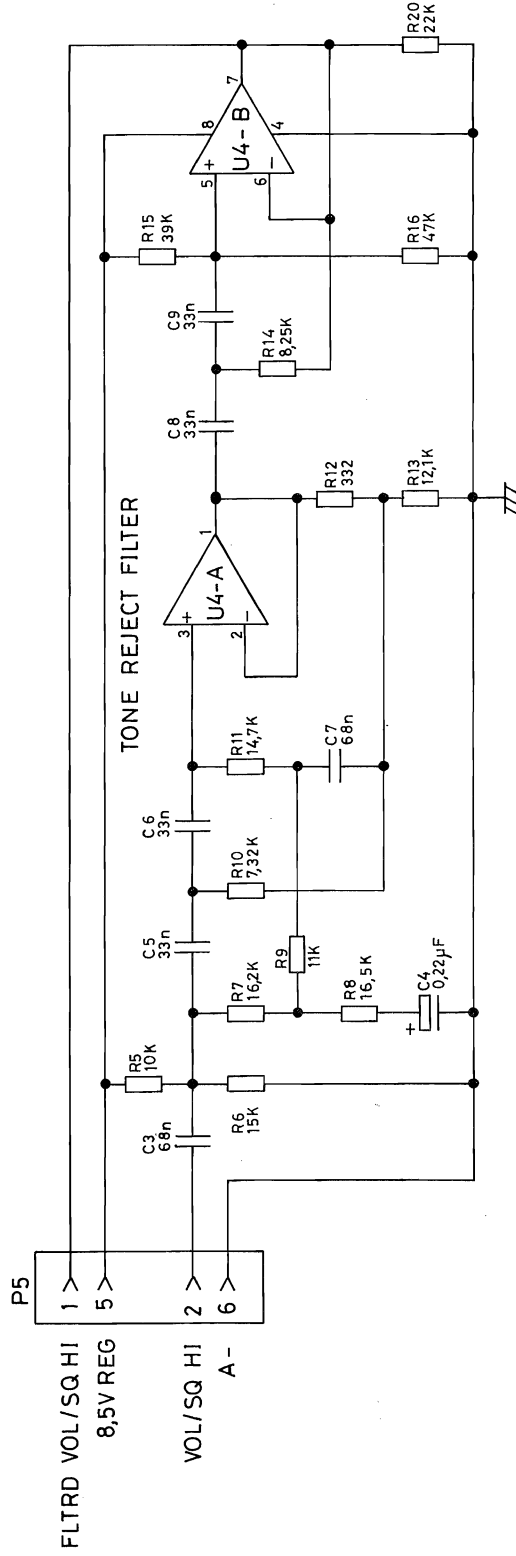
PROM ADDRESS	FUNCTION	ABBREV	DATA
1F40 1F41 1F42 1F43 1F44 1F45	ID-Number Example: IDN = 123456 System 1234 indiv. 56 Program F1-F2-F3- F4-F5-F6	IDN	1. system digit 2. system digit 3. system digit 4. system digit 1. Individ. digit 2. Individ. digit
1F46	TX Admit	TXA	00 _H = CH free or LS open 01 _H = CH free 02 _H = LS open
1F47	Automatic Call on First PTT	ACL	00 _H = YES FF _H = NO
1F48	ID on Each PTT	IDP	00 _H = YES FF _H = NO
1F49	ID Time Interval	IDT	00 = Definite 1 - 255 seconds 01 _H - FF _H)
1F4A	ID Includes Call Address	IDA	00 _H = YES FF _H = NO
1F4B	Carrier Control Timer	CCT	00 _H = (definite) 3C _H = 1 min. 78 _H = 2 min. B4 _H = 3 min. F0 _H = 4 min. FF _H = NO
1F4C	Acknowledge	ACK	00 _H = YES FF _H = NO
1F4D	Privacy	PRI	00 _H = NO FF _H = YES
1F4E	Incomming Status Readout	INS	00 _H = YES FF _H = NO
1F4F	Address Tens, Low Limit	ALO	00 - 09 _H Value specified by ALO =

PROM ADDRESS	FUNCTION	ABBREV	DATA
1F50	Address Tens, High Limit	AHI	00 - 09 _H Value specified by AHI =
1F51	Mobile Cross Group low limit	MXL	00 - 09 _H value specified by MXL
1F52	Mobile Cross Group High limit	MXH	00 - 09 _H Value specified by MXH =
1F53	Group call low limit	CGL	00 - 09 _H Value specified by CGL =
1F54	Group call high limit	CGH	00 - 09 _H Value specified by CGH =
1F55	Status, Low Limit	SLO	00 - 0F _H (0-15) Value specified by SLO =
1F56	Status, High Limit	SHI	00 - 0F _H (0-15) Value specified by SHI =
1F57	Group and All Call	GAT	00 _H = YES FF _H = NO
1F58	Base Station Option	BSO	00 _H = YES FF _H = NO
1F59	Extra Base Station Addressing	XBA	00 _H = NO 01H - 09 _H specified by XBA =
1F5A	Base address Low limit	BAL	00 - 09 _H Value specified by BAL =
1F5B	Base address High limit	BAH	00 - 09 _H Value specified by BAH =
1F5C	Base cross Group call Low limit	BXL	00 - 09 _H 00 = NO lower limit Value specified by BXL =
1F5D	Base Cross GroupCall High limit	BXH	00 - 09 _H 00 = NO higher limit Value specified by BXH =
1F5E	Test Mode	TSM	00 _H = Fixed data



NOTE.
 1. S1 ONLY MOUNTED IN HS5004
 S1 SHOWN WITH MIKE OUT OF RETAINER

HANDHELD MICROPHONE MC5002
 CODE NO. L855903G6
 D403.854/2



NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
FOR COMPLETE DESIGNATION, PREFIX WITH 1000SERIES.
EXAMPLE: C1=C1001, R1=R1001....ETC.

CHANNEL GUARD TONE REJECT FILTER FN5002

CODE No. : 10.4225-00

SUB. ASM. 10.5021-00 (19C850801G4)

D403.008/2

Storno

N ^o	CODE	DATA
C1003	19A116080P206	68 nF Polyester
C1004	19A134202P10	0.22 uF Tantal
C1005	19C300075P33001G	33 nF Polyester
C1006	19C300075P33001G	33 nF Polyester
C1007	19C300075P68001G	68 nF Polyester
C1008	19A700005P10	33 nF Polyester
C1009	19A700005P10	33 nF Polyester
P1005	19A134152P35	Connector
R1005	19A700019P49	10 Kohm Resistor
R1006	19A700019P51	15 Kohm Resistor
R1007	19C314256P21622	16.2 Kohm Metal film
R1008	19C314256P21652	16.5 Kohm Metal film
R1009	19C314256P21102	11 Kohm Metal film
R1010	19C314256P27321	7.32 Kohm Metal film
R1011	19A314256P21472	14.7 Kohm Metal film
R1012	19A701250P151	330 ohm Metal film
R1013	19C314256P21212	10 Kohm Metal film
R1014	19C314256P28251	8.2 Kohm Metal film
R1015	19A700019P56	39 Kohm Resistor
R1016	19A700019P57	47 Kohm Resistor
R1020	19A143400P52	20 Kohm Resistor Depos
U1004	19A134511P2	Int. Circuit

Storno

N ^o	CODE	DATA

CHANNEL GUARD TONE REJECT FILTER FN5002

X403.019

TQ5009

PILOT TONE MODULE

FUNCTIONAL DESCRIPTION

TQ5009 is an optional board which provides the COM5000 radio with a continuous tone controlled squelch system (CTCSS) conform to the EIA Standard RS-220 normes, or in MPT 1306 normes. The module provides both encode and decode functions using a standard integrated circuit FX335J to produce the pilot tones.

Tone frequencies are selected, via a six out of eight position Dii switch, from an internal preprogrammed tone table in the FX335J. The tone frequencies range from 67 Hz to 250 Hz in 37 steps.

Encode only and decode only as well as tone reject filter only are options selectable by means of the remaining to Dii switches.

CIRCUIT DESCRIPTION

POWER SUPPLY

The input voltage (8.5 V reg.) from pin 5 is further regulated down to 5 V by U1, an integrated circuit 78L05. The 5 volt are the only voltage supply used on board.

X-TAL CLOCK OSCILLATOR

U3 is a small integrated circuit oscillator with build in frequency divider. The output frequency is 1.0 MHz.

ENCODER/DECODER IC. FX335J

The FX335J (U2) is a CMOS CTCSS encoder/decoder used to generate and detect the 38 sub-audible tones. The sub-audible tone encode/decode functions, are all derived from the 1.0 MHz clock oscillator, and are selected by means of six sections of the Dii switch S1. For detection of a correct CTCSS tone an audio switch in the speech path is activated. Channel monitoring is achieved by use of the push to listen input. The decoder has an onboard switch capacitor high-pass filter, used to attenuate the CTCSS tones in the speech path.

RX AUDIO AMPLIFIER MUTE

When no correct CTCSS tone is received the TONE DECODER O.P, U2 pin 12 is high and the collector of Q10 is then low, and therewith, via RX Mute P5 pin 9, mute the audio amplifier on the RF5000 board.

RX DECODE DISABLE

If the PUSH TO LISTEN I.P, U2 pin 18 is brought high it is possible to monitor a channel or use the module in an encode only mode, this can be done by closing S1(7) or from external by grounding P5 pin 10. Q3 is an inverting buffer.

TQ5009, PILOT TONE MODULE

TX ENCODE, WITH DISABLE

PILOT TONE encoder is activated when PTT P5 pin 7 is low, the PTT level is inverted twice in Q1 and Q4 and feed to U2 pin 17 where it controls the pilot tone output while transmitting. The tone output can be disabled either by closing S1(8) or by pulling the CG ENCODE/DECODE DIS, P5 pin 10 to 8.5 V reg. P5 pin 5. With switch S1(8) closed, the module can be used in decode only mode.

CTCSS TONE OUTPUT LEVEL

The pilot tone frequency deviation can be adjusted with potentiometer R4. Output from module is CG HI P5 pin 4.

STE, SQUELCH TAIL ELIMINATION

Q5, Q8 and Q9 together with Q6, Q7 and several passive components form a Squelch Tail Elimination circuitry. Q5, Q8, Q9, C12 and R27 make a monostable circuit which delays the Key-Off timing of the transmitter with approx. 160 mS. For all the delay time the PILOT TONE tone is reversed in phase by approx. 180 deg.

SPECIFICATIONS

Input voltage:

8.5 VDC + 0.15 VDC

Current drain:

15 mA maximum.

Decode sensitivity level:

10 to 35 mV, dev from 122 to 420 Hz

Decode bandwidth:

maximum: + 2.5%

minimum: + 1.0%

Encode output level:

77.5 mV RMS minimum at 67 Hz to 210.7 Hz., Equal to -20 dBm.

RX mute:

muted: 0.5 VDC max.

un-muted: 8 VDC min.

Frequency stability:

+0.2%.

Tone reject filter response:

More negative than 30 dB from 70 Hz to 210 Hz

0 dB + 1.5 dB at 300 Hz

0 dB + 1.5 dB at 400 Hz (for pilot tones > 187 Hz)

0 dB + 1 dB at 3000 Hz

Tone reject filter distortion:

2.0% max.

Temperature range:

-30°C to +60°C.

FREQUENCY PROGRAMMING TABLE

1 = SWITCH OPEN
 0 = SWITCH CLOSED
 X = DO NOT CARE

NOMINAL FREQUENCY	FX335 FREQUENCY	Fo %	SWITCH							
			8	7	6	5	4	3	2	1
67.0	67.05	+0.67	X	X	1	1	1	1	1	1
71.9	71.90	0.00	X	X	0	1	1	1	1	1
74.4	74.35	-0.07	X	X	1	1	1	1	1	0
77.0	76.96	-0.05	X	X	0	0	1	1	1	1
79.7	79.77	+0.09	X	X	1	1	1	1	0	1
82.5	82.59	+0.10	X	X	0	1	1	1	1	0
85.4	85.38	-0.02	X	X	1	1	1	1	0	0
88.5	88.61	+0.13	X	X	0	0	1	1	1	0
91.5	91.58	+0.09	X	X	1	1	1	0	1	1
94.8	94.76	-0.04	X	X	0	1	1	1	0	1
97.4	97.29	-0.11	X	X	1	1	1	0	1	0
100.0	99.96	-0.04	X	X	0	0	1	1	0	1
103.5	103.43	-0.07	X	X	0	1	1	1	0	0
107.2	107.15	-0.05	X	X	0	0	1	1	0	0
110.9	110.77	-0.12	X	X	0	1	1	0	1	1
114.8	114.64	-0.14	X	X	0	0	1	0	1	1
118.8	118.80	0.00	X	X	0	1	1	0	1	0
123.0	122.80	-0.17	X	X	0	0	1	0	1	0
127.3	127.08	-0.17	X	X	0	1	1	0	0	1
131.8	131.67	-0.10	X	X	0	0	1	0	0	1
136.5	136.61	+0.08	X	X	0	1	1	0	0	0
141.3	141.32	+0.02	X	X	0	0	1	0	0	0
146.2	146.37	+0.12	X	X	0	1	0	1	1	1
151.4	151.09	-0.20	X	X	0	0	0	1	1	1
156.7	156.88	+0.11	X	X	0	1	0	1	1	0
162.2	162.31	+0.07	X	X	0	0	0	1	1	0
167.9	168.14	+0.14	X	X	0	1	0	1	0	1
173.8	173.48	-0.19	X	X	0	0	0	1	0	1
179.9	180.15	+0.14	X	X	0	1	0	1	0	0
186.2	186.29	+0.05	X	X	0	0	0	1	0	0
192.8	192.86	+0.03	X	X	0	1	0	0	1	1
203.5	203.65	+0.07	X	X	0	0	0	0	1	1
210.7	210.17	-0.25	X	X	0	1	0	0	1	0

TQ5009, PILOT TONE MODULE

ENCODE/DECODE CONTROL

Module function set by means of the switch S1001 (S8 and S7)

MODULE FUNCTION	S8	S7
ENCODE/DECODE	1	1
ENCODE only	1	0
DECODE only	0	1
FILTER only	0	0

FREQUENCY PROGRAMMING

example: 103.5 Hz.

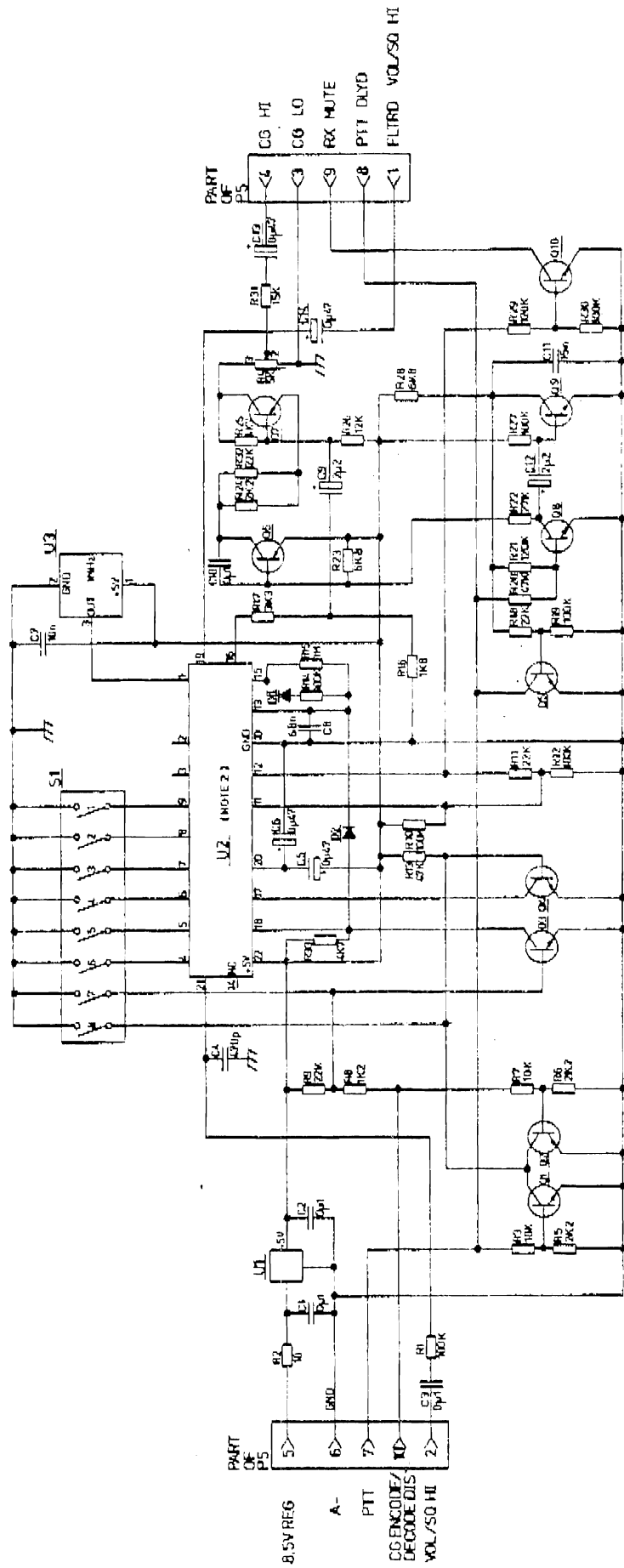
on S1001 open = 1 closed = 0

switch position	8	7	6	5	4	3	2	1
program	1	1	0	1	1	1	0	0

position 1 to 6 are for frequency setting as per the following tabel.

position 7 : decoder enable when open " 1 "

position 8 : Encode enable when open " 1 "



COMPONENTS MARKED EXX ARE PLACED ON NO SOLDERING SIDE

CHANNEL GUARD MODULE TQ5009
 CODE NO. M906454G1 D404.846

SERVICE NEWS 232
OKTOBER 1987

service
news

CQM5000 Channel Guard moduler er udgået.

I CQM5000 anlæg med Channel Guard (pilottone) er hidtil anvendt enhederne:

TQ5006 - 10.4222-00

TT5002 - 10.4223-00

TR5002 - 10.4224-00

FN5002 - 10.4225-00

Disse enheder er nu udgået og erstattet af et nyt universalt channel guard modul type TQ5009 (vare nr. M906454G1).

TQ5009 har en indbygget funktions omskifter, således at den kan indstilles som TQ, TT, TR eller FN. Der er specifikationsmæssigt fuld kompatibilitet mellem de udgåede og den nye enhed, dog er den elektriske og mekaniske udformning anderledes. Ved programmering af channel guard tone(r) på TQ5009 vælges tonen fra en tabel, og en omskifter række stilles i modsætning til tidligere, hvor der anvendtes binær generering.

Storno**service news** Nr. 232

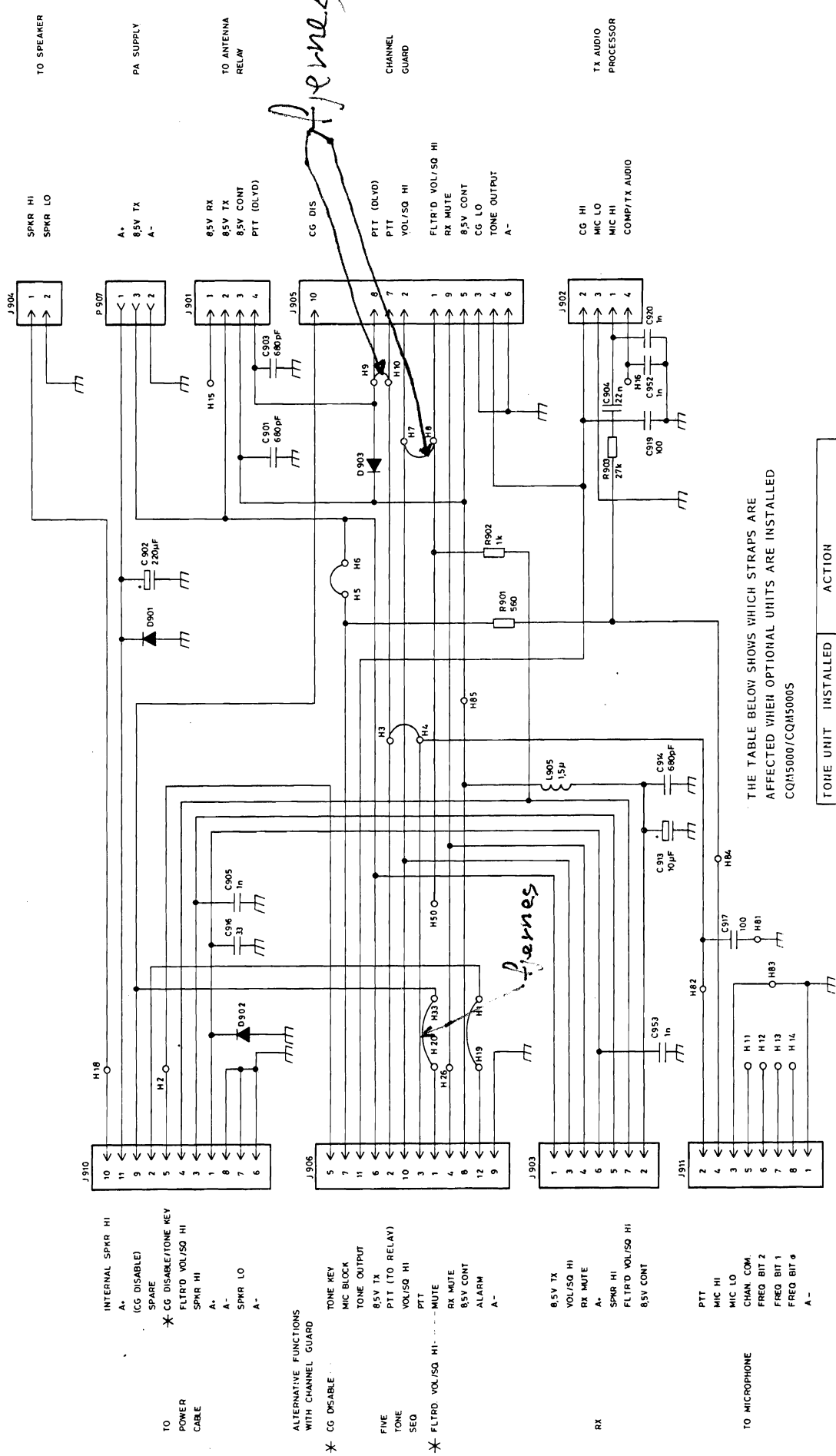
- 3 -

Nominel Frekvens	Switch							Frekvenskodning (S1001)	
	8	7	6	5	4	3	2		1
67.0	X	X	1	1	1	1	1	1	1 = Switch open 0 = Switch closed X = Function switch
71.9	X	X	0	1	1	1	1	1	
74.4	X	X	1	1	1	1	1	0	
77.0	X	X	0	0	1	1	1	1	
79.7	X	X	1	1	1	1	0	1	
82.5	X	X	0	1	1	1	1	0	
85.4	X	X	1	1	1	1	0	0	
88.5	X	X	0	0	1	1	1	0	
91.5	X	X	1	1	1	0	1	1	
94.8	X	X	0	1	1	1	0	1	
97.4	X	X	1	1	1	0	1	0	
100.0	X	X	0	0	1	1	0	1	
103.5	X	X	0	1	1	1	0	0	
107.2	X	X	0	0	1	1	0	0	
110.9	X	X	0	1	1	0	1	1	
114.8	X	X	0	0	1	0	1	1	
118.8	X	X	0	1	1	0	1	0	
123.0	X	X	0	0	1	0	1	0	
127.3	X	X	0	1	1	0	0	1	
131.8	X	X	0	0	1	0	0	1	
136.5	X	X	0	1	1	0	0	0	
141.3	X	X	0	0	1	0	0	0	
146.2	X	X	0	1	0	1	1	1	
151.4	X	X	0	0	0	1	1	1	
156.7	X	X	0	1	0	1	1	0	
162.2	X	X	0	0	0	1	1	0	
167.9	X	X	0	1	0	1	0	1	
173.8	X	X	0	0	0	1	0	1	
179.9	X	X	0	1	0	1	0	0	
186.2	X	X	0	0	0	1	0	0	
192.8	X	X	0	1	0	0	1	1	
203.5	X	X	0	0	0	0	1	1	
210.7	X	X	0	1	0	0	1	0	

Funktionsomskifter			
Modul funktion:	S8	S7	
Encode/Decode (TQ)	1	1	
Encode (TT)	1	0	
Decode (TR)	0	1	
Filter (FN)	0	0	

NØGLEORD:

TQ5009 Nyt Channel Guard (pilottone) modul.



THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM5000/CQM5000S

TONE UNIT	INSTALLED	ACTION
TQ5001	TQ5002	CUT
TQ5004	TQ5005	CUT
CL5001		
TQ5006		CUT
TR5002	FN5002	CUT
TT5002		CUT

* ALTERNATIVE FUNCTIONS WITH CG UNITS:
TG 5003, ST 5001, SR 5001, FN 5001

INTERCONNECT UNIT
XS 5001

D402.615/3

STORNOPHONE 5000
Maintenance Manual
Section 9

CONTENTS

SU5003	Description	60.411-E1
	Schematic Diagram	D402.725
	Parts List	X402.710
PS5001	Description	60.440-E1

SWITCHING UNIT

SU5003

The SU5003 switching unit is used as driver for an alarm device, horn, buzzer, bell, etc., or as a broadcast radio muting switch. The unit comprises a timer circuit and a relay with one changeover contact set. The unit is triggered by the CQM5000, either the tone receiver, or the squelch circuit and the monostable multivibrator timer sounds the alarm device for a preset time, approximately 1 second.

Alarm.

A horn or bell is connected to the relay and the SU5003 is controlled by the alarm output of the CQM5000 (pin 2 on J910). The alarm will be on for approximately 1 second.

Broadcast Radio Mating

The unit is connected to the muting output on the CQM5000 (pin 9 on J910) which actuates the relay when the TQ5001/TQ5002 opens the AF output. In radiotelephones without tone equipment the relay will be activated whenever the squelch circuit is opened or the transmitter is keyed. The broadcast radio supply voltage is applied via the relay contacts that are normally closed, or its loudspeaker is disconnected.

Technical Specifications

Supply Voltage

10.8V to 16.6V

Current Drain, 13.2V

Standby: approximately 0 mA

Engaged: 140 mA

Relay Contact Current

Max. 16A (t less than 3 seconds)

5A continuously

One change over contact set

Input

Alarm: A short pulse grounding the input terminal will actuate the relay for approx. 1 second.

Mute: A ground connection will actuate the relay.

SWITCHING UNIT

SU5003

The SU5003 switching unit is used as driver for an alarm device, horn, buzzer, bell, etc., or as a broadcast radio muting switch. The unit comprises a timer circuit and a relay with one changeover contact set. The unit is triggered by the CQM5000, either the tone receiver, or the squelch circuit and the monostable multivibrator timer sounds the alarm device for a preset time, approximately 1 second.

ALARM

A horn or bell is connected to the relay and the SU5003 is controlled by the alarm output

of the CQM5000 (pin 2 on J910). The alarm will be on for approximately 1 second.

BROADCAST RADIO MUTING

The unit is connected to the muting output on the CQM5000 (pin 9 on J910) which actuates the relay when the TQ5001/TQ5002 opens the AF output. In radiotelephones without tone equipment the relay will be activated whenever the squelch circuit is opened or the transmitter is keyed. The broadcast radio supply voltage is applied via the relay contacts that are normally closed, or its loudspeaker is disconnected.

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REPLACED BY SU907

SWITCHING UNIT

SU5003

The SU5003 switching unit is used as driver for an alarm device, horn, buzzer, bell, etc., or as a broadcast radio muting switch. The unit comprises a timer circuit and a relay with one changeover contact set. The unit is triggered by the CQM5000, either the tone receiver, or the squelch circuit and the monostable multivibrator timer sounds the alarm device for a preset time, approximately 1 second.

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A horn or bell is connected to the relay and the SU5003 is controlled by the alarm output

of the CQM5000 (pin 2 on J910). The alarm will be on for approximately 1 second.

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The unit is connected to the muting output on the CQM5000 (pin 9 on J910) which actuates the relay when the TQ5001/TQ5002 opens the AF output. In radiotelephones without tone equipment the relay will be activated whenever the squelch circuit is opened or the transmitter is keyed. The broadcast radio supply voltage is applied via the relay contacts that are normally closed, or its loudspeaker is disconnected.

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Current Drain, 13.2 V

Standby: approximately 0 mA

Engaged: 140 mA

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Max. 16 A (time less than 3 seconds)

5 A continuously

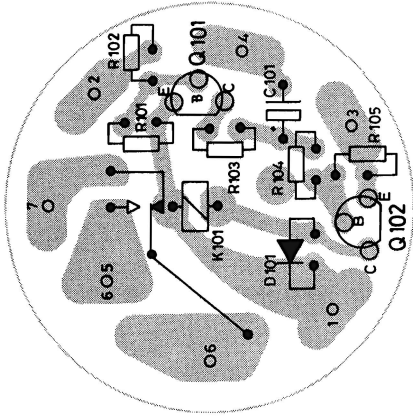
One change over contact set

Input

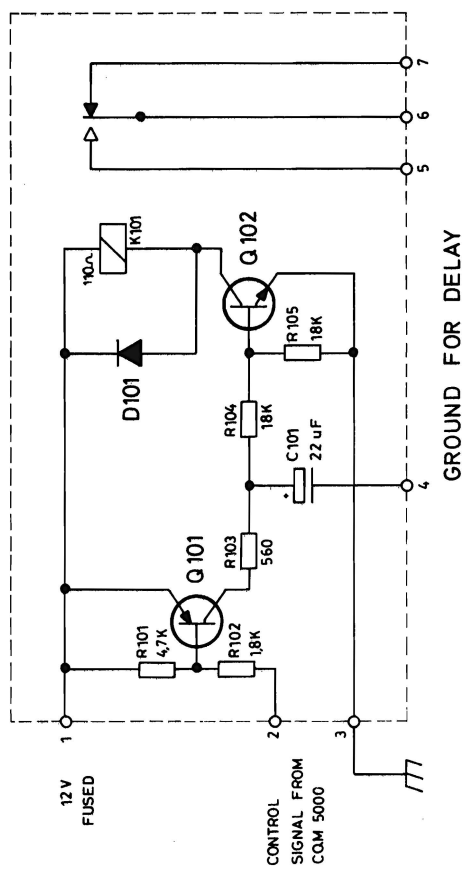
Alarm: A short pulse grounding the input terminal will actuate the relay for approx. 1 second.

Mute: A ground connection will actuate the relay.

BOTTOM VIEW

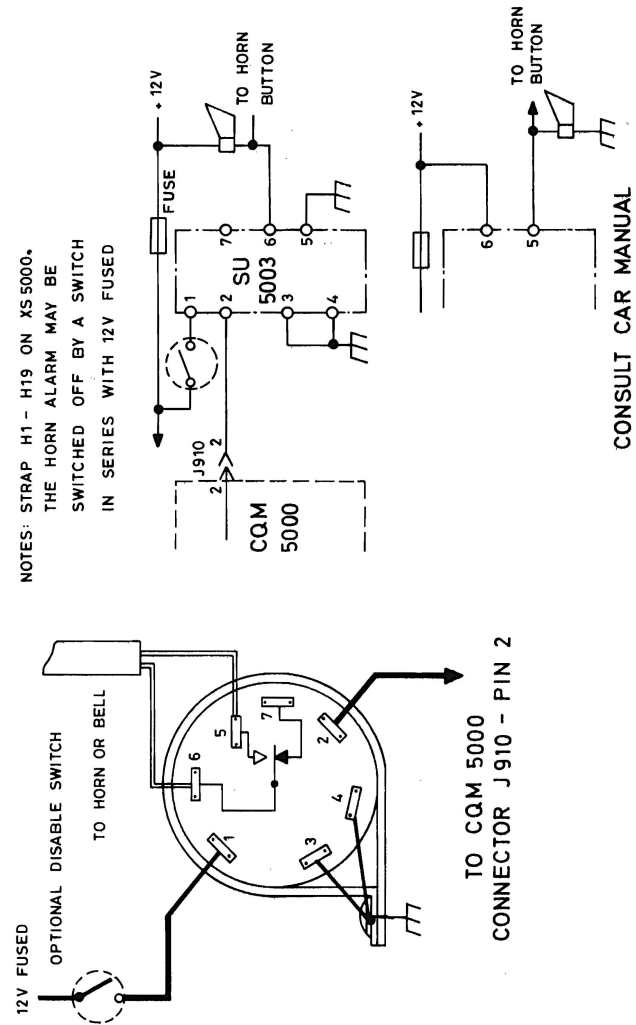


PRINTED CIRCUIT VIEWED FROM SOLDER SIDE



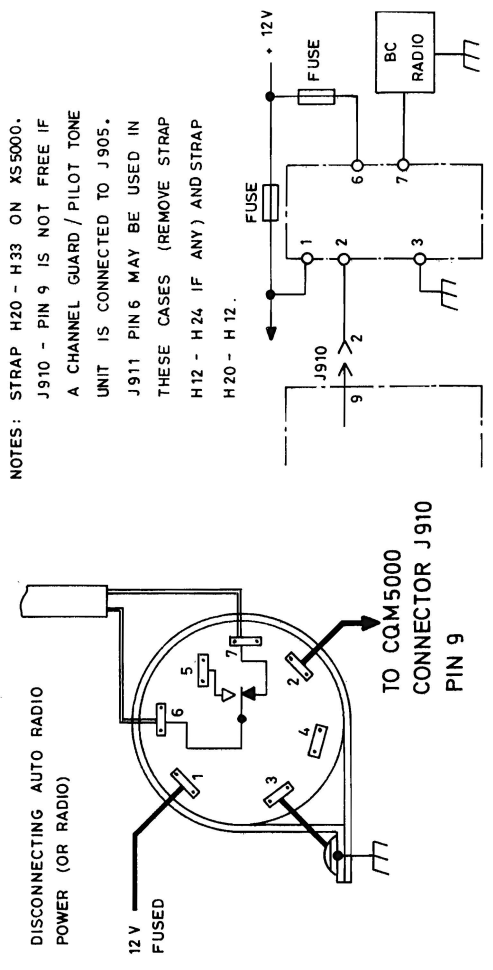
GROUND FOR DELAY

ALARM (HORN, BELL)



CONSULT CAR MANUAL FOR HORN SCHEMATIC

DISCONNECTING AUTO BROADCAST RADIO



NOTES: STRAP H20 - H33 ON XS5000.
 J910 - PIN 9 IS NOT FREE IF A CHANNEL GUARD / PILOT TONE UNIT IS CONNECTED TO J905.
 J911 PIN 6 MAY BE USED IN THESE CASES (REMOVE STRAP H12 - H24 IF ANY) AND STRAP H20 - H12.

SWITCHING UNIT SU5003

D402.725

ITEM NUMBER DESCRIPTION
 K805495G1 SWITCH UNIT ASM SU 907

=====

K805496G1 SUB. ASM.: - A001: COMPONENT BD PW
 J706813G1 SUB. ASM.: - KIT, ASM.-C9SU02 / SU 907
 K805204G1 SUB.-SUB. ASM.: -CABLE,-C9SU02 / SU 907

P A R T S L I S T :

CIRCUIT POSITION	COMPONENT ITEM NUMBER	COMPONENT DESCRIPTION	QUANTITY
A001	K805496G1	COMPONENT BD PW	1 (SEE BELOW)
0002	J706685P1	CAN	1
0003	J706813G1	KIT, ASM.- F.C9SU02 / SU 907	1 (SEE BELOW)
0004	J706307P32	NAME PLATE	1
0005	J708301P1	CASTING, PEU RESIN-	0.005 KG
0006	J708301P2	CASTING, PEU RESIN-	0.010 KG
0010	K805499	INSTRUCTION, MOUNTING- SU 907	

A001 : K805496G1 : COMPONENT BD PW :

C101	A700003P8	CAP TA SOL 22U 20% 16V	1
C102	A700233P7	CAP CER CL2 1N0 20% 50V	1
D101	A700028P1	DIO SI SIG 1N4148	1
E101	J706002P3	CORE TOR FERR	1
E102	J706002P3	CORE TOR FERR	1
E103	J706002P3	CORE TOR FERR	1
J001	J706683P1	TABS RECP L=16.5 MM	1
J002	J706683P1	TABS RECP L=16.5 MM	1
J003	J706683P1	TABS RECP L=16.5 MM	1
J004	J706683P1	TABS RECP L=16.5 MM	1
J005	J706683P1	TABS RECP L=16.5 MM	1
J006	J706683P1	TABS RECP L=16.5 MM	1
J007	J706683P1	TABS RECP L=16.5 MM	1
K101	J708281P1	RELAY OPEN 110R 12V	1
Q101	A700020P1	TSTR PNP SI , BC 558A/B	1
Q102	J706133P1	TSTR NPN MPS-A13	1
R101	A700019P37	RES DEPC 1K0 5% 1/4W	1
R102	A700019P40	RES DEPC 1K8 5% 1/4W	1

CIRCUIT POSITION	COMPONENT ITEM NUMBER	COMPONENT DESCRIPTION	QUANTITY
------------------	-----------------------	-----------------------	----------

R103	A700019P34	RES DEPC 560R 5% 1/4W	1
R104	A700019P52	RES DEPC 18K 5% 1/4W	1
R105	A700019P52	RES DEPC 18K 5% 1/4W	1

0002	K8-----P1R0	BD PW., REVISION NO.: 0	1
------	-------------	-------------------------	---

0003 :	J706813G1 :	KIT, ASM.- F.: C9SU02 / SU 907 :	
--------	-------------	----------------------------------	--

0001	J706795P5	BRACKET, MOUNTING-	1
0002	A701507P606	SCREW PAN HD SZ-3.5 X 9.6 AB	1
0003	K805204G1	CABLE ASM., C9SU02 / SU 907	1
0004	J706657P1	BOOT, INSULATING-	2
0005	J706684P4	TERM SPADE RECP 6.3MM	2

(SEE
BELC

0003 :	K805204G1 :	CABLE ASM., C9SU02 / SU 907 :	
--------	-------------	-------------------------------	--

P001	J706418P103	CONN. PWB. FEMALE 03 CKT	1
W001	J706156P1	CABLE	5.0 M
0002	J706657P1	BOOT, INSUL.-	2
0003	J706684P4	TERM. SPADE - RECP. 6.3 MM	2
0004	J706152P5	STRAP, RET.- W. BDL D19 NYL.	1
0005	J707094P102	COVER	1

PS5001 POWER SUPPLY UNIT

General

The PS5001 is a mains operated power supply for the Stornophone 5000 radiotelephone when used as base station. The unit consists of a mains transformer, a rectifier, a smoothing filter, a switching regulator, and an output filter. The unit will supply 13.6 Volt stabilized DC when connected to a 220V/240V AC outlet. A LED (light emitting diode) on the front panel is lit when the unit is on.

Circuit Description

Power Transformer

The power transformer is wound on a toroide core and has two windings, a 220/240Volt primary and a 24 Volt secondary. A 4 Amp slow blow fuse in series with the secondary winding protects those parts of the circuitry which are not protected by the electronic current limiter in the switching regulator.

Switching Regulator

The switching circuit is built as a normal switching mode regulator with constant switching frequency, approximately 32KHz, and variable duty cycle. The actual switching function is performed by the transistor configuration Q2, Q3, Q4 and the fly-back diode D4, which clamps the input of L-C filter L2-C8 to ground potential in that portion of the cycle where the switching transistors are off and D4 is forced to conduct by the energy from the collapsing field of L2.

The output voltage across C8 is sensed by IC1a and compared to the reference voltage across D2-D3. The resulting signal is amplified by IC1b which is driving Q2 and in turn Q3 and Q4.

Output current limiting is achieved by monitoring the voltage drop across R17 and feed this voltage to IC1d. The IC1d output is 'OR-ed' with the voltage control signal at the IC1a output and therefore overrides the control voltage when the output current goes excessively high.

The two filters, C2-L1-C3, and C8-L3-C9, are ripple-transient filters on the input and output and their function is to ensure that the inherent switching noise does not exceed acceptable limits on the input and output terminals, and the cables as well.

Technical Specifications

Mains Voltage

220/240V AC + 10/-15%; 50-60Hz

Power Consumption

Approx. 6mA; 0 Amp load

Approx. 450mA; 6 Amp load

Output Voltage

13,6V DC \pm 1,0V

Output Current

Maximum 6 Ampere (short circuit protected)

Output Voltage Ripple

Less than 100mV pp (peak to peak)

Switching Frequency

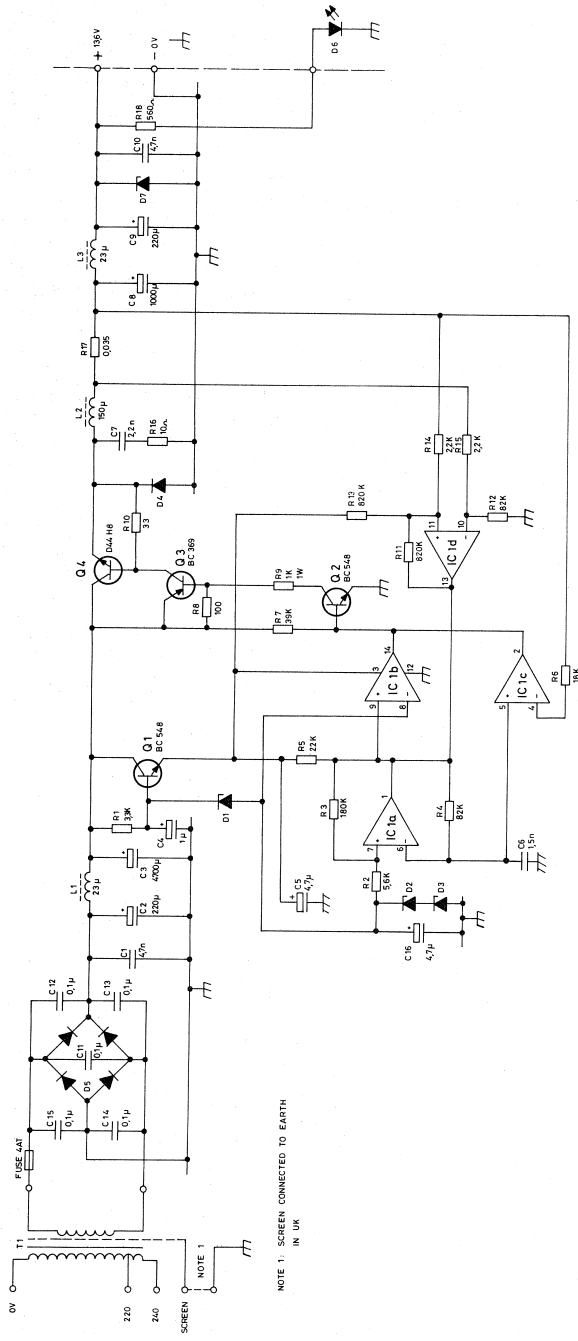
approx. 32KHz

Temperature Range

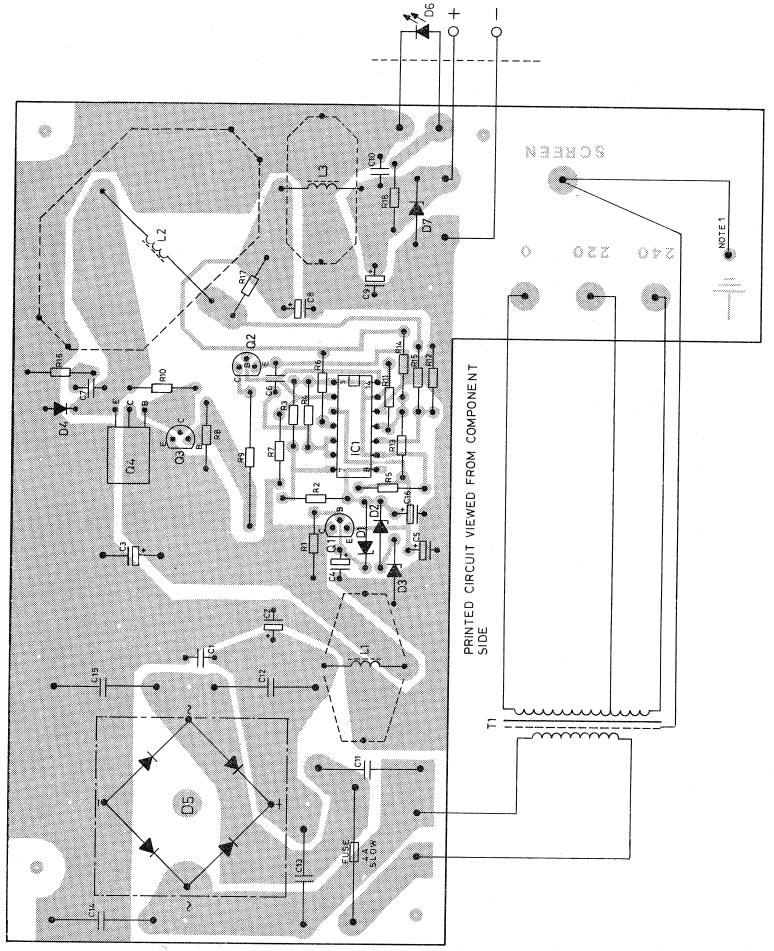
-10°C to +50°C

Duty Cycle

as specified for CQM5000



NOTE 1: SCREEN CONNECTED TO EARTH
IN UK



PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE

N ^o	CODE	DATA
C 1	74.5401	4700pF 10% Ceram DI
C 2	73.5178	220uF -10 +100% Elco
C 3	73.5155	4700uF -10 +50% Elco
C 4	73.5170	1uF 20% Tantal
C 5	73.5172	4.7uF 20% Tantal
C 6	76.5130	1.5nF 10% Polyester FL
C 7	74.5399	2200pF 20% Ceram DI
C 8	73.5179	1000uF -10 +100% Elco
C 9	73.5165	220uF -10 +100% Elco
C 10	74.5401	4700pF 10% Ceram DI
C 11	76.5073	0.1uF 10% Polyester TB
C 12	76.5073	0.1uF 10% Polyester TB
C 13	76.5073	0.1uF 10% Polyester TB
C 14	76.5073	0.1uF 10% Polyester TB
C 15	76.5073	0.1uF 10% Polyester TB
C 16	73.5172	4.7uF 20% Tantal
D 1	99.5224	4.7V 5% Zenerdiode
D 2	99.5146	6.8V 5% Zenerdiode
D 3	99.5146	6.8V 5% Zenerdiode
D 4	99.5371	BYW29-150 Diode
D 5	99.5174	10A Rectifier bridge
D 6	99.5303	LED red
D 7	99.5334	16V 5% Zenerdiode
F1	92.5094	4A Fuse, slow
L 1	61.1419	Choke
L 2	61.1420	Choke
L 3	61.1419	Choke
Q 1	99.5143	BC548 Transistor
Q 2	99.5143	BC548 Transistor
Q 3	99.5337	BC369 Transistor
Q 4	99.5372	D44H. 8 Transistor
R 1	80.5265	22Kohm 5% Carbon film
R 2	80.5258	5.6Kohm 5% Carbon film
R 3	80.5276	180Kohm 5% Carbon film
R 4	80.5272	82Kohm 5% Carbon film
R 5	80.5265	22Kohm 5% Carbon film
R 6	80.5264	18Kohm 5% Carbon film
R 7	80.5268	39Kohm 5% Carbon film
R 8	80.5237	100ohm 5% Carbon film
R 9	82.5049	1Kohm 5% Carbon film
R 10	80.5231	33ohm 5% Carbon film
R 11	80.5284	820Kohm 5% Carbon film
R 12	80.5272	82Kohm 5% Carbon film
R 13	80.5284	820Kohm 5% Carbon film
R 14	80.5253	2.2Kohm 5% Carbon film
R 15	80.5253	2.2Kohm 5% Carbon film

N ^o	CODE	DATA
R 16	80.5225	10ohm 5% Carbon film
R 17	89.0026	0.035ohm Resistor Constantan
R 18	80.5246	560ohm 5% Carbon film
T 1	60.5170	Main transformer
U 1	14.5019	MC3302P Quad comparator

POWER SUPPLY PS5001

X402. 821/1

NOTE: Vigtigt! De farver gul/grøn (YV/GN)
 og sort (BK) skal være brun/hvid (BN/WH)

*LF til
 Hørtaler*

*LF fra
 Udgang*

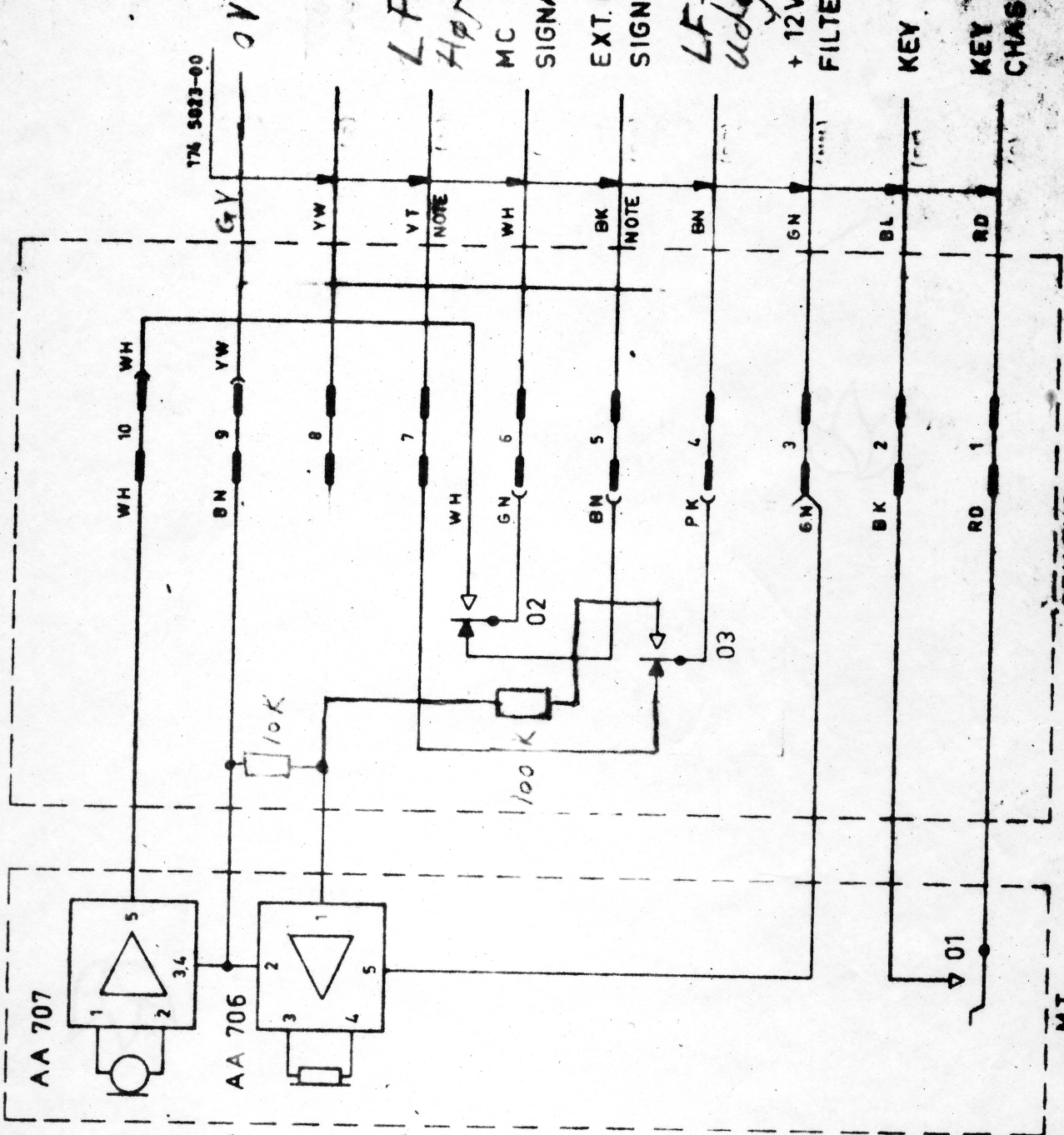
MC
 SIGNAL
 EXT. MC
 SIGNAL

+ 12V
 FILTER

KEY

KEY

CHASSIS



Ben nr i ørhæng 69 nr.

MICROPHONE
 CARTRIDGE

TELEPHONE
 CARTRIDGE

8	7	6	5	4	3	2	1
WH	GY	BL	RD				

WH
 GY
 BL
 RD

11	10	9	8	7	6	5	4	3	2	1
GN	VT						BN			

GN
 VT

BN

TAST KEY

MT
 HANDSET

ØPHÆNG
 RETAINER

02 og 03 vist med MT i ørhæng

MICROTELEPHONE MT 706
 FORBUNDET TIL CQM 5000
 FJERNBETJENT

D25578

STORNOPHONE 5000
Maintenance Manual
Section 9.1

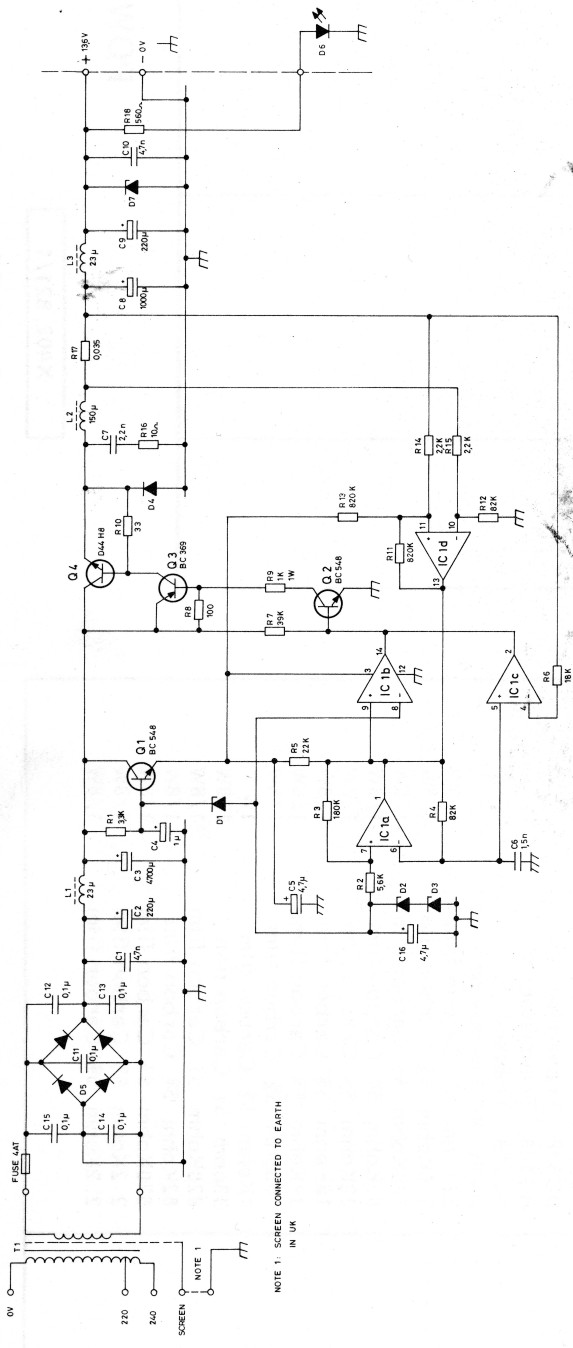
PS5001	Schematic Diagram	D402.713/3
MC704a	Schematic Diagram	D403.193
MC703b		
MT5001	Description	60.518-E1
	Schematic Diagram	D402.880

Nº	CODE	DATA
C 1	74.5401	4700pF 10% Ceram DI
C 2	73.5178	220uF -10 +100% Elco
C 3	73.5155	4700uF -10 +50% Elco
C 4	73.5170	1uF 20% Tantal
C 5	73.5172	4.7uF 20% Tantal
C 6	76.5130	1.5nF 10% Polyester FL
C 7	74.5399	2200pF 20% Ceram DI
C 8	73.5179	1000uF -10 +100% Elco
C 9	73.5165	220uF -10 +100% Elco
C 10	74.5401	4700pF 10% Ceram DI
C 11	76.5073	0.1uF 10% Polyester TB
C 12	76.5073	0.1uF 10% Polyester TB
C 13	76.5073	0.1uF 10% Polyester TB
C 14	76.5073	0.1uF 10% Polyester TB
C 15	76.5073	0.1uF 10% Polyester TB
C 16	73.5172	4.7uF 20% Tantal
D 1	99.5224	4.7V 5% Zenerdiode
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R 6	80.5264	18Kohm 5% Carbon film
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R 8	80.5237	100ohm 5% Carbon film
R 9	82.5049	1Kohm 5% Carbon film
R 10	80.5231	33ohm 5% Carbon film
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R 14	80.5253	2.2Kohm 5% Carbon film
R 15	80.5253	2.2Kohm 5% Carbon film

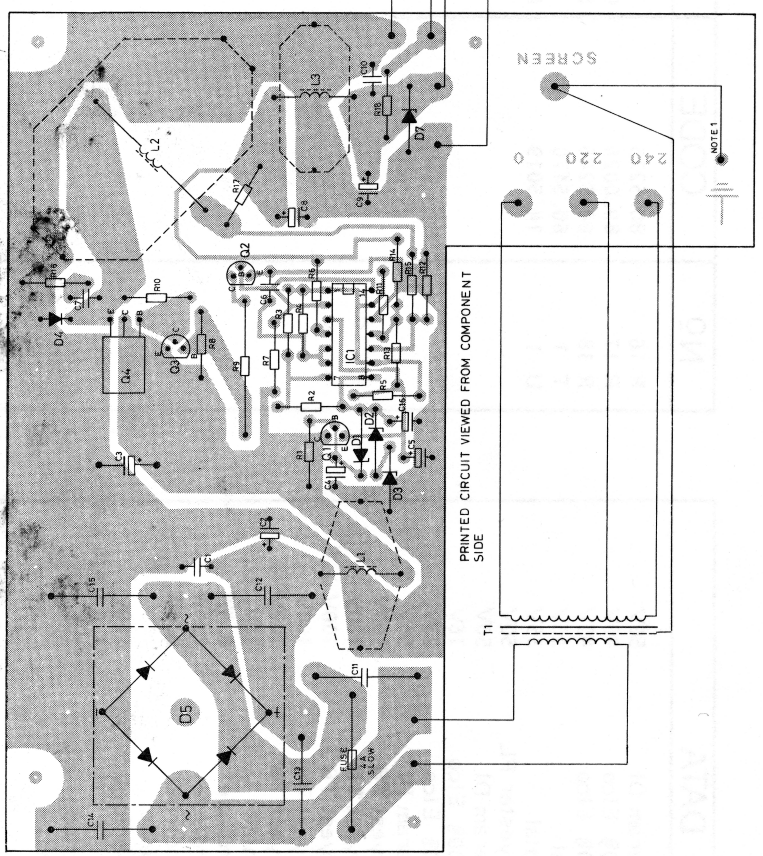
Nº	CODE	DATA
R 16	80.5225	10ohm 5% Carbon film
R 17	89.0026	0.035ohm Resistor Constantan
R 18	80.5246	560ohm 5% Carbon film
T 1	60.5170	Main transformer
U 1	14.5019	MC3302p Quad comparator

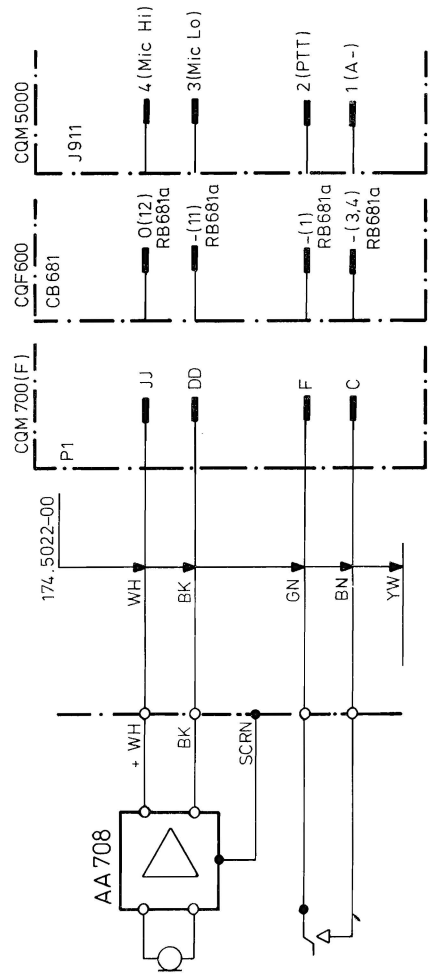
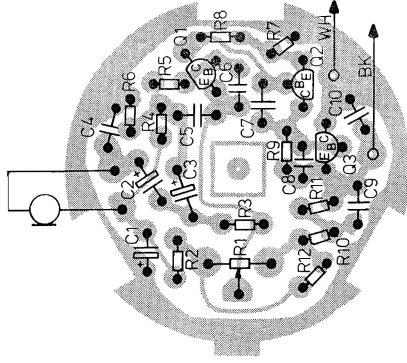
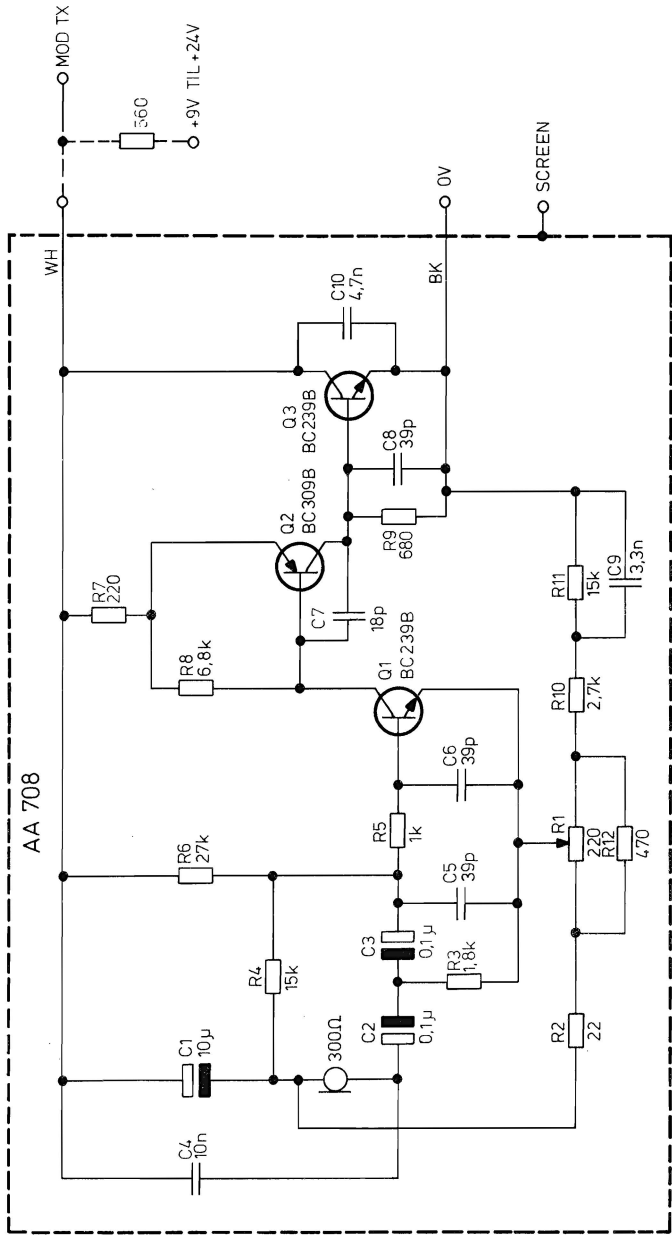
POWER SUPPLY PS5001

X402.821/1



NOTE 1: SCREEN CONNECTED TO EARTH IN UK





FIXED MOUNT MICROPHONE MC704a
 DESK MICROPHONE MC703b
 W. AMPLIFIER AA708

D403.193

Storno**Storno**

N ₀	CODE	DATA
	96.0102-01	Fixed Mount microphone MC704a
	96.0095-02	Desk Top microphone MC703b
	10.4403-00	AF-preamplifier AA708
	96.5079-00	Microphone cartridge, 600 Ohm
	18.1030-00	Multicable, shielded, f. MC703b
	47.5034-00	PTT switch
		<u>AA708</u>
C1	73.5109	10 uF +20%, Tantal 16V
C2	73.5089	0.1 uF +20%, Tantal 35V
C3	73.5089	0.1 uF +20%, Tantal 35V
C4	74.5109	10 nF Ceram. PL 20V
C5	74.5187	39 pF 10% Ceram. 25V
C6	74.5187	39 pF 10% Ceram. 25V
C7	74.5138	18 pF 5% Ceram. 125V
C8	74.5187	39 pF 10% Ceram. 25V
C9	76.5060	3.3 nF Polyester 50V
C10	74.5108	4.7 nF Ceram 20V
R1	86.5076	220 Ohm 20% Potentiometer 0.1W
R2	80.5229	22 Ohm 5% Carb. film 1/8W
R3	80.5252	1.8 kOhm 5% Carb. film 1/8W

N ₀	CODE	DATA
R4	80.5263	15 kOhm 5% Carb. film 1/8W
R5	80.5249	1 kOhm 5% Carb. film 1/8W
R6	80.5266	27 kOhm 5% Carb. film 1/8W
R7	80.5241	220 ohm 5% Carb. film 1/8W
R8	80.5259	6.8 kOhm 5% Carb. film 1/8W
R9	80.5247	680 ohm 5% Carb. film 1/8W
R10	80.5254	2.7 kOhm 5% Carb. film 1/8W
R11	80.5263	15 kOhm 5% Carb. film 1/8W
R12	80.5245	470 ohm 5% Carb. film 1/8W
Q1	99.5201	Transistor, NPN, BC239B
Q2	99.5115	Transistor, PNP, BC309B
Q3	99.5201	Transistor, NPN, BC239B

MICROPHONE MC704a
MICROPHONE MC703b

X403.194

MICROTELEPHONE

MT5001

Microphone MT5001 is designed for mobile use in association with series 5000 radiotelephones. The unit consists of a handset and a retainer interconnected by a coil cord. When placed in the retainer the handset activates a microswitch which is used to switch off the internal loudspeaker when the microtelephone is lifted. Built into the handset are two amplifiers, AA706 and AA707, which are used to drive the telephone and amplify the microphone signals, respectively.

The microtelephone MT5001 is equipped with a Mic. connector.

STRAPPING IN CQM5000

The cable connections to the MICROPHONE connector are as follows:

Terminal no.	Colour
1	RD/Red
2	BL/Blue
3	BN/Brown
4	WH/White
5	GN/Green
6	VT/Violet
7	BK/Black
8	(N. C.)/No connection

When connecting the MT5001 to CQM5000, it is necessary to cut 3 straps and mount 3 others on the XS board in CQM5000.

Cut the following straps:

H11 - H25
H12 - H24
H13 - H23

Connect the new straps as follows:

H11 to Terminal 1 on J910 (A⁺-RX)

H12 to Terminal 3 on J910 (SPKR-H₁)

H13-H18 to Terminal 10 on J910 (INT SPKR-H₁)
(see diagram D402.880)

CIRCUIT DESCRIPTION

Amplifier AA706

The amplifier consists of two stages of which the first is an amplifier and the last an emitterfollower. To ensure sufficient suppression of ripple voltage the base voltage divider of Q1 is utilizing the low dynamic resistance of a dual diode. The AF gain is for the greater part determined by the ratio of R3 to R4, and the telephone is driven via C3 in order to counteract the DC polarity. Capacitor C2 between the base and collector of Q2 between the base and collector Q2 stabilises the amplifier.

Amplifier AA707

The amplifier consists of two stages in which the AC and DC feedback is determined by the components that form the base network by Q1. The AF gain is for the greater part determined by the ratio of R4 to the series connection of R3, R2, and the microphone impedance. The normal AF gain is 30 dB but can be raised to 42 dB by shorting R3. Capacitors C2 and C3 are bypassing RF, if any present.

TECHNICAL SPECIFICATIONS

GENERAL

Temperature range

-30°C to +60°C

Dimensions

215 x 80 x 65 mm

Weight

650 g

AA706

Supply Voltage

13.6 V

Current Consumption

16 mA (19 mA)

Input Impedance

9.5 Kohm

Input Level

90 mV

Output Level

450 mV

Load Impedance

300 ohm

Distortion, Vout= 1 V

10%

AA707

Supply Voltage

9 V

Current Consumption

Gain 42 dB: 7.3 mA (11 mA)

Gain 30 dB: 8.3 mA (12 mA)

Gain

30 dB (28 dB)

R3 shorted: 42 dB (40 dB)

Load Impedance

560 ohm

Output Impedance

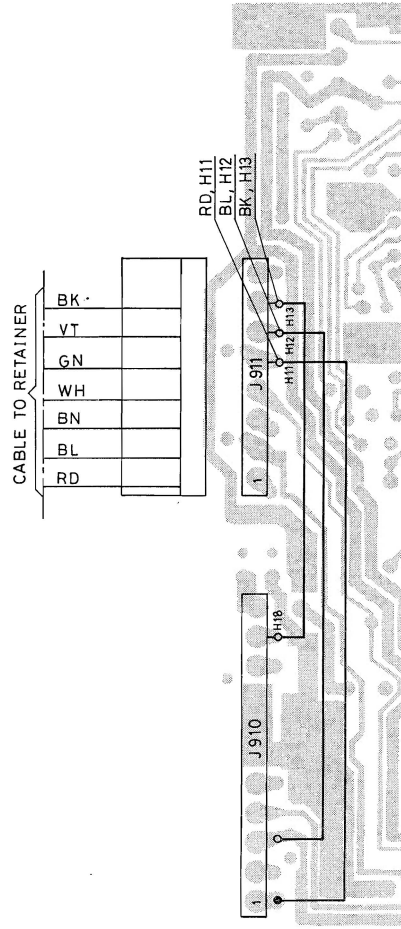
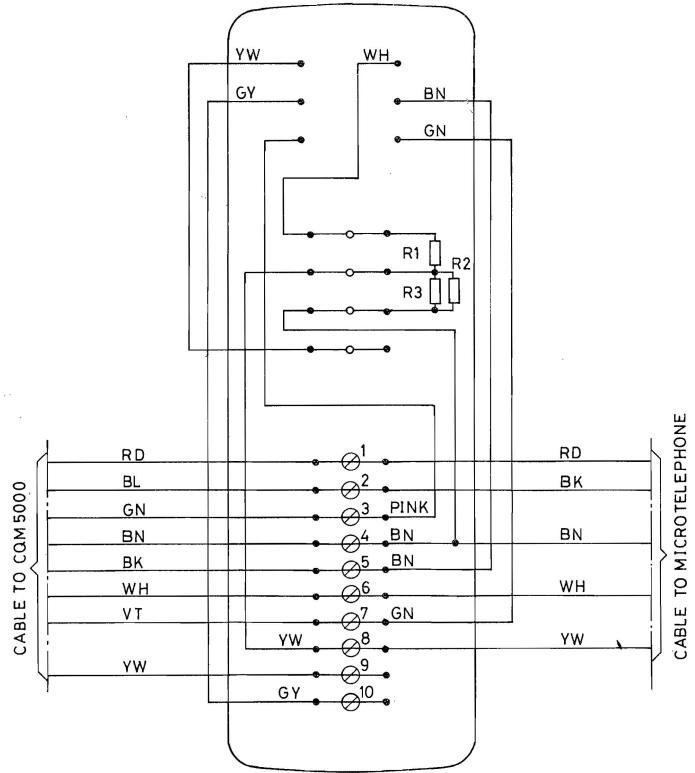
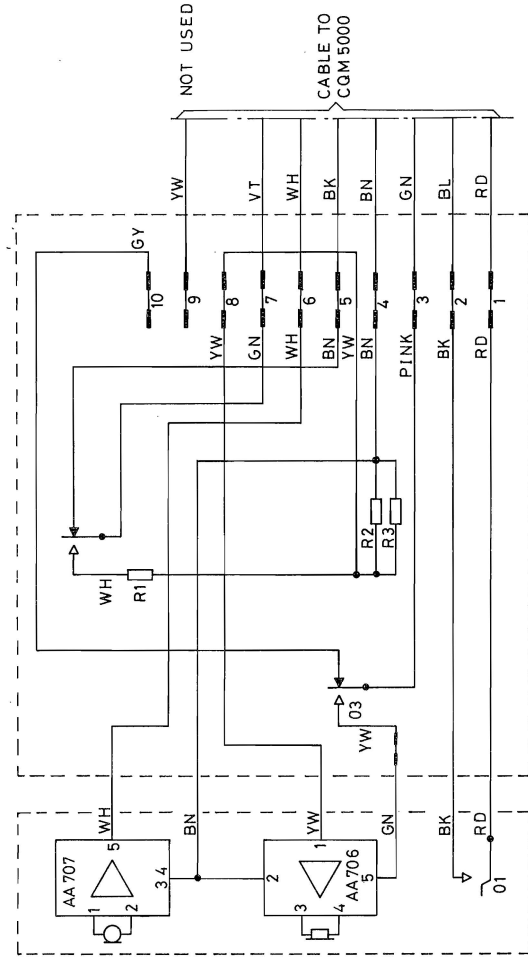
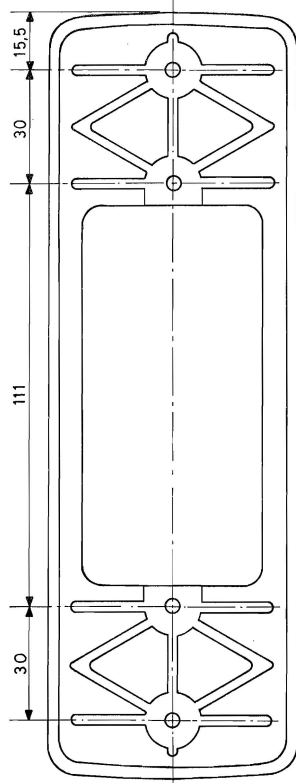
15-50 ohm

Output Level

110 mV

Distortion, Vout= 1 V

10%



**INSTALLATION DIAGRAM MT5001
MICROTELEPHONE WITH RETAINER**

D402.880

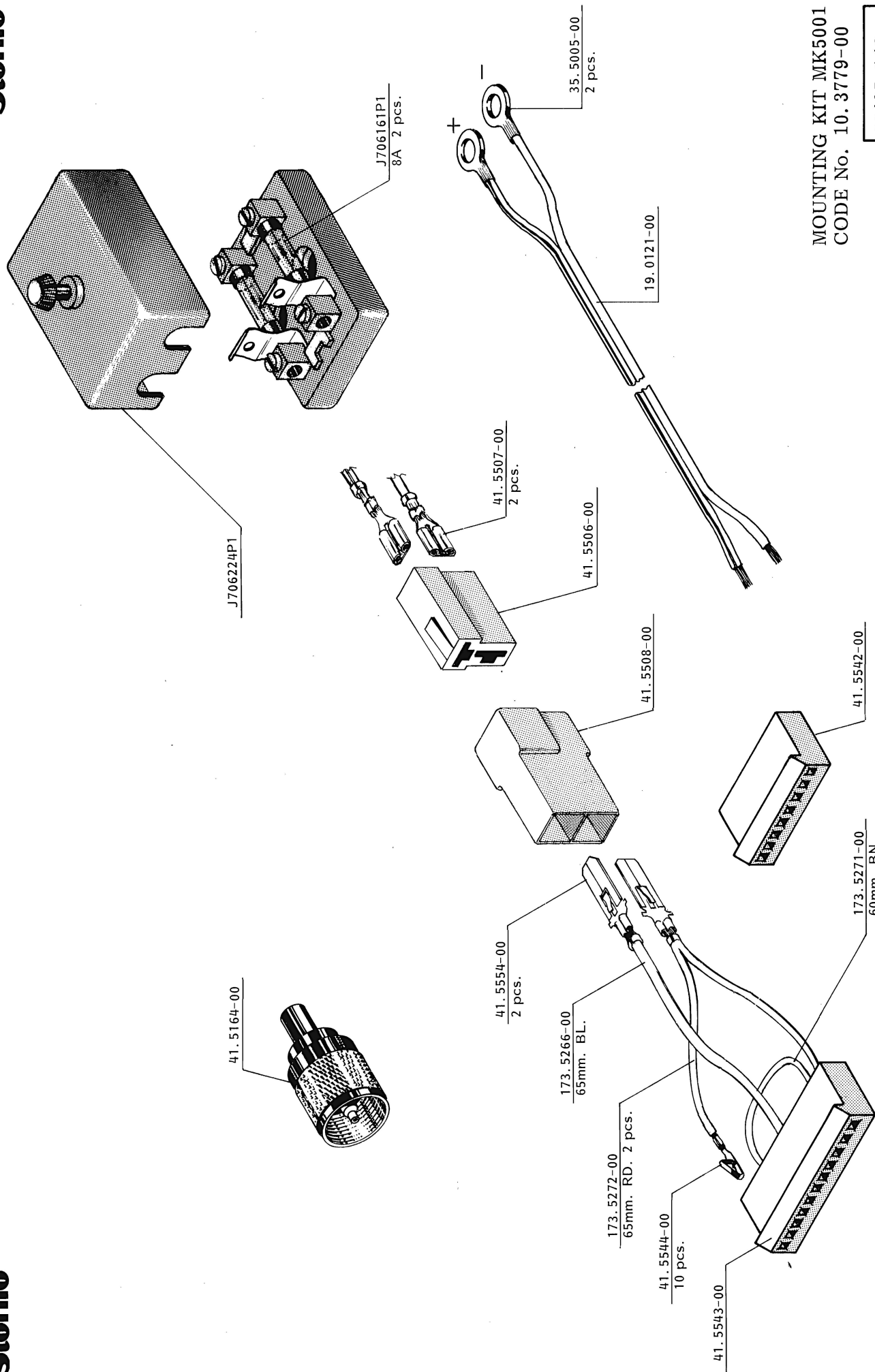
STORNOPHONE 5000
Maintenance Manual
Section 10

CONTENTS

CQM5000	Mechanical Lay-out Spare Part Numbers	M405.096/1
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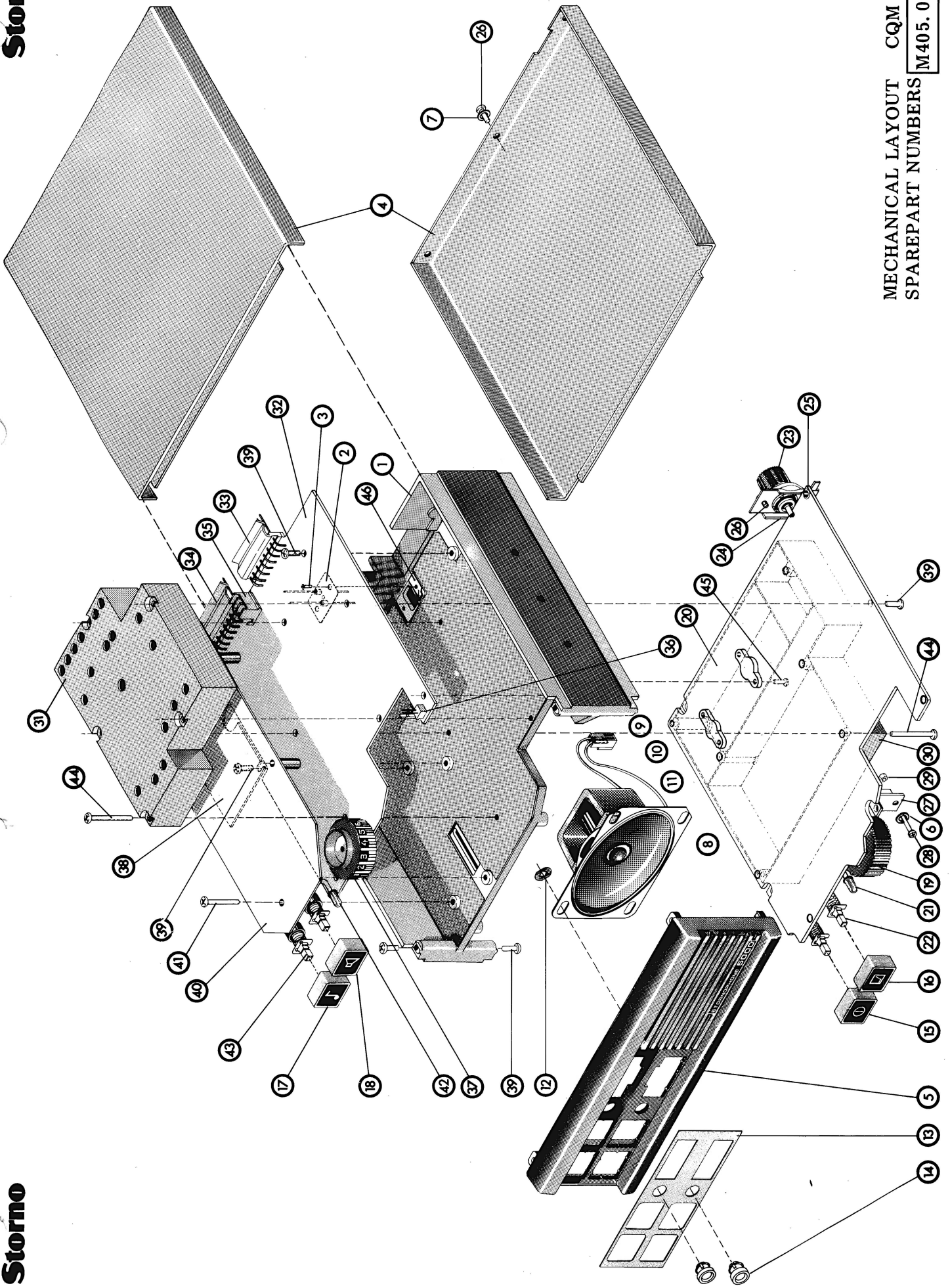
Storno

Storno



MOUNTING KIT MK5001
CODE No. 10.3779-00

M405.148



MECHANICAL LAYOUT CQM 5000
SPAREPART NUMBERS M405.096/1

ITEM	CODE	DESCRIPTION
1	10.3742-00	Cabinet Coffret
2	69.0016-00	Feed through connector Connecteur d'alimentation
3	20022-02003	Screw M2x3mm Vis M2x3mm
4	11.1177-00	Cover Couvercle
5	15.0379-00	Front cap Eur.
	15.0380-00	Avant Europ. Front cap U.S. Avant Améric
6	2450-048027	Spring washer Rondelle grower
7	2450-06032	Spring washer Rondelle grower
8	97.0018-00	Loudspeaker modified Haut-parleur modifié
9	41.5546-00	Connector housing female Prise femelle pour connecteur
10	41.5547-00	Crimp terminal for connector Embout pour connecteur
11	173.5203-00	Wire for loudspeaker Fil du H. P.
12	2453-102040	Speed nut Ecrou
		Item No. 5 to 12 are assembled under one code No. 10.3740-00 for Eur. and 10.3741 for U.S.
		L'ensemble des pièces 5 à 12 a le numéro 10.3740-00 (europ.) L'ensemble des pièces 5 à 12 a le numero 10.3741 (améric.)
	51.1160-00	Nameplate
	51.1161-00	Nameplate Eur. Version
	51.1164-00	Nameplate Plaque europ.
	51.1165-00	Nameplate
13	51.1169-00	Nameplate
	51.1170-00	Nameplate U.S. version
	51.1173-00	Nameplate Plaque améric.
	51.1174-00	Nameplate
14	32.0512-00	Bushing for led indicator Voyant pour diode lumineuse
15	490271-00	Push button (on/off) Eur. Bouton marche/arrêt europ.
	49.0275-00	Push button (on/off) U.S. Bouton marche/arrêt améric.

ITEM	CODE	DESCRIPTION
16	490272-00	Push button (SQ) Eur. Bouton de squelch europ.
	49.0276-00	Push button (SQ) U.S. Bouton de squelch améric.
17	49.0273-00	Push button (tone key) Eur. Bouton de tonalité europ.
	49.0277-00	Push button (tone key) U.S. Bouton de tonalité améric.
18	49.0274-00	Push button (LS. in/out) Eur. Bouton de H. P. europ.
	49.0278-00	Push button (LS. in/out) U.S. Bouton de H. P. améric.
19	49.0267-00	Knob volume control Eur. Bouton de volume europ.
	49.0281-00	Knob volume control U.S. Bouton de volume améric.
		Item No. 13 to 19 are available as a Kit for name plate. At ordering of Kit or single item see choice sheet No. M405.096-4
		Les pièces 13 à 19 peuvent être com- mandées ensemble. Voir choice sheet M405.096-4
	10.3732-00	RF 5112-6/10 WATT
	10.3733-00	RF 5112-25 WATT
20	10.3734-00	RF 5113-6/10 WATT
	10.3776-00	RF 5113-25 WATT
	10.3735-00	RF 5114-6/10 WATT
	10.3736-00	RF 5114-25 WATT
21	99.5303-00	Light emitt. diode red Diode lumineuse rouge
22	470641-00	Switch Commutateur
23	41.5165-00	Connector UHF Connecteur UHF
24	33.0406-00	Braket Applique
25	305023-00	Tubular rivet Rivet tubulaire
26	20022-03005	Screw M3x5 Vis M3x5
27	59.0049-00	Heat sink Radiateur
28	20022.02508	Screw M2, 5x8 Vis M2, 5x8
29	2202-025050	Nut M2, 5 Ecrou M2, 5
		Item No. 20 is fully assembled cir- cuit including item No. 21 to 29.
		20 complètement assemblé contient les pièces 21 à 29.

ITEM	CODE	DESCRIPTION
30	12. 0357-01 12. 0400-00	Shield Eur. Ecran europ. Shield U.S. Ecran améric.
31	12. 0361-00	Shield Multifreq. Ecran multifreq.
32	10. 3737-00 10. 3738-00 10. 3739-00	Channel selector unit XS5001 Channel selector unit XS5002 Channel selector unit XS5003 Sélecteur de canal XS5001, XS5002, XS5003
33	41. 0231-00	Connector 8 pos. male Connecteur mâle 8 pos.
34	41. 0232-00	Connector 11 pos. male Connecteur mâle 11 pos.
35	41. 5545-00	Connector 3 pos. female Connecteur femelle 3 pos.
36	41. 0225-00	Connector 2 pos. male Connecteur mâle 2 pos.
37	49. 0268-00	Knob channel switch (only XS5002 and XS5003) Bouton de sélecteur de canal (pour XS5002 et XS5003 seul)
		Item No. 32 is fully assembled circuit including item No. 33 to 37.
		32 complètement assemblé contient les pièces 33 à 37.
38	10. 3745-00 10. 3746-00	Switching unit SU5001 Switching unit SU5002
39	20562-03008	Screw M3x8 mm Vis M3x8 mm
40	10. 3743-00 10. 3744-00	Tone transmitter/receiver TQ5001 Emetteur-récepteur de tonalité TQ5001 Tone transmitter/receiver TQ5002 Emetteur-récepteur de tonalité TQ5002
41	20562-03022	Screw M3x22 mm Vis M3x22 mm
42	99. 5325-00	L. E. D. Yellow Diode lumineuse jaune
43	47. 0642-00	Switch Commutateur
		Item No. 40 is fully assembled circuit including item No. 41 to 43.
		40 complètement assemblé contient les pièces 41 à 43.
44	20562-03028	Screw M3x28 mm Vis M3x28 mm
45	20022-02508	Screw M2, 5x8 mm Vis M2, 5x8 mm
46	36. 0298-00	Plate, grounding spring Plaque à ressort de mise à la terre

* ONE CHANNEL ** MORE THAN ONE CHANNEL

TONE EQUIPMENT COM 5000	T. No.	KIT WITH NAMEPLATE AND BUTTON		NAME PLATE						BUSHING Eur. & US. 32.0512-00	KNOB VOL. 49.0267-00Eur. 49.0281-00 US.	PUSH BUTTON				
		ONE CHANNEL	MORE THAN ONE CHANNEL	EUR.								ON/OFF	SQ.	TONE KEY	LS. IN/OUT	
				*	**	*	**	*	**							*
		17.0116-00Eur.	17.0120-00Eur.	17.0117-00Eur.	17.0121-00Eur.	51.1160-00*	51.1164-00*	51.1169-00*	51.1173-00*	51.1170-00**	51.1174-00**	49.0271-00Eur.	49.0272-00Eur.	49.0273-00Eur.	49.0274-00Eur.	
		17.0122-00 US.	17.0126-00 US.	17.0123-00 US.	17.0127-00 US.	51.1160-00*	51.1164-00*	51.1169-00*	51.1173-00*	51.1170-00**	51.1174-00**	49.0275-00 US.	49.0276-00 US.	49.0277-00 US.	49.0278-00 US.	
T0	1		1	1		1	1	1	1	1	1	1	1			
T1		1			1	1	1	1	1	1	1	1	1	1	1	1
T2		1			1	1	1	1	1	1	1	1	1	1	1	1
T3		1			1	1	1	1	1	1	1	1	1	1	1	1
T4		1			1	1	1	1	1	1	1	1	1	1	1	1
T5	1		1			1	1	1	1	1	1	1	1			
T6	1		1			1	1	1	1	1	1	1	1			
T7	1		1			1	1	1	1	1	1	1	1			
T8	1		1			1	1	1	1	1	1	1	1			
T9		1			1	1	1	1	1	1	1	1	1	1	1	1
T10		1			1	1	1	1	1	1	1	1	1	1	1	1
T11		1			1	1	1	1	1	1	1	1	1	1	1	1
T12		1			1	1	1	1	1	1	1	1	1	1	1	1
T13		1			1	1	1	1	1	1	1	1	1	1	1	1
T14		1			1	1	1	1	1	1	1	1	1	1	1	1
T15		1			1	1	1	1	1	1	1	1	1	1	1	1
T16		1			1	1	1	1	1	1	1	1	1	1	1	1
T17		1			1	1	1	1	1	1	1	1	1	1	1	1
T18		1			1	1	1	1	1	1	1	1	1	1	1	1
T19		1			1	1	1	1	1	1	1	1	1	1	1	1
T20		1			1	1	1	1	1	1	1	1	1	1	1	1
T21		1			1	1	1	1	1	1	1	1	1	1	1	1
T22		1			1	1	1	1	1	1	1	1	1	1	1	1
T23		1			1	1	1	1	1	1	1	1	1	1	1	1
T24		1			1	1	1	1	1	1	1	1	1	1	1	1

EXAMPLE: COM 5112 Spec. 25x6 T2J → COMBINATIONS OF TONE EQUIPMENT

WATT → NUMBER OF CHANNELS

CHOICE OF NAMEPLATE KIT AND PUSH BUTTON

M405096-4

The versions T9 - T24 incl. are not available
 antil further notice is given.

GENERAL DESCRIPTION

CQM5330 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

A comparison of the various models is presented in the table below.

Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential encoder/decoder, or Channel Guard (Pilot tone), Group Call, All Call, and up to 12 transmit and receive channels.

Type	CQM5332	CQM5333	CQM5334
SPEC	6 25	6 25	6/10 25
Frequency Range MHz	66 - 88	66 - 88	66 - 88
RF Power W	6	25	6/10 25
Channel Spacing kHz	30/25	20	12.5
Max. Number of Channels	12	12	12

ACCESSORIES

Standard accessories include:

Mounting frame	HS5001	Retainer for MC5001
Power cable	HS5002	Retainer, with switches, for MC5001
Fist microphone with retainer or Fixed - mount microphone	MC5002	Cylindrical handmicrophone with build-in amplifier and press-to talk switch. Fitted with a coiled cord terminated into a connector which fits into the microphone retainer.
External loudspeaker		
External switches		
LS701 Loudspeaker enclosed in a plastic housing, complete with cable.	HS5003	Retainer for MC5002, without hook switch.
MC702b Dynamic fist microphone with adjust- able output level.	HS5004	Retainer for MC5002, with hook switch.
JB701a Junction box for MC702b. Consists of a plastic housing provided with cable for soldering assembly. Junction box is to mounted behind the first microphone retainer.	MK5001	Installation kit containing connectors, power cable, fuses and fuseholders.
MC703a Desk microphone with PTT (Push -to - Talk) switch for fixed installations.	MN703	Desk stand for fixed installations.
MC704 Microphone with chockabsorbing moun- ting bracket for mobile installation.	MN704	Mounting bracket for the radio ca- binet.
MK704 Mounting kit consisting of 2 flexible tubes, used for mounting the MC704 in close-talk position.	MN5001	Mounting frame for mobile installa- tions allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.
MC5001 Fist microphone with retractables piral cable for mobile installation.	MN5002	Mounting cassette for the radio cabinet (see mechanical layout).
	MT5001	Microphone with retainer. The retai- ner contains a microswitch which is used to switch off the internal loud- speaker, when the microphone is lifted.

- SU701 Transmitter keying switch for mounting on the steering coloum.
- SU702 Transmitter keying switch for mounting on the dashboard.
- SU704 Switch circuit for autoradio mounting.
- SU5003 External alarm with timer (Horn Alarm).

Power Supply Units:

Equipment

	220 V AC	+24 V DC
CQM5000, max. 6/10 W	PS703	PS704
CQM5000, max. 25 W	PS5001	PS702

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slides under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FB) and the Frequency Control (FC) mount in the top section of the chassis.

Their switches and push buttons mount directly to the boards and protrude through the front.

Thin cast shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

- Receiver front end
- 1st IF section with first and second oscillator
- 455 kHz 2nd IF section with demodulator.

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to

RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V \pm 0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code	R636 Value
Brown	omit
Red	270
Orange	100
Yellow	47
Green	22
Blue	6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: \leq 50 mV

Repeat the procedure with the power supply adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and prom codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 250 mV \pm 125 mV
(corresponding to -10 dBm to -4 dBm).

Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition is indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

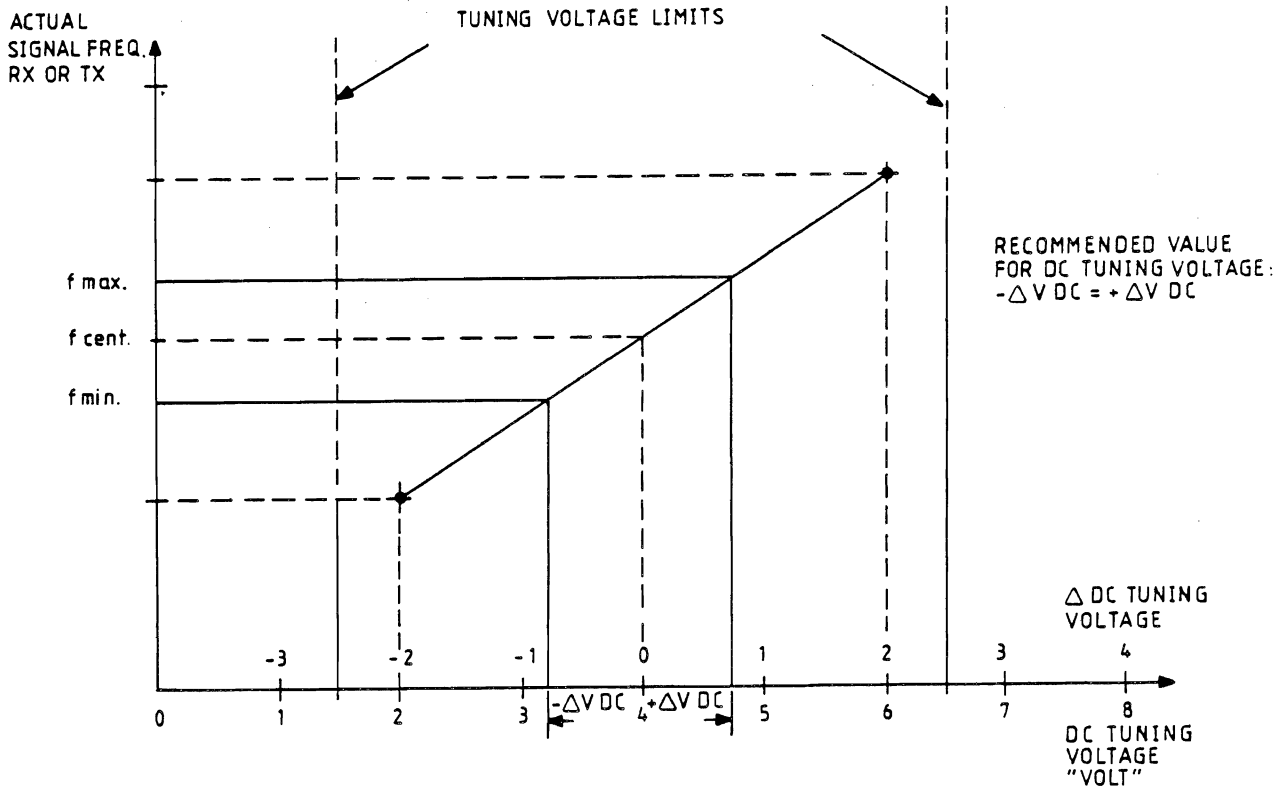
High channel reading: 4.8 volt (4.0 + 0.8)
Center channel reading: 4.0 volts
Low channel reading: 3.2 volt (4.0 - 0.8)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.



$f = f_x \times 2$ (f_x = crystal frequency)
 Adjust L711 to the calculated frequency.
 Requirement: $f \pm 0.3$ ppm at 25°C.
 ppm = parts per million = 10^{-6}

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.
 Connect the frequency counter to the probe.
 Calculate the injection frequency for all channels.

$f_{inj} = f_{ant} + 10.7$ (MHz)
 Select, one by one, the channels and read the injection frequency.
 Requirement: $F_{inj} \pm 0.4$ ppm

IF AMPLIFIERS

Connect a 10.7 MHz signal generator to TP401 via coax probe 95.0179-00.
 Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range).

During adjustment the RF generator output must be kept low enough to prevent limiting in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.
 Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range).
 Connect an unmodulated RF generator to the antenna connector, J601.
 Set the generator frequency to the receiver frequency.
 Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.
 Adjust L401 and L402 for maximum deflection.
 Detune L403 and 405 as much as possible.

	Frequency	Level	Tol.
Type CQM5332 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	3000 Hz	-9.5 dB	+1 dB/-3 dB
Type CQM5333 S12	300 Hz	+10.5 dB	+1.5 dB/-3 dB
	400 Hz	+8 dB	+1.5 dB/-1.5 dB
	1000 Hz	0 dB	
	2700 Hz	-8.6 dB	+1.5 dB/-1.5 dB
	3000 Hz	-9.5 dB	+1.5 dB/-3 dB
	6000 Hz	<-20 dB	
Type CQM5334 S12	300 Hz	+9 dB	+1 dB/-3 dB
	1000 Hz	0 dB	
	2550 Hz	-8 dB	+1 dB/-3 dB

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0.

Set the frequency outside the 66 - 88 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting ≤ 6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD $\leq 5\%$.

SQUELCH

Release the squelch cancel button.

Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

Requirements

Condition	Current consumption
Standby	≤ 400 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	≤ 750 mA

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

- 25 W transmitter: 6A
- 6 W transmitter: 4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95.0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

250 mV ± 125 mV

(corresponding to -10 dBm to -4 dBm)

Note: Be careful not to resonate L704 to the false harmonics. If in doubt con-

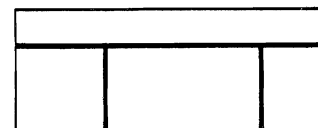
sult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the oscilloscope to test point TP706.

The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition is indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible.

Connect the multimeter to test point TP703.

Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 5.1 volt (4.0 + 1.1)

Center channel reading: 4.0 volts

Low channel reading: 2.9 volt (4.0 - 1.1)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Nº	CODE	DATA
C701	19A700233P7	1 nF Capacitor Ceramic
C702	19J706005P3	47 uF Capacitor Electrolytic
C703	19A700233P7	1 nF Capacitor Ceramic
C704	19A700233P7	1 nF Capacitor Ceramic
C705	19A700233P7	1 nF Capacitor Ceramic
C706	19A700003P7	10 uF Capacitor Tantalum
C707	19A700233P7	1 nF Capacitor Ceramic
C708	19A700233P7	1 nF Capacitor Ceramic
C711	19A700003P1	0.1 uF Capacitor Tantalum
C712	19A700003P5	2.2 uF Capacitor Tantalum
C713	19A700235P31	330 pF Capacitor Ceramic
C714	19J706256P101	100 pF N750 Capacitor Ceramic
C715	19A700235P27	150 pF Capacitor Ceramic
C716	19A700233P7	1 nF Capacitor Ceramic
C717	19A700235P21	47 pF Capacitor Ceramic
C718	19A700235P10	5.6 pF Capacitor Ceramic
C719	19A700235P17	22 pF Capacitor Ceramic
C720	19A700233P7	1 nF Capacitor Ceramic
C721	19A700235P10	5.6 pF Capacitor Ceramic
C722	19A700235P23	68 pF Capacitor Ceramic
C723	19A700235P15	15 pF Capacitor Ceramic
C724	19A700233P7	1 nF Capacitor Ceramic
C725	19J706256P203	27 pF N1500 Capacitor Ceramic
C726	19J706256P206	100 pF N1500 Capacitor Ceramic
C727	19A700235P28	180 pF Capacitor Ceramic
C728	19A700003P7	10 uF Capacitor Tantalum
C729	19A700233P7	1 nF Capacitor Ceramic
C730	19A700003P6	4.7 uF Capacitor Tantalum
C731	19A700233P7	1 nF Capacitor Ceramic
C732	19A700235P10	5.6 pF Capacitor Ceramic
C733	19A700013P11	0.68 pF Capacitor Phenolic
C734	19A700233P7	1 nF Capacitor Ceramic
C735	19A700233P8	1.5 nF Capacitor Ceramic
C737	19J706003P2	2-18 pF Capacitor Variable
C738	19A700235P16	18 pF Capacitor Ceramic
C739	19A700003P4	1 uF Capacitor Tantalum
C740	19A700235P27	150 pF Capacitor Ceramic
C741	19A700003P7	10 uF Capacitor Tantalum
C742	19A700235P10	5.6 pF Capacitor Ceramic
C743	19A700233P7	1 nF Capacitor Ceramic
C745	19J706003P2	2-18 pF Capacitor Variable
C746	19A700235P14	12 pF Capacitor Ceramic
C747	19A700003P4	1 uF Capacitor Tantalum
C748	19A700233P8	1.5 nF Capacitor Ceramic
C749	19A700235P10	5.6 pF Capacitor Ceramic
C750	19A700233P1	100 pF Capacitor Ceramic

Nº	CODE	DATA
C751	19A700003P5	2.2 uF Capacitor Tantalum
C752	19A700233P7	1 nF Capacitor Ceramic
C753	19A700233P2	150 pF Capacitor Ceramic
C754	19A700235P18	27 pF Capacitor Ceramic
C755	19A700003P4	1 uF Capacitor Tantalum
C756	19A700003P7	10 uF Capacitor Tantalum
C757	19A700233P7	1 nF Capacitor Ceramic
C758	19A700233P8	1.5 nF Capacitor Ceramic
C759	19A700003P4	1 uF Capacitor Tantalum
C760	19A700003P3	0.47 uF Capacitor Tantalum
C761	19A700233P7	1 nF Capacitor Ceramic
C762	19A700233P7	1 nF Capacitor Ceramic
C763	19A700233P7	1 nF Capacitor Ceramic
C764	19A700235P1	1 pF Capacitor Ceramic
C765	19A700233P7	1 nF Capacitor Ceramic
C766	19A700233P7	1 nF Capacitor Ceramic
C767	19A700233P7	1 nF Capacitor Ceramic
C768	19A700233P7	1 nF Capacitor Ceramic
C769	19A700235P16	18 pF Capacitor Ceramic
C770	19A700233P7	1 nF Capacitor Ceramic
C771	19A700233P5	470 pF Capacitor Ceramic
C772	19A700233P5	470 pF Capacitor Ceramic
C773	19A700233P7	1 nF Capacitor Ceramic
C774	19A700233P7	1 nF Capacitor Ceramic
C776	19A700235P13	10 pF Capacitor Ceramic
C777	19A700233P7	1 nF Capacitor Ceramic
C780	19A700233P7	1 nF Capacitor Ceramic
C781	19J706005P5	220 uF Capacitor Electrolytic
C782	19A700233P7	1 nF Capacitor Ceramic
C783	19A700235P19	33 pF Capacitor Ceramic
C784	19A700233P7	1 nF Capacitor Ceramic
C785	19A700233P7	1 nF Capacitor Ceramic
C791	19J706261P1	22 nF Capacitor Polyester
C792	19A700233P1	100 pF Capacitor Ceramic
C793	19A700233P1	100 pF Capacitor Ceramic
D721	19A700028P1	1N4148 Diode Silicon
D722	19A700028P1	1N4148 Diode Silicon
D723	19A700073P1	BB409 Variable Cap. Diode
D724	19J706262P1	Variable Cap. Diode
D725	19A700073P1	BB409 Variable Cap. Diode

FREQUENCY SYNTHESIZER FS5331

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Storno

Nº	CODE	DATA
D726	19A700073P1	BB409 Variable Cap. Diode
D727	19A700073P1	BB409 Variable Cap. Diode
D733	19J706006P2	BA282 Diode
D734	19J706006P2	BA282 Diode
D741	19J706026P1	1N5401 Diode Silicon
D742	19J706026P1	1N5401 Diode Silicon
J730	19J706215P108	Male Connector
J732	19J706215P114	Male Connector
J901	19J706214P4	Male Connector
J902	19J706214P4	Male Connector
J903	19J706214P7	Male Connector
J904	19A700072P28	Male Connector
J905	19A700072P9	Male Connector
J906	19A700072P11	Male Connector
J907	19A700102P21	Female Connector
J910	19J706223P11	Male Connector
J911	19J706223P8	Male Connector
J921	19J706219P1	Variable Coil
J961	19J706219P1	Jumper Wire
L701	19J706029P6	Jumper Wire
L702	19A700184P1	Variable Coil
L703	19A700184P1	Variable Coil
L704	19J706083P6	10 uH Coil
L705	19A700024P25	10 uH Coil
L706	19A700024P25	10 uH Coil
L707	19J706083P6	Variable Coil
L708	19A700024P15	1.5 uH Coil
L711	19J706029P3	Variable Coil
L712	19A700024P25	Variable Coil
L713	19A700024P25	10 uH Coil
L714	19J706258P3	Coil
L715	19A700024P25	10 uH Coil
L716	19A700024P25	10 uH Coil
L717	19J706258P2	Coil
L718	19A700024P25	6.8 uH Coil
L721	19A700024P23	1 uH Coil
L722	19A700024P13	0.47 uH Coil
L723	19A700024P9	0.47 uH Coil
Q702	19A700020P1	BC558 Transistor
Q703	19A700020P1	BC558 Transistor
Q704	19A700020P1	BC558 Transistor
Q711	19A700017P2	BC548 Transistor
Q713	19J706283P1	BFR54 Transistor
Q714	19J706283P1	BFR54 Transistor
Q715	19J706264P1	BF414 Transistor
Q716	19J706038P1	2N5245 Transistor

Storno

Nº	CODE	DATA
Q717	19J706038P1	2N5245 Transistor
Q722	19J706146P1	BF357S Transistor
Q723	19J706164P1	BF414 Transistor
Q724	19J706146P1	BF357S Transistor
R704	19A700019P34	560 ohm Resistor Depos.
R705	19A700019P42	2.7 Kohm Resistor Depos.
R706	19A700019P21	47 ohm Resistor Depos.
R707	19A700019P49	10 Kohm Resistor Depos.
R708	19A700019P49	10 Kohm Resistor Depos.
R709	19A700019P42	2.7 Kohm Resistor Depos.
R711	19A700019P42	2.7 Kohm Resistor Depos.
R712	19A700019P49	10 Kohm Resistor Depos.
R713	19A700019P17	22 ohm Resistor Depos.
R714	19A700019P17	22 ohm Resistor Depos.
R720	19A700019P37	1 Kohm Resistor Depos.
R721	19A700019P45	4.7 Kohm Resistor Depos.
R722	19A700019P60	82 Kohm Resistor Depos.
R723	19A700019P58	56 Kohm Resistor Depos.
R724	19A700019P49	10 Kohm Resistor Depos.
R725	19A700019P57	47 Kohm Resistor Depos.
R726	19A700019P49	10 Kohm Resistor Depos.
R727	19A700019P40	1.8 Kohm Resistor Depos.
R728	19A700019P47	6.8 Kohm Resistor Depos.
R729	19A700019P30	270 ohm Resistor Depos.
R730	19A700019P45	4.7 Kohm Resistor Depos.
R731	19A700019P30	270 ohm Resistor Depos.
R732	19A700019P49	10 Kohm Resistor Depos.
R733	19A700019P48	8.2 Kohm Resistor Depos.
R734	19A700019P35	680 ohm Resistor Depos.
R735	19A700029P57	47 Kohm Resistor Depos.
R736	19A700029P31	330 ohm Resistor Depos.
R737	19A700019P31	330 ohm Resistor Depos.
R738	19A700019P25	100 ohm Resistor Depos.
R739	19A700019P39	100 ohm Resistor Depos.
R741	19A700019P43	1.5 Kohm Resistor Depos.
R742	19A700019P37	3.3 Kohm Resistor Depos.
R743	19A700019P25	1 Kohm Resistor Depos.
R748	19A700019P27	100 ohm Resistor Depos.
R749	19A700019P25	150 ohm Resistor Depos.
R750	19A700019P57	100 ohm Resistor Depos.
		47 Kohm Resistor Depos.

FREQUENCY SYNTHESIZER FS5331

Storno

N ^o	CODE	DATA
R752	19A700016P3	4.7 Kohm Resistor Variable
R753	19A700019P37	1 Kohm Resistor Depos.
R754	19A700019P25	100 ohm Resistor Depos.
R761	19A700019P13	10 ohm Resistor Depos.
R763	19A700019P51	15 Kohm Resistor Depos.
R765	19A700019P26	120 ohm Resistor Depos.
R769	19A700019P35	820 ohm Resistor Depos.
R770	19A700019P42	2.7 Kohm Resistor Depos.
R771	19A700019P15	15 ohm Resistor Depos.
R772	19A700019P57	47 Kohm Resistor Depos.
R773	19A700019P55	33 Kohm Resistor Depos.
R774	19A700019P50	12 Kohm Resistor Depos.
R775	19A700019P40	1.8 Kohm Resistor Depos.
R776	19A700010P37	1 Kohm Resistor Depos.
R777	19A700019P21	47 ohm Resistor Depos.
R778	19A700019P25	100 ohm Resistor Depos.
R779	19A700019P34	560 ohm Resistor Depos.
R780	19A700019P23	68 ohm Resistor Depos.
R781	19A700019P19	33 ohm Resistor Depos.
R782	19A700019P44	3.9 Kohm Resistor Depos.
R783	19A700019P27	150 ohm Resistor Depos.
R784	19A700019P25	100 ohm Resistor Depos.
R785	19A700019P39	1.5 Kohm Resistor Depos.
R786	19A700019P31	330 ohm Resistor Depos.
R787	19A700019P43	3.3 Kohm Resistor Depos.
R788	19A700019P26	120 ohm Resistor Depos.
R789	19A700019P34	560 ohm Resistor Depos.
R791	19A700019P30	270 ohm Resistor Depos.
R792	19A700019P38	1.2 Kohm Resistor Depos.
R793	19A700019P17	22 ohm Resistor Depos.
R794	19A700019P17	22 ohm Resistor Depos.
R798	19A700019P37	1 Kohm Resistor Depos.
R799	19A700019P54	27 Kohm Resistor Depos.
T701	19J706284G1	Transformer
U701	19J706263P1	MC145106
U702	19J706238P1	INT CKT TDA 1062 S
U703	19A700029P44	4066B IC

Storno

N ^o	CODE	DATA

FREQUENCY SYNTHESIZER FS5331

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N _Q	CODE	DATA
C701	19A700233P7	1 nF Capacitor Ceramic
C702	19J706005P3	47 uF Capacitor Electrolytic
C703	19A700233P7	1 nF Capacitor Ceramic
C704	19A700233P7	1 nF Capacitor Ceramic
C705	19A700233P7	1 nF Capacitor Ceramic
C706	19A700003P7	10 uF Capacitor Tantalum
C707	19A700233P7	1 nF Capacitor Ceramic
C708	19A700233P7	1 nF Capacitor Ceramic
C711	19A700003P1	0.1 uF Capacitor Tantalum
C712	19A700003P5	2.2 uF Capacitor Tantalum
C713	19A700235P31	330 pF Capacitor Ceramic
C714	19J706256P101	100 pF N750 Capacitor Ceramic
C715	19A700235P27	150 pF Capacitor Ceramic
C716	19A700233P7	1 nF Capacitor Ceramic
C717	19A700235P21	47 pF Capacitor Ceramic
C718	19A700235P10	5.6 pF Capacitor Ceramic
C719	19A700235P17	22 pF Capacitor Ceramic
C720	19A700233P7	1 nF Capacitor Ceramic
C721	19A700235P10	5.6 pF Capacitor Ceramic
C722	19A700235P23	68 pF Capacitor Ceramic
C723	19A700235P15	15 pF Capacitor Ceramic
C724	19A700233P7	1 nF Capacitor Ceramic
C725	19J706256P203	27 pF N1500 Capacitor Ceramic
C726	19J706256P206	100 pF N1500 Capacitor Ceramic
C727	19A700235P28	180 pF Capacitor Ceramic
C728	19A700003P7	10 uF Capacitor Tantalum
C729	19A700233P7	1 nF Capacitor Ceramic
C730	19A700003P6	4.7 uF Capacitor Tantalum
C731	19A700233P7	1 nF Capacitor Ceramic
C732	19A700235P10	5.6 pF Capacitor Ceramic
C733	19A700013P11	0.68 pF Capacitor Phenolic
C734	19A700233P7	1 nF Capacitor Ceramic
C735	19A700233P8	1.5 nF Capacitor Ceramic
C737	19J706003P2	2-18 pF Capacitor Variable
C738	19A700235P16	18 pF Capacitor Ceramic
C739	19A700003P4	1 uF Capacitor Tantalum
C740	19A700235P27	150 pF Capacitor Ceramic
C741	19A700003P7	10 uF Capacitor Tantalum
C742	19A700235P10	5.6 pF Capacitor Ceramic
C743	19A700233P7	1 nF Capacitor Ceramic
C745	19J706003P2	2-18 pF Capacitor Variable
C746	19A700235P14	12 pF Capacitor Ceramic
C747	19A700003P4	1 uF Capacitor Tantalum
C748	19A700233P8	1.5 nF Capacitor Ceramic
C749	19A700235P10	5.6 pF Capacitor Ceramic
C750	19A700233P1	100 pF Capacitor Ceramic
C751	19A700003P5	2.2 uF Capacitor Tantalum

N _Q	CODE	DATA
C752	19A700233P7	1 nF Capacitor Ceramic
C753	19A700233P2	150 pF Capacitor Ceramic
C754	19A700235P18	27 pF Capacitor Ceramic
C755	19A700003P7	1 uF Capacitor Tantalum
C756	19A700003P4	10 uF Capacitor Tantalum
C757	19A700233P7	1 nF Capacitor Ceramic
C758	19A700233P8	1.5 nF Capacitor Ceramic
C759	19A700003P4	1 uF Capacitor Tantalum
C760	19A700003P3	0.47 uF Capacitor Tantalum
C761	19A700233P7	1 nF Capacitor Ceramic
C762	19A700233P7	1 nF Capacitor Ceramic
C763	19A700233P7	1 nF Capacitor Ceramic
C764	19A700235P1	1 pF Capacitor Ceramic
C765	19A700233P7	1 nF Capacitor Ceramic
C766	19A700233P7	1 nF Capacitor Ceramic
C767	19A700233P7	1 nF Capacitor Ceramic
C768	19A700233P7	1 nF Capacitor Ceramic
C769	19A700235P16	18 pF Capacitor Ceramic
C770	19A700233P7	1 nF Capacitor Ceramic
C771	19A700233P5	470 pF Capacitor Ceramic
C772	19A700233P5	470 pF Capacitor Ceramic
C773	19A700233P71	1 nF Capacitor Ceramic
C774	19A700233P7	1 nF Capacitor Ceramic
C776	19A700235P13	10 pF Capacitor Ceramic
C777	19A700233P7	1 nF Capacitor Ceramic
C780	19A700233P7	1 nF Capacitor Ceramic
C781	19J706005P5	220 uF Capacitor Electrolytic
C782	19A700233P7	1 nF Capacitor Ceramic
C783	19A700235P19	1 nF Capacitor Ceramic
C784	19A700233P7	33 pF Capacitor Ceramic
C785	19A700233P7	1 nF Capacitor Ceramic
C791	19J706261P1	22 nF Capacitor Polyester
C792	19A700233P1	100 pF Capacitor Ceramic
C793	19A700233P1	100 pF Capacitor Ceramic
D701	19A700028P1	1N4148 Diode Silicon
D702	19A700028P1	1N4148 Diode Silicon
D703	19A700028P1	1N4148 Diode Silicon
D704	19A700028P1	1N4148 Diode Silicon
D705	19A700028P1	1N4148 Diode Silicon
D706	19A700028P1	1N4148 Diode Silicon
D707	19A700028P1	1N4148 Diode Silicon

FREQUENCY SYNTHESIZER FS5332

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Nº	CODE	DATA
D708	19A700028P1	1N4148 Diode Silicon
D709	19A700028P1	1N4148 Diode Silicon
D710	19A700028P1	1N4148 Diode Silicon
D711	19A700028P1	1N4148 Diode Silicon
D712	19A700028P1	1N4148 Diode Silicon
D713	19A700028P1	1N4148 Diode Silicon
D714	19A700028P1	1N4148 Diode Silicon
D721	19A700028P1	1N4148 Diode Silicon
D722	19A700028P1	1N4148 Diode Silicon
D723	19A700073P1	BB409 Variable Cap. Diode
D724	19J706262P1	Variable Cap. Diode
D725	19A700073P1	BB409 Variable Cap. Diode
D726	19A700073P1	BB409 Variable Cap. Diode
D727	19A700073P1	BB409 Variable Cap. Diode
D733	19J706006P2	BA282 Diode
D734	19J706006P2	BA282 Diode
D741	19J706026P1	1N5401 Diode Silicon
D742	19J706026P1	1N5401 Diode Silicon
J730	19J706215P108	Male Connector
J732	19J706215P114	Male Connector
J901	19J706214P4	Male Connector
J902	19J706214P4	Male Connector
J903	19J706214P7	Male Connector
J904	19A700072P28	Male Connector
J905	19A700072P9	Male Connector
J906	19A700072P11	Male Connector
J907	19A700102P21	Female Connector
J910	19J706223P11	Male Connector
J911	19J706223P8	Male Connector
J921	19J706219P1	Male Connector
J961	19J706219P1	Male Connector
L701	19J706029P6	Variable Coil
L702	19A700184P1	Jumper Wire
L703	19A700184P1	Jumper Wire
L704	19J706083P6	Variable Coil
L705	19A700024P25	10 uH Coil
L706	19A700024P25	10 uH Coil
L707	19J706083P6	Variable Coil
L708	19A700024P15	1.5 uH Coil
L711	19J706029P3	Variable Coil
L712	19A700024P25	10 uH Coil
L713	19A700024P25	10 uH Coil
L714	19J706258P3	Coil
L715	19A700024P25	10 uH Coil
L716	19A700024P25	10 uH Coil
L717	19J706258P2	Coil
L718	19A700024P25	10 uH Coil

Nº	CODE	DATA
L721	19A700024P23	6.8 uH Coil
L722	19A700024P13	1 uH Coil
L723	19A700024P9	0.47 uH Coil
Q701	19A700017P1	BC548 Transistor
Q702	19A700020P1	BC558 Transistor
Q703	19A700020P1	BC558 Transistor
Q704	19A700020P1	BC558 Transistor
Q711	19A700017P2	BC548 Transistor
Q713	19J706283P1	BFR54 Transistor
Q714	19J706283P1	BFR54 Transistor
Q715	19J706264P1	BF414 Transistor
Q716	19J706038P1	2N5245 Transistor
Q717	19J706038P1	2N5245 Transistor
Q722	19J706146P1	BF357S Transistor
Q723	19J706146P1	BF414 Transistor
Q724	19J706146P1	BF357S Transistor
R701	19A700019P21	47 ohm Resistor Depos.
R702	19A700019P39	1.5 Kohm Resistor Depos.
R703	19A700019P53	22 Kohm Resistor Depos.
R704	19A700019P34	560 ohm Resistor Depos.
R705	19A700019P42	2.7 Kohm Resistor Depos.
R706	19A700019P21	47 ohm Resistor Depos.
R707	19A700019P49	10 Kohm Resistor Depos.
R708	19A700019P49	10 Kohm Resistor Depos.
R709	19A700019P42	2.7 Kohm Resistor Depos.
R711	19A700019P42	2.7 Kohm Resistor Depos.
R712	19A700019P49	10 Kohm Resistor Depos.
R713	19A700019P17	22 ohm Resistor Depos.
R714	19A700019P17	22 ohm Resistor Depos.
R720	19A700019P37	1 Kohm Resistor Depos.
R721	19A700019P45	4.7 Kohm Resistor Depos.
R722	19A700019P60	82 Kohm Resistor Depos.
R723	19A700019P58	56 Kohm Resistor Depos.
R724	19A700019P49	10 Kohm Resistor Depos.
R725	19A700019P57	47 Kohm Resistor Depos.
R726	19A700019P49	10 Kohm Resistor Depos.
R727	19A700019P40	1.8 Kohm Resistor Depos.
R728	19A700019P47	6.8 Kohm Resistor Depos.
R729	19A700019P30	270 ohm Resistor Depos.
R730	19A700019P45	4.7 Kohm Resistor Depos.

FREQUENCY SYNTHESIZER FS5332

NO	CODE	DATA
R731	19A700019P30	270 ohm Resistor Depos. 0.25 W
R732	19A700019P49	10 Kohm Resistor Depos. 0.25 W
R733	19A700019P48	8.2 Kohm Resistor Depos. 0.25 W
R734	19A700019P35	680 ohm Resistor Depos. 0.25 W
R735	19A700029P57	47 Kohm Resistor Depos. 0.25 W
R736	19A700029P31	330 ohm Resistor Depos. 0.25 W
R737	19A700019P31	330 ohm Resistor Depos. 0.25 W
R738	19A700019P25	100 ohm Resistor Depos. 0.25 W
R739	19A700019P39	1.5 Kohm Resistor Depos. 0.25 W
R741	19A700019P43	3.3 Kohm Resistor Depos. 0.25 W
R742	19A700019P37	1 Kohm Resistor Depos. 0.25 W
R743	19A700019P25	100 ohm Resistor Depos. 0.25 W
R748	19A700019P27	150 ohm Resistor Depos. 0.25 W
R749	19A700019P25	100 ohm Resistor Depos. 0.25 W
R750	19A700019P57	47 Kohm Resistor Depos. 0.25 W
R752	19A700016P3	4.7 Kohm Resistor Variable
R753	19A700019P37	1 Kohm Resistor Depos. 0.25 W
R754	19A700019P25	100 ohm Resistor Depos. 0.25 W
R761	19A700019P13	10 ohm Resistor Depos. 0.25 W
R763	19A700019P51	15 Kohm Resistor Depos. 0.25 W
R765	19A700019P26	120 ohm Resistor Depos. 0.25 W
R769	19A700019P34	560 ohm Resistor Depos. 0.25 W
R770	19A700019P42	2.7 Kohm Resistor Depos. 0.25 W
R771	19A700019P15	15 ohm Resistor Depos. 0.25 W
R772	19A700019P57	47 Kohm Resistor Depos. 0.25 W
R773	19A700019P55	33 Kohm Resistor Depos. 0.25 W
R774	19A700019P50	12 Kohm Resistor Depos. 0.25 W
R775	19A700019P40	1.8 Kohm Resistor Depos. 0.25 W
R776	19A700010P37	1 Kohm Resistor Depos. 0.25 W
R777	19A700019P21	47 ohm Resistor Depos. 0.25 W
R778	19A700019P25	100 ohm Resistor Depos. 0.25 W
R779	19A700019P35	680 ohm Resistor Depos. 0.25 W
R780	19A700019P23	68 ohm Resistor Depos. 0.25 W
R781	19A700019P19	33 ohm Resistor Depos. 0.25 W
R782	19A700019P44	3.9 Kohm Resistor Depos. 0.25 W
R783	19A700019P27	150 ohm Resistor Depos. 0.25 W
R784	19A700019P25	100 ohm Resistor Depos. 0.25 W
R785	19A700019P39	1.5 Kohm Resistor Depos. 0.25 W
R786	19A700019P31	330 ohm Resistor Depos. 0.25 W
R787	19A700019P43	3.3 Kohm Resistor Depos. 0.25 W
R788	19A700019P26	120 ohm Resistor Depos. 0.25 W
R789	19A700019P34	560 ohm Resistor Depos. 0.25 W
R791	19A700019P30	270 ohm Resistor Depos. 0.25 W
R792	19A700019P38	1.2 Kohm Resistor Depos. 0.25 W
R793	19A700019P17	22 ohm Resistor Depos. 0.25 W
R794	19A700019P17	22 ohm Resistor Depos. 0.25 W

NO	CODE	DATA
R798	19A700019P37	1 Kohm Resistor Depos. 0.25 W
R799	19A700019P54	27 Kohm Resistor Depos. 0.25 W
S901	19J706322G1	Channel Switch
T701	19J706284G1	Transformer
U701	19J706263P1	MC145106
U702	19J706238P1	INT CKT TDA 1062 S
U703	19A700029P44	4066B IC

FREQUENCY SYNTHESIZER FS5332

X402.898/2

GENERAL DESCRIPTION

CQM5660 S12

The Stornophone 5000 is a mobile radiotelephone unit with self-contained controls and loudspeaker.

A comparison of the various models is presented in the table below.

Although compact in size, it contains a transmitter/receiver, optional 5-tone sequential encoder/decoder or Channel Guard, and up to 12 transmit and receive channels.

Type	CQM5662		CQM5663	
SPEC	5	20	5	20
Frequency Range MHz	420 - 470		420 - 470	
RF Power W	5	20	5	20
Channel Spacing kHz	30/25		20	
Max. Number of Channels	12		12	

ACCESSORIES

STANDARD ACCESSORIES

Mounting frame

Power cable

Fist microphone with retainer or

Fixed - mount microphone

External loudspeaker

External switches

LS701 Loudspeaker enclosed in a plastic housing, complete with cable.

MC702b Dynamic fist microphone with adjustable output level.

JB701a Junction box for MC702b. Consists of a plastic housing provided with cable for soldering assembly. Junction box is to mounted behind the first microphone retainer.

MC703a Desk microphone with PTT (Push -to - Talk) switch for fixed installations.

MC704 Microphone with chockabsorbing mounting bracket for mobile installation.

MK704 Mounting kit consisting of 2 flexible tubes, used for mounting the MC704 in close-talk position.

MC5001

HS5001

HS5002

MC5002

HS5003

HS5004

MK5001

MN703

MN704

MN5001

MN5002

MT5001

Fist microphone with retractable spiral cable for mobile installation.

Retainer for MC5001

Retainer, with switches, for MC5001

Cylindrical handmicrophone with build-in amplifier and press-to talk switch. Fitted with a coiled cord terminated into a connector which fits into the microphone retainer.

Retainer for MC5002, without hook switch.

Retainer for MC5002, with hook switch.

Installation kit containing connectors, power cable, fuses and fuseholders.

Desk stand for fixed installations.

Mounting bracket for the radio cabinet.

Mounting frame for mobile installations allowing the radio to be fixed in 36 positions. Includes a base plate with locking screw.

Mounting cassette for the radio cabinet (see mechanical layout).

Microphone with retainer. The retainer contains a microswitch which is

	used to switch off the internal loud-speaker, when the microphone is lifted.
SU701	Transmitter keying switch for mounting on the steering column.
SU702	Transmitter keying switch for mounting on the dashboard.
SU704	Switch circuit for autoradio mounting.
SU5003	External alarm with timer (Horn Alarm).

POWER SUPPLY UNITS:

Equipment	SUPPLY 220V AC	VOLTAGE +24V DC
CQM5000, max. 5 W	PS703	PS704
CQM5000, max. 20 W	PS5001	PS702

MECHANICAL AND ELECTRICAL DESCRIPTION

The internal construction of CQM5000 is on an H-frame chassis with a shelf separating the receiver/transmitter (RF) printed circuit board and the various option printed boards. Front panel controls are an integral part of the printed board assemblies.

The chassis is a die cast aluminium frame comprising the left and right sides, the back, and a shelf located midway between the top and bottom. The chassis front is open and looks like an "H" viewed from the front.

Interconnection to the package exterior and to internal options are made via the Frequency Synthesizer Board located on the option side of the H-frame. A test connector is also located on the synthesizer board and is accessible from the rear of the radio.

The moulded plastic front is directly attached to the chassis and has the speaker mounted to it. A separate moulded speaker grill and aluminum nameplate are attached to the front.

The top and bottom covers slide under the edge of the front and are then secured by screws at the rear.

The tone signalling encoder/decoder board (TQ), the Frequency Synthesizer Board (FS) and the Frequency Control (FC) mount in the top section of the chassis. Their switches and push buttons mount directly to the boards and protrude through the front.

Thin casted shields with adjustment holes are placed over the transmitter and receiver oscillators and parts of the transmitter in order to reduce spurious radiation.

CIRCUIT DESCRIPTION

RECEIVER

The receiver circuitry is placed on the main board and can be divided into:

- Receiver front end
- 1st IF section with first and second oscillator.
- 455 kHz 2nd IF section with demodulator.

(refer to functional block diagram)

FRONT-END

The receiver front-end consists of a dual-resonator input filter, a transistor RF amplifier, Q401, a triple-resonator intermediate filter and a FET mixer, Q402. The drain of the FET is terminated in the first IF resonant circuit which adapts the output impedance to the crystal filter. The front-end, antenna relay, first mixer and part of the transmitter PA interconnections are designed in micro-stripline techniques on the mainboard.

RECEIVER ADJUSTMENT

CHECKING 8.5 V REGULATED SUPPLY

Turn the power supply ON and set the voltage to 13.2 V. Set the power supply current limiter to 1 A.

Turn the radiotelephone ON by depressing the ON/OFF button. Note the light in the Channel selector, if any, is on.

Depress the Squelch button.

Set the volume control to minimum.

Connect the DC voltmeter to J901 pin 3 and read the Voltage.

Requirement: 8.5 V ± 0.15 V

If the requirement is not fulfilled check resistor R636 against the colour code of U602.

U602 colour code	R636 Value
Brown	omit
Red	270
Orange	100
Yellow	47
Green	22
Blue	6.8

Adjust the power supply voltage to 16.6 V and read the 8.5 V regulated. Compare the change in the 8.5 Volt regulated to the value obtained at 13.2 V.

Requirement: ≤ 50 mV

Repeat the procedure with the power supply adjusted for 10.8 V

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and PROM codes.

Mixer crystal output

Connect RF diode probe 95.0089-00 with multimeter to test point TP701. (1 V range).

Adjust L711 for maximum deflection on the multimeter.

Adjust L707 for maximum deflection on the multimeter.

Requirement: 45 mV ± 15 mV

(corresponding to -10 dBm to -4 dBm).

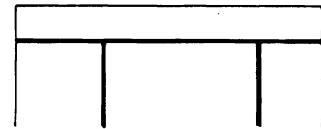
Note: Be careful not to resonate L707 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Receiver VCO

Connect the oscilloscope to test point TP706.

The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition is indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible.

Connect the multimeter to test point TP703.

Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 4.8 volt (4.0 + 0.8)

Center channel reading: 4.0 volts

Low channel reading: 3.2 volt (4.0 - 0.8)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

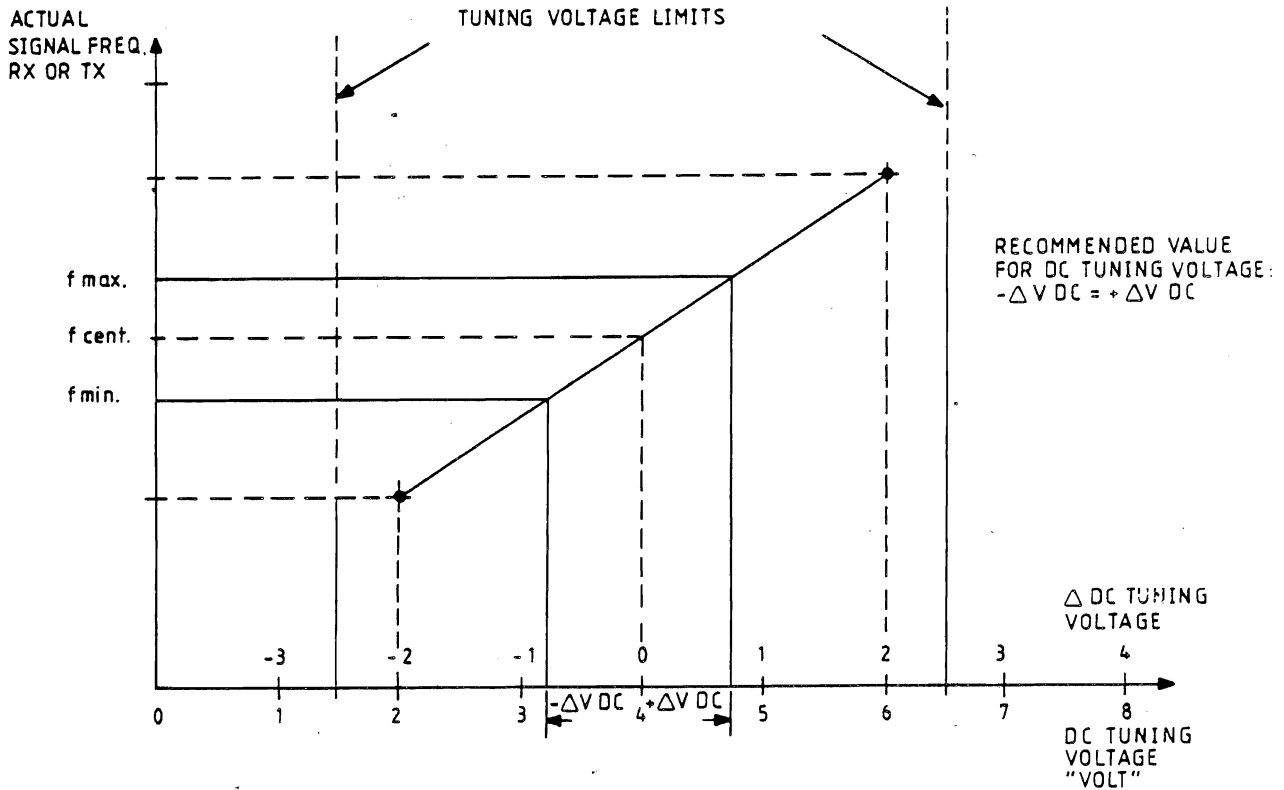
Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe and read the frequency.

$$f = f_x \times 3 \quad (f_x = \text{crystal frequency})$$

Adjust L711 to the calculated frequency.



Requirement: $f \pm 0.3 \text{ ppm}$ at 25°C .
 $\text{ppm} = \text{parts per million} = 10^{-6}$

Injection Frequency

Connect coax probe 95.0179-00 to test point TP401.
 Connect the frequency counter to the probe.
 Calculate the injection frequency for all channels.

$$f_{inj} = f_{ant} - 21.4 \text{ (MHz)}$$

Select, one by one, the channels and read the injection frequency.

Requirement: $F_{inj} \pm 0.2 \text{ ppm}$

IF AMPLIFIERS

Connect a 21.4 MHz signal generator to TP401 via coax probe 95.0179-00.
 Connect RF diode probe 95.0089-00 with multimeter to test point TP501. (50 uA range).
 During adjustment the RF generator output must be kept low enough to prevent limiting

in the IF stages, i.e. a maximum reading of 50 uA on the multimeter.

Adjust coils L503, L502, L501, and L406, in that order, for maximum deflection on the multimeter.

FRONT-END

Connect the RF probe 95.0089-00 and the multimeter to test point TP501. (50 uA range).
 Connect an unmodulated RF generator to the antenna connector, J601.

Set the generator frequency to the receiver frequency.

Adjust the generator output to produce a deflection on the multimeter, i.e. a maximum reading of 50 uA on the multimeter.

Adjust L401 and L402 for maximum deflection.

Detune L406: Adjust L405 and L407 for maximum deflection on the multimeter.

Adjust L406 for maximum deflection.

SELF QUIETING CHECK

Internal oscillators, dividers and the harmonic frequencies hereof, may cause self quieting of the receiver if a mixer product falls in the RF or IF pass band.

For proper operation of the squelch all channels must be checked for the self quieting phenomenon.

Connect the RF generator to the antenna connector. Reduce the RF output to 0. Set the frequency outside the 420 - 470 MHz band.

Alternatively, an attenuator (50 ohm) may be connected to the antenna connector.

Connect an AF voltmeter across the 4 ohm speaker load.

Adjust the volume control for 774 mV (0 dBm) as read on the AF voltmeter.

Select, in turn, all allocated channels.

The reading on the AF voltmeter shall not on any selected channel decline more than 6 dB.

Requirement: Quieting ≤ 6 dB.

AF POWER OUTPUT

Adjust the RF signal generator to Standard Test Condition.

Set the supply voltage to 13.2 V.

Adjust the volume control for 3 W output (3.46 V across the 4 ohm load).

Measure the distortion (THD).

Requirement: THD $\leq 5\%$.

SQUELCH

Release the squelch cancel button.

Adjust potentiometer R607 squelch adj. to open the receiver for an RF input signal corresponding to 8-10 dB SINAD.

The final squelch adjustment must not be set on a channel that has shown a minor degree of selfquieting.

CURRENT CONSUMPTION

Measure the current consumption at 13.2 V.

Requirements

Condition	Current consumption
Standby	≤ 400 mA
Receive 2 W AF ~ 2.83 V r.m.s. across 4 ohm.	≤ 750 mA

For sets with selective calling facilities add current consumption of the tone unit to the figures above.

TRANSMITTER ADJUSTMENT

Adjust the power supply voltage to 13.2 V and set current limiter as follows:

- 20 W transmitter: 6A
- 5 W transmitter: 4A

Refer to Receiver Alignment for measuring 8.5 V regulated supply.

Preset all transmitter tuning slugs, L151, L153, L201, L202, L204, and L205 to be flush with the coil form top.

Connect a multimeter (2.5 volt range) to test point TP201.

Turn the power control potentiometer, R221, to minimum, anticlockwise (CCW).

Connect a Wattmeter, (25 W) to the antenna connector, J601.

FREQUENCY SYNTHESIZER ALIGNMENT

Check the PROM U801, the TX mixer crystal, the RX mixer crystal, and the reference crystal and verify the frequencies and the prom codes.

Mixer crystal output

Connect RF probe 95.0089-00 with multimeter to test point TP701 (1 V range).

Key the transmitter.

Adjust L701 for maximum deflection on the multimeter.

Adjust L704 for maximum deflection on the multimeter.

Requirement:

40 mV ± 15 mV

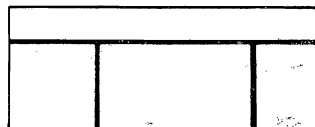
(corresponding to -10 dBm to -4 dBm)

Note: Be careful not to resonate L704 to the false harmonics. If in doubt consult table 1 or check the crystal oscillator output with a spectrum analyzer.

Transmitter VCO

Connect the oscilloscope to test point TP706. The oscilloscope measures the synthesizer's lock signal which is +8 volts with very narrow negative going pulses when in locked position. Unlocked condition is indicated by a variable duty signal or logic "low".

Typical trace for locked condition



The pulse-repetition rate is 10 or 12.5 kHz corresponding to the channel spacing respectively. Select the channel whose frequency is closest to the center frequency.

Adjust C745 for as narrow pulses as possible. Connect the multimeter to test point TP703. Adjust C745 for 4.0 volt on the multimeter.

If the radio has more than one channel adjust C745 so that the multimeter reading for all channels are evenly distributed around 4.0 volt. The high channel frequency shall give a voltage reading above 4.0 volt equal to the low channel reading below 4.0 volt.

Example:

High channel reading: 5.1 volt (4.0 + 1.1)

Center channel reading: 4.0 volts

Low channel reading: 2.9 volt (4.0 - 1.1)

The deviation of the voltage reading from 4.0 volts depends on the spread of the high and low channel.

Mixer Crystal Frequency

Connect coax probe 95.0179-00 to test point TP701.

Connect the frequency counter to the probe, key the transmitter and read the frequency. $f = f_x \times 3$ (f_x = crystal frequency).

Adjust L701 to the calculated frequency.

Requirement: $f \pm 0.3$ ppm at 25°C.

ppm = parts per million = 10^{-6} .

Synthesizer Output Level

Connect a multimeter, 2.5 V range, to test point TP201. Key the transmitter.

Adjust L153 for maximum deflection on the multimeter, typical more than 0.75 V.

EXCITER

Connect a multimeter (1.0 V range) to test point TP201.

Adjust L203 for minimum deflection. The dip is small.

Connect the multimeter, (1 V range) to test point TP202.

Adjust L204 for maximum deflection on the multimeter, typical 0.7 V.

Repeat the adjustments of L203, L153, and L151 (L921-L926) until no further improvements is obtainable.

Adjust C213 for minimum reading. The dip is small.

Connect the multimeter, 1 volt range, to test point TP203.

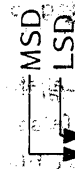
Adjust C215 for maximum reading on the multimeter, typical 0.5 V.

Least Significant Digit (LSD) of Hex Code

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271
1	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287
2	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303
3	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319
4	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335
5	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
6	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367
7	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383
8	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399
9	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415
A	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431
B	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447
C	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463
D	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479
E	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495
F	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511

Most Significant Digit of Hex Code.

"V DEC" Numbers.



Example "V DEC" = 345 equals to hex code 59.

"V DEC" = 469 equals to hex code D5.

Table 4.

"V" Number to hex code conversion table.