61.042-E1

MAINTENANCE MANUAL

CQM5000

VOLUME III

SEE:

VOLUME I AND VOLUME II

STORNOPHONE 5000
Maintenance Manual
Section 8

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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. Reciept 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 by 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. Simultanously 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 accomodate a Group Call unit, SU5001, when an extention 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

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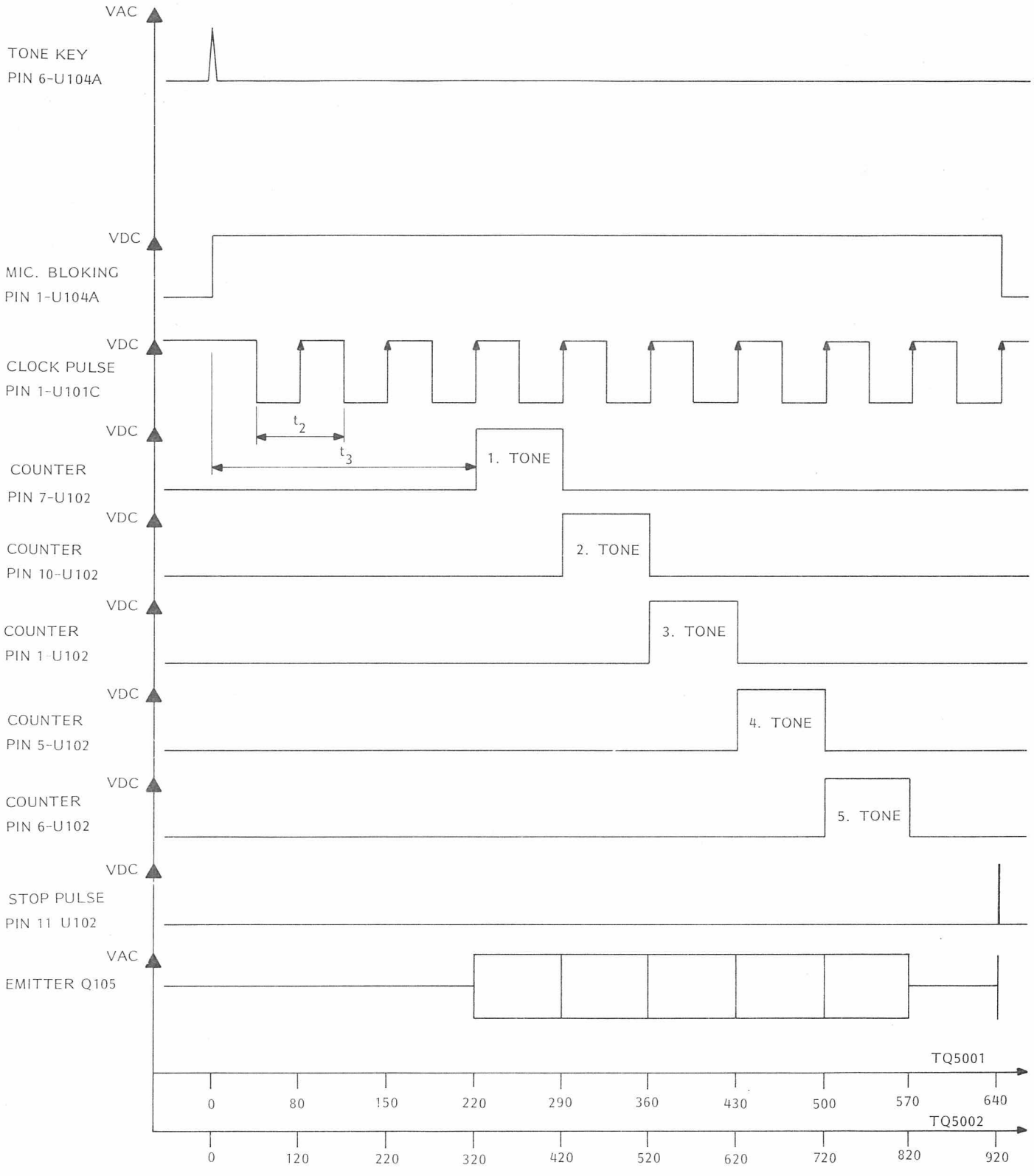
when the selective circuit is part of the tone transmitter.
Owing to the high signal voltage across the selective circuit the gate transistors are biased in the nonconductive direction, and simultaneously the tone and oscillator signal amplitude is limited.
If the level of the 1st tone is within the 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 lenght 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 preceeding 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 $\overline{Q}$ 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



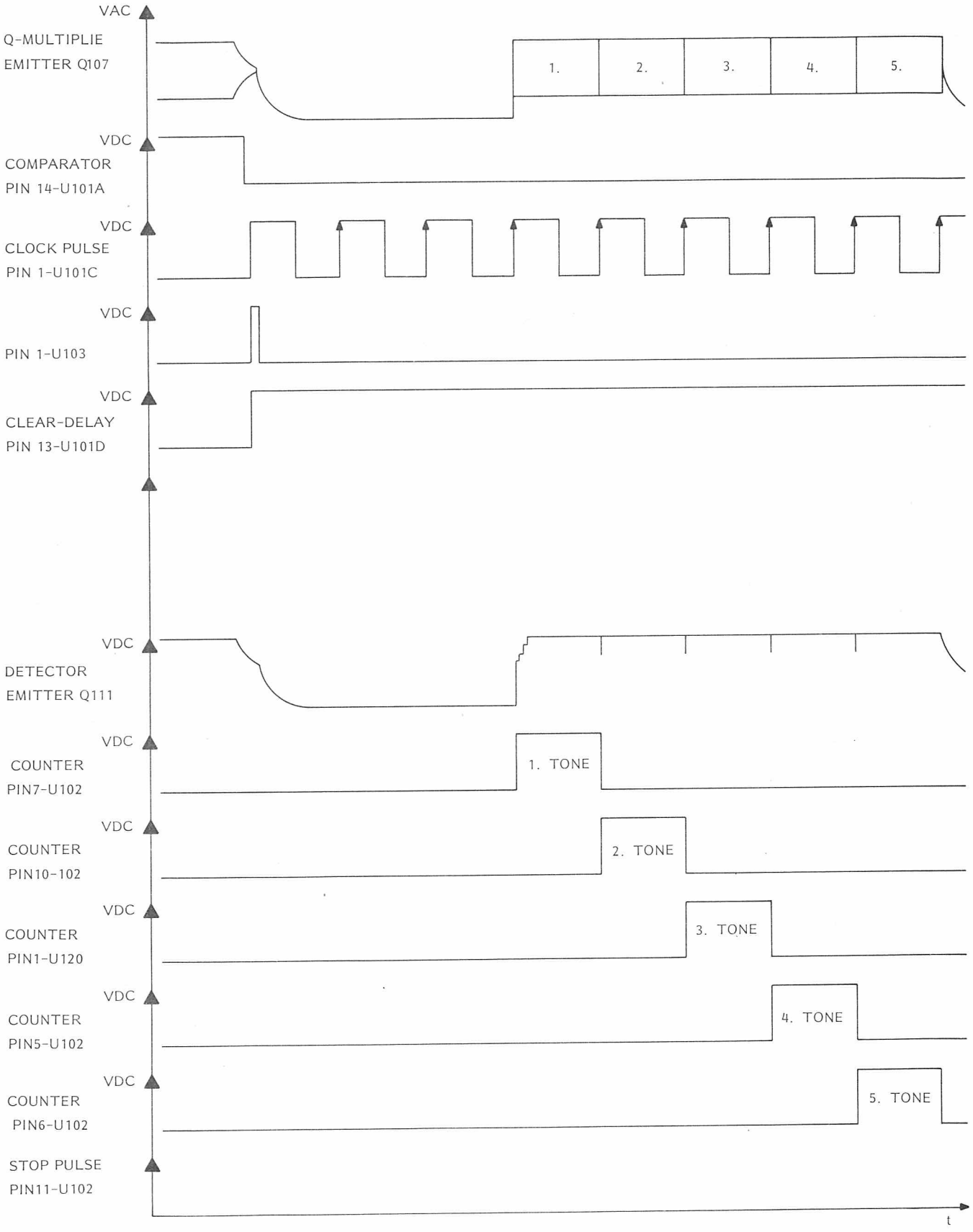
LOUDSPEAKER MANUALLY TURNED ON

t_1 CHARGING TIME FOR CLOCK GENERATOR

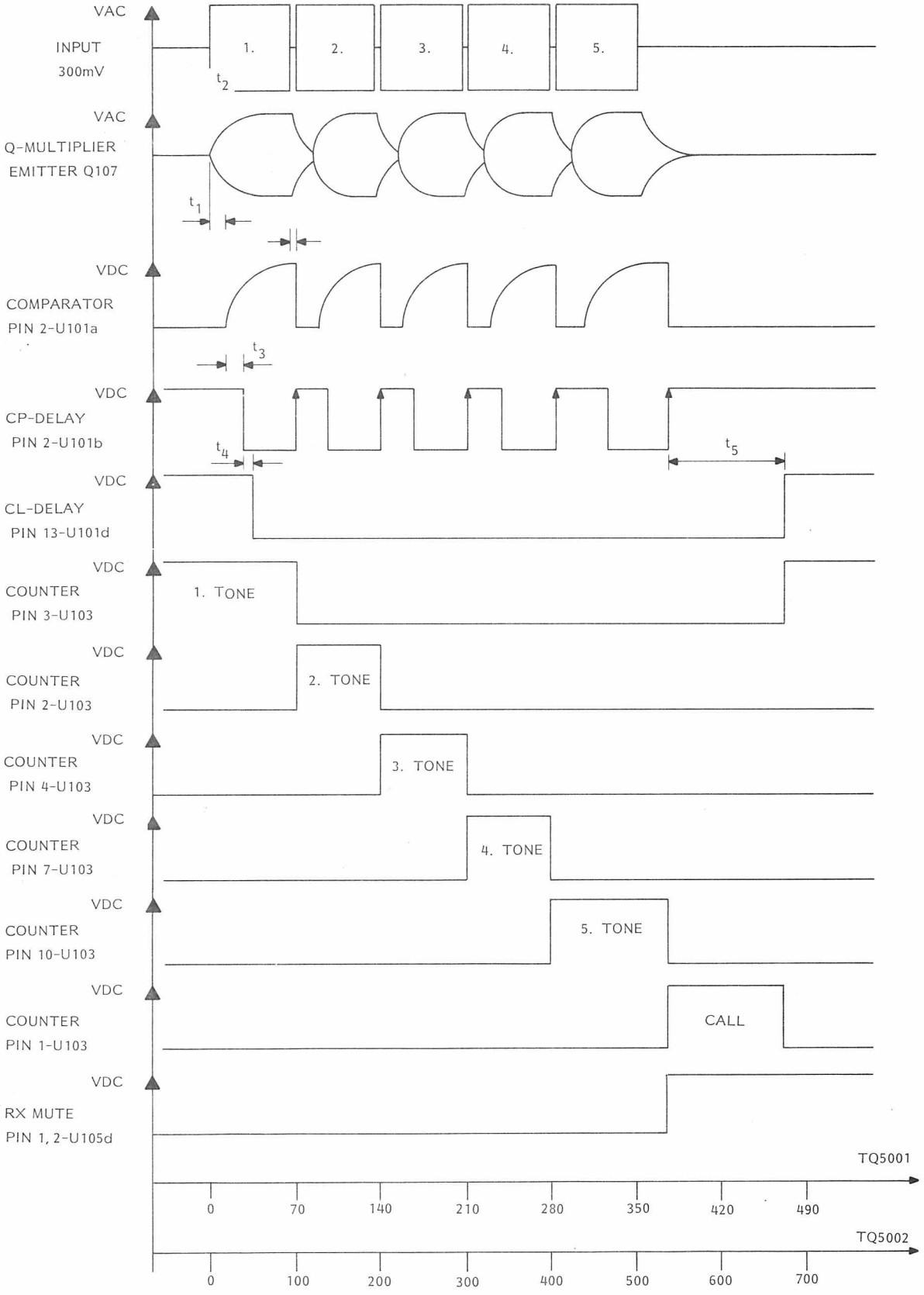
t_2 CLOCK PULSE PERIOD (TONE LENGHT)

t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

PULSE-TIME DIAGRAM FOR 5-TONE AUTOMATIC RECEIPT

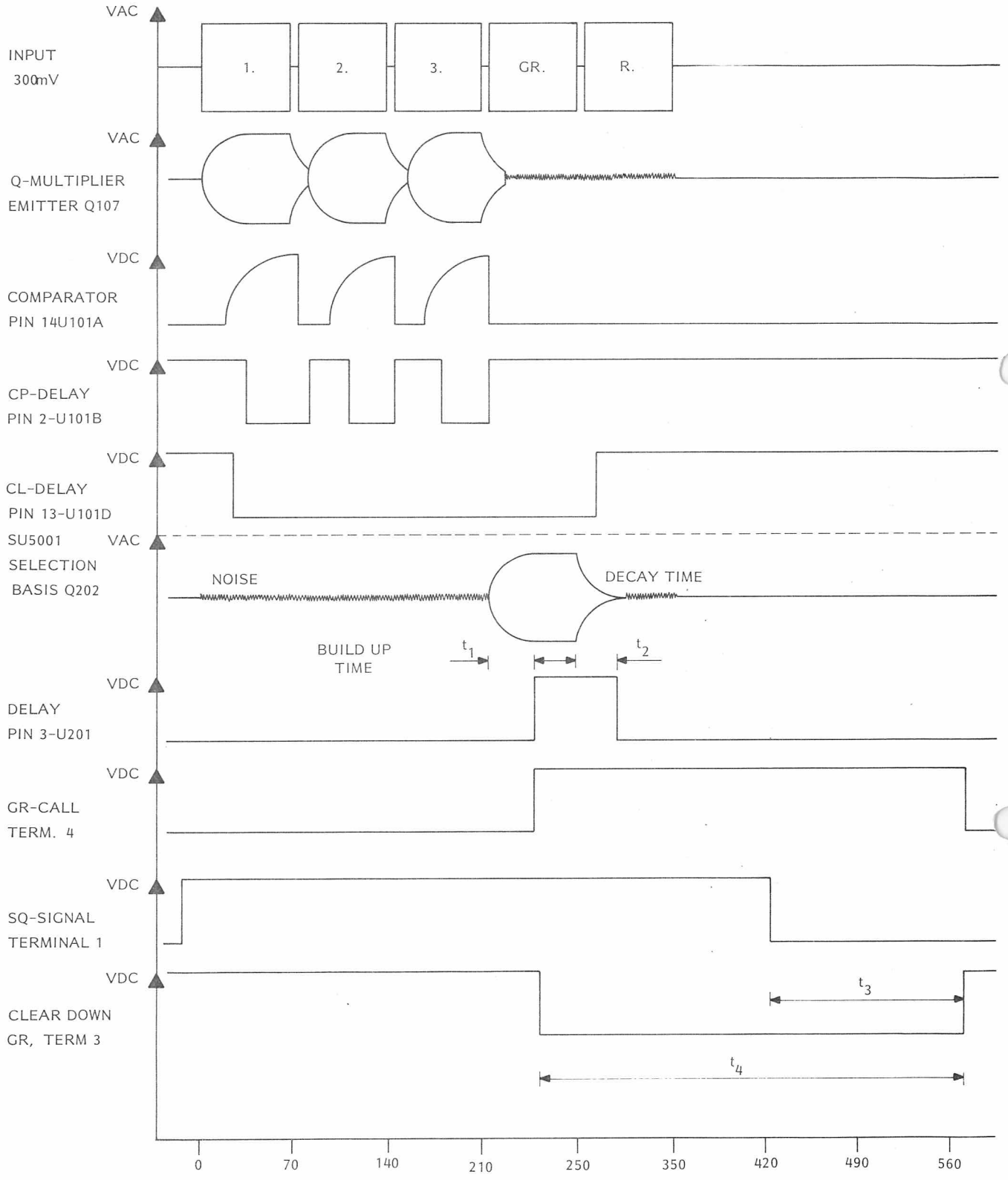


PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5001 AND TQ5002



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 accociated 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 resonent 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 lenght 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 termined 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 transistion 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 coltage, 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 references 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 deagrams.

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 manuel 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
$-30^{o}C$ to $+60^{o}C$

SEQUENTIAL TONE TRANSMITTER

Output Impedance
50Kohm max.

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Output Signal

3.4 or 5 tones in burst of 70ms ± 15ms.
The interval between triggering and emission of the 1st tone is min. 200ms.

Signal output level

600mV emf. max.

Frequency response

Flat. ± 1dB

Distortion

max. 5%

Tone frequencies

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

Frequency accuracy

Typical deviation (2δ)
1%
Maximum deviation
1.4%
Relative frequency accuracy
0.3%
Adjustment accuracy
0.1%
Frequency stability
1%

CONTROL FUNCTIONS

Receipt

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 RECEIVER

Input 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 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

± 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.

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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 TRANSMITTER

Output 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 (2δ)
1%
Maximum deviation
1.4%
Relative frequency accuracy
0.3%
Adjustment accuracy
0.1%
Frequency stability
1%

CONTROL FUNCTIONS

Receipt
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 RECEIVER

Input 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

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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-cricuit 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

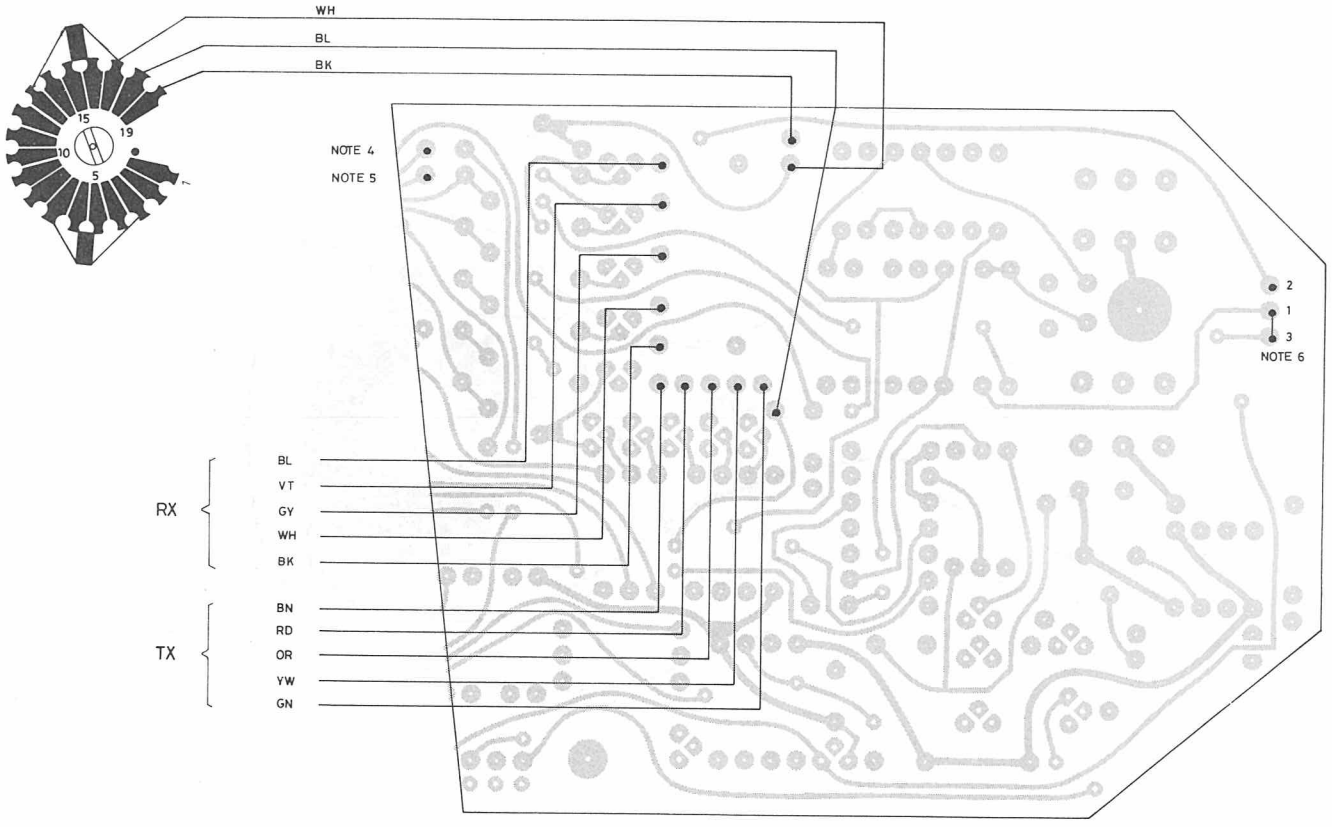

Fig. 1

Viewed from component side

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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	1 st 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

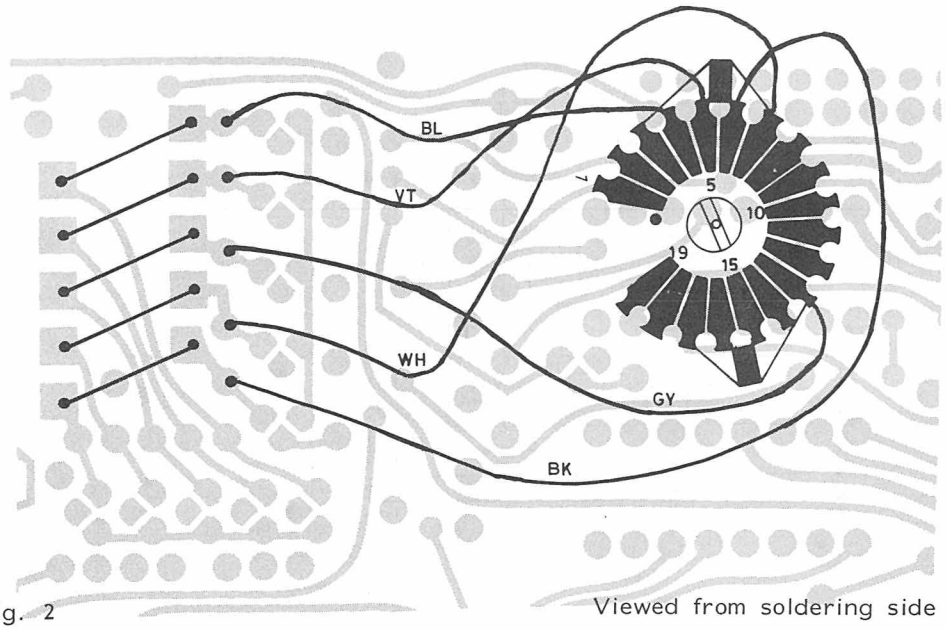


Fig. 2

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.

GROUP CALL UNIT SU5001
ALL CALL UNIT SU5002

The All-Call unit, SU5002, and Group Call unit, SU5001, are identical expect 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.

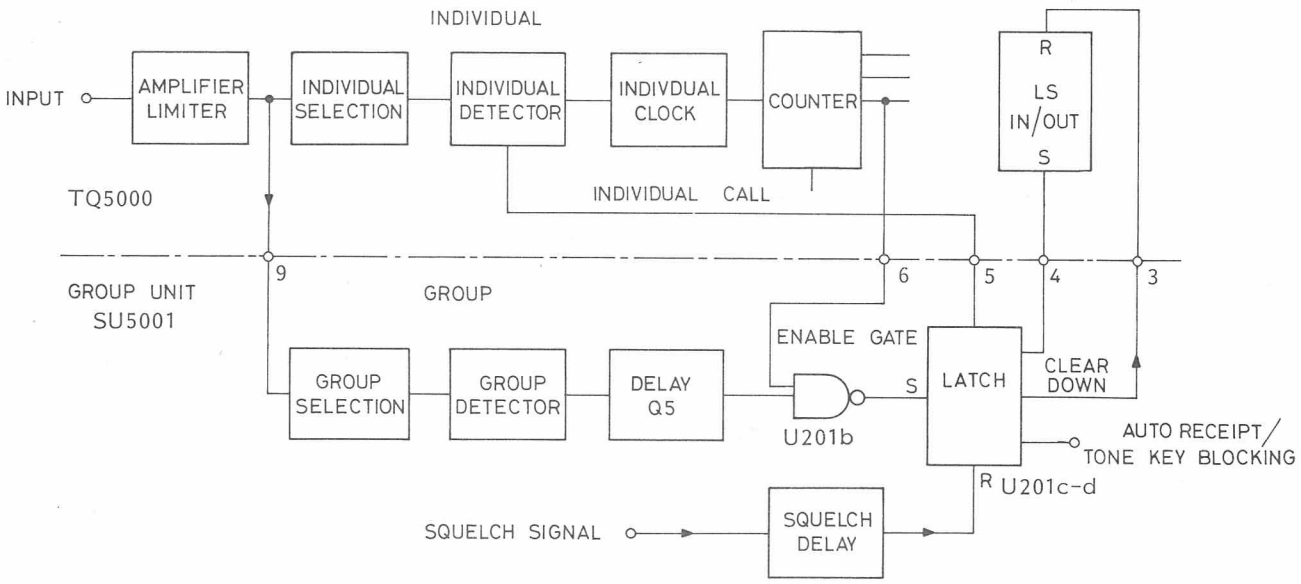
The blockings are all cancelled approximately 500 milliseconds (ms) after the group call is terminated. Also see notes on TQ5001/2 schematic.

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



Storno

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.

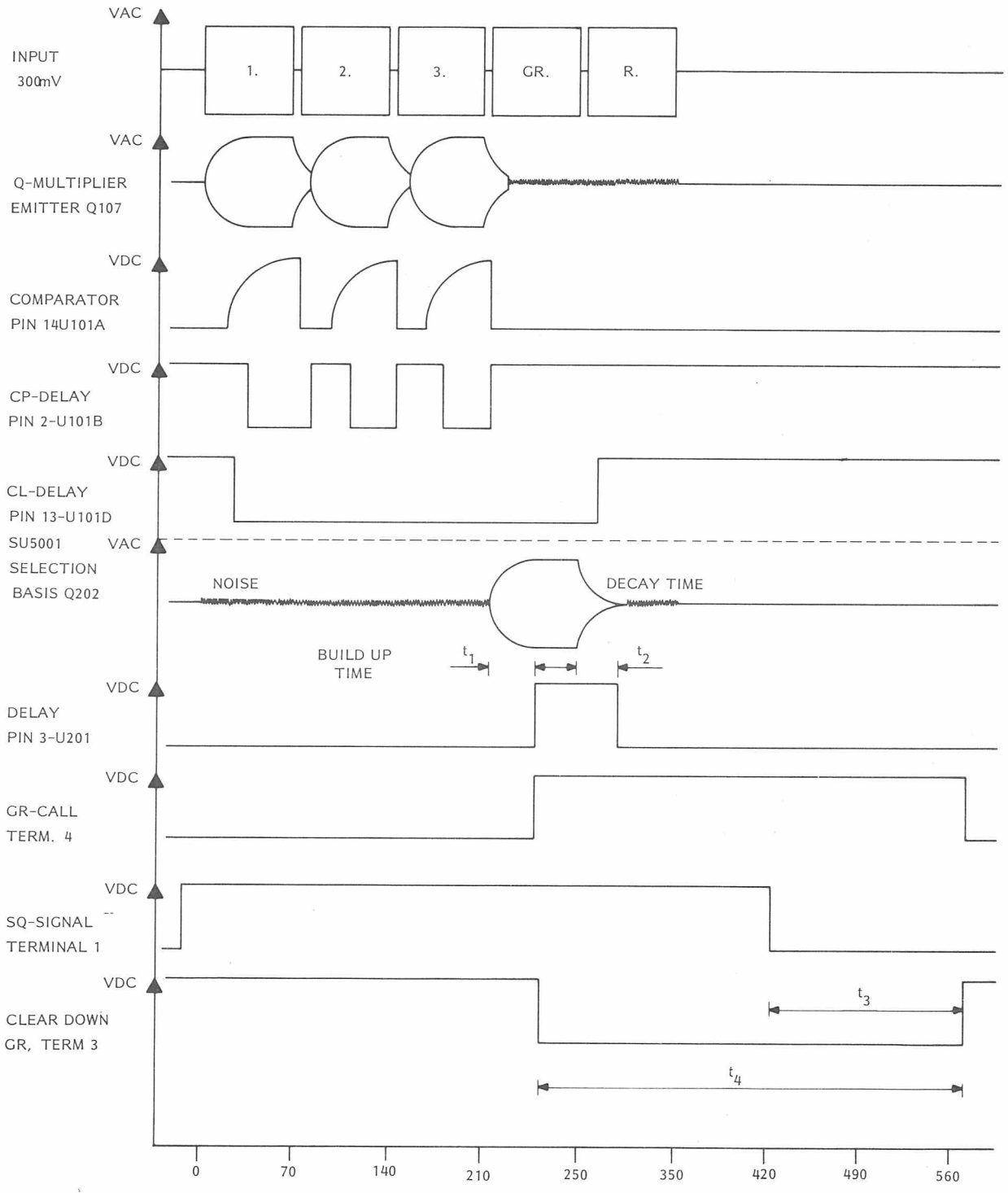
The latch reads out the group call to the indivi-dual tone receiver TQ5001/2 and, simultaneously, establishes the blocking functions:

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.

Storno

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 idential, consercutive tones for which reason digit 0 cannot be used as the last digit of a group number.

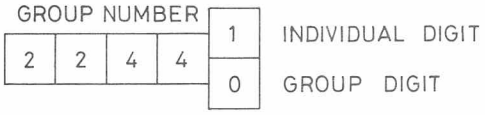
Note

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

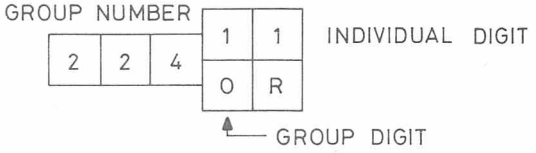
a: SU5001 strapped to 2400Hz (=digit 0).

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



9 individual numbers from 22441 to 22449

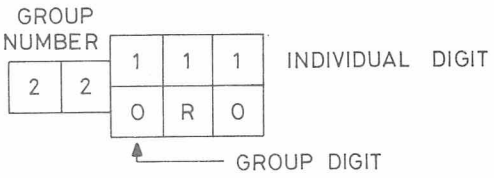
5-digit sequential tone signal with group call on 4th digit



81 individual numbers from 22411 to 22499.

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

(non standard according to ZVEI)

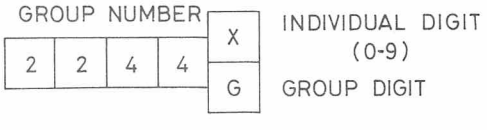


729 individual numbers from 22111 to 22999

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)

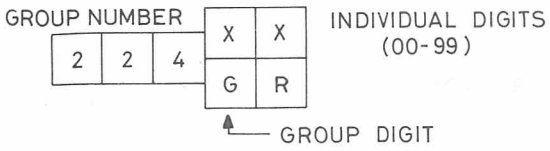
5 digit sequential tone signal with group call on 5th digit



10 individual numbers from 22440 to 22449.

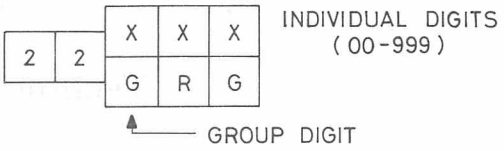
Storno

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

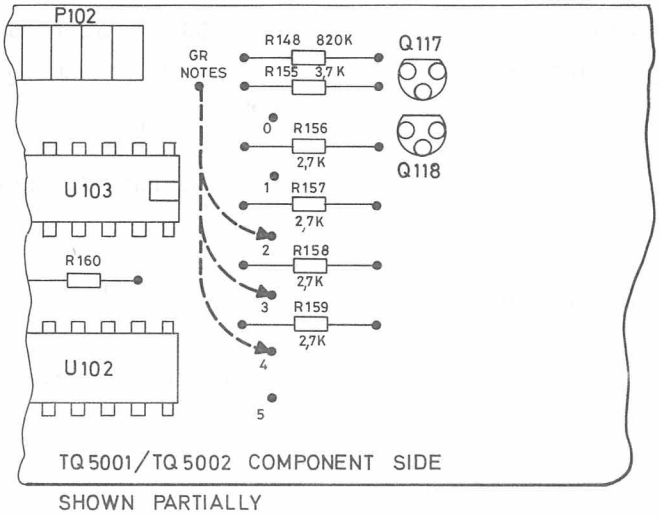


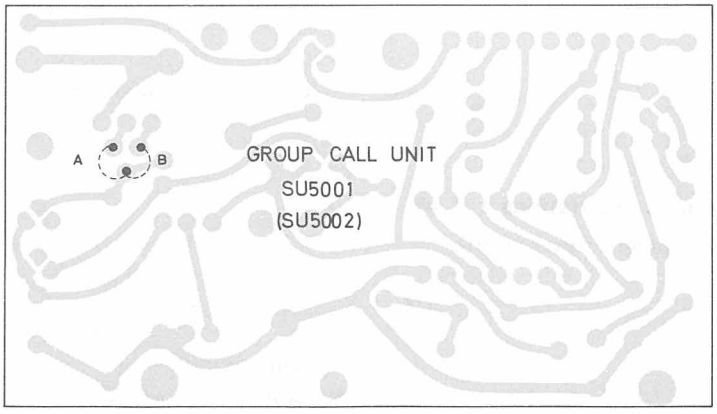
100 individual numbers from 22400 to 22499

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



1000 individual numbers from 22000 to 22999





A = 2800 Hz (DIGIT G)
B = 2400 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.

Storno

GROUP CALL UNIT
SU5001
Technical Specifications

Supply Voltage
8.5V ± 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 55 ms duration. The location of the group tone is coded on the TQ5001/TQ5002.

Tone Frequencies
2400Hz, 2800Hz.

Frequency Accuracy
± 0.3%

Selectivity
SU5001 responds to frequency deviations ± 1.4%. SU5001 is insensitive to adjacent tones of the same standard series.

Reaction Time
30ms ± 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 ± 0.25V

Current Drain
Standby: 0.5 mA (no external load)
Engaged: approx. 0.65 mA (with SQ signal)

Temperature Range
$-30^{o}C$ to $+60^{o}C$.

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
± 0.3%

Selectivity
SU5002 responds to frequency deviations ± 1.4%.
SU5002 is insensitive to adjacent tones of the same standard series.

Reaction Time
2 seconds ± 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

Appendix

SU5002

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.

Storno

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 toneequipment 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

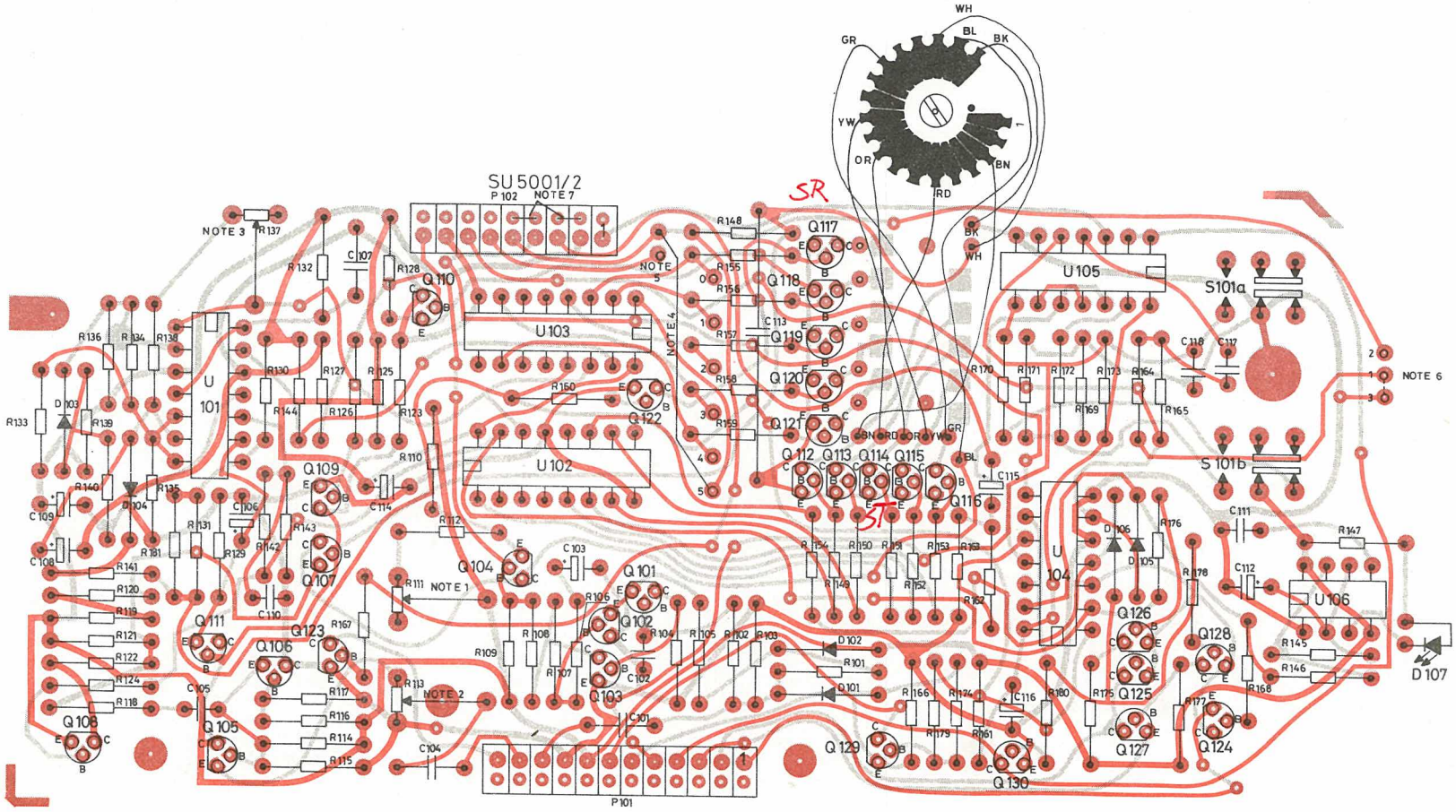
Input
Alarm: A short pulse grounding the input terminal will actuate the relay for approx. 1 second.

Mute: A ground connection will actuate the relay.

Storno

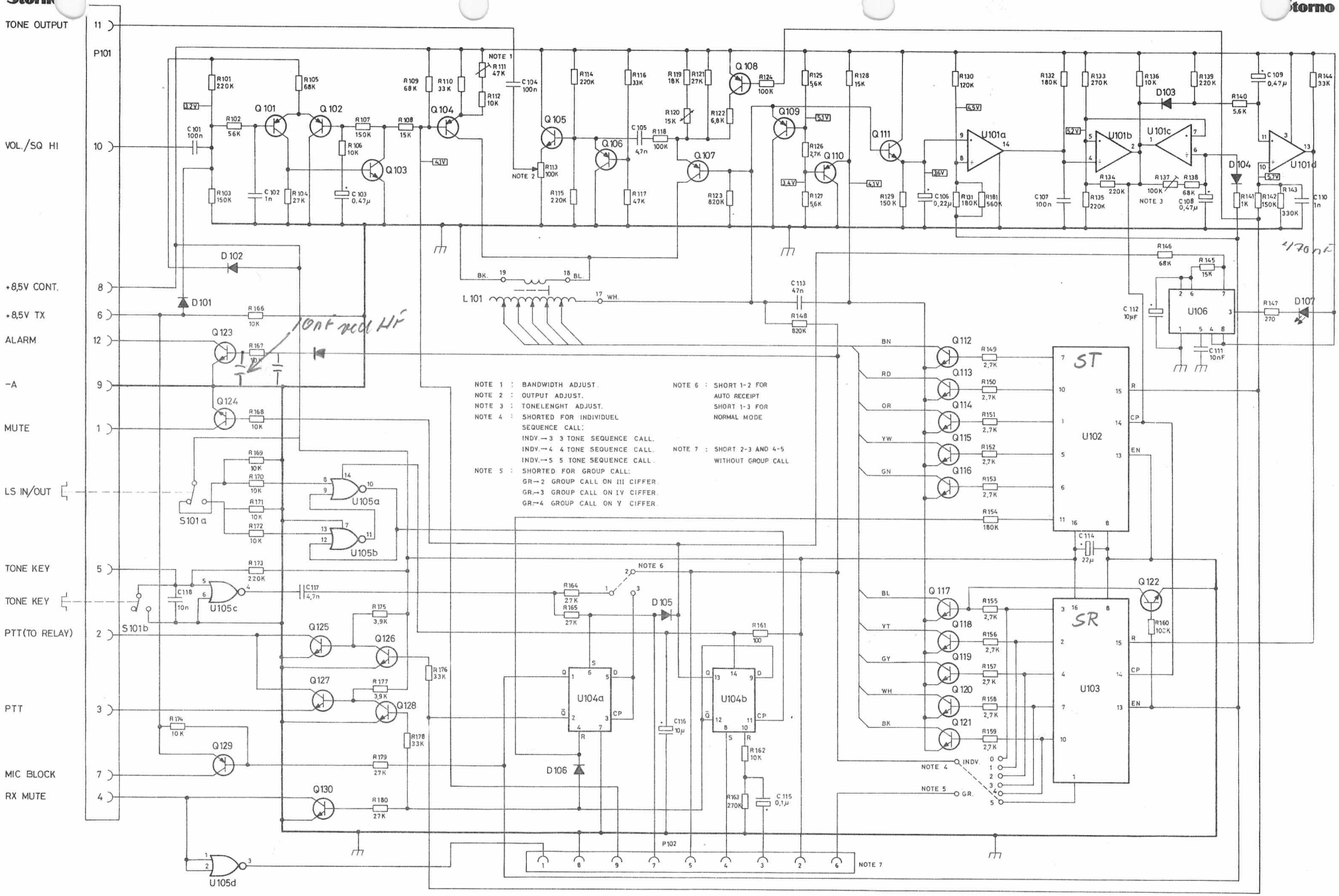
Storno

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



SEQUENTIAL TONE UNIT
TQ 5001, TQ 5002

0402.610

Storno

TYPE	Nº	CODE	DATA	
	C101	76.5144	0.1 uF 10% Polyest. FL	63 V
	C102	76.5129	1 nF 10% Polyest. FL	50 V
	C103	73.5169	0.47 uF 20% Tantal	35 V
	C104	76.5144	0.1 uF 10% Polyest. FL	63 V
	C105	76.5133	4.7 nF 10% Polyest. FL	50 V
	C106	73.5168	0.22 uF 20% Tantal	35 V
	C107	76.5144	0.1 uF 10% Polyest. FL	63 V
	C108	73.5169	0.47 uF 20% Tantal	35 V
	C109	73.5169	0.47 uF 20% Tantal	35 V
	C110	76.5129	1 nF 10% Polyest. FL	50 V
	C111	76.5135	10 nF 10% Polyest. FL	50 V
	C112	73.5173	10 uF 20% Tantal	16 V
	C113	76.5123	47 nF 25% Polyest. TB	63 V
	C114	73.5174	22 uF 20% Tantal	16 V
	C115	73.5167	0.1 uF 20% Tantal	35 V
73.5109.00 →	C116	73.5173	10 uF 20% Tantal	16 V
	C117	76.5133	4.7 nF 10% Polyest. FL	50 V
	C118	76.5135	10 nF 10% Polyest. FL	50 V
	D101	99.5237	1N4148 Diode	
	D102	99.5237	1N4148 Diode	
	D103	99.5237	1N4148 Diode	
	D104	99.5237	1N4148 Diode	
	D105	99.5237	1N4148 Diode	
	D106	99.5237	1N4148 Diode	
Storno →	D107	99.5325	LED Yellow	
L1: K80529961	L1	61.1366	Tone coil	
CCIR L2: K80529962	P101	41.5549	Fem. Connector	2 PIN
	P102	41.5548	Fem. Connector	9 PIN
	Q101	99.5230	BC308 Transistor	
	Q102	99.5230	BC308 Transistor	
	Q103	99.5230	BC308 Transistor	
	Q103	99.5115	BC238 Transistor	
	Q104	99.5230	BC308 Transistor	
	Q105	99.5115	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	99.5115	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	

Storno

TYPE	Nº	CODE	DATA	
	Q119	99.5324	BC338-25 Transistor	
	Q120	99.5324	BC338-25 Transistor	
	Q121	99.5115	BC238 Transistor	
	Q121	99.5324	BC338-25 Transistor	
99.5143-00 →	Q123	99.5115	BC238 Transistor	
	Q124	99.5115	BC238 Transistor	
	Q125	99.5115	BC238 Transistor	
	Q126	99.5115	BC238 Transistor	
	Q127	99.5115	BC238 Transistor	
	Q128	99.5115	BC238 Transistor	
	Q129	99.5230	BC308 Transistor	
99.5143-02 →	Q130	99.5115	BC238 Transistor	
	R101	80.5277	220 Kohm 5% Carbon film	0.125 W
	R103	80.5275	150 Kohm 5% Carbon film	0.125 W
	R104	80.5266	27 Kohm 5% Carbon film	0.125 W
	R106	80.5261	10 Kohm 5% Carbon film	0.125 W
	R107	80.5275	150 Kohm 5% Carbon film	0.125 W
	R108	82.5263	15 Kohm 5% Carbon film	0.125 W
	R109	80.5271	68 Kohm 5% Carbon film	0.125 W
	R110	80.5267	33 Kohm 5% Carbon film	0.125 W
	R111	86.5036	47 Kohm 20% Carbon pot.	0.05 W
	R112	80.5261	10 Kohm 5% Carbon film	0.125 W
	R113	86.5074	100 Kohm 20% Carbon pot.	0.1 W
	R114	80.5277	220 Kohm 5% Carbon film	0.125 W
	R115	80.5277	220 Kohm 5% Carbon film	0.125 W
	R116	80.5267	33 Kohm 5% Carbon film	0.125 W
	R117	80.5269	47 Kohm 5% Carbon film	0.125 W
	R118	80.5273	100 Kohm 5% Carbon film	0.125 W
	R119	80.5264	18 Kohm 5% Carbon film	0.125 W
	R120	80.5270	56 Kohm 5% Carbon film	0.125 W
	R120	89.5010	15 Kohm 20% NTC	0.5 W
	R121	80.5266	27 Kohm 5% Carbon film	0.125 W
	R122	80.5259	6.8 Kohm 5% Carbon film	0.125 W
	R123	80.5284	820 Kohm 5% Carbon film	0.125 W
	R124	80.5273	100 Kohm 5% Carbon film	0.125 W
	R125	80.5258	5.6 Kohm 5% Carbon film	0.125 W
	R125	80.5271	68 Kohm 5% Carbon film	0.125 W
	R126	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R127	80.5258	5.6 Kohm 5% Carbon film	0.125 W
	R128	80.5263	15 Kohm 5% Carbon film	0.125 W
	R129	80.5275	150 Kohm 5% Carbon film	0.125 W

SEQUENTIAL TONE UNIT TQ5001

SEQUENTIAL TONE UNIT TQ5002

X402.645

TYPE	Nº	CODE	DATA	
	R130	80.5274	120 Kohm 5% Carbon film	0.125 W
	R131	80.5276	180 Kohm 5% Carbon film	0.125 W
	R132	80.5276	180 Kohm 5% Carbon film	0.125 W
	R133	80.5278	270 Kohm 5% Carbon film	0.125 W
	R134	80.5277	220 Kohm 5% Carbon film	0.125 W
	R135	80.5277	220 Kohm 5% Carbon film	0.125 W
	R136	80.5261	10 Kohm 5% Carbon film	0.125 W
	R137	86.5074	100 Kohm 20% Carbon pot.	0.1 W
	R138	80.5271	68 Kohm 5% Carbon film	0.125 W
	R139	80.5277	220 Kohm 5% Carbon film	0.125 W
	R140	80.5258	5.6 Kohm 5% Carbon film	0.125 W
	R141	80.5249	1 Kohm 5% Carbon film	0.125 W
	R142	80.5275	150 Kohm 5% Carbon film	0.125 W
	R143	80.5279	330 Kohm 5% Carbon film	0.125 W
	R144	80.5267	33 Kohm 5% Carbon film	0.125 W
	R145	82.5263	15 Kohm 5% Carbon film	0.125 W
	R146	80.5271	68 Kohm 5% Carbon film	0.125 W
	R147	80.5243	270 ohm 5% Carbon film	0.125 W
	R148	80.5284	820 Kohm 5% Carbon film	0.125 W
	R149	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R150	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R151	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R152	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R153	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R154	80.5276	180 Kohm 5% Carbon film	0.125 W
	R155	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R156	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R157	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R158	80.5254	2.7 Kohm 5% Carbon film	0.125 W
	R159	80,5254	2.7 Kohm 5% Carbon film	0.125 W
	R160	80.5273	100 Kohm 5% Carbon film	0.125 W
	R161	80.5237	10 ohm 5% Carbon film	0.125 W
	R162	80.5261	10 Kohm 5% Carbon film	0.125 W
	R163	80.5278	270 Kohm 5% Carbon film	0.125 W
	R164	80.5266	27 Kohm 5% Carbon film	0.125 W
	R165	80.5266	27 Kohm 5% Carbon film	0.125 W
	R166	80.5261	10 Kohm 5% Carbon film	0.125 W
	R167	80.5261	10 Kohm 5% Carbon film	0.125 W
	R168	80.5261	10 Kohm 5% Carbon film	0.125 W
	R169	80.5261	10 Kohm 5% Carbon film	0.125 W
	R170	80.5261	10 Kohm 5% Carbon film	0.125 W
	R171	80.5261	10 Kohm 5% Carbon film	0.125 W
	R172	80.5261	10 Kohm 5% Carbon film	0.125 W
	R173	80.5277	220 Kohm 5% Carbon film	0.125 W
	R174	80.5261	10 Kohm 5% Carbon film	0.125 W
	R175	80.5256	3.9 Kohm 5% Carbon film	0.125 W
	R176	80.5267	33 Kohm 5% Carbon film	0.125 W

Storno

TYPE	Nº	CODE	DATA	
	R177	80.5256	3.9 Kohm 5% Carbon film	0.125 W
	R178	80.5267	33 Kohm 5% Carbon film	0.125 W
	R179	80.5266	27 Kohm 5% Carbon film	0.125 W
	R180	80.5266	27 Kobm 5% Carbon film	0.125 W
	R181	80.5281	560 Kohm 5% Carbon film	0.125 W
	S101	47.0642	Switch	
	U101	14.5019	MC3302 Quad. Comparat.	
	U102	14.5052	4017 Johnson Counter	
	U103	14.5052	4017 Johnson Counter	
	U104	14.5098	4013 Dual D-FF	
	U105	14.5074	4001 Quad. 2-inp. NAND	
	U106	14.5134	555 Timer	

SEQUENTIAL TONE UNIT TQ5001

SEQUENTIAL TONE UNIT TQ5002

X402.645

Storno

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 independant 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 circuits boards, a TONE BOARD and a LOGIC BOARD, which mount together to a sandwich units with the soldering sides facing each other. The unit fits mechanical 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 (Programable 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.

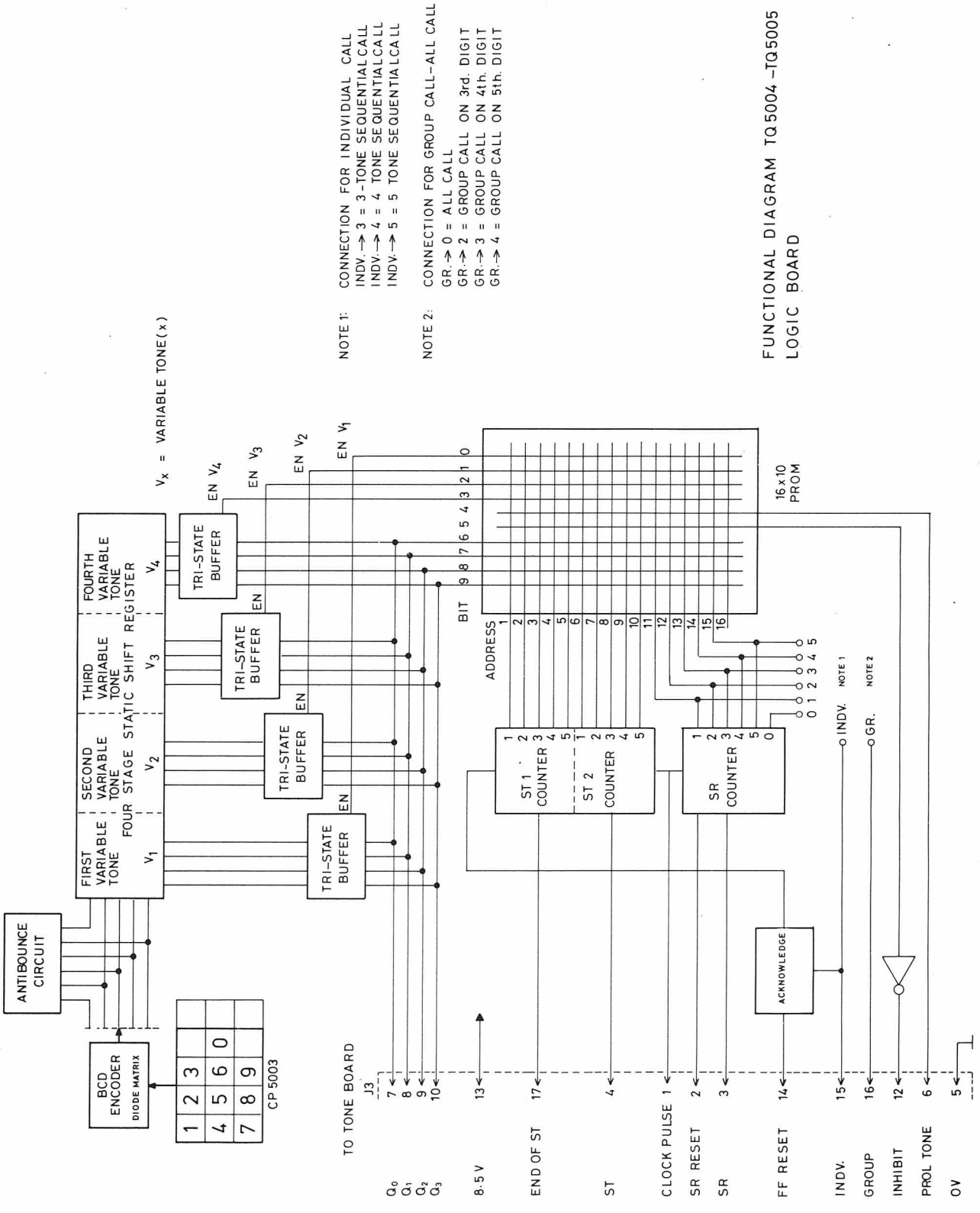


FIG. 1. LOGIC BOARD FUNCTIONS

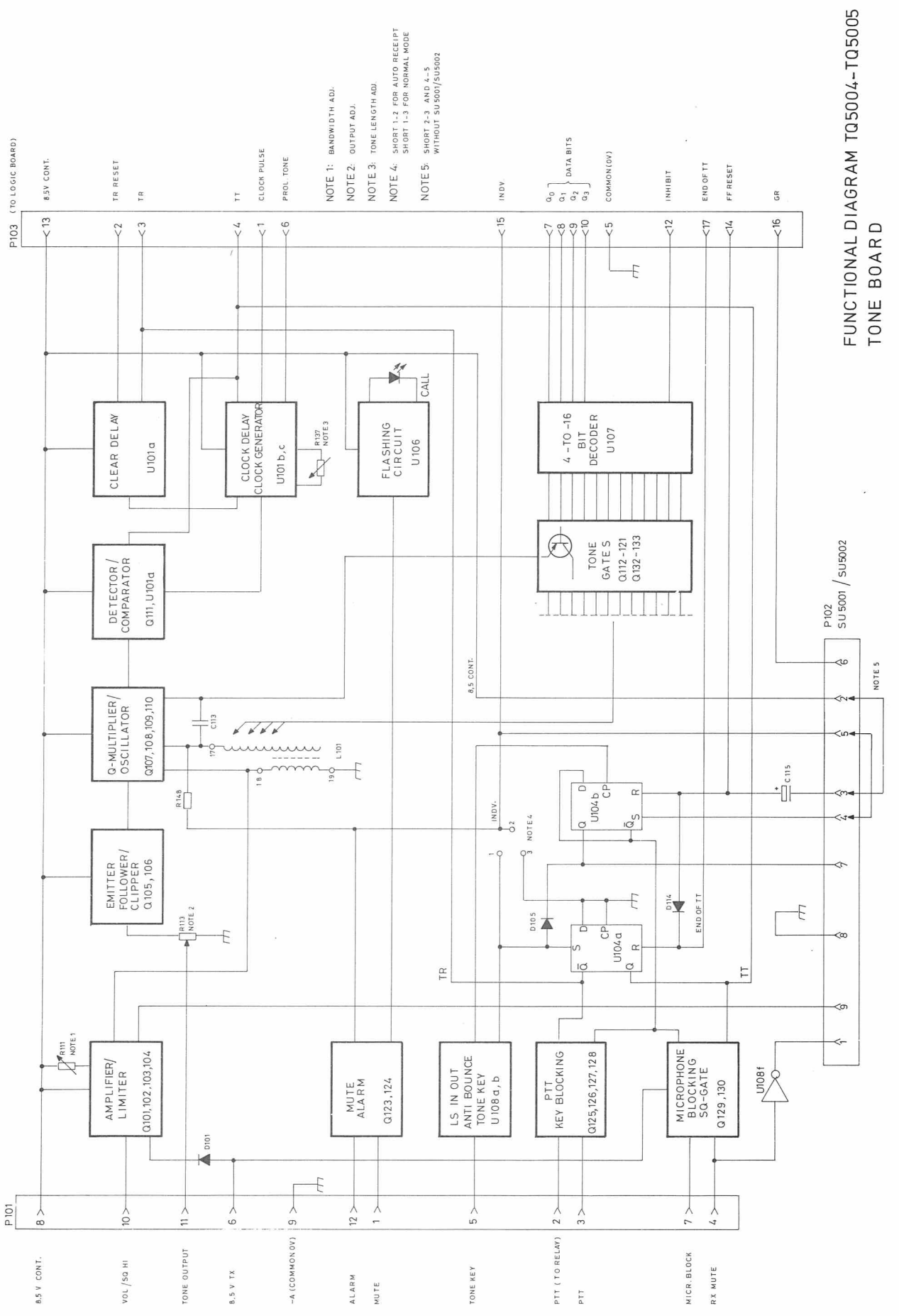


FIG. 2. TONE BOARD FUNCTIONS

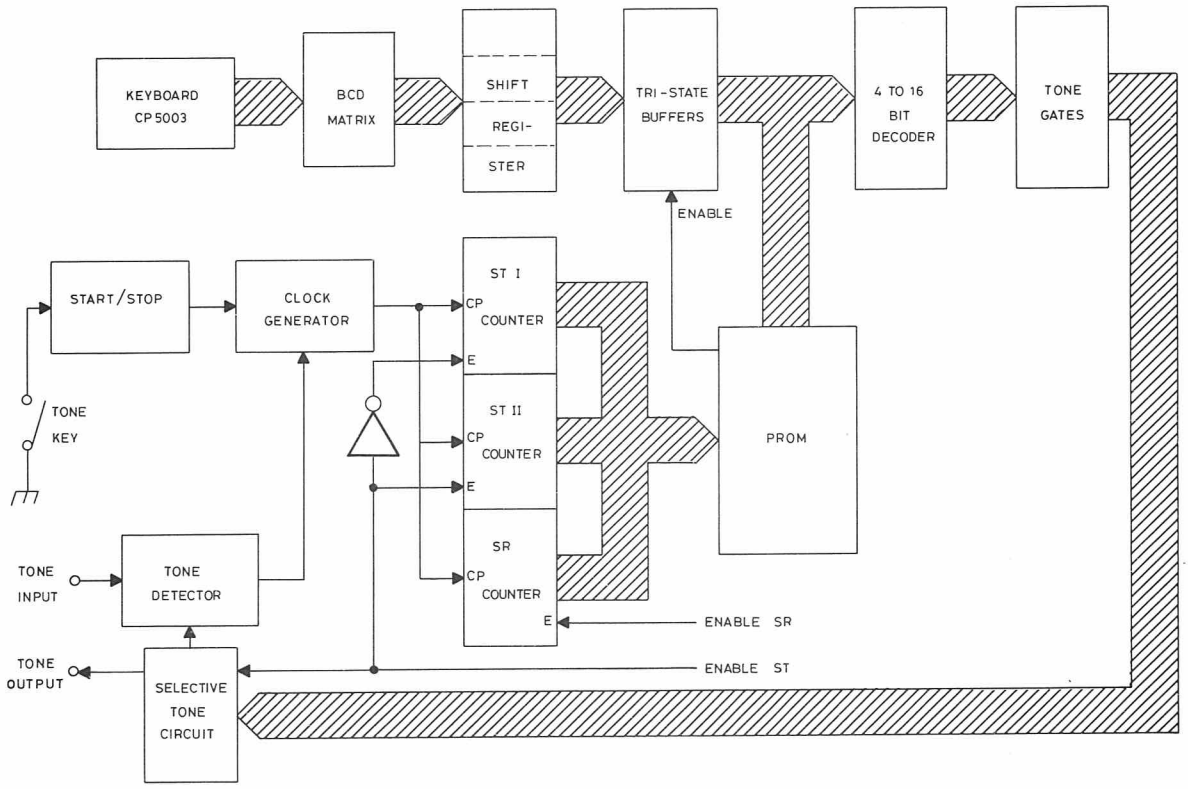


FIG. 3. DATA FLOW CHART

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:

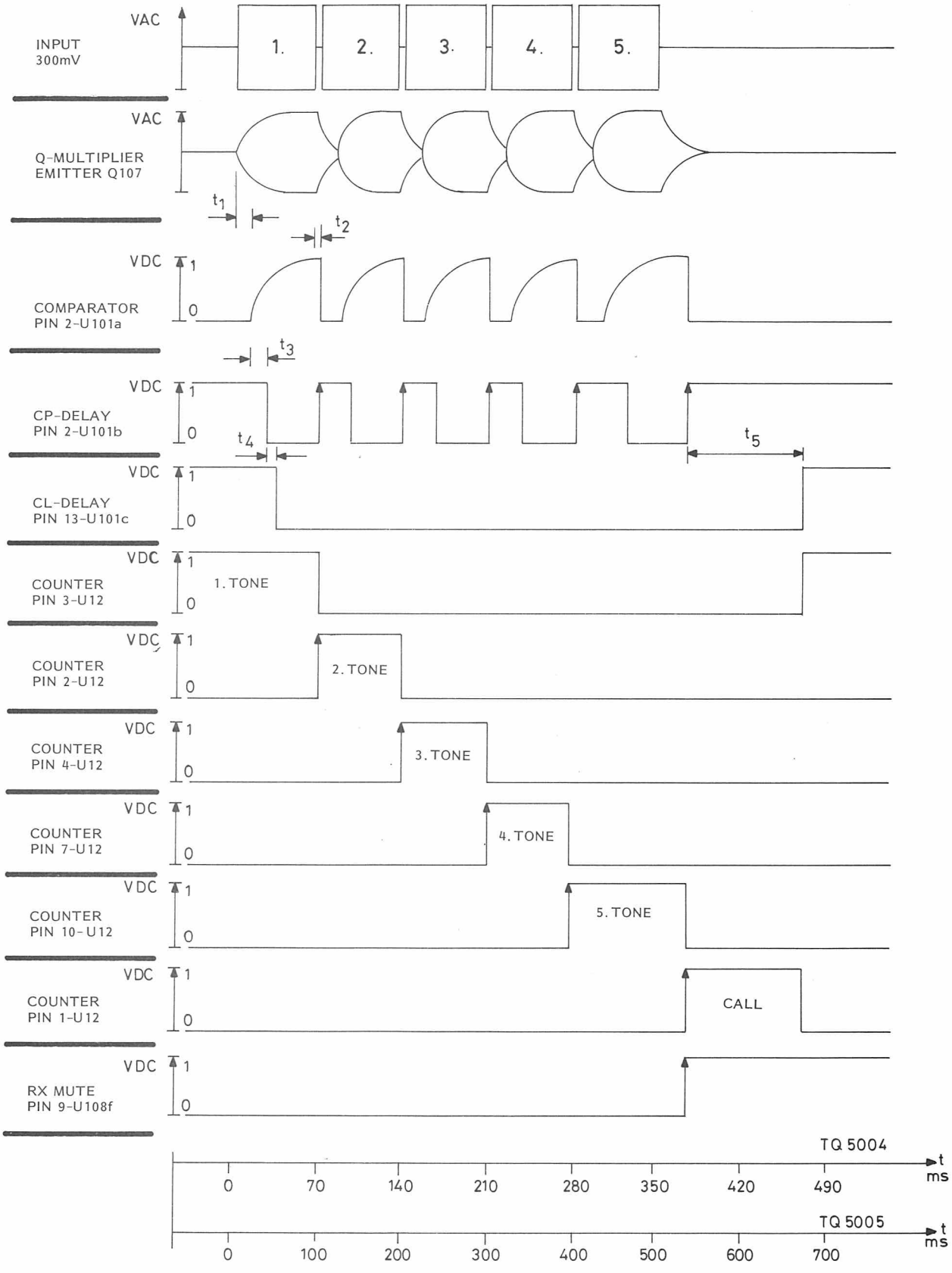
"1" = ∿8.5 V
"0" = ∿0 V

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

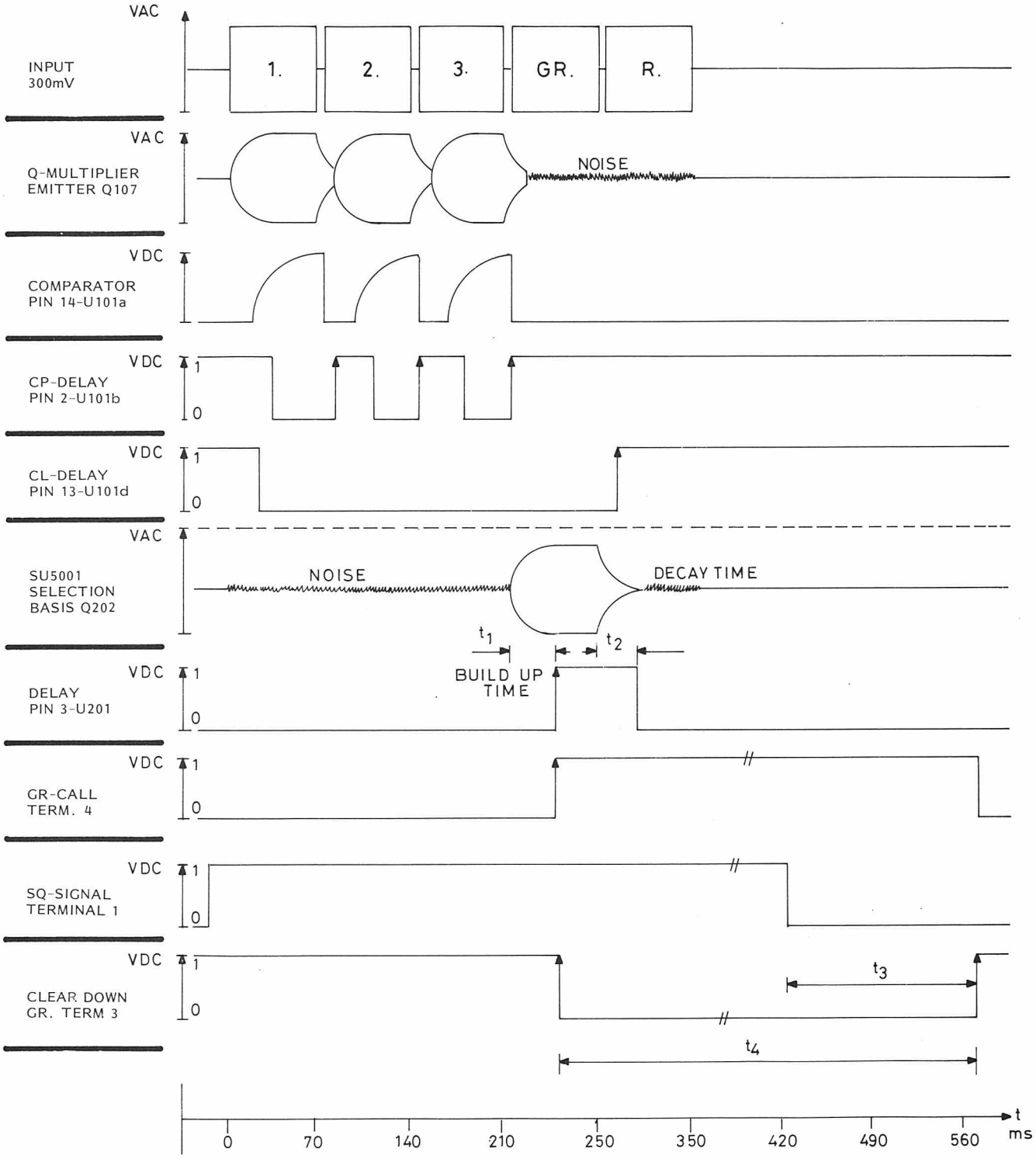
PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5004 AND TQ5005



t_1 = SELECTIVE CIRCUIT BUILD-UP TIME
t_2 = DECAYTIME
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 oscilator 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 preceeding 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 lach 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

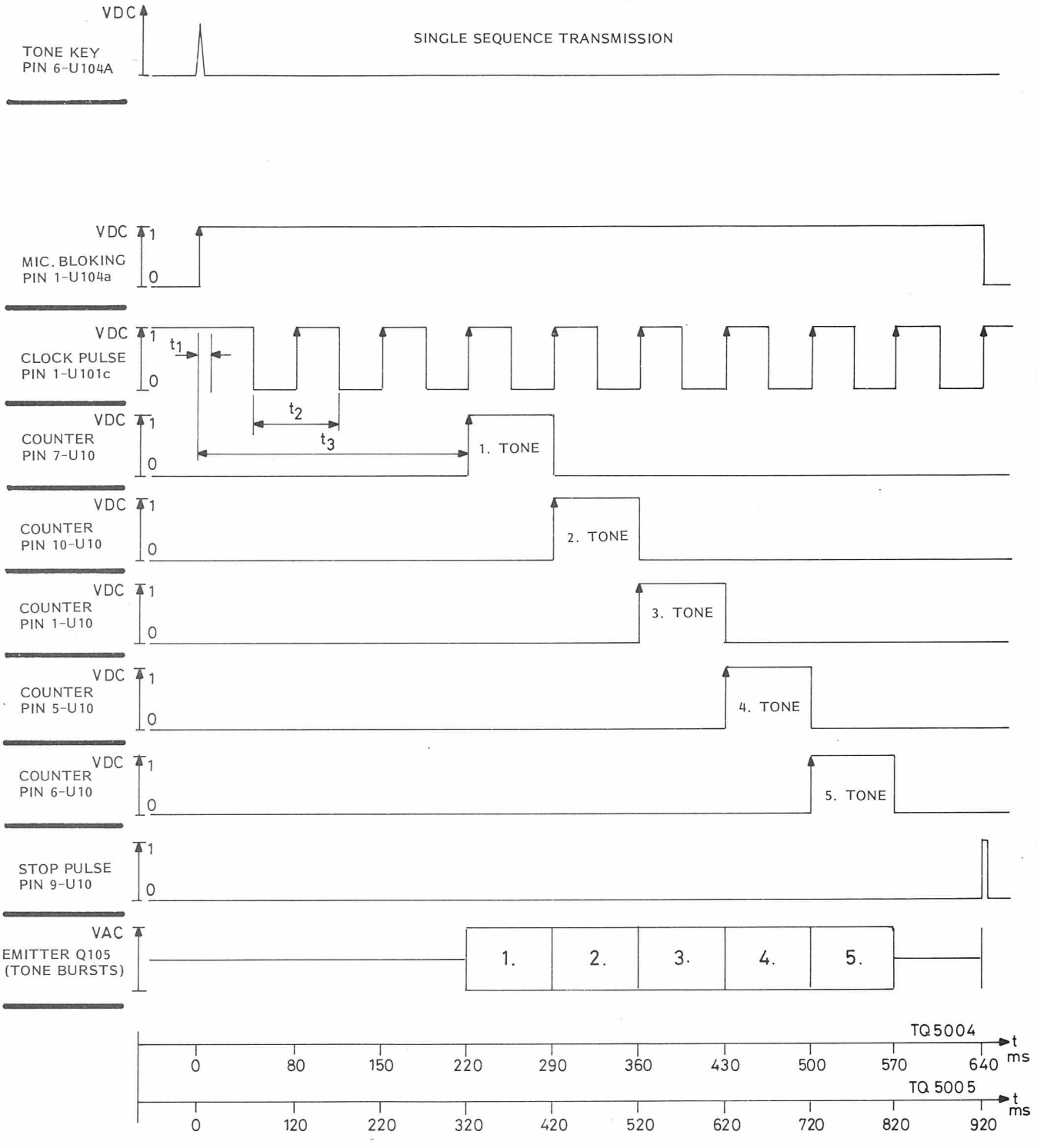
All tones used in the tone transmitter codes are programmed in the PROM.

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 $\overline{Q}$ 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 $\overline{Q}$-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 LENGHT)

t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

FIG. 6. 5-TONE SEQUENTIAL TRANSMISSION

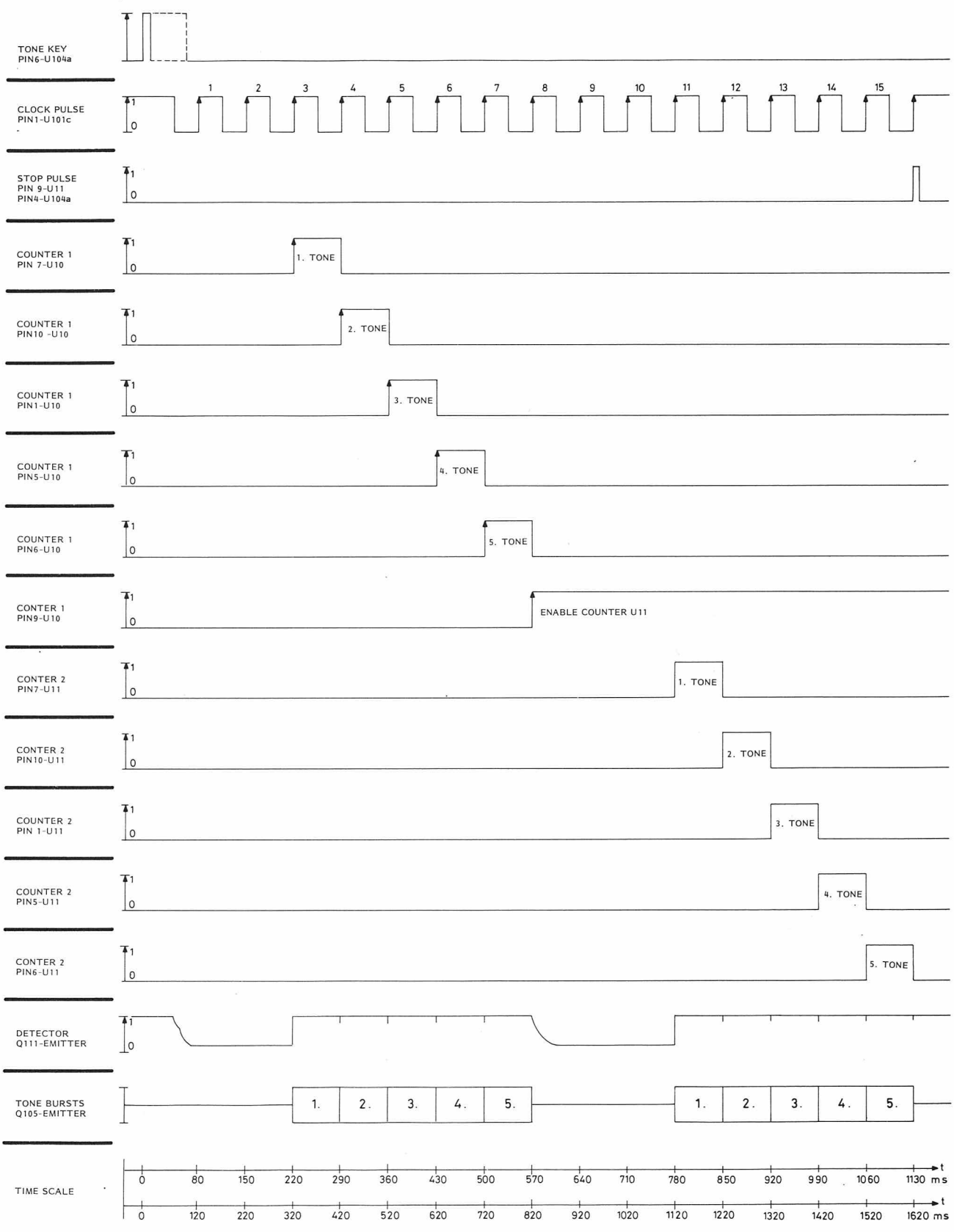


FIG. 7. DUAL SEQUENCE TRANSMISSION

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 of 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 exeeds 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 transistion 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.

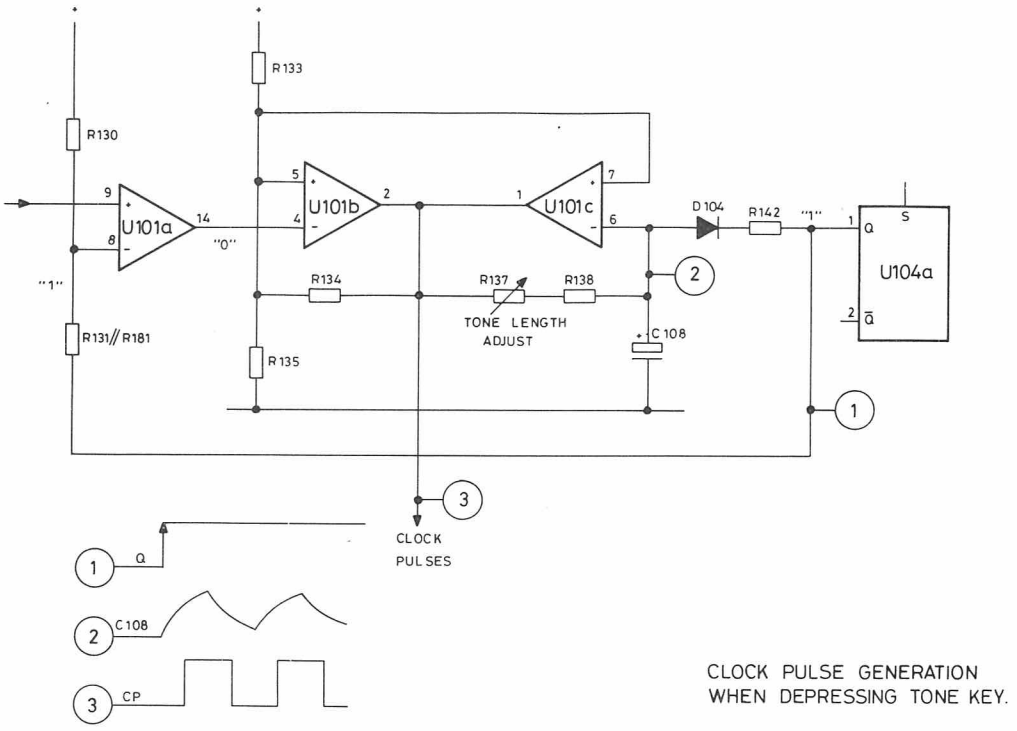
The positive pulses so appearing of the outputs of U101b and U101c are used as clock input to the counters U10 and U11. The period time is adjusted by means of resistor R137 to 70 ms for TQ5004 or 100 ms for TQ5005.

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

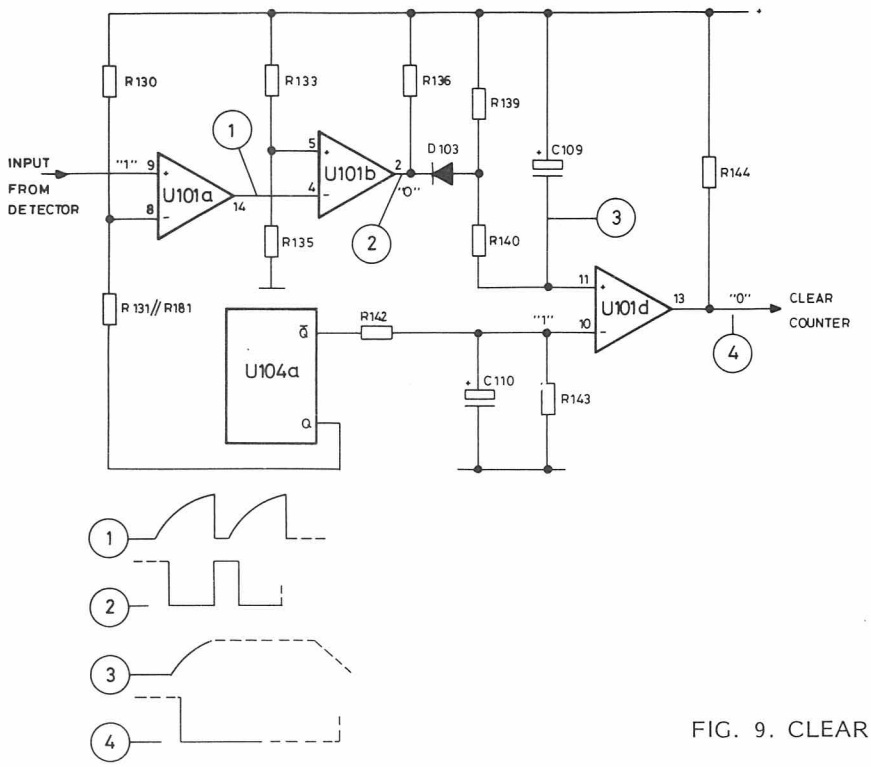


FIG. 9. CLEAR DELAY CIRCUITRY

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

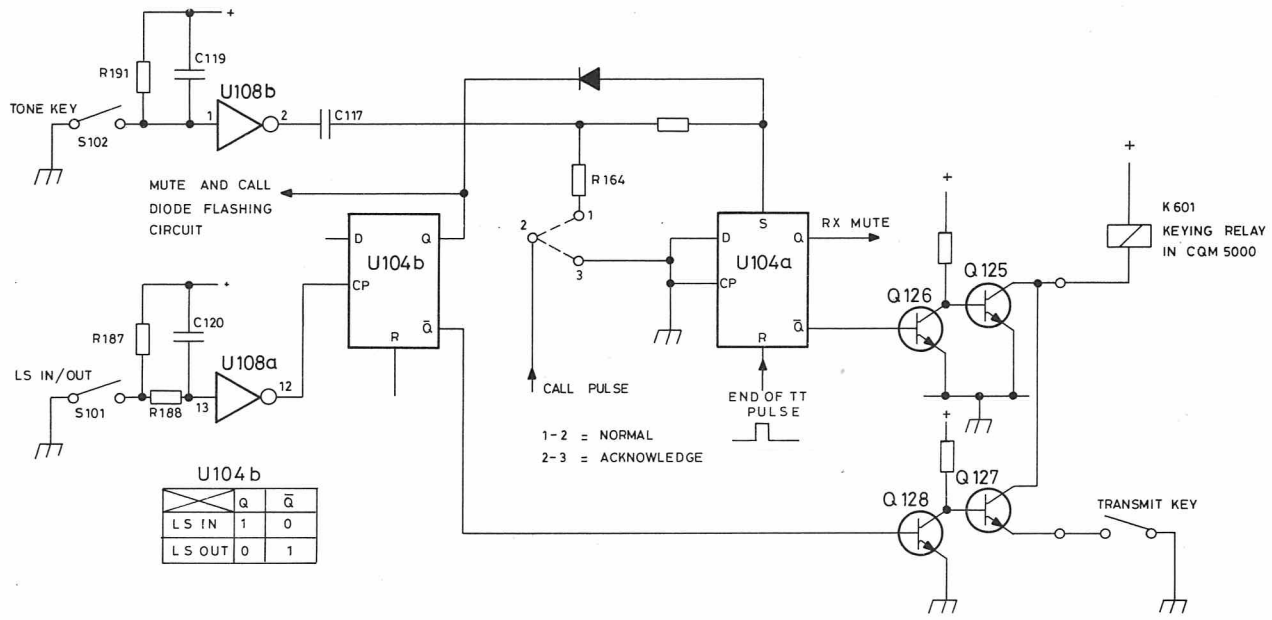


FIG. 10. LS IN/OUT AND TONE CIRCUITRY

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 $\overline{Q}$-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.

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 desides whether the audio channel is open or not.

LOGIC BOARD CIRCUIT DESCRIPTION

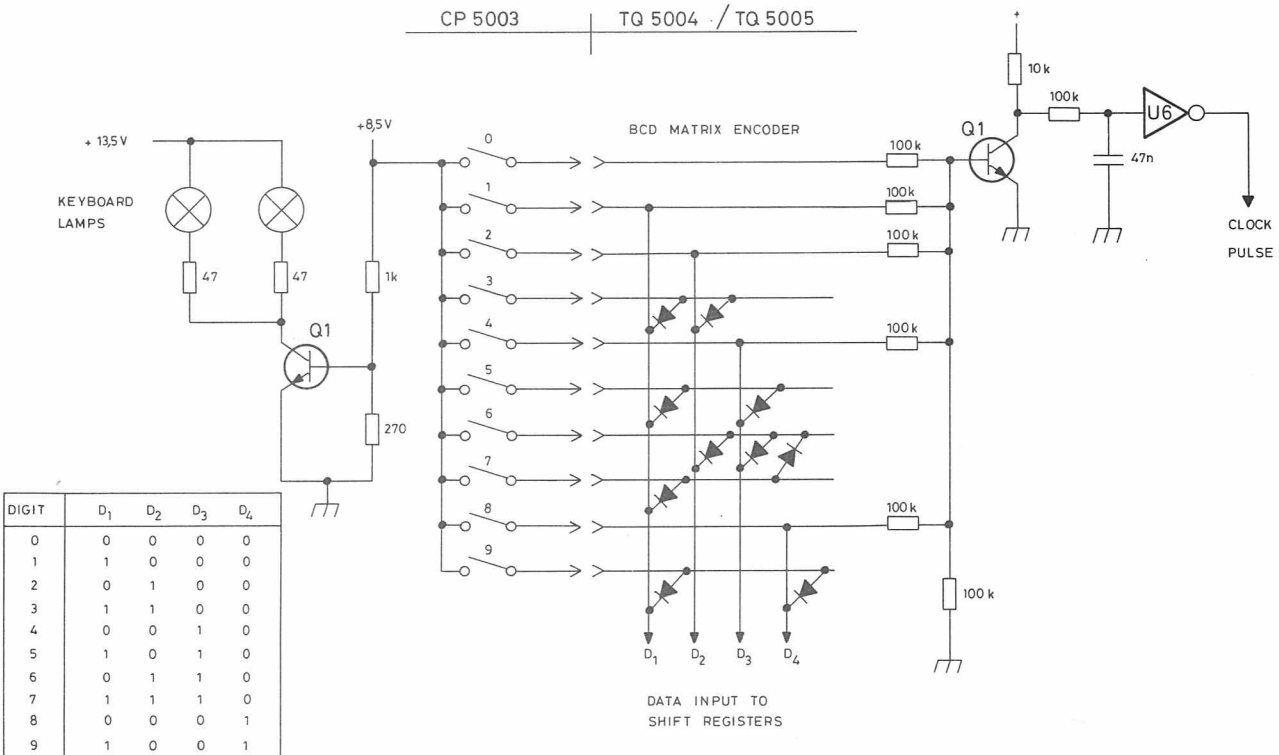
KEY BOARD, DECIMAL TO BCD ENCODING AND ANTIBOUNCE

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

SHIFT REGISTERS AND DATA BUFFERS

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

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



DIGIT	D_1	D_2	D_3	D_4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

FIG. 11. BCD ENCODER - CLOCK PULSE CIRCUITRY

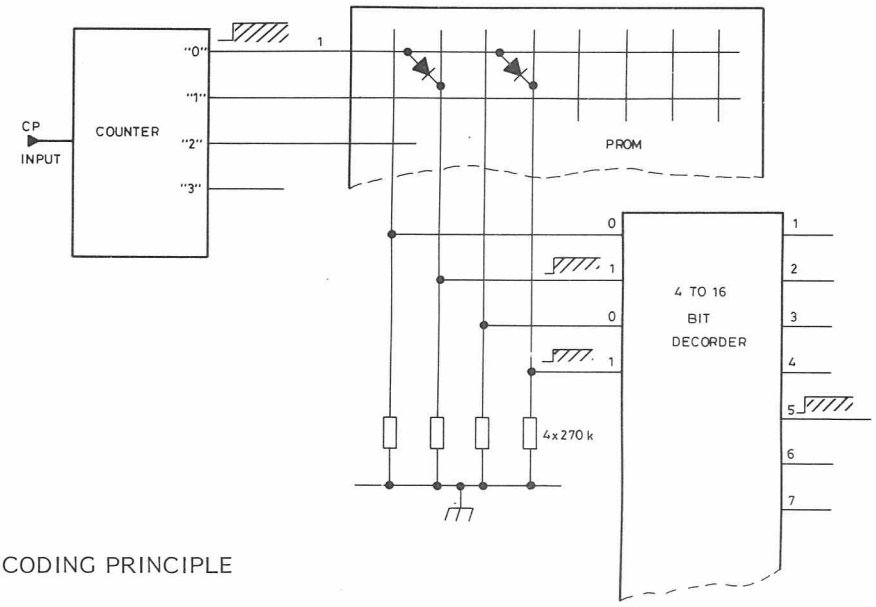


FIG. 12. PROM DECODING PRINCIPLE

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 $\overline{Q}$ 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 $\overline{Q}$ 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

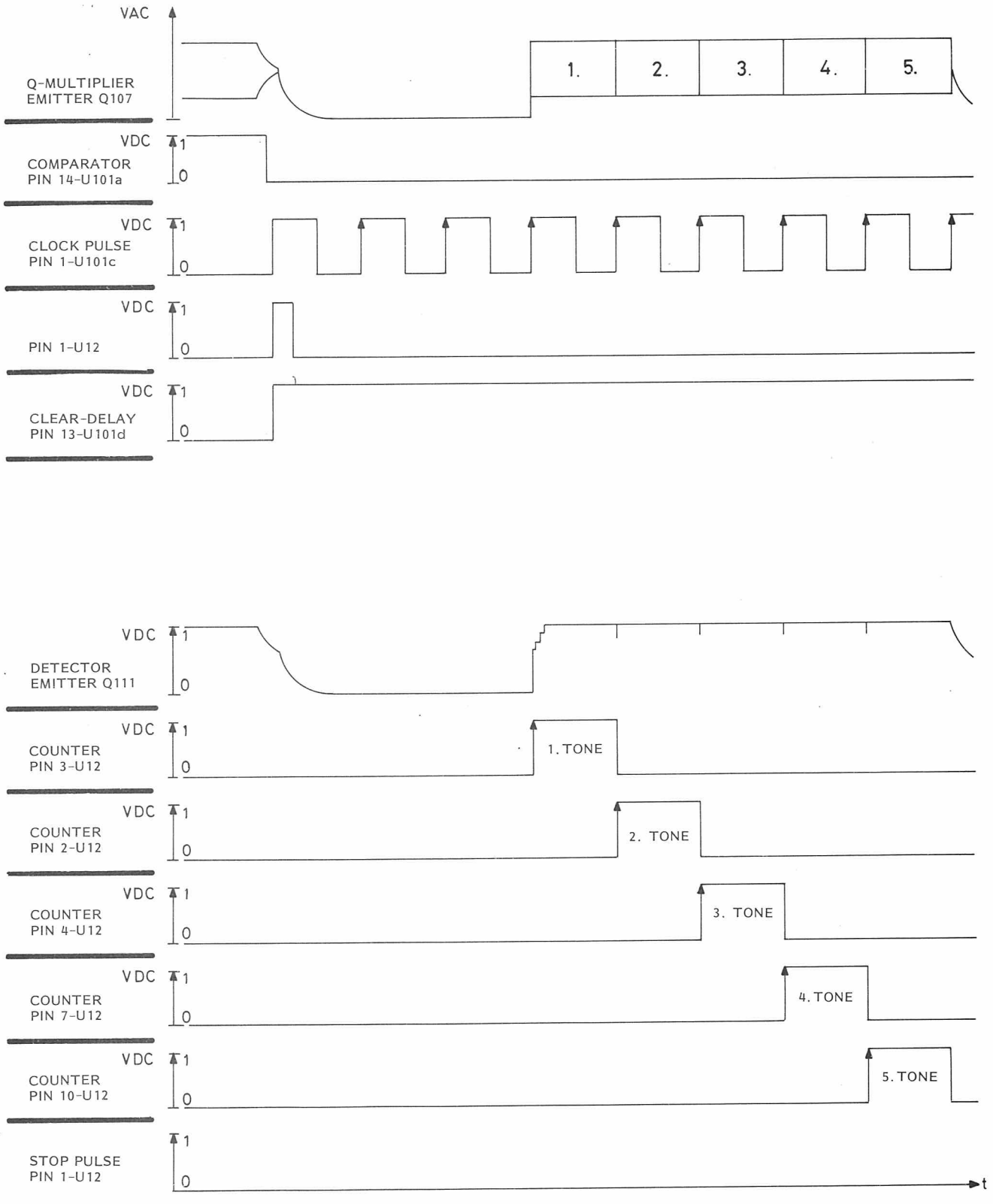


FIG. 13. ACKNOWLEDGE TRANSMISSION

TECHNICAL SPECIFICATIONS

SPECIFICATIONS COMMON TO TQ5004 AND TQ5005

Supply Voltage
8.5 V ±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
$-30^{o}C$ to $+60^{o}C$

SEQUENTIAL TONE TRANSMITTER

Signal Output Level
Max. 600 mV EMF (Adjustable)

Frequence Response
Flat ±1 dB

Signal Distortion
<5%

Tone Frequency Acceracy

Max. diviation:	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 speach channel of the CQM5000.

Input Frequency Response
Deemphasis according to an RC function with F_c= 2900 Hz

Activating Input Level
300 mV ±6 dB

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

Tone Frequency Accuracy
±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 ± 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 ± 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.

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. Frequences 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 sequencies. 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.

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).

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

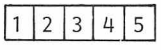
The tone format, 1 or 2 tone transmitter codes, automatic receipt (acknowledge), and group call options are all coded by a strapping and diode arrangement on the printed wiring board.

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.



Standard 5 tone sequence.

	BIT	9	8	7	6	5	4	3	2	1	0
ADDRESS	TQ5004 TQ5005 PROM CODE SPECIFICATION	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
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

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

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
R= repeat tone.
100 CALLS.

EX. B

1	2	R	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2.
90 CALLS.

EX. C

1	2	3	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2 and V_1 cannot be selected equal to 3.
81 CALLS.

EX. D

V_1	R	V_2	R	V_3

No limitations in the variable digits, V_1, V_2 and V_3. R= repeat tone.
1000 CALLS.

EX. E

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
Prolonged 1st-tone max 1.2 sec.

FORMAT 2.

- Transmission of two consecutive sequential tone signals.

1	2	3	4	5				6	7	8	9	10

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

1	2	3	4	V_1				V_2	R	V_3	R	V_4

$V_1 = V_2$ 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 accomodate 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).

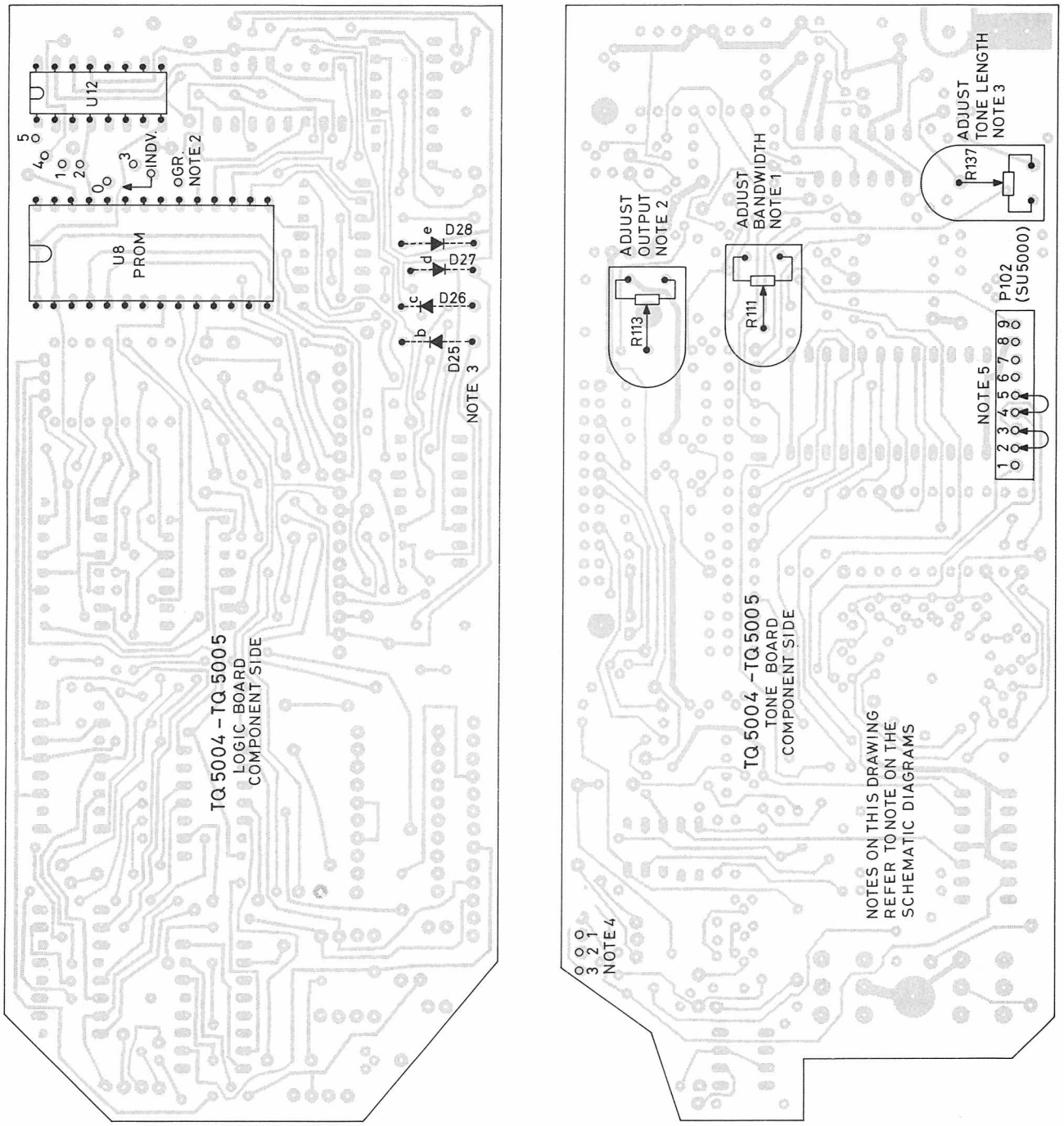


FIG 2. CIRCUIT BOARD LAYOUT TQ5004-TQ5005.

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

Storno

TYPE	Nº	CODE	DATA
	C 1	76.5139	47 nF 10% Polyester FL 50 V
	C 6	76.5133	4.7 nF 10% Polyester FL 50 V
	C 7	76.5133	4.7 nF 10% Polyester FL 50 V
	C101	76.5144	0.1 uF 10% Polyester FL 63 V
	C102	76.5129	1 nF 10% Polyester FL 50 V
	C103	73.5169	0.47 uF 20% Tantal 35 V
	C104	76.5144	0.1 uF 10% Polyester FL 63 V
	C105	76.5133	4.7 nF 10% Polyester FL 50 V
	C106	73.5168	0.22 uF 20% Tantal 35 V
	C107	76.5144	0.1 uF 10% Polyester FL 63 V
	C108	73.5170	1.0 uF 20% Tantal 35 V
	C109	73.5169	0.47 uF 20% Tantal 35 V
	C110	73.5169	0.47 uF 20% Tantal 35 V
	C111	76.5135	10 nF 10% Polyester FL 50 V
	C112	73.5173	10 uF 20% Tantal 16 V
	C113	76.5123	47 nF 2.5% Polyester TB 63 V
	C114	73.5174	22 uF 20% Tantal 16 V
	C115	73.5171	2.2 uF 20% Tantal 35 V
	C116	73.5173	10 uF 20% Tantal 16 V
	C117	76.5133	4.7 nF 10% Polyester FL 50 V
	C118	76.5135	10 nF 10% Polyester FL 50 V
	C120	76.5139	47 nF 10% Polyester FL 50 V
	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
	D 27	99.5237	1N4148 Diode
	D 28	99.5237	1N4148 Diode
	D101	99.5237	1N4148 Diode
	D102	99.5237	1N4148 Diode
	D103	99.5237	1N4148 Diode
	D104	99.5237	1N4148 Diode
	D105	99.5237	1N4148 Diode
	D107	99.5325	LED Yellow
	D108	99.5237	1N4148 Diode

Storno

TYPE	Nº	CODE	DATA
	D109	99.5237	1N4148 Diode
	D112	99.5237	1N4148 Diode
	D114	99.5237	1N4148 Diode
	J 3	41.5568	Male Connector 18 pos
TQ5004	L101	61.1421	Tone coil ZVEI
TQ5005	L101	61.1422	Tone coil CCIR
	P 1	41.5570	PROM socket
	P101	41.5549	Female connector 12 pos.
	P102	41.5548	Female connector 9 pos.
	P103	41.5569	Female connector 18 pos.
	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 Transistor
	Q113	99.5324	BC338 Transistor
	Q114	99.5324	BC338 Transistor
	Q115	99.5324	BC338 Transistor
	Q116	99.5324	BC338 Transistor
	Q117	99.5324	BC338 Transistor
	Q118	99.5324	BC338 Transistor
	Q119	99.5324	BC338 Transistor
	Q120	99.5324	BC338 Transistor
	Q121	99.5324	BC338 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
	Q131	99.5115	BC309 Transistor
	Q132	99.5324	BC338 Transistor

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

TYPE	Nº	CODE	DATA	
	Q133	99.5324	BC338 Transistor	
	R 1	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 2	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 3	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 4	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 5	80.5273	100 Kohm 5% Carbon film	1/8W
	R 6	80.5273	100 Kohm 5% Carbon film	1/8W
	R 7	80.5261	10 Kohm 5% Carbon film	1/8 W
	R 8	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 9	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 10	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 11	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 13	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 14	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 15	80.5267	33 Kohm 5% Carbon film	1/8 W
	R 17	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 18	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 19	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 20	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 21	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 26	80.5260	8.2 Kohm 5% Carbon film	1/8 W
	R 27	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 28	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 29	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 30	80.5249	1 Kohm 5% Carbon film	1/8 W
	R 33	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 34	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 35	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 36	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 37	80.5273	100 Kohm 5% Carbon film	1/8 W
	R101	80.5277	220 Kohm 5% Carbon film	1/8 W
	R102	80.5270	56 Kohm 5% Carbon film	1/8 W
	R103	80.5275	150 Kohm 5% Carbon film	1/8 W
	R104	80.5266	27 Kohm 5% Carbon film	1/8 W
	R105	80.5271	68 Kohm 5% Carbon film	1/8 W
	R106	80.5261	10 Kohm 5% Carbon film	1/8 W
	R107	80.5275	150 Kohm 5% Carbon film	1/8 W
	R108	80.5263	15 Kohm 5% Carbon film	1/8 W
	R109	80.5271	68 Kohm 5% Carbon film	1/8 W
	R110	80.5267	33 Kohm 5% Carbon film	1/8 W
	R111	86.5036	47 Kohm 20% Trim carbon	0.05 W
	R112	80.5261	10 Kohm 5% Carbon film	1/8 W
	R113	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R114	80.5277	220 Kohm 5% Carbon film	1/8 W
	R115	80.5277	220 Kohm 5% Carbon film	1/8 W
	R116	80.5267	33 Kohm 5% Carbon film	1/8 W
	R117	80.5269	47 Kohm 5% Carbon film	1/8 W

Storno

TYPE	Nº	CODE	DATA	
	R118	80.5273	100 Kohm 5% Carbon film	1/8 W
	R119	80.5264	18 Kohm 5% Carbon film	1/8 W
	R120	89.5010	15 Kohm 20% NTC	0.5 W
	R121	80.5266	27 Kohm 5% Carbon film	1/8 W
	R122	80.5259	6.8 Kohm 5% Carbon film	1/8 W
	R123	80.5284	820 Kohm 5% Carbon film	1/8 W
	R124	80.5273	100 Kohm 5% Carbon film	1/8 W
	R125	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R126	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R127	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R128	80.5263	15 Kohm 5% Carbon film	1/8 W
	R129	80.5275	150 Kohm 5% Carbon film	1/8 W
	R130	80.5274	120 Kohm 5% Carbon film	1/8 W
	R131	80.5276	180 Kohm 5% Carbon film	1/8 W
	R132	80.5276	180 Kohm 5% Carbon film	1/8 W
	R133	80.5278	270 Kohm 5% Carbon film	1/8 W
	R134	80.5277	220 Kohm 5% Carbon film	1/8 W
	R135	80.5277	220 Kohm 5% Carbon film	1/8 W
	R136	80.5261	10 Kohm 5% Carbon film	1/8 W
	R137	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R138	80.5266	27 Kohm 5% Carbon film	1/8 W
	R139	80.5277	220 Kohm 5% Carbon film	1/8 W
	R140	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R141	80.5249	1 Kohm 5% Carbon film	1/8 W
	R142	80.5275	150 Kohm 5% Carbon film	1/8 W
	R143	80.5279	330 Kohm 5% Carbon film	1/8 W
	R144	80.5267	33 Kohm 5% Carbon film	1/8 W
	R145	80.5263	15 Kohm 5% Carbon film	1/8 W
	R146	80.5271	68 Kohm 5% Carbon film	1/8 W
	R147	80.5242	270 ohm 5% Carbon film	1/8 W
	R148	80.5284	820 Kohm 5% Carbon film	1/8 W
	R149	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R150	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R151	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R152	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R153	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R155	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R156	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R157	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R158	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R159	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R161	80.5237	100 ohm 5% Carbon film	1/8 W

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

Storno

TYPE	Nº	CODE	DATA
	R162	80.5261	10 Kohm 5% Carbon film 1/8 W
	R163	80.5278	270 Kohm 5% Carbon film 1/8 W
	R164	80.5266	27 Kohm 5% Carbon film 1/8 W
	R167	80.5261	10 Kohm 5% Carbon film 1/8 W
	R168	80.5261	10 Kohm 5% Carbon film 1/8 W
	R174	80.5261	10 Kohm 5% Carbon film 1/8 W
	R175	80.5256	3.9 Kohm 5% Carbon film 1/8 W
	R176	80.5267	33 Kohm 5% Carbon film 1/8 W
	R177	80.5256	3.9 Kohm 5% Carbon film 1/8 W
	R178	80.5267	33 Kohm 5% Carbon film 1/8 W
	R179	80.5266	27 Kohm 5% Carbon film 1/8 W
	R180	80.5266	27 Kohm 5% Carbon film 1/8 W
	R181	80.5282	560 Kohm 5% Carbon film 1/8 W
	R183	80.5277	220 Kohm 5% Carbon film 1/8 W
	R184	80.5271	68 Kohm 5% Carbon film 1/8 W
	R185	80.5254	2.7 Kohm 5% Carbon film 1/8 W
	R186	80.5254	2.7 Kohm 5% Carbon film 1/8 W
	R187	80.5261	10 Kohm 5% Carbon film 1/8 W
	R188	80.5273	100 Kohm 5% Carbon film 1/8 W
	R191	80.5273	100 Kohm 5% Carbon film 1/8 W
	R198	80.5261	10 Kohm 5% Carbon film 1/8 W
	R201	80.5269	47 Kohm 5% Carbon film 1/8 W
	R202	80.5287	1.5 Mohm 5% Carbon film 1/8 W
	R203	80.5273	100 Kohm 5% Carbon film 1/8 W
	S101	47.0642	Switch assembly
	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 PROM
	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	14.5019	MC3302P Quad comparator
	U104	14.5098-01	CD4013B Dual D-FF
	U106	14.5134	555 Timer
	U107	14.5145	4514B Encoder
	U108	14.5146	CD40106B Hex Schmitt trigger

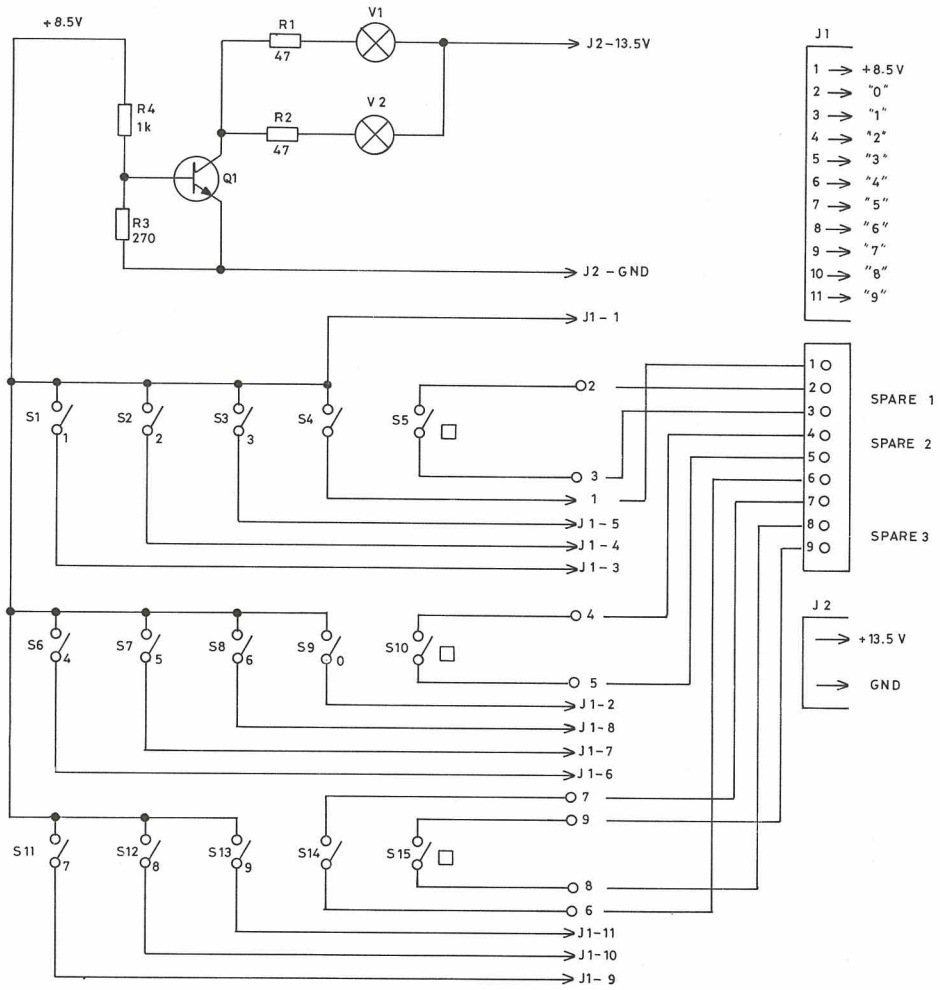
Storno

TYPE	Nº	CODE	DATA

SEQUENTIAL TONE UNIT TQ5004, TQ5005

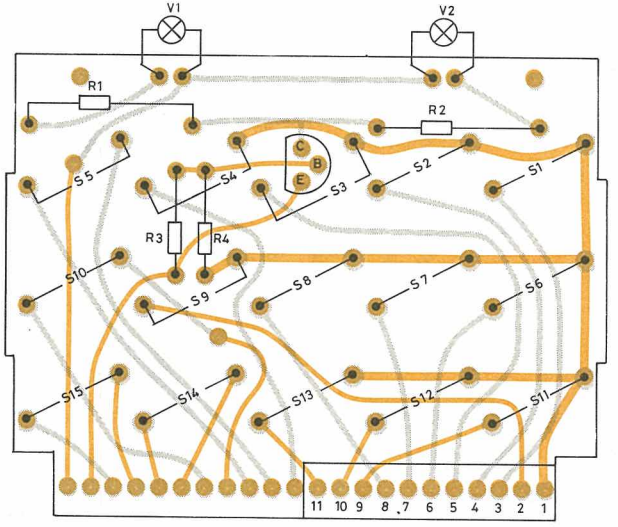
X402.810

Storno



□ SPARE

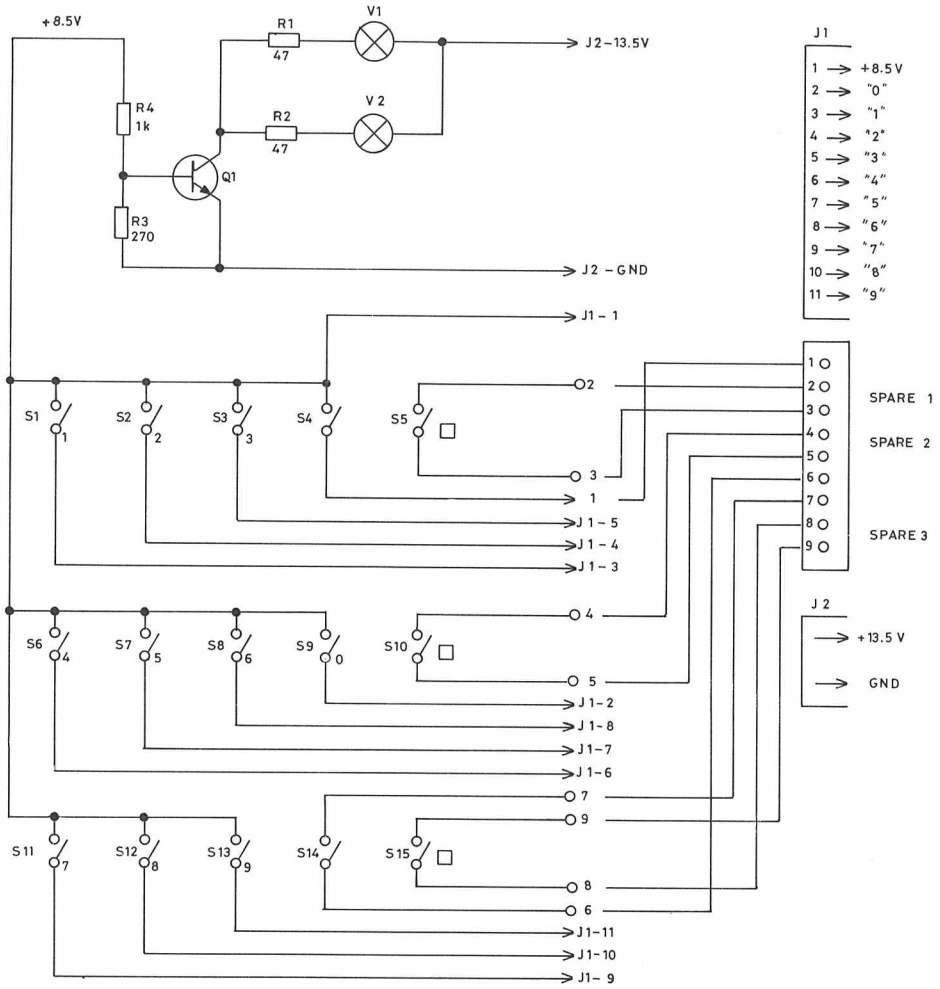
PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE (BACK)



NOTE: PUSHBUTTON S1-S15 MOUNTED ON FRONT

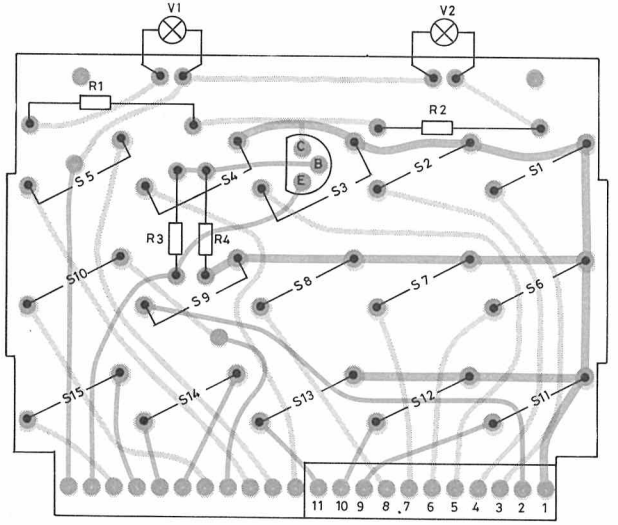
CONTROL HEAD CP5003
KEYBOARD D402.807

Storno



□ SPARE

PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE (BACK)



NOTE: PUSHBUTTON S1-S15 MOUNTED ON FRONT

CONTROL HEAD CP 5003
KEYBOARD D402.807

Storno

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 independant 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 circuits boards, a TONE BOARD and a LOGIC BOARD, which mount together to a sandwich units with the soldering sides facing each other. The unit fits mechanical 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 (Programable 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.

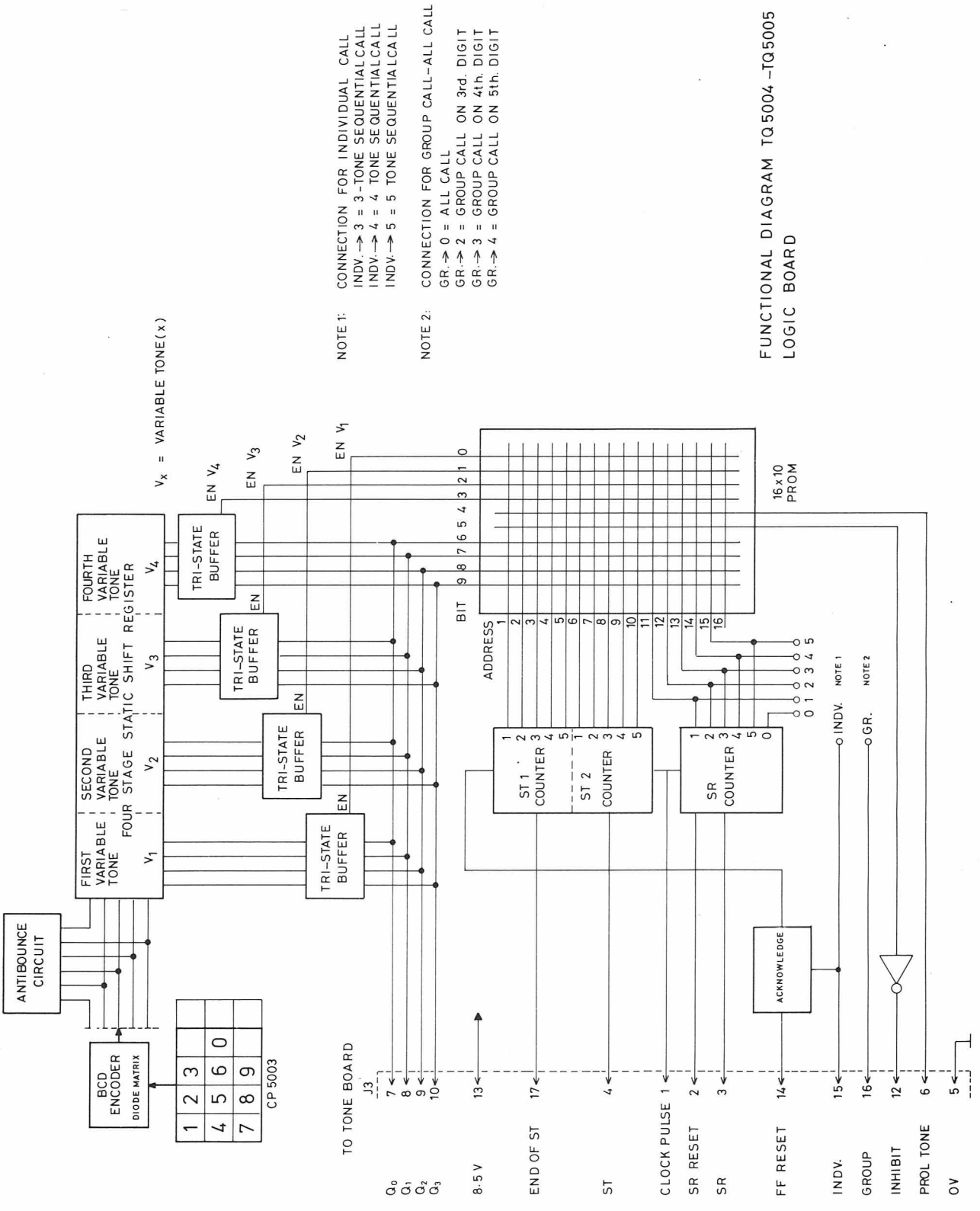


FIG. 1. LOGIC BOARD FUNCTIONS

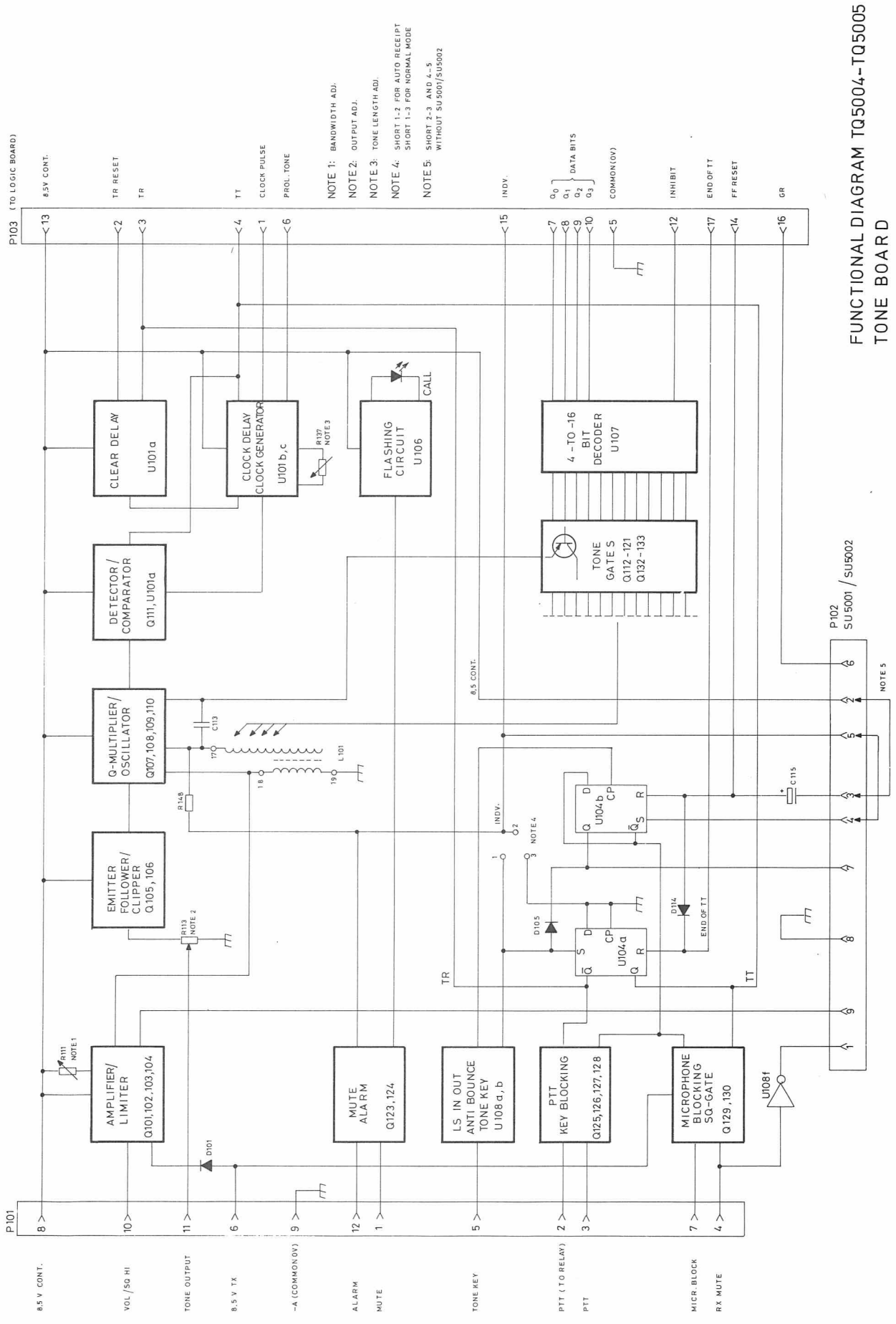


FIG. 2. TONE BOARD FUNCTIONS

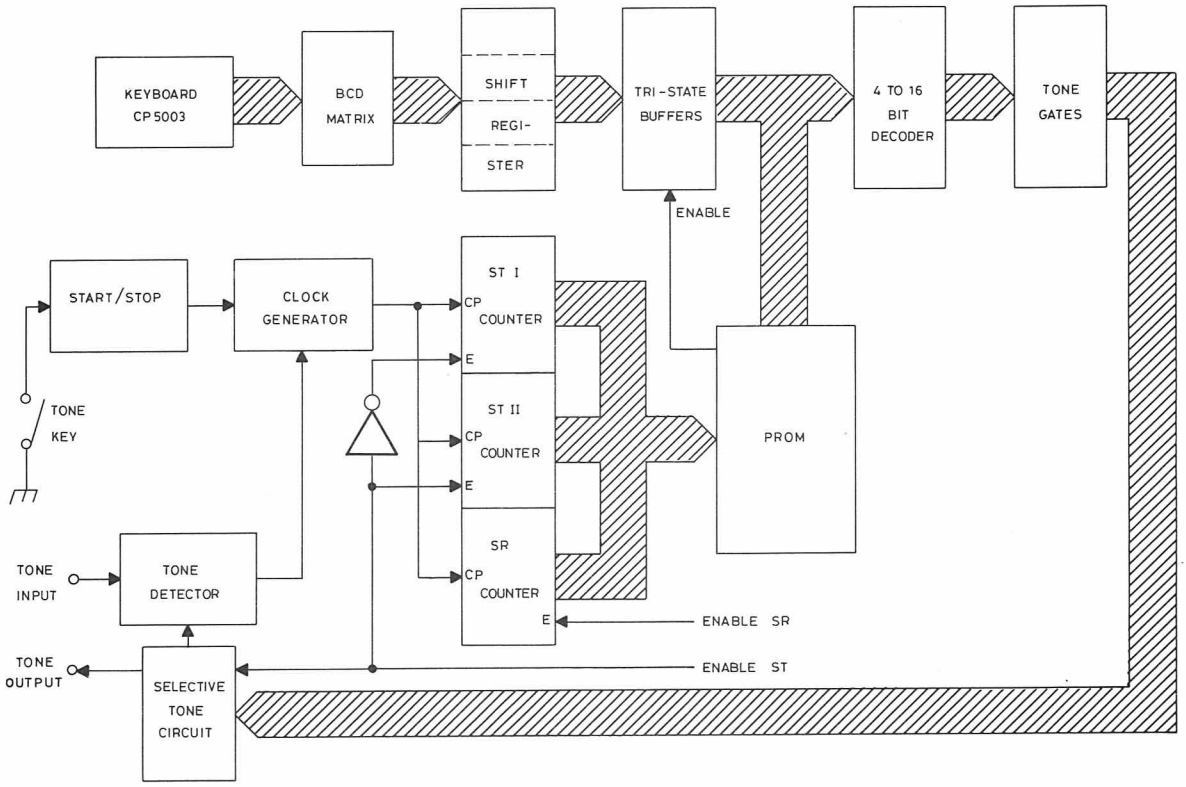


FIG. 3. DATA FLOW CHART

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:

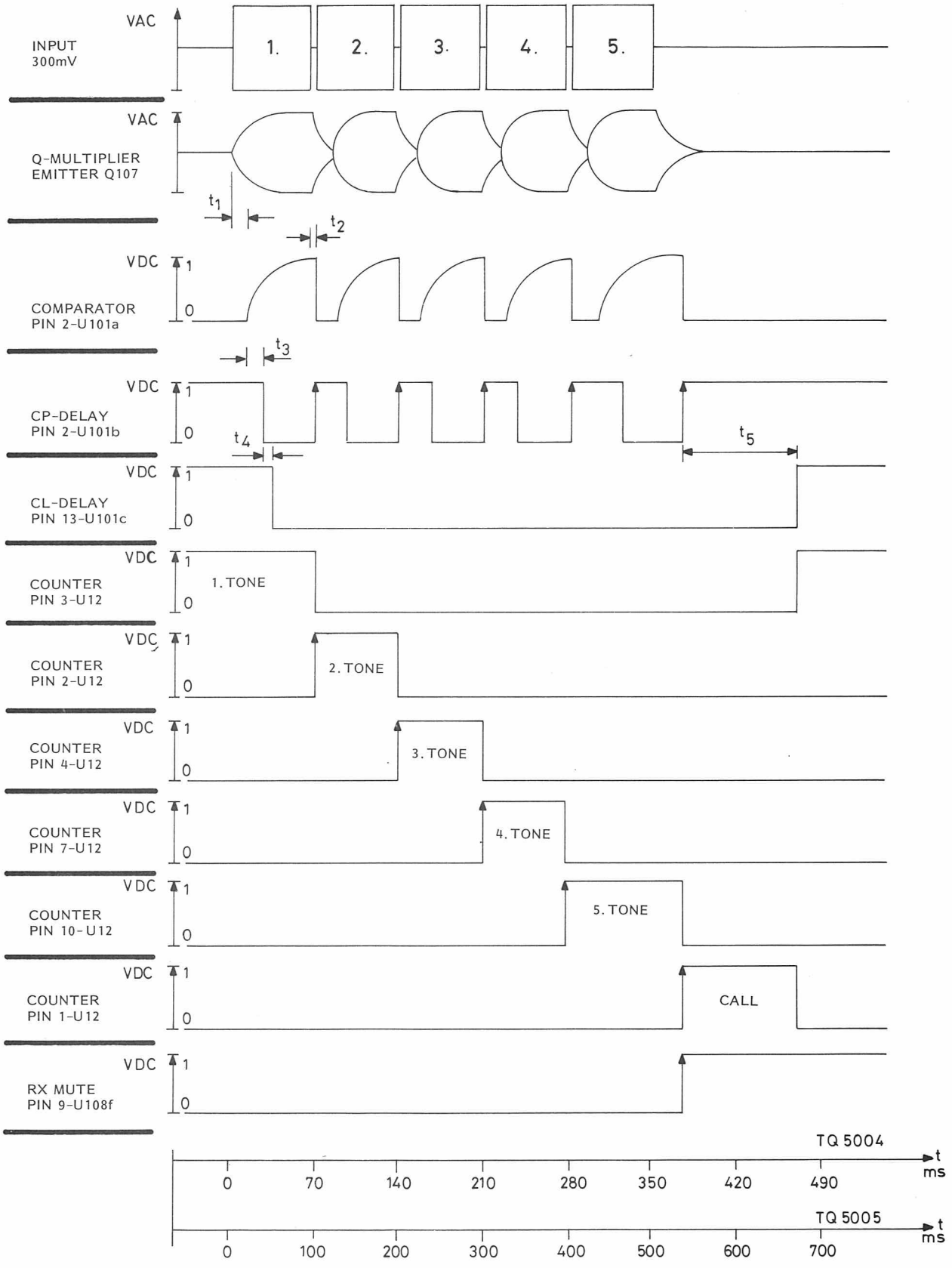
"1"= ~8.5 V
"0"= ~0 V

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

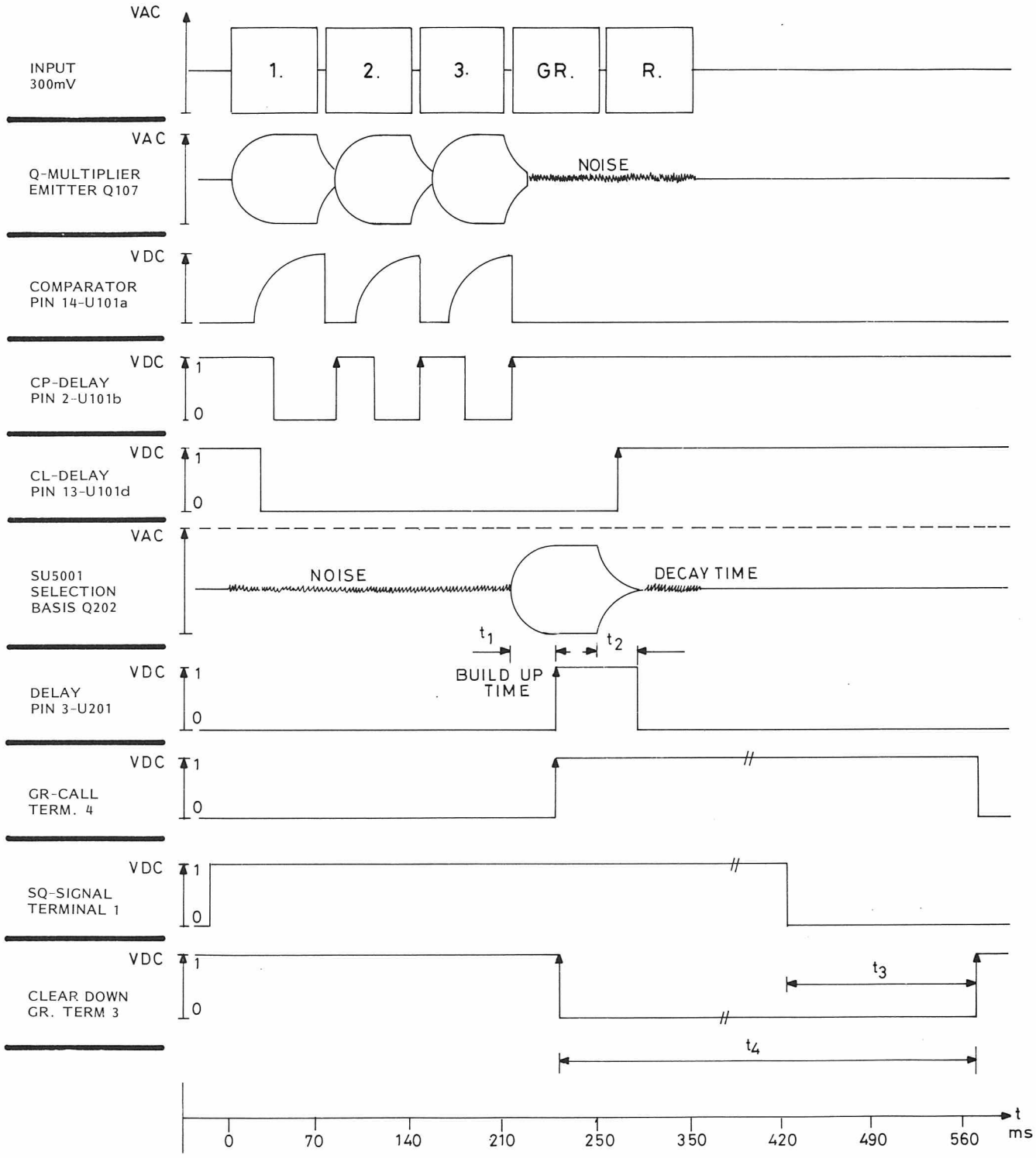
PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5004 AND TQ5005



t_1 = SELECTIVE CIRCUIT BUILD-UP TIME
t_2 = DECAYTIME
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 oscilator 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 preceeding 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 lach 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

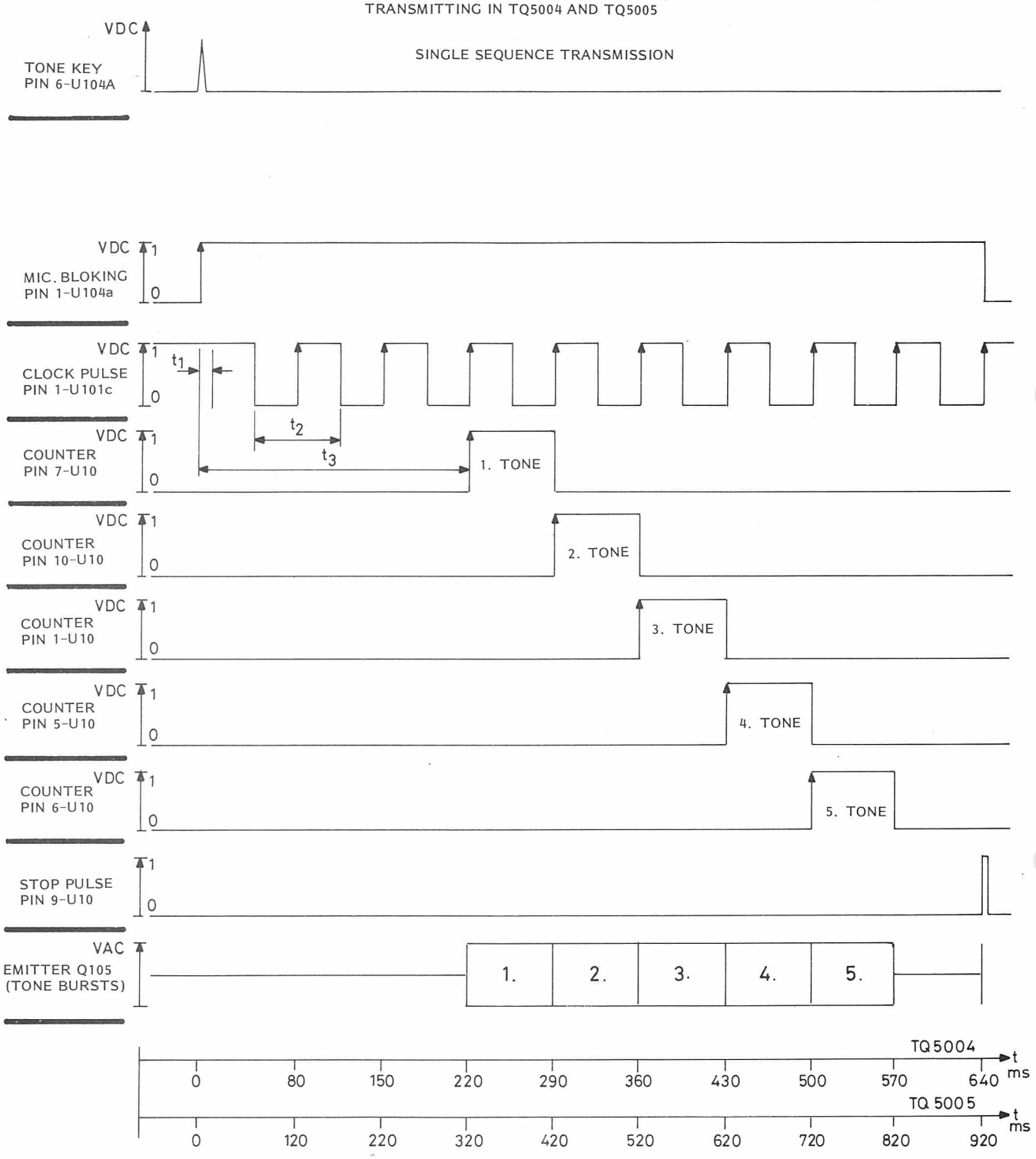
All tones used in the tone transmitter codes are programmed in the PROM.

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 $\overline{Q}$ 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 $\overline{Q}$-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 LENGHT)

t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

FIG. 6. 5-TONE SEQUENTIAL TRANSMISSION

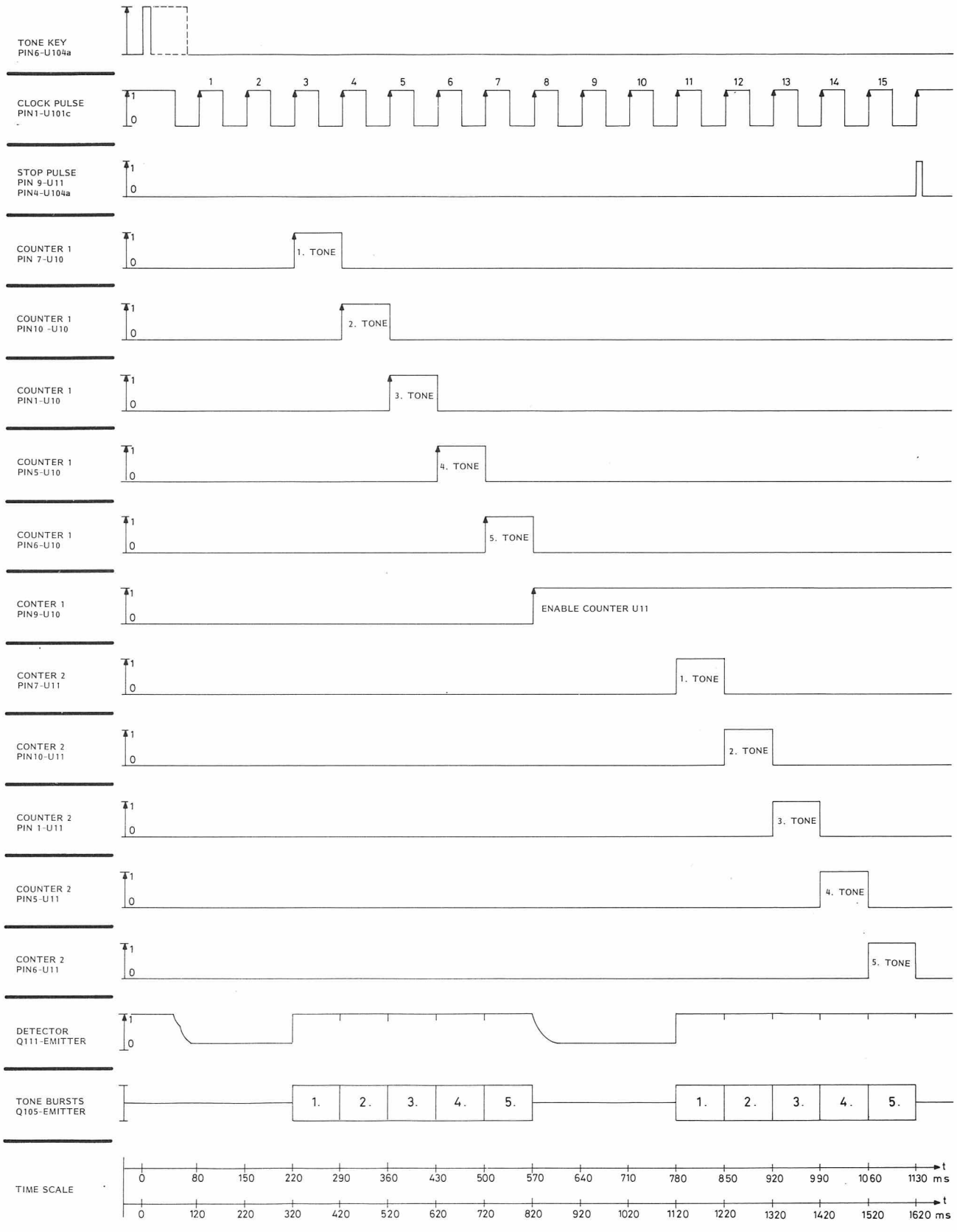


FIG. 7. DUAL SEQUENCE TRANSMISSION

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 of 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 exeeds 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 transistion 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.

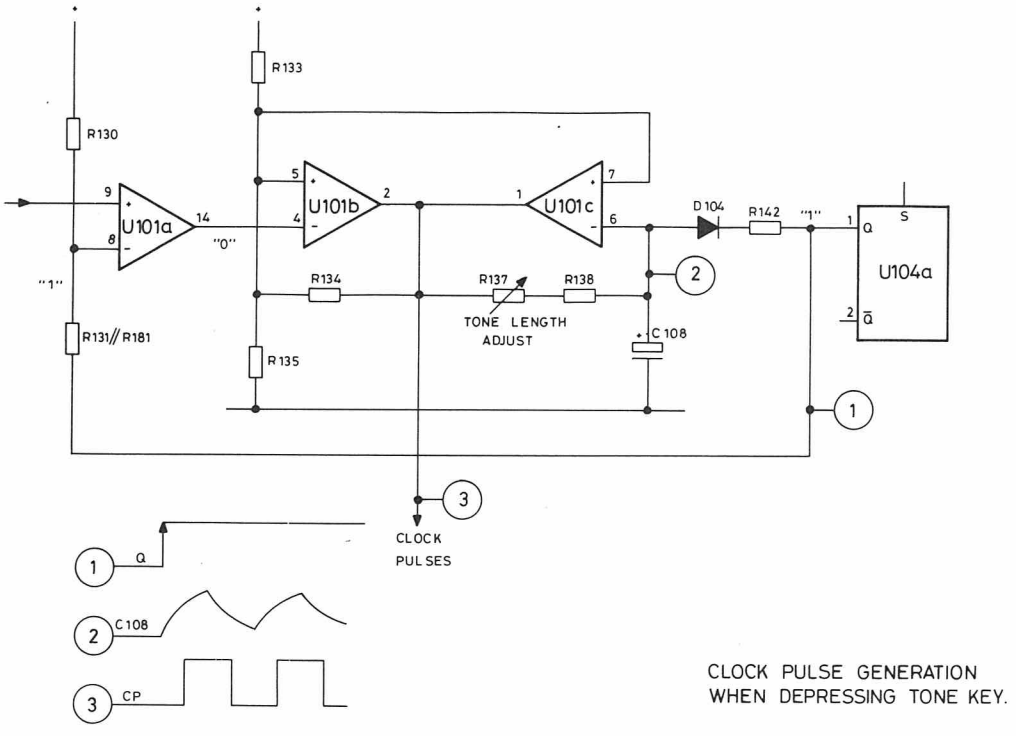
The positive pulses so appearing of the outputs of U101b and U101c are used as clock input to the counters U10 and U11. The period time is adjusted by means of resistor R137 to 70 ms for TQ5004 or 100 ms for TQ5005.

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

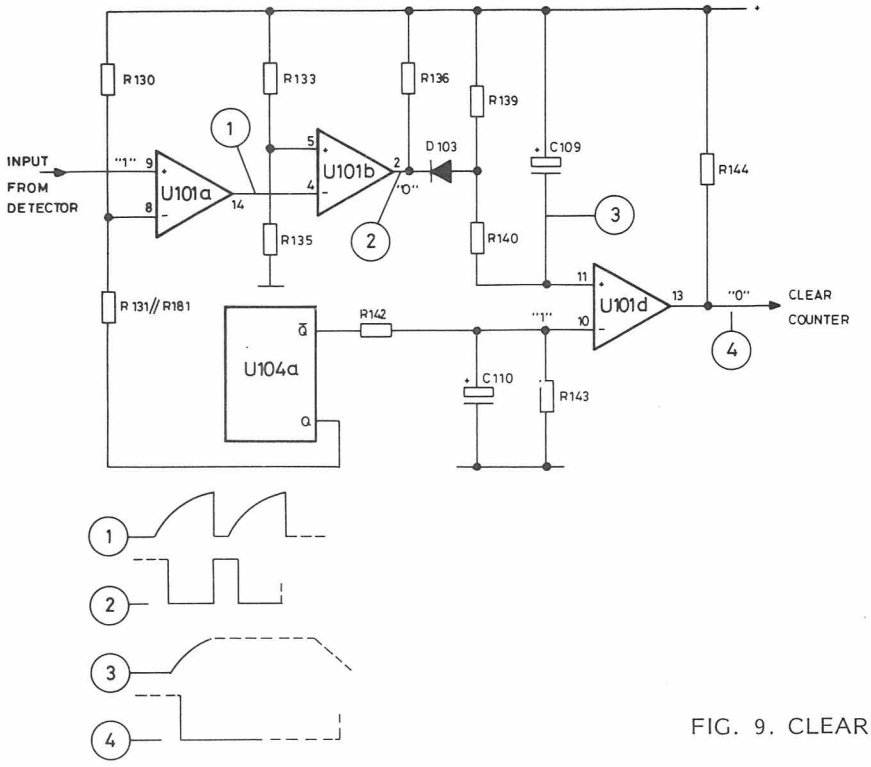


FIG. 9. CLEAR DELAY CIRCUITRY

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

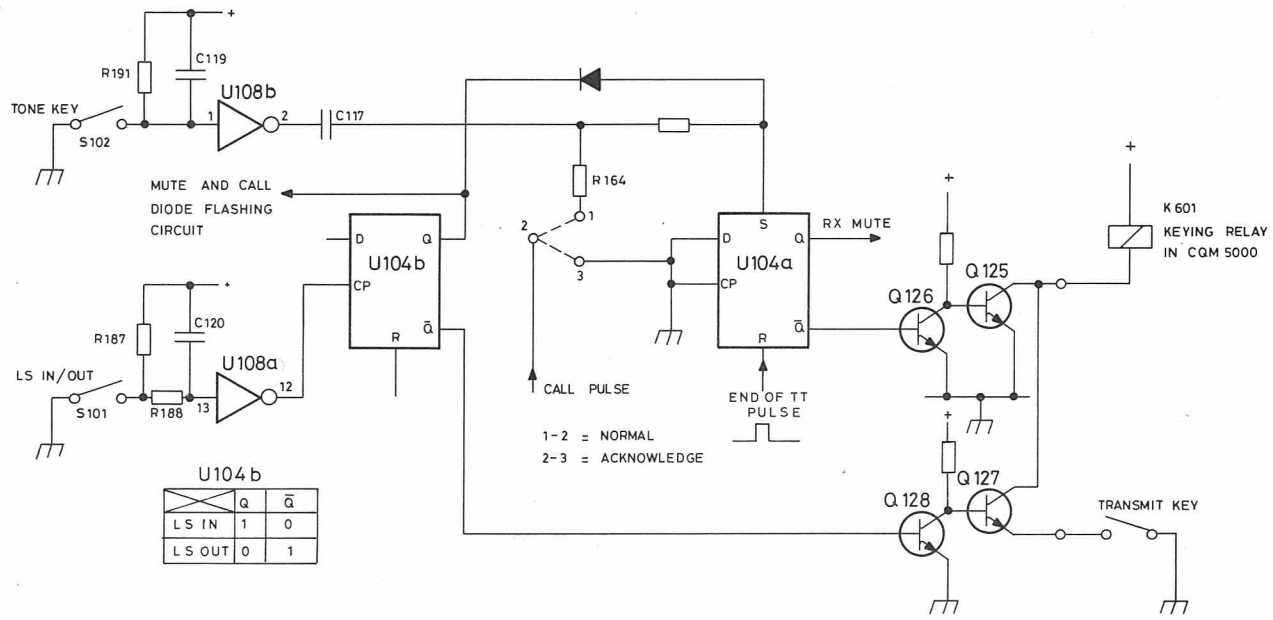


FIG. 10. LS IN/OUT AND TONE CIRCUITRY

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 $\overline{Q}$-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.

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 desides whether the audio channel is open or not.

LOGIC BOARD CIRCUIT DESCRIPTION

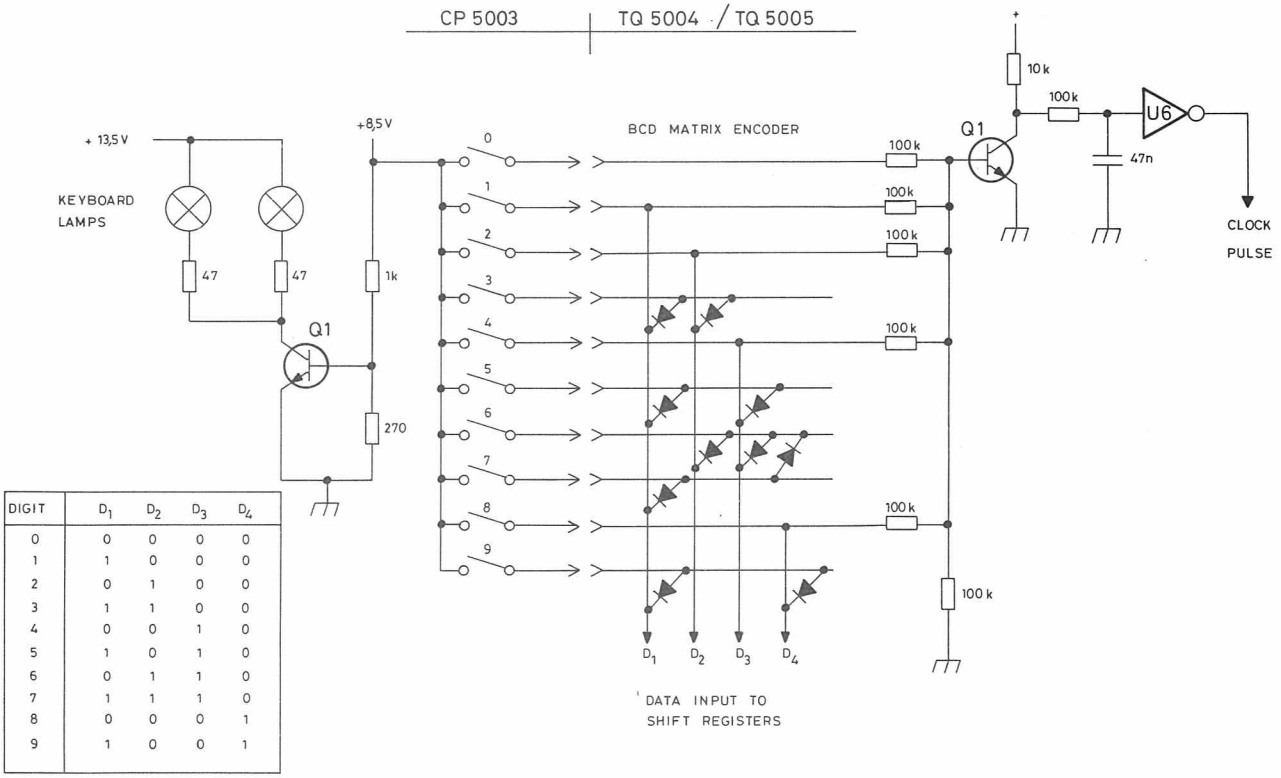
KEY BOARD, DECIMAL TO BCD ENCODING AND ANTIBOUNCE

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

SHIFT REGISTERS AND DATA BUFFERS

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

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



DIGIT	D_1	D_2	D_3	D_4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

FIG. 11. BCD ENCODER - CLOCK PULSE CIRCUITRY

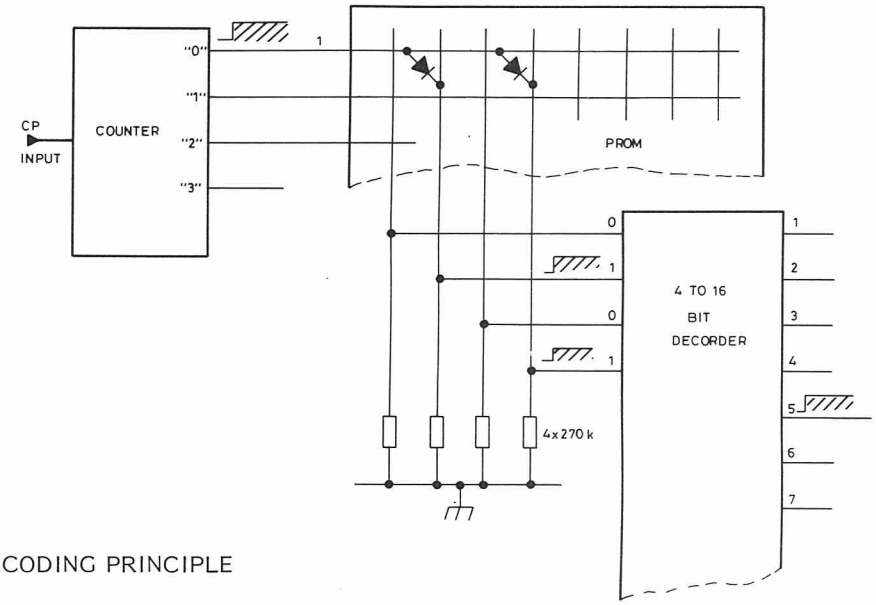


FIG. 12. PROM DECODING PRINCIPLE

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 $\overline{Q}$ 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 $\overline{Q}$ 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

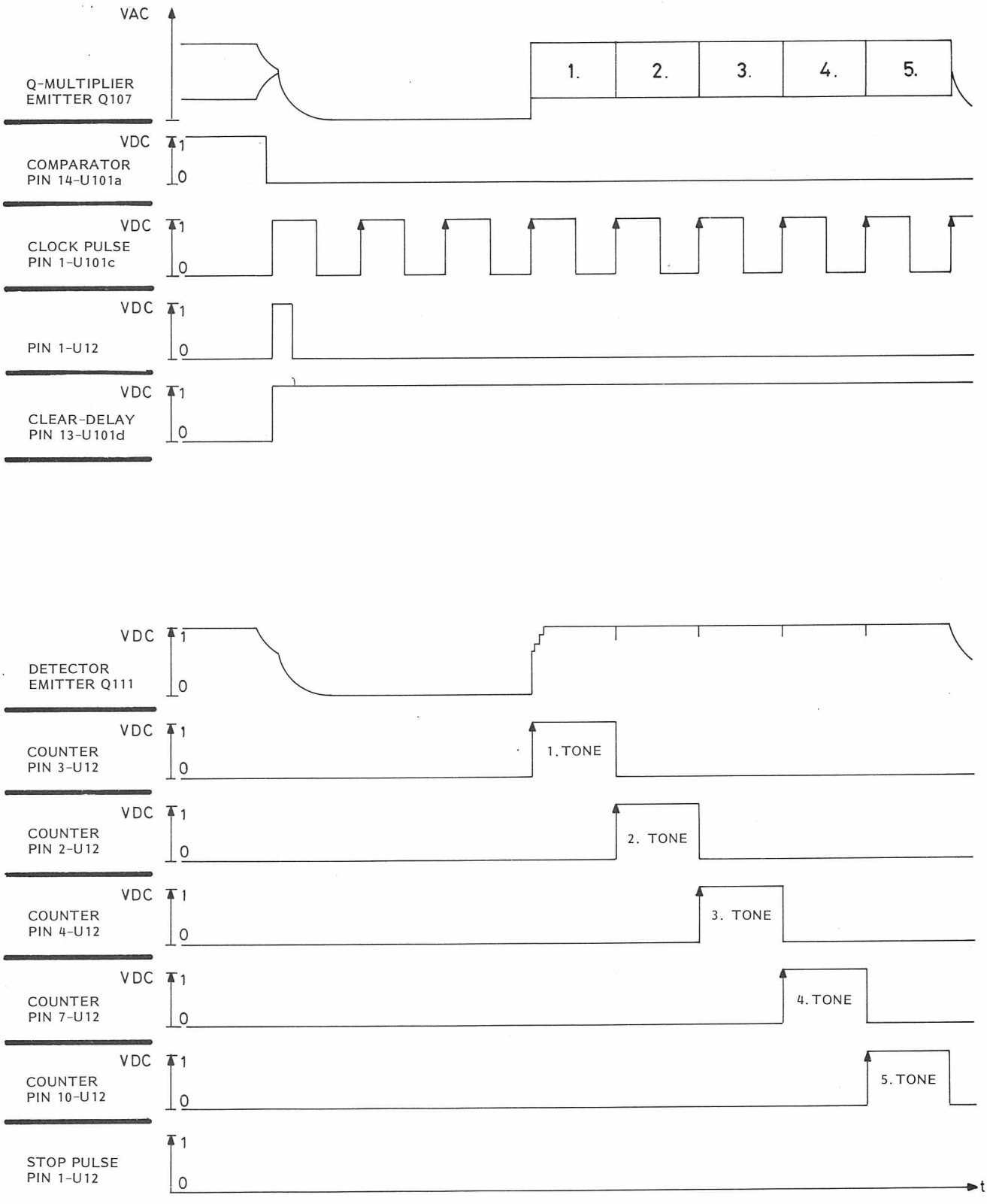


FIG. 13. ACKNOWLEDGE TRANSMISSION

TECHNICAL SPECIFICATIONS

SPECIFICATIONS COMMON TO TQ5004 AND TQ5005

Supply Voltage
8.5 V ±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
$-30^{o}C$ to $+60^{o}C$

SEQUENTIAL TONE TRANSMITTER

Signal Output Level
Max. 600 mV EMF (Adjustable)

Frequence Response
Flat ±1 dB

Signal Distortion
<5%

Tone Frequency Acceracy
Max. diviation: 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 speach channel of the CQM5000.

Input Frequency Response
Deemphasis according to an RC function with F_c= 2900 Hz

Activating Input Level
300 mV ±6 dB

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

Tone Frequency Accuracy
±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 ± 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 ± 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.

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. Frequences 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 sequencies. 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.

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).

The tone transmitter codes and the tone receiver code are independant 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.

ADDRESS	BIT	9	8	7	6	5	4	3	2	1	0
	TQ5004 TQ5005 PROM CODE SPECIFICATION	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 / V_3 / V_2 / V_1	VARIABLE TONE V_3 / V_2 / V_1	VARIABLE TONE V_2 / V_1	VARIABLE TONE V_1
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										

Total number of variables in system
1 Variable
2 Variables
3 Variables
4 Variables

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

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
R= repeat tone.
100 CALLS.

EX. B

1	2	R	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2.
90 CALLS.

EX. C

1	2	3	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2 and V_1 cannot be selected equal to 3.
81 CALLS.

EX. D

V_1	R	V_2	R	V_3

No limitations in the variable digits, V_1, V_2 and V_3. R= repeat tone.
1000 CALLS.

EX. E

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
Prolonged 1st-tone max 1.2 sec.

FORMAT 2.

- Transmission of two consecutive sequential tone signals.

1	2	3	4	5				6	7	8	9	10

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

1	2	3	4	V_1				V_2	R	V_3	R	V_4

$V_1 = V_2$ 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 accomodate 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).

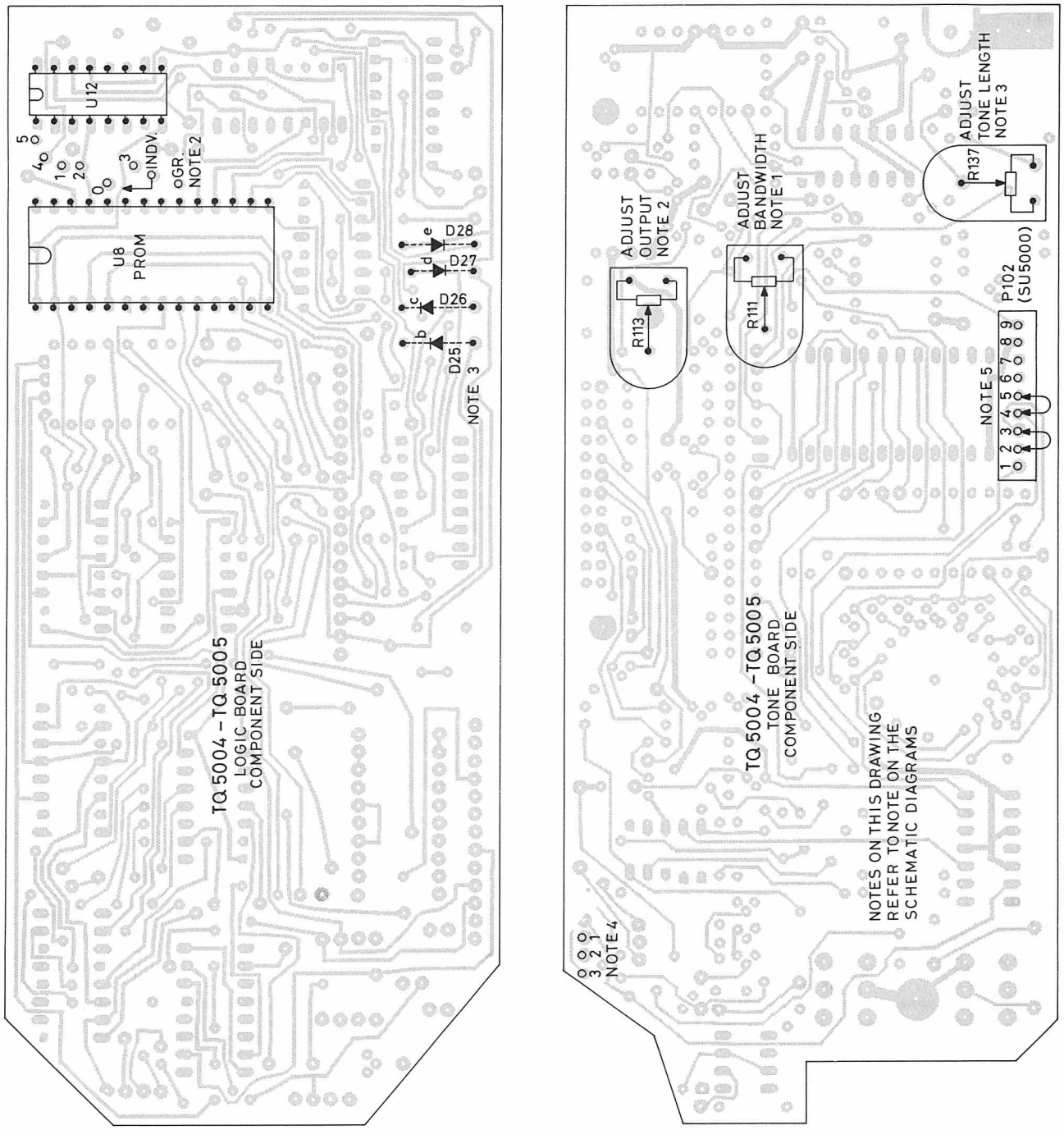


FIG 2. CIRCUIT BOARD LAYOUT TQ5004-TQ5005.

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

Item no.	Cat.	Quantity	Part No.	Description	Remarks	Ref. Item no.	Publ. No.	Size A:
1	A	2	80.5433-00	47Ω 5% 1/4W	R1, 2			
2	A	1	80.5242-00	270Ω 5% 1/8W	R3			
3	A	1	80.5249-00	1kΩ 5% 1/8W	R4			
4								
5	A	1	99.5333-00	transistor BC 337	Q1			
6								
7								
8								
9								
10	A	1	53.0897-0□	PC - boards			K 26728	3
11	A	(1)		hole lay-out		10	K 26729	2
12								
13	A	1	33.0408-00	angle			K 26608	4
14	A	2	30.5011-00	tubular rivet				
15	A	4	34.5040-00	minisert				
16	A	2	92.5120-00	lamp 12V, 60mA				
17								
18	A	1	41.5573-00	connector, 11 pos, male	J1			
19	A	1	41.5566-00	connector, 2 pos, male	J2			
20								
21	A	15	47.5105-00	push button switch	S1-15			
22								
23	A	1	12.0386-01	button 1			K 26616	4
24	A	1	12.0386-02	button 2			K 26616	4
25	A	1	12.0386-03	button 3			K 26616	4
26	A	1	12.0386-04	button 4			K 26616	4
27	A	1	12.0386-05	button 5			K 26616	4
28	A	1	12.0386-06	button 6			K 26616	4
29	A	1	12.0386-07	button 7			K 26616	4
30	A	1	12.0386-08	button 8			K 26616	4

Type and Part No.	Electrical processing	Mechanical processing	Date	Final Parts L. approved
15.0415-00	5410	5310		

Subassembly
(Keyboard)
(CP5003)

Parts List No. X 26861 Page 1 of 2

Date of issue
21-9-77

Stormo

Item	Cat.	Quantity	Part No.	Description	Remarks	Ref. Item no.	Publ. No.	Size A:
31	A	1	12.0386-09	button 9			K 26616	4
32	A	1	12.0386-10	button 0			K 26616	4
33	A	5	12.0378-00	button dummy			K 26451	3
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								
45								
46								
47								
48	A	X		assembly			K 26920	2
49								
50	A	X		schematic diagram			D 26887	3
51								
52								
53								
54								
55								
56								
57								
58								
59								
60								

Type and Part No.	Electrical processing	Mechanical processing	Date	Final Parts L. approved
15.0415-00	5410	5310		

Subassembly
(keyboard)
(CP5003)

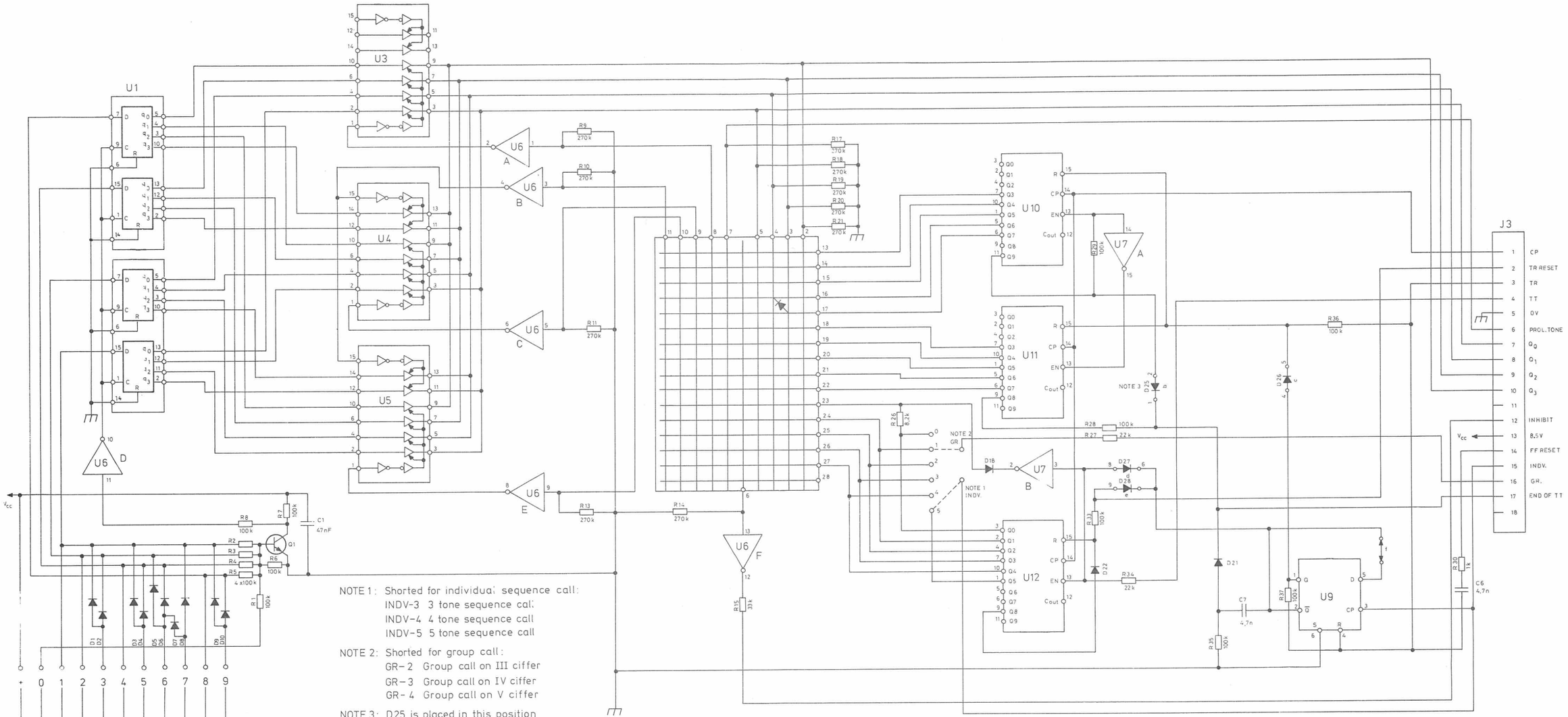
Parts List No. X 26861 Page 2 of 2

Date of issue
21-9-...

Stormo

Storno

Storno



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 ciffer
GR-3 Group call on IV ciffer
GR-4 Group call on V ciffer

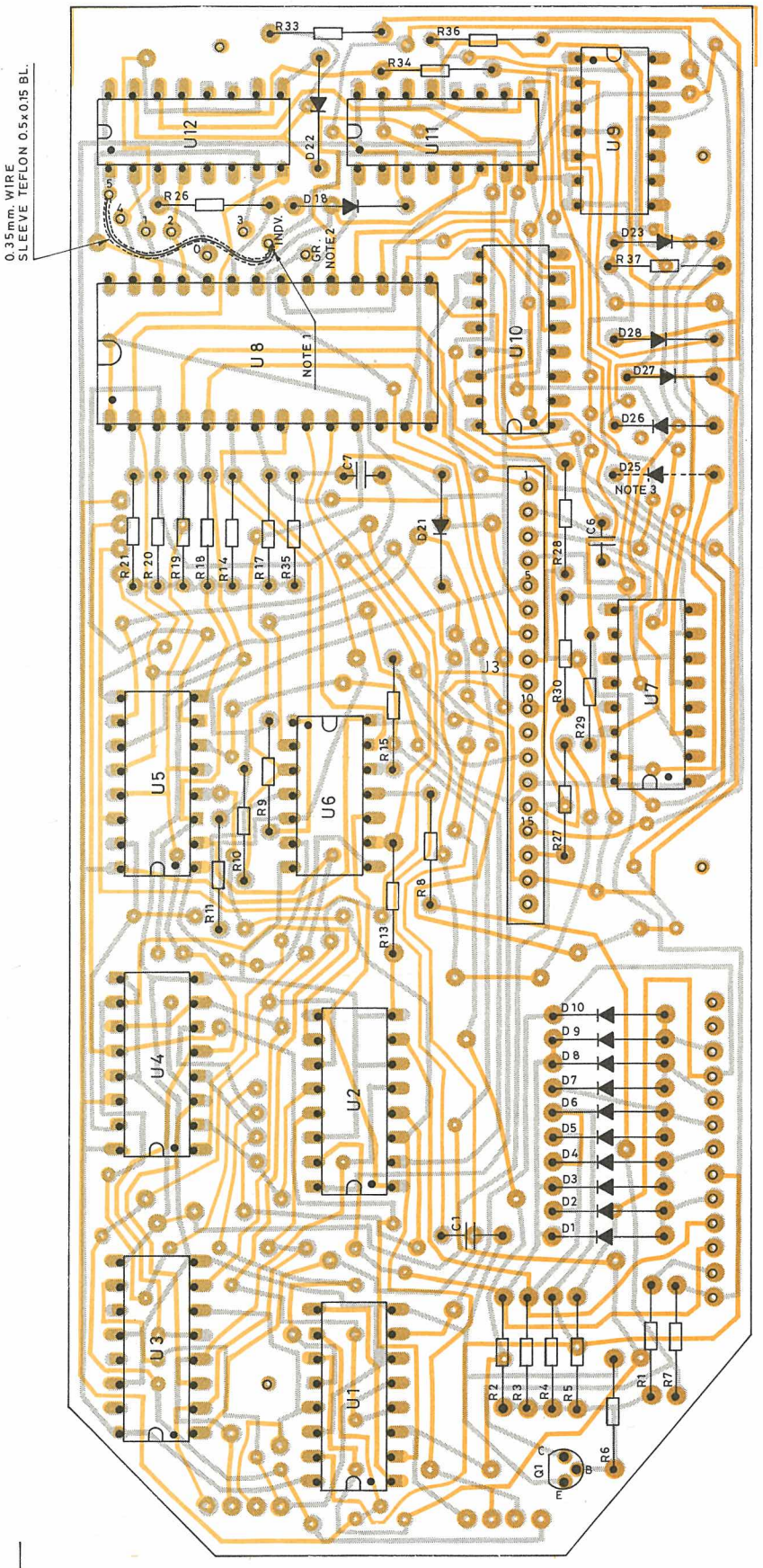
NOTE 3: D25 is placed in this position according to "Coding and strapping."

TYPE	V_{CC}	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 = 4017	16	8

SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
LOGIC BOARD

D402. 849

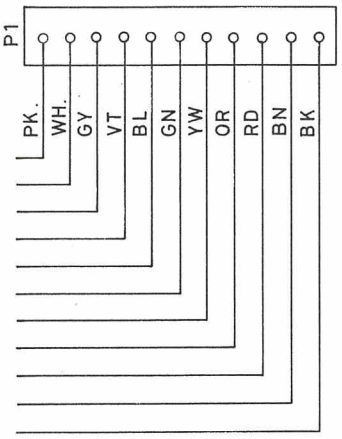
Storno



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

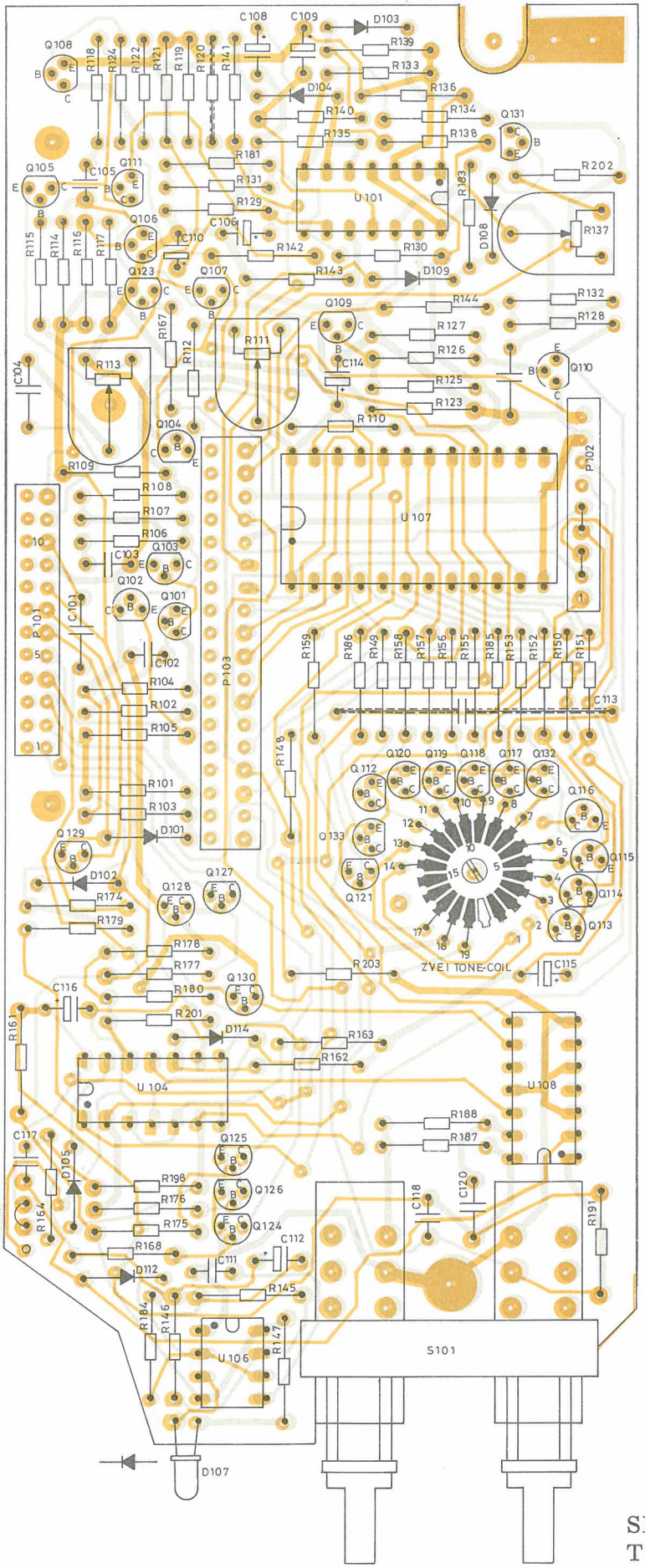
NOTE 3: D25 IS mounted in this position according to "coding and strapping"

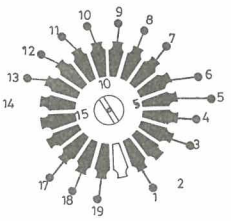


SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
LOGIC BOARD

D402. 832

Storno



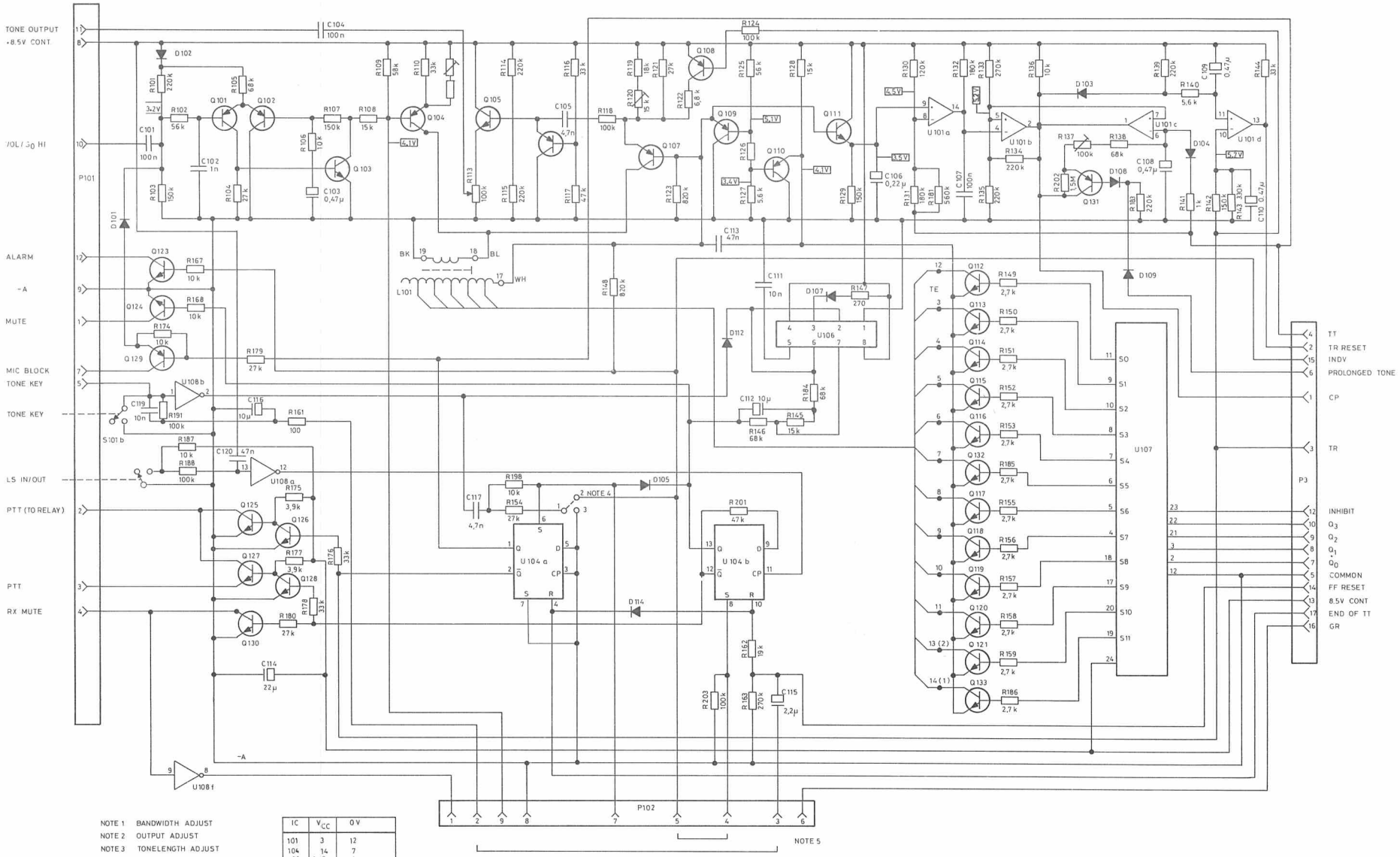


SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402. 831

Storno

Storno



NOTE 1 BANDWIDTH ADJUST
NOTE 2 OUTPUT ADJUST
NOTE 3 TONELENGTH ADJUST
NOTE 4 SHORT 1-2 FOR AUTO RECEIPT
SHORT 1-3 FOR NORMAL MODE
NOTE 5 SHORT 2-3 AND 4-5
WITHOUT SU5001 OR SU5002

IC	V_{CC}	0V
101	3	12
104	14	7
106	4-8	1
107	24	12
108	14	7

SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402. 848

Storno

TYPE	Nº	CODE	DATA
	C 1	76.5139	47 nF 10% Polyester FL 50 V
	C 6	76.5133	4.7 nF 10% Polyester FL 50 V
	C 7	76.5133	4.7 nF 10% Polyester FL 50 V
	C101	76.5144	0.1 uF 10% Polyester FL 63 V
	C102	76.5129	1 nF 10% Polyester FL 50 V
	C103	73.5169	0.47 uF 20% Tantal 35 V
	C104	76.5144	0.1 uF 10% Polyester FL 63 V
	C105	76.5133	4.7 nF 10% Polyester FL 50 V
	C106	73.5168	0.22 uF 20% Tantal 35 V
	C107	76.5144	0.1 uF 10% Polyester FL 63 V
	C108	73.5170	1.0 uF 20% Tantal 35 V
	C109	73.5169	0.47 uF 20% Tantal 35 V
	C110	73.5169	0.47 uF 20% Tantal 35 V
	C111	76.5135	10 nF 10% Polyester FL 50 V
	C112	73.5173	10 uF 20% Tantal 16 V
	C113	76.5123	47 nF 2.5% Polyester TB 63 V
	C114	73.5174	22 uF 20% Tantal 16 V
	C115	73.5171	2.2 uF 20% Tantal 35 V
	C116	73.5173	10 uF 20% Tantal 16 V
	C117	76.5133	4.7 nF 10% Polyester FL 50 V
	C118	76.5135	10 nF 10% Polyester FL 50 V
	C120	76.5139	47 nF 10% Polyester FL 50 V
	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
	D 27	99.5237	1N4148 Diode
	D 28	99.5237	1N4148 Diode
	D101	99.5237	1N4148 Diode
	D102	99.5237	1N4148 Diode
	D103	99.5237	1N4148 Diode
	D104	99.5237	1N4148 Diode
	D105	99.5237	1N4148 Diode
	D107	99.5325	LED Yellow
	D108	99.5237	1N4148 Diode

Storno

TYPE	Nº	CODE	DATA
	D109	99.5237	1N4148 Diode
	D112	99.5237	1N4148 Diode
	D114	99.5237	1N4148 Diode
	J 3	41.5568	Male Connector 18 pos
TQ5004	L101	61.1421	Tone coil ZVEI
TQ5005	L101	61.1422	Tone coil CCIR
	P 1	41.5570	PROM socket
	P101	41.5549	Female connector 12 pos.
	P102	41.5548	Female connector 9 pos.
	P103	41.5569	Female connector 18 pos.
	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 Transistor
	Q113	99.5324	BC338 Transistor
	Q114	99.5324	BC338 Transistor
	Q115	99.5324	BC338 Transistor
	Q116	99.5324	BC338 Transistor
	Q117	99.5324	BC338 Transistor
	Q118	99.5324	BC338 Transistor
	Q119	99.5324	BC338 Transistor
	Q120	99.5324	BC338 Transistor
	Q121	99.5324	BC338 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
	Q131	99.5115	BC309 Transistor
	Q132	99.5324	BC338 Transistor

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

TYPE	Nº	CODE	DATA	
	Q133	99.5324	BC338 Transistor	
	R 1	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 2	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 3	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 4	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 5	80.5273	100 Kohm 5% Carbon film	1/8W
	R 6	80.5273	100 Kohm 5% Carbon film	1/8W
	R 7	80.5261	10 Kohm 5% Carbon film	1/8 W
	R 8	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 9	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 10	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 11	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 13	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 14	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 15	80.5267	33 Kohm 5% Carbon film	1/8 W
	R 17	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 18	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 19	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 20	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 21	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 26	80.5260	8.2 Kohm 5% Carbon film	1/8 W
	R 27	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 28	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 29	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 30	80.5249	1 Kohm 5% Carbon film	1/8 W
	R 33	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 34	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 35	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 36	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 37	80.5273	100 Kohm 5% Carbon film	1/8 W
	R101	80.5277	220 Kohm 5% Carbon film	1/8 W
	R102	80.5270	56 Kohm 5% Carbon film	1/8 W
	R103	80.5275	150 Kohm 5% Carbon film	1/8 W
	R104	80.5266	27 Kohm 5% Carbon film	1/8 W
	R105	80.5271	68 Kohm 5% Carbon film	1/8 W
	R106	80.5261	10 Kohm 5% Carbon film	1/8 W
	R107	80.5275	150 Kohm 5% Carbon film	1/8 W
	R108	80.5263	15 Kohm 5% Carbon film	1/8 W
	R109	80.5271	68 Kohm 5% Carbon film	1/8 W
	R110	80.5267	33 Kohm 5% Carbon film	1/8 W
	R111	86.5036	47 Kohm 20% Trim carbon	0.05 W
	R112	80.5261	10 Kohm 5% Carbon film	1/8 W
	R113	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R114	80.5277	220 Kohm 5% Carbon film	1/8 W
	R115	80.5277	220 Kohm 5% Carbon film	1/8 W
	R116	80.5267	33 Kohm 5% Carbon film	1/8 W
	R117	80.5269	47 Kohm 5% Carbon film	1/8 W

Storno

TYPE	Nº	CODE	DATA	
	R118	80.5273	100 Kohm 5% Carbon film	1/8 W
	R119	80.5264	18 Kohm 5% Carbon film	1/8 W
	R120	89.5010	15 Kohm 20% NTC	0.5 W
	R121	80.5266	27 Kohm 5% Carbon film	1/8 W
	R122	80.5259	6.8 Kohm 5% Carbon film	1/8 W
	R123	80.5284	820 Kohm 5% Carbon film	1/8 W
	R124	80.5273	100 Kohm 5% Carbon film	1/8 W
	R125	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R126	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R127	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R128	80.5263	15 Kohm 5% Carbon film	1/8 W
	R129	80.5275	150 Kohm 5% Carbon film	1/8 W
	R130	80.5274	120 Kohm 5% Carbon film	1/8 W
	R131	80.5276	180 Kohm 5% Carbon film	1/8 W
	R132	80.5276	180 Kohm 5% Carbon film	1/8 W
	R133	80.5278	270 Kohm 5% Carbon film	1/8 W
	R134	80.5277	220 Kohm 5% Carbon film	1/8 W
	R135	80.5277	220 Kohm 5% Carbon film	1/8 W
	R136	80.5261	10 Kohm 5% Carbon film	1/8 W
	R137	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R138	80.5266	27 Kohm 5% Carbon film	1/8 W
	R139	80.5277	220 Kohm 5% Carbon film	1/8 W
	R140	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R141	80.5249	1 Kohm 5% Carbon film	1/8 W
	R142	80.5275	150 Kohm 5% Carbon film	1/8 W
	R143	80.5279	330 Kohm 5% Carbon film	1/8 W
	R144	80.5267	33 Kohm 5% Carbon film	1/8 W
	R145	80.5263	15 Kohm 5% Carbon film	1/8 W
	R146	80.5271	68 Kohm 5% Carbon film	1/8 W
	R147	80.5242	270 ohm 5% Carbon film	1/8 W
	R148	80.5284	820 Kohm 5% Carbon film	1/8 W
	R149	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R150	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R151	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R152	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R153	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R155	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R156	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R157	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R158	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R159	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R161	80.5237	100 ohm 5% Carbon film	1/8 W

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

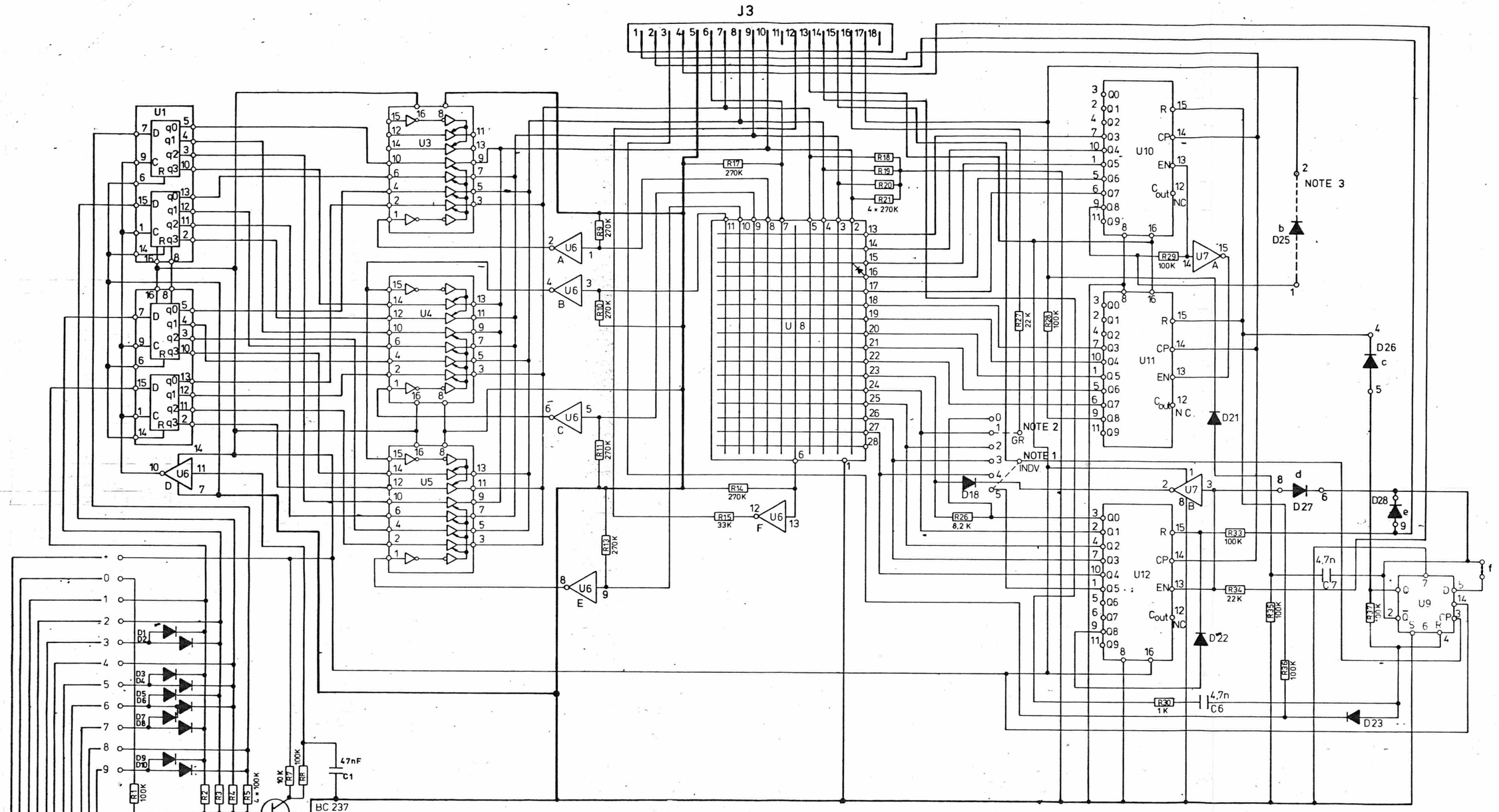
TYPE	Nº	CODE	DATA
	R162	80.5261	10 Kohm 5% Carbon film 1/8 W
	R163	80.5278	270 Kohm 5% Carbon film 1/8 W
	R164	80.5266	27 Kohm 5% Carbon film 1/8 W
	R167	80.5261	10 Kohm 5% Carbon film 1/8 W
	R168	80.5261	10 Kohm 5% Carbon film 1/8 W
	R174	80.5261	10 Kohm 5% Carbon film 1/8 W
	R175	80.5256	3.9 Kohm 5% Carbon film 1/8 W
	R176	80.5267	33 Kohm 5% Carbon film 1/8 W
	R177	80.5256	3.9 Kohm 5% Carbon film 1/8 W
	R178	80.5267	33 Kohm 5% Carbon film 1/8 W
	R179	80.5266	27 Kohm 5% Carbon film 1/8 W
	R180	80.5266	27 Kohm 5% Carbon film 1/8 W
	R181	80.5282	560 Kohm 5% Carbon film 1/8 W
	R183	80.5277	220 Kohm 5% Carbon film 1/8 W
	R184	80.5271	68 Kohm 5% Carbon film 1/8 W
	R185	80.5254	2.7 Kohm 5% Carbon film 1/8 W
	R186	80.5254	2.7 Kohm 5% Carbon film 1/8 W
	R187	80.5261	10 Kohm 5% Carbon film 1/8 W
	R188	80.5273	100 Kohm 5% Carbon film 1/8 W
	R191	80.5273	100 Kohm 5% Carbon film 1/8 W
	R198	80.5261	10 Kohm 5% Carbon film 1/8 W
	R201	80.5269	47 Kohm 5% Carbon film 1/8 W
	R202	80.5287	1.5 Mohm 5% Carbon film 1/8 W
	R203	80.5273	100 Kohm 5% Carbon film 1/8 W
	S101	47.0642	Switch assembly
	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 PROM
	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	14.5019	MC3302P Quad comparator
	U104	14.5098-01	CD4013B Dual D-FF
	U106	14.5134	555 Timer
	U107	14.5145	4514B Encoder
	U108	14.5146	CD40106B Hex Schmitt trigger

Storno

TYPE	Nº	CODE	DATA

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810



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

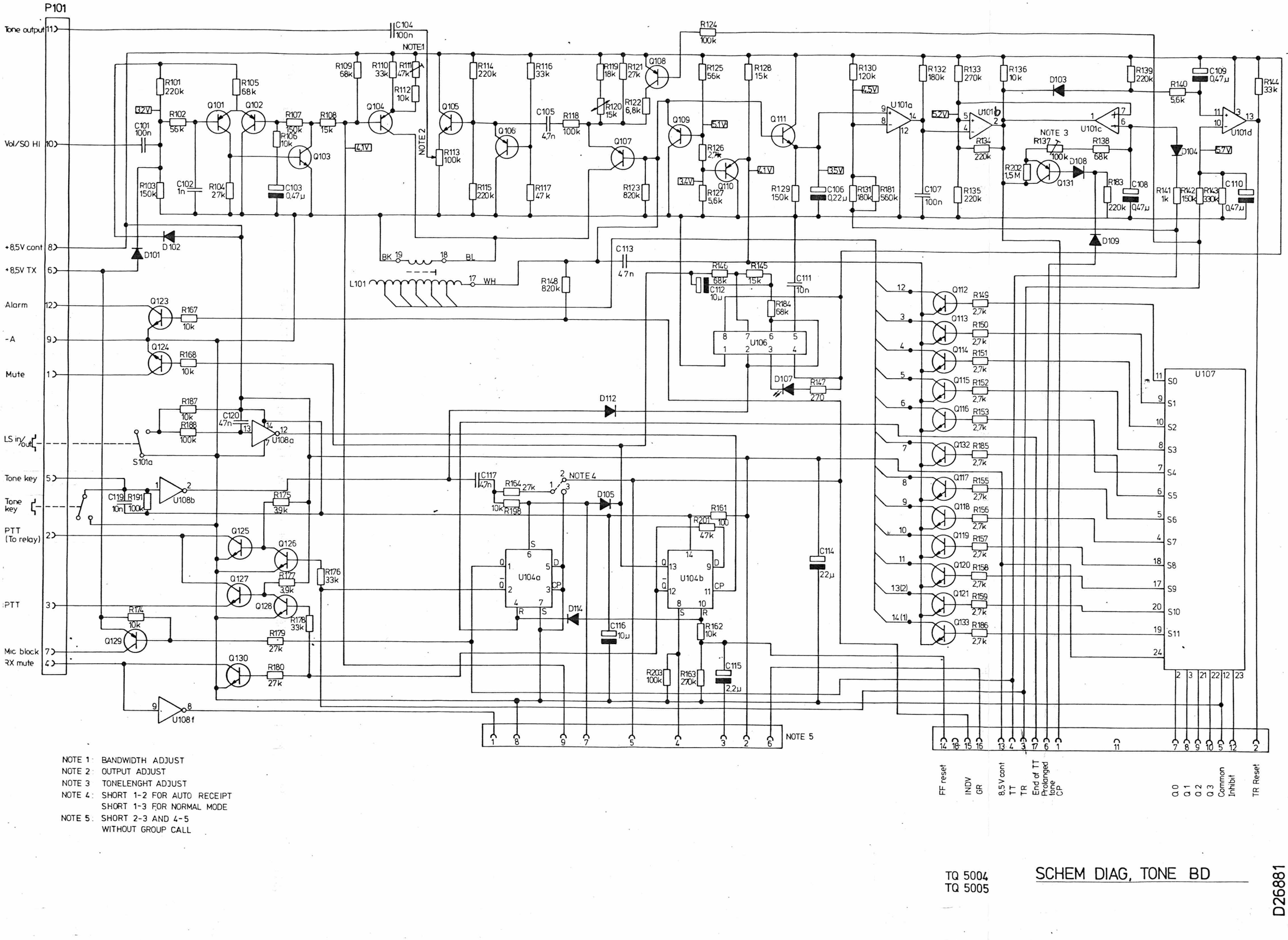
NOTE 2: Shorted for group call:
GR-2 Group call on III ciffer
GR-3 Group call on IV ciffer
GR-4 Group call on V ciffer

NOTE 3: D 25 is placed in this position according to „ Coding and strapping"

TQ 5004
TQ 5005

LOGIC BOARD

D26923



NOTE 1: BANDWIDTH ADJUST
NOTE 2: OUTPUT ADJUST
NOTE 3: TONELENGHT ADJUST
NOTE 4: SHORT 1-2 FOR AUTO RECEIPT
SHORT 1-3 FOR NORMAL MODE
NOTE 5: SHORT 2-3 AND 4-5
WITHOUT GROUP CALL

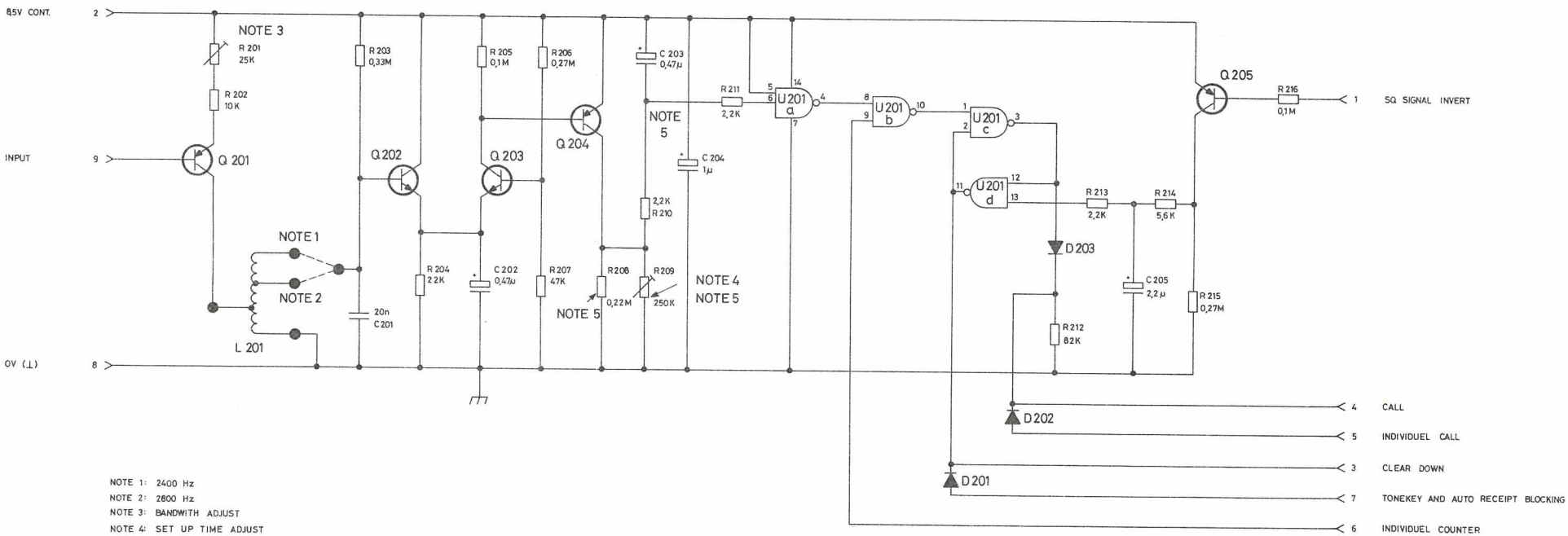
TQ 5004
TQ 5005

SCHEM DIAG, TONE BD

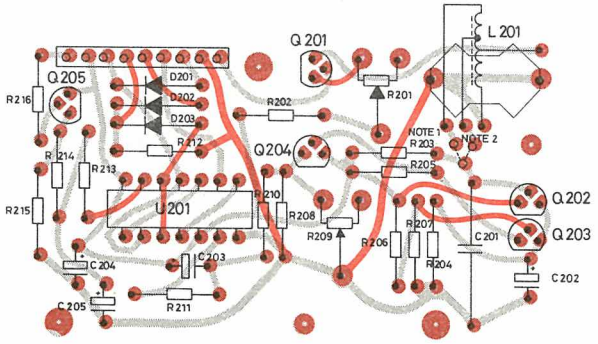
D26881

Storno

Storno



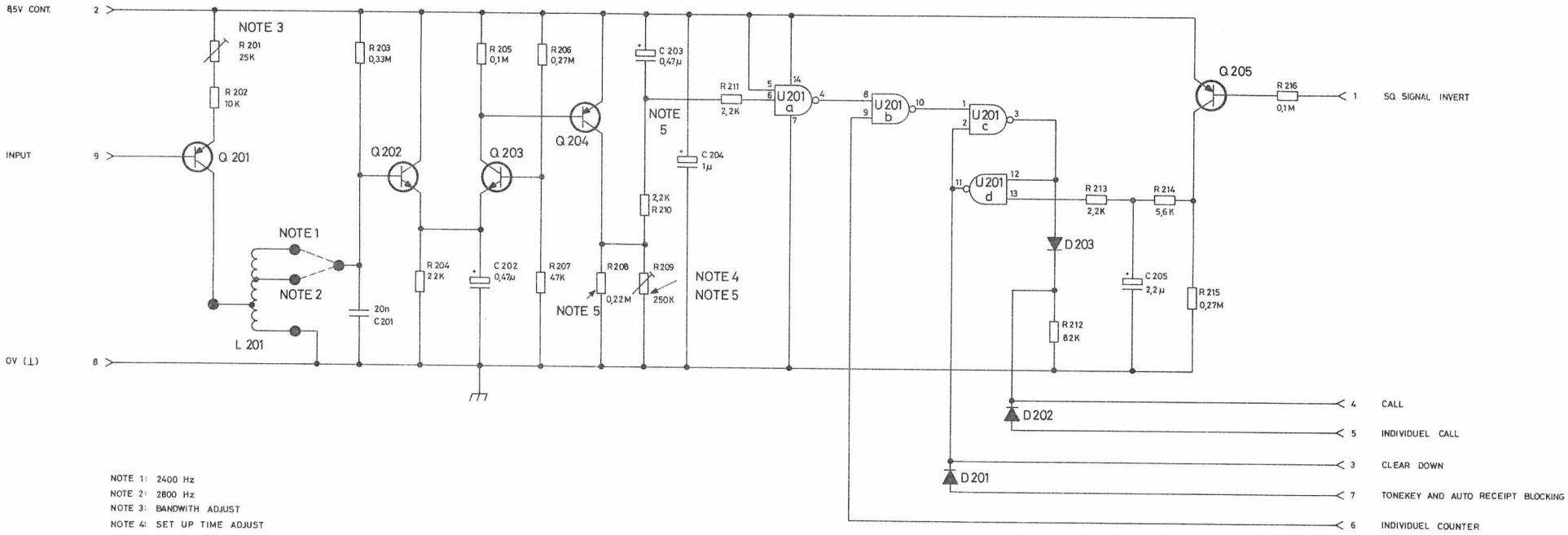
NOTE 1: 2400 Hz
NOTE 2: 2800 Hz
NOTE 3: BANDWITH ADJUST
NOTE 4: SET UP TIME ADJUST
NOTE 5: FOR SU 5002
R 208 = 0,56 M
R 209 = 500 K
C 203 = 10uF/16V



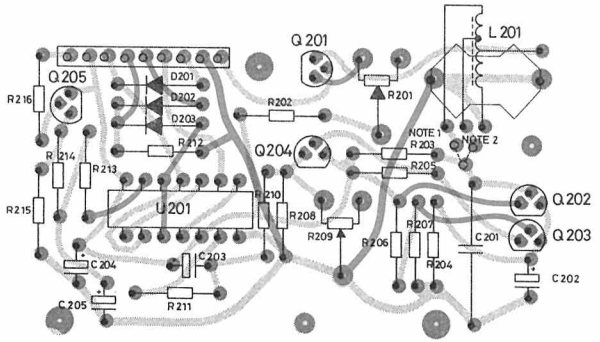
GROUP CALL - ALL CALL UNIT
SU 5001, SU 5002

D402.620

Storno



NOTE 1: 2400 Hz
NOTE 2: 2800 Hz
NOTE 3: BANDWITH ADJUST
NOTE 4: SET UP TIME ADJUST
NOTE 5: FOR SU 5002
R 208 = 0,56 M
R 209 = 500 K
C 203 = 10uF/16V



GROUP CALL - ALL CALL UNIT
SU 5001, SU 5002

D402.620

TYPE	Nº	CODE	DATA	
	C202	73.5125	0.47 uF 20% Tantal	35 V
SU5002	C203	73.5109	10 uF 20% Tantal	16 V
	C204	73.5114	1 uF 20% Tantal	35 V
	C205	73.5102	2.2 uF 20% Tantal	35 V
	C210	76.5127	20 nF 2% Polystyr. TB	63 V
	D201	99.5237	1N4148 Diode	
	D202	99.5237	1N4148 Diode	
	D203	99.5237	1N4148 Diode	
	L1	61.1358	Tone coil	
	Q201	99.5237	BC308 Transistor	
	Q202	99.5143	BC238 Transistor	
	Q203	99.5143	BC238 Transistor	
	Q204	99.5237	BC308 Transistor	
	Q205	99.5237	BC308 Transistor	
	R201	86.5054	25 Kohm 20% Carbon pot.	0.05 W
	R202	80.5260	10 Kohm 5% Carbon film	0.125 W
SU5002	R203	80.5282	560 Kohm 5% Carbon film	0.125 W
	R204	80.5265	22 Kohm 5% Carbon film	0.125 W
	R205	80.5273	100 Kohm 5% Carbon film	0.125 W
	R206	80.5278	270 Kohm 5% Carbon film	0.125 W
	R207	80.5269	47 Kohm 5% Carbon film	0.125 W
	R208	80.5277	220 Kohm 5% Carbon film	0.125 W
SU5002	R209	86.5038	500 Kohm 20% Carbon pot.	0.05 W
	R210	80.5253	2.2 Kohm 5% Carbon film	0.125 W
	R211	80.5253	2.2 Kohm 5% Carbon film	0.125 W
	R212	80.5272	82 Kohm 5% Carbon film	0.125 W
	R213	80.5253	2.2 Kohm 5% Carbon film	0.125 W
	R214	80.5258	5.6 Kohm 5% Carbon film	0.125 W
	R215	80.5278	270 Kohm 5% Carbon film	0.125 W
	R216	80.5273	100 Kohm 5% Carbon film	0.125 W
	U201	14.5051	4011 Quad-2-inp. NAND	

Storno

TYPE	Nº	CODE	DATA

GROUP CALL UNIT SU5001

ALL CALL UNIT SU5002

Storno

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 toneequipment 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

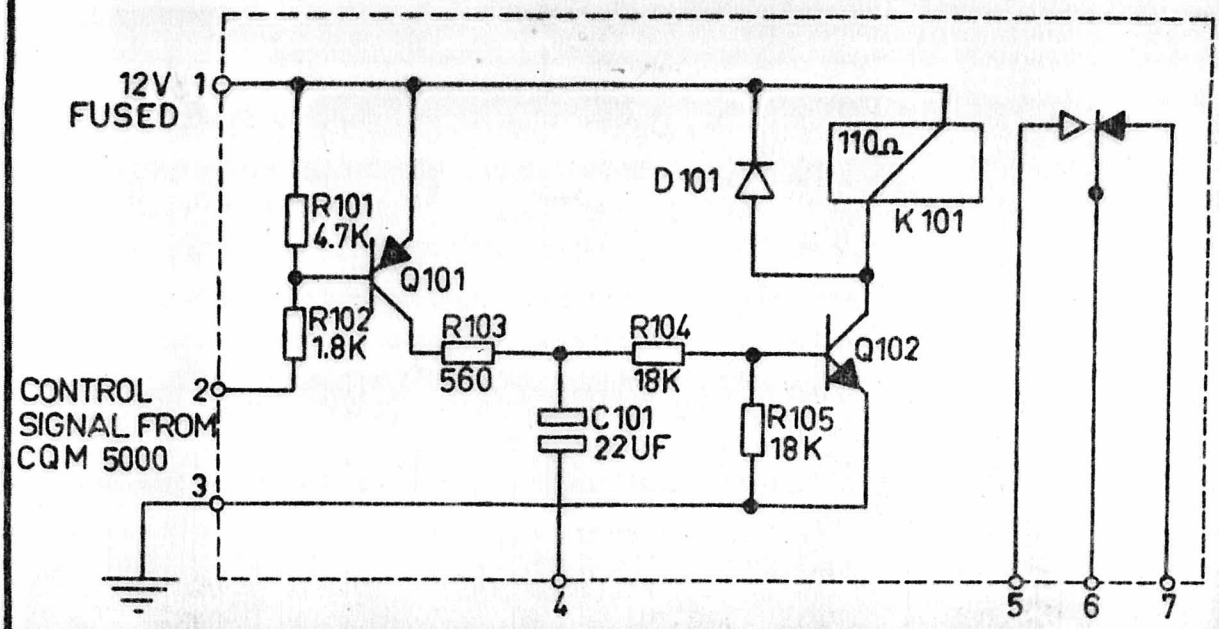
Supply Voltage
10.8V to 16.6V

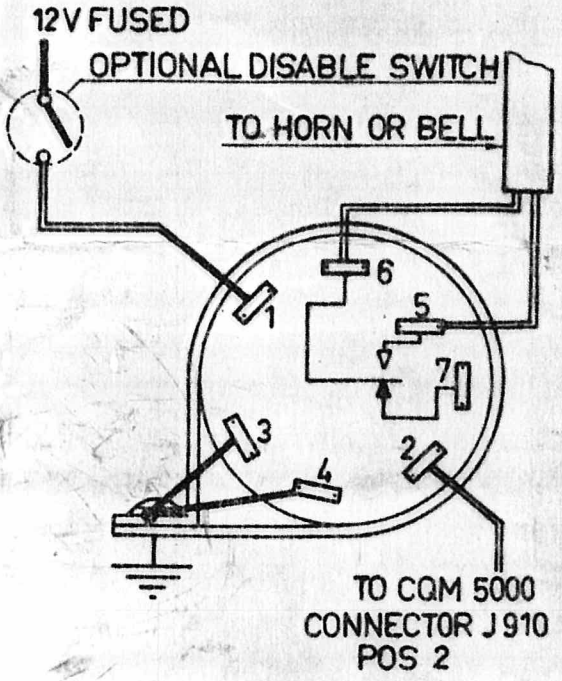
Current Drain, 13.2V
Standby: approximately 0 mA
Engaged: 140 mA

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.

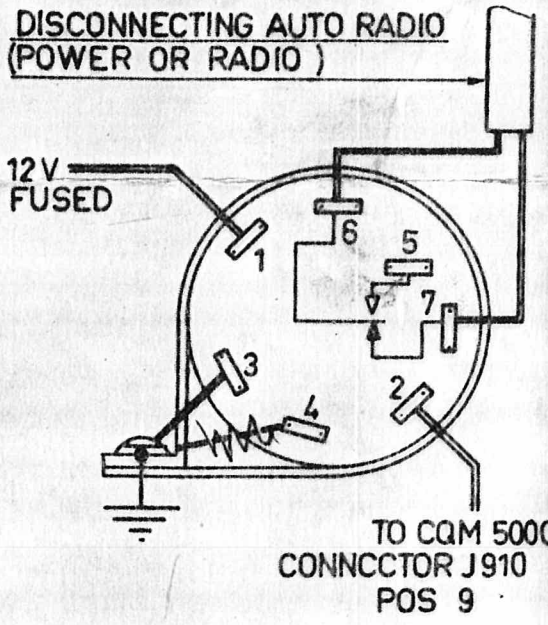




Strap H1-H19 on ZS5XXX

The horn alarm can be switched off by a switch connected in serie with 12V after fuse (Pin 1)

ALARM



Strap H20 - H33 on XS5XXX

Note : J910 pos 9 is not available for this purpose if a CG unit is connected to J905 on XS5XXX.
Pos 6 of J911 may be used in these cases- (remove strap H12 - H24 if installed and strap H20 - H12)

AUTO RADIO MUTING

REVISED

LANNG & STELMAN aps
Havnegade 16 E, DK-8000 Arhus C, Danmark Tlf.:(06) 19 35 00

3333.0350-00

To-tone transceiver til CQM 5000

LUSTIG

280380/BJ

Emne Tonetranceiver, to-tone

Kredsløbsbeskrivelse.

Strømforsyning.
Enheden strømforsynes udefra med en stabiliseret spænding på 8,5V
Internt genereres en referencespænding VR af zenerdioden D 17, efterfulgt af emitterfølger V 9.
Derforuden findes der en spændingsdeler R 25/24, der fastlægger en tærskelværdispænding VRT til tonedektoren IC 1D.

Clock-oscilator.
Denne består af en kontinuerligt arbejdende multivibrator IC 4, der i modtagerstilling arbejder på 100 mS og i senderstilling på 200 mS (simultan).

Reset kredsløb.
Reset kredsløbet består af C 17 og R 49 og giver en positiv spænding ud ved spændingstilslutning MC.

Funktionsomskifter.
Funktionsomskifteren består af en binær tæller IC 6B.
Den clockes konstant frem til selvblokering.
Dette opstår, når Q4=1=modtagestilling.
Ved at trigge på reset ben 15 bliver Q4=0 i minimum 700 mS, og tonesenderen er aktiv i denne tid.

Højttaler ind/ud.
D-flip-floppen IC 11A kan påvirkes, enten fra valid tone VT eller fra HT-knappen.
Når ben 1 = 1 er HT og senderblokering ophævet via V 15/V16, og samtidig tændes kaldelampen D 14 via IC 8D og V 19.
Hvis det er tonemodtageren, der har aktiveret, vil IC 11B samtidig blive sat $\bar{Q}$=0, og der vil opstå en multivibrator gennem IC 8D, IC 10A og tidskonstanten C 18/R52, så-

ledes at D 14 blinker.

"Busy" lampe.
Lampen drives af IC 3B fra P 1 ben 4, og skiftespændingen er ca. 4V.

Tonesending (beskrevet som simultan-koblet).
IC 6B Q4=0, TX=1 og RX=0.
Gennem IC 7A+B og IC 9 C+D gøres V 4 + V 7 ledende, og disses indkodning på T 1 og T 2 bestemmer resonansfrekvens ved tonesending.
NB: Ved at koble TTX 1(2) til en omskifters arm og tonespolens udtag til selve omskifteren kan tonesenderen varieres.
V 1 + T1 og V 2 + T 2 danner oscilator og gøres aktive via IC 2 A+C.
Signalerne summeres gennem R 20/ R 22 til IC 1 C, hvor der impedansomsættes.
Gennem IC 2 D ledes signalet til P 1, hvor niveauet indstilles.

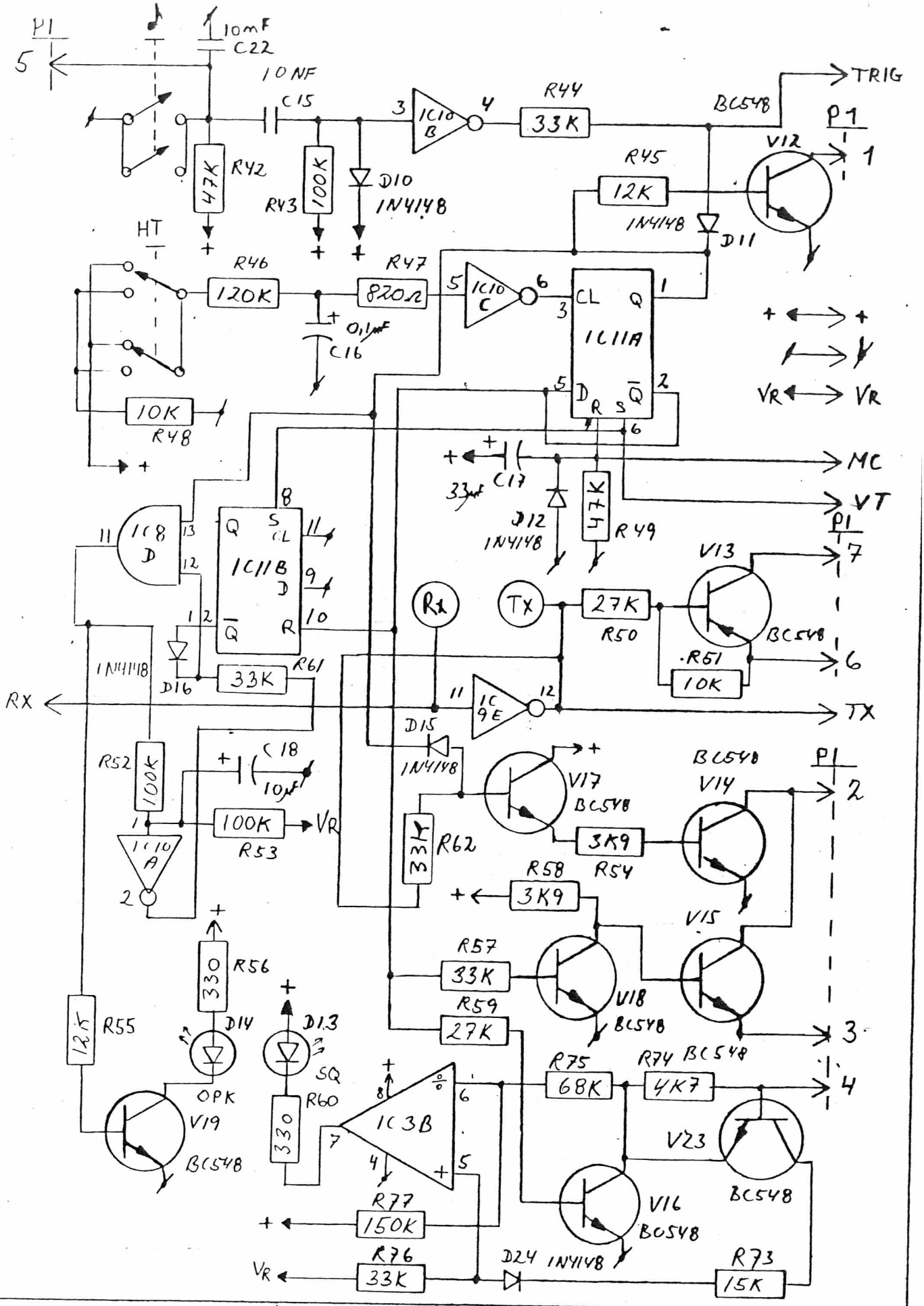
Tonemodtagning (beskrevet som simultankoblet).
IC 6 B Q4=1, TX=0 og RX=1.
Tonesignalet tilføres via C 1 til IC 1A, hvor det forstærkes, inden det, gennem R 5 og IC 2B, filtreres i T1.(T1 og T2s resonans er nu bestemt af enten V 3 + V 6 eller V 5 + V 8.).
Herefter forstærkes og klippes signalet i IC 1 B og føres gennem R 18 til T 2, hvor det endnu en gang filtreres.
I IC 1 D fastlægges tærskelværdien for valid niveau, og D 4 ensretter til DC.
C 9, R 29 samt IC 3 A omsætter til logisk niveau, idet IC 3 A er koblet som Schmitt Trigger.

Tonemodtagerlogik.
IC 5 B er koblet som flip-flop og styrer gennem IC 7C+D

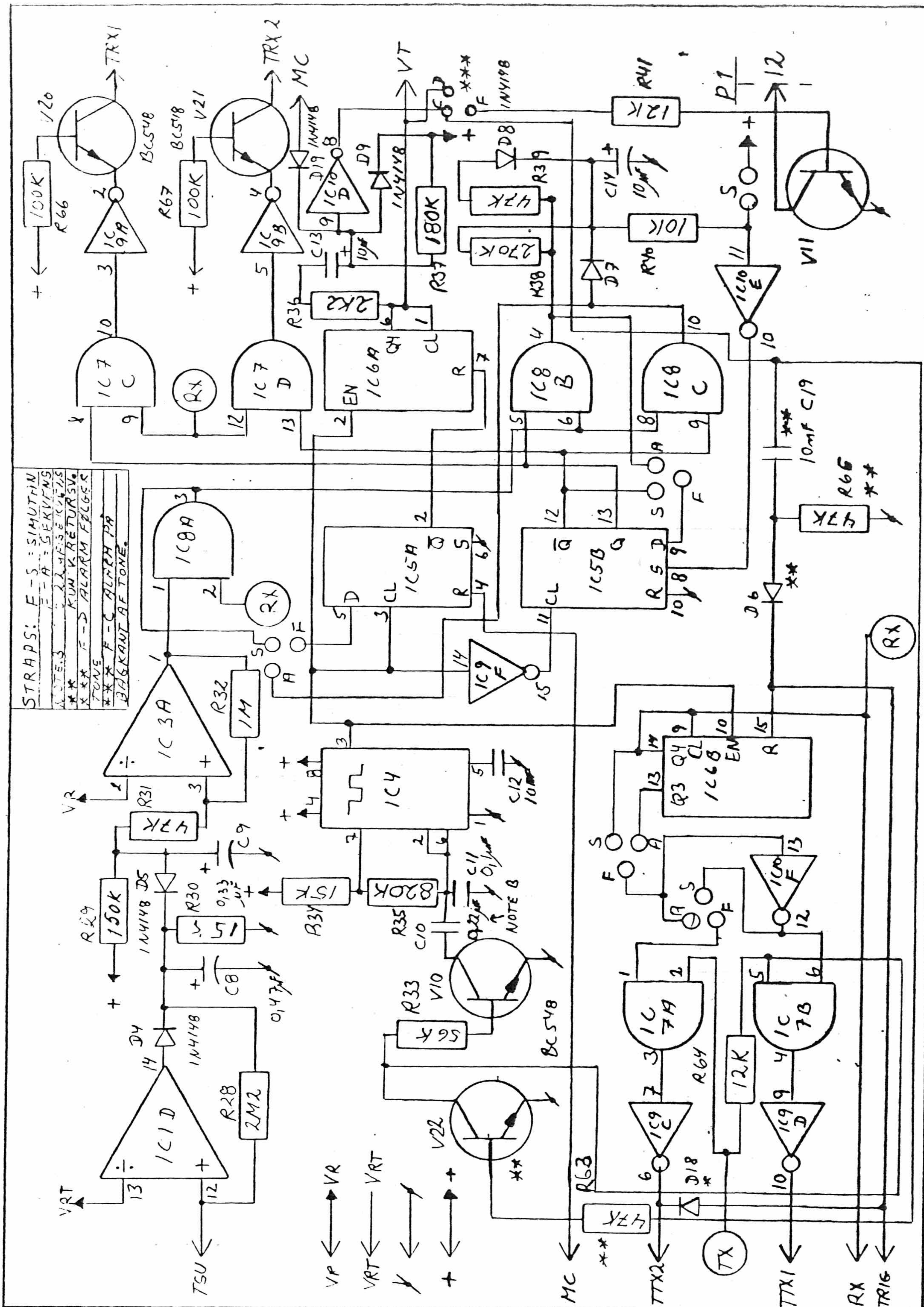
efter tur tone 1 og 2.
IC 5 A er koblet som D-flip-flop, repræsenterende valid tone.
Der foregår således en aftastning af tone 1 og 2 med clock-frekvensen 100 mS, og IC 5A ben 2 vil være "0", så længe de to toner er til stede i resonans.
Dette medfører, at IC 6 A mister reset og clockes frem til Q4=1=valid tone VT.

Alarm kreds.
V 11 får enten signal under tonemodtagning fra VT eller fra IC 10 D, der giver en puls ud, når tonen forsvinder (strap DF/CF).
NB: For at undgå, at støj fra bilens horn påvirker tonesignalet, kan det være en fordel at anvende horn-puls på bagkanten (strap CF).

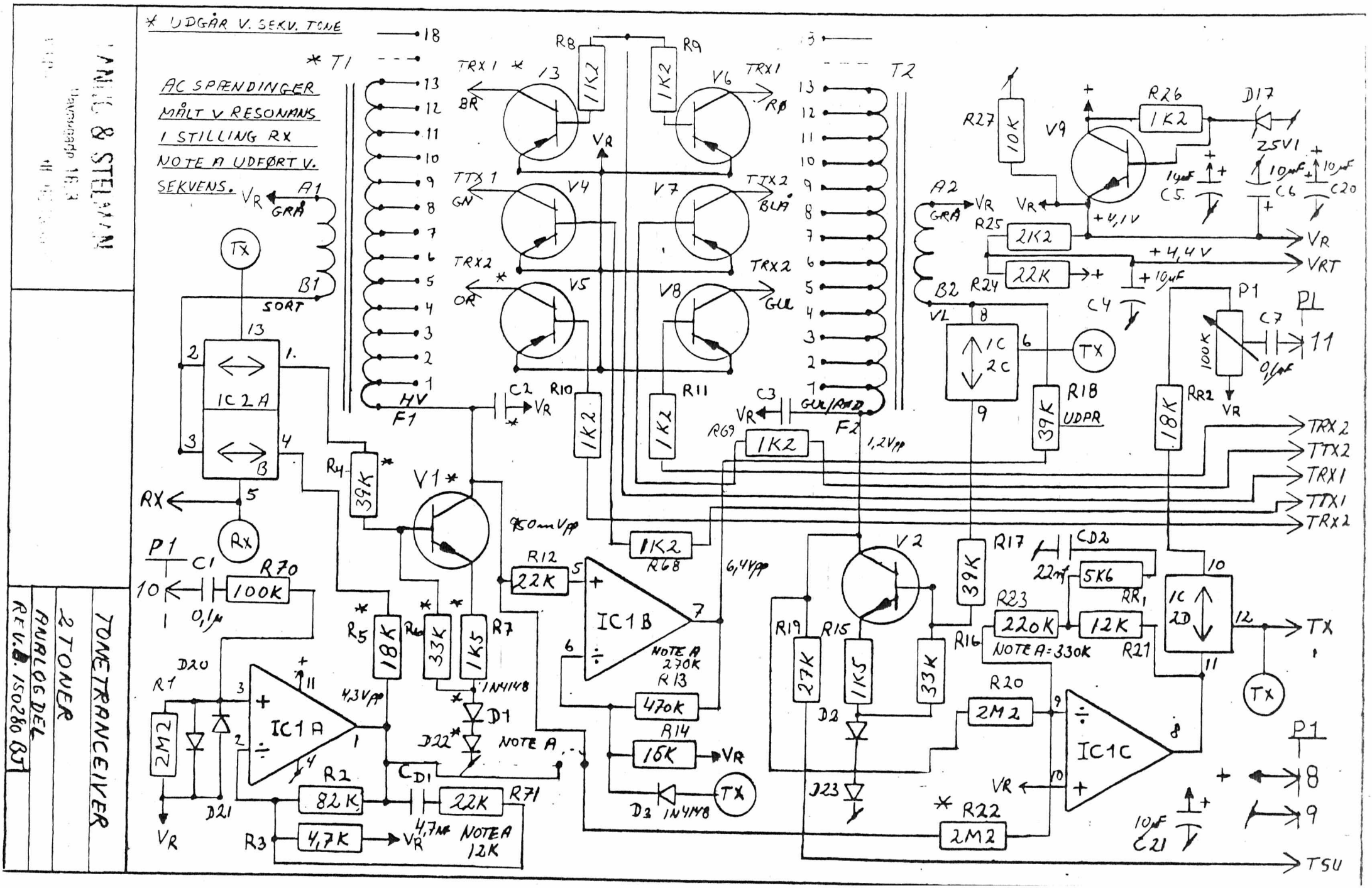
Retursvar.
Retursvar styres også af IC 10 D, der via C 19 og D 6 trigger tonesenderen og evt. blokerer den ene tone med D 18.



		TONE TRANCEIVER
		2 TONER
		INTERFACE
		REV. B. 15/2/80 BJ



	TONETRANCEIVER
	2 TONER
	LOGIKDEL
	REV.B. 150280 BJ


* UDGÅR V. SEKV. TONE
AC SPÆNDINGER MÅLT V RESONANS I STILLING RX NOTE A UDEFØRT V. SEKVENS.
T1
T2
TX
RX
IC 2A
IC 2B
IC 2C
IC 1A
IC 1B
IC 1C
IC 2D
V1
V2
V4
V5
V6
V7
V8
V9
TRX1
TTX1
TRX2
TTX2
VR
VRT
VL
HV
F1
F2
P1
PL
SORT
GRÅ
BLÅ
GUL
GUL/RØD
BR
RØ
GN
OR
1,2Vpp
6,4Vpp
4,3Vpp
NOTE A
NOTE A: 330K
NOTE A 270K
NOTE A 12K
1N4148
UDPR
TSU
TONETRANCEIVER
2 TONER
ANALOG DEL
REV.B. ISO280 BJT

Kunde	Korr.	A	B	C	Tegning nr	
Storno			V			
Projekt: 5000 toneudstyr					Udført af / Dato	Godkendt

Position	Artikel		Type	Antal	Leverandør	L. nr	Pris 1	Pris 2
R 1	2M2	1/8W						
– 2	82K	–						
– 3	4K7	–						
– 4	39K	–	simultan					
– 5	18K	–	–					
– 6	33K	–	–					
– 7	1K5	–	–					
– 8	1K2	–	–					
– 9	1K2	–						
– 10	1K2	–	–					
– 11	1K2	–						
– 12	22K	–						
– 13	470k/270K	–	sim 470K/AP 270K					
– 14	15K	–						
– 15	1K5	–						
– 16	33K	–						
– 17	39K	–						
– 18	39K	–						
– 19	27K	–						
– 20	2M2	–						
– 21	12K	–						
– 22	2M2	–	simultan					
– 23	220K/330K	–	sim 220K/AP 330K					
– 24	22K	–						
– 25	2K2	–						
– 26	1K2	–						
– 27	10K	–						
– 28	2M2	–						
– 29	150K	–						
– 30	15K	–						
– 31	47K	–						
– 32	1M	–						
– 33	56K	–						
– 34	15K	–						
– 35	820K	–						
– 36	2K2	–						
– 37	180K	–						
– 38	270K	–						
– 39	47K	–						
– 40	10K	–						
– 41	12K	–						
– 42	47K	–						
– 43	100K	–						
– 44	33K	–						
– 45	12K	–						
– 46	120K	1/16 W						
– 47	820E	1/8 W						
– 48	10K	1/16 W						
– 49	47K	1/8 W						
– 50	27K	–						
– 51	10K	–						
– 52	100K	–						
– 53	100K	–						
– 54	3K9	–						
– 55	12K	–						

Kunde	Korr.	A	B	C	Tegning nr	
Storno			✓			
Projekt					Udført af / Dato	Godkendt
5000 toneudstyr						

Position	Artikel		Type	Antal	Leverandør	L. nr	Pris 1	Pris 2
R 56	330E	1/8 W						
– 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	–						
– 70	100K	–						
– 71	22K / 12K	–	sim 22K /AP 12K					
– 72								
– 73	15K	–	busylampe					
– 74	4K7	1/16 W	–					
– 75	68K	–	–					
– 76	33K	1/8 W	–					
– 77	150K	–	–					
RR 1	5K6 / 2K2	–	sim 5K6/ AP 2K2					
– 2	18K							
P 1	100K trimmer		liggende					
CD 1	4N7	3M						
– 2	22NF	3M						
C 1	u1/100	3M	poly					
– 2	u1/100 1%		– simultan					
– 3	u1/100 1%							
– 4	10u/16		tantal					
– 5	10u/16		–					
– 6	10u/16		–					
– 7	u1/100	3M	poly					
– 8	u47/16		tantal					
– 9	u33/16		–					
– 10	u1 (u22)	3/4 M	poly		sim u1/ AP u22			
– 11	u1/100	3M	–					
– 12	10n/100	3M	–					
– 13	10u/16		tantal					
– 14	10u/16		–					
– 15	10n/100	3M	poly					
– 16	u1/100	3M	–					
– 17	33u/16		lyt, blå					
– 18	10u/16		tantal					
– 19	10n/100	3M	poly					
– 20	10u/16		tantal					
– 21	10u/16		tantal					
– 22	10n/100	2M	keramisk					
T 1	tonespole		simultan					
– 2	tonespole							

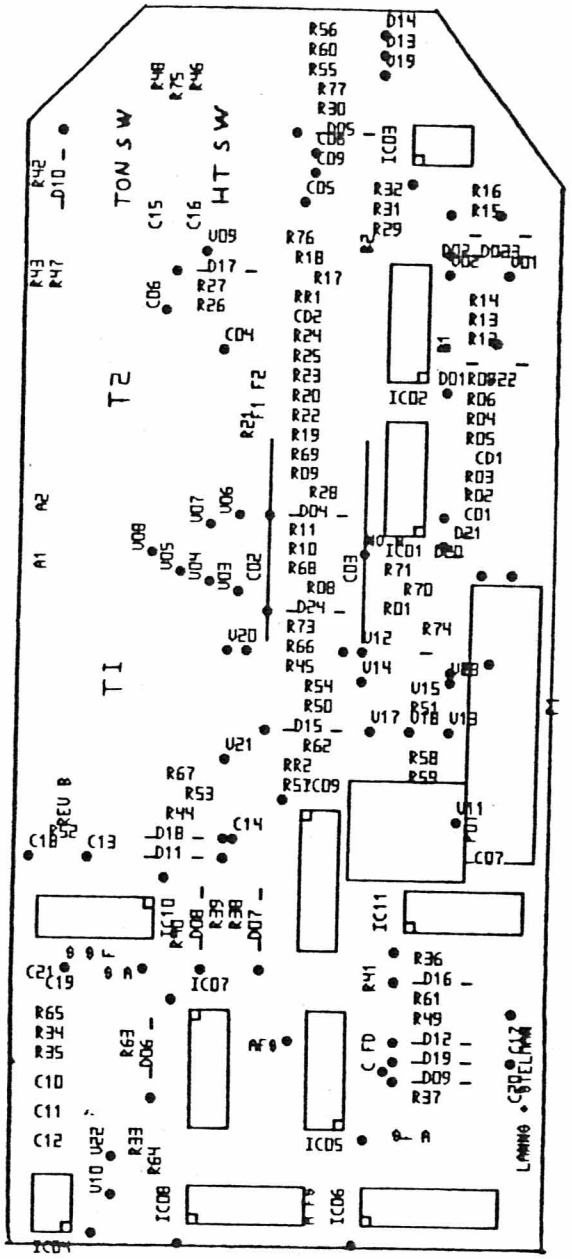
LANNG & STELMAN
Ingeniørfirma

Emne Tonetransceiver

Side 1 af

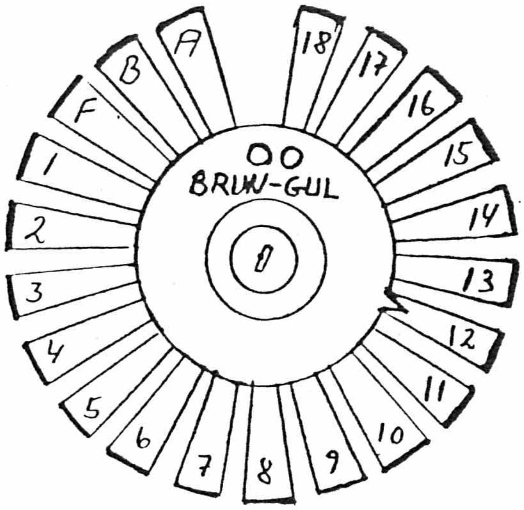
Kunde	Korr.	A	B	C	Tegning nr	
Storno			✓			
Projekt					Udført af / Dato	Godkendt
5000 toneudstyr						

Position	Artikel	Type	Antal	Leverandør	L. nr	Pris 1	Pris 2
J 1	12 polet hun	Molex A-4455-12 C		5 x 30,4 x 8,5			
S 1	omskifter Storno			Storno			
K 1+2	trykknapper	med underlag	2	Storno			
D 1-12	1N4148		12				
- 13	LED LD 56/II	kun ved busy		Siemens			
- 14	LED LD 56/II			-			
- 15	1N4148						
- 16	1N4148						
- 17	Z 5V1	zener 400 mW					
- 18	1N4148						
- 19	1N4148						
- 20	1N4148						
- 21	1N4148						
- 22	1N4148						
- 23	1N4148						
- 24	1N4148	ved busy lampe					
V 1	BC 548	simultan					
- 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				
- 23	BC 548						
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						



		TONETRANCEIVER
		KOMPONENT PLACERING
		80/801 BJ | REV. B.

T1 OG 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 = SEKVENS AP. KUN T2. MONTERET.

SPOLE KODE:		BRUN-GUL		GUL-RØD			HVID-RØD
UDTAG	FREKV	STORNO Nº	FREKV	SRA.Nº	SRA.Nº	FREKV.	AP. Nº
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	—

ANNG & STELLMAN

TONE TRANCEIVER

KODE VEJLEDNING

801201 BJ

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 toneequipment 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
10.8 V to 16.6 V

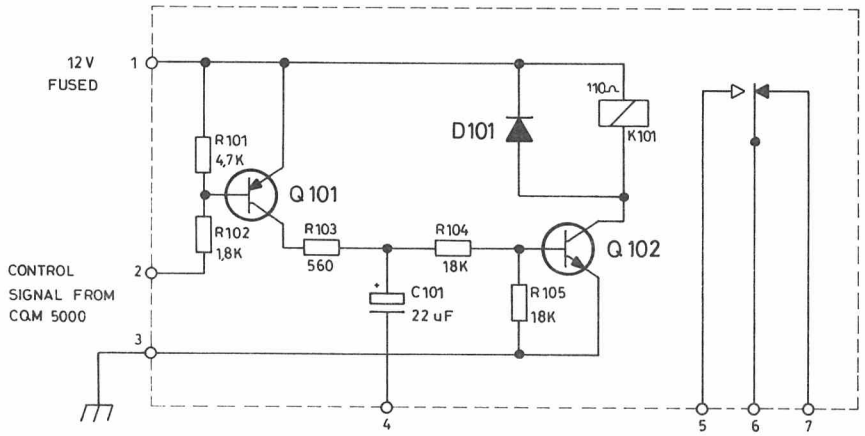
Current Drain, 13.2 V
Standby: approximately 0 mA
Engaged: 140 mA

Relay Contact Current
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.

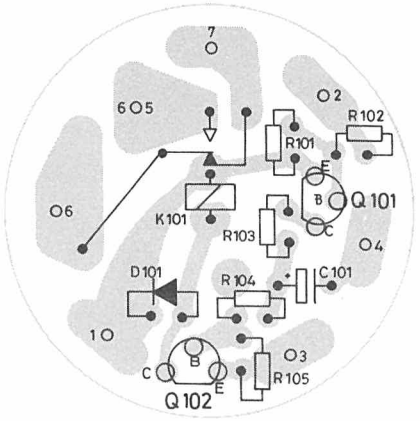
Storno



GROUND FOR DELAY

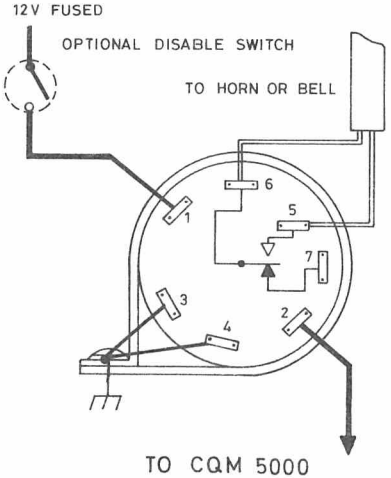
BOTTOM VIEW

Storno



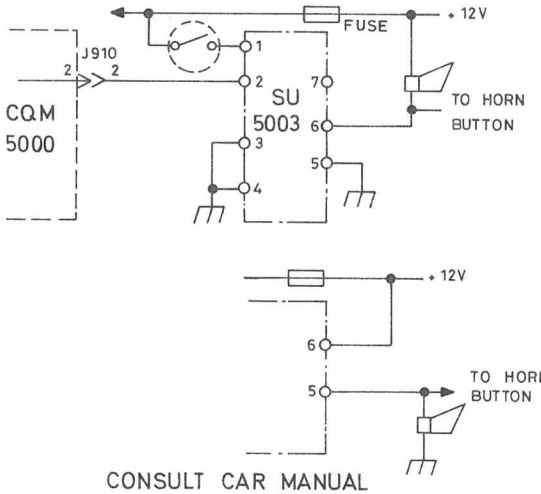
PRINTED CIRCUIT VIEWED FROM
SOLDER SIDE

ALARM (HORN, BELL)



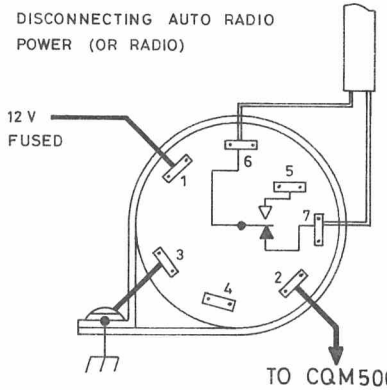
TO CQM 5000
CONNECTOR J910 - PIN 2

NOTES: STRAP H1 - H19 ON XS5000.
THE HORN ALARM MAY BE
SWITCHED OFF BY A SWITCH
IN SERIES WITH 12V FUSED



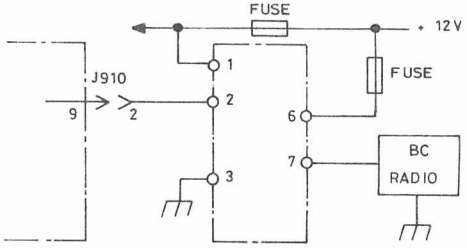
CONSULT CAR MANUAL
FOR HORN SCHEMATIC

DISCONNECTING AUTO BROADCAST RADIO



TO CQM5000
CONNECTOR J910
PIN 9

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

TYPE	Nº	CODE	DATA
	C101	73.5174	22uF, 20%, Tantal 16 V
	D101	99.5237	1N4148, Diode
	FB102	65.5102	Ferrite bead
	FB103	65.5102	Ferrite bead
	FB103	65.5102	Ferrite bead
	K101	58.5083	12 V Relay, 110 ohm,
	Q101	99.5365	MPS-A13, Transistor
	Q102	99.5251	BC307, Transistor
	R101	80.5249	1 Kohm, 5%, Carbon film 0.125 W
	R102	80.5252	1.8 Kohm, 5%, Carbon film 0.125 W
	R103	80.5246	560 ohm, 5%, Carbon film 0.125 W
	R104	80.5264	18 Kohm, 5%, Carbon film 0.125 W
	R105	80.5264	18 Kohm, 5%, Carbon film 0.125 W

Storno

TYPE	Nº	CODE	DATA

SWITCHING UNIT SU5003

X402.710/2

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:

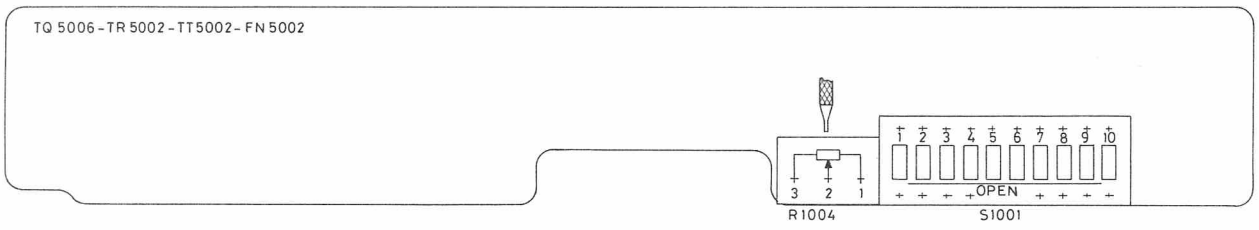
For TQ5006 - cut H7-H8 and H9-H10-H20-H33
For TT5002 - cut H9-H10
For TR5002 - cut H7-H8
For FN5002 - cut H7-H8

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

105.5= 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 to156.75 Hz)

157.75= 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 pulled "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} ±0.2%

CHANNEL GUARD DECODING CHECK

Use receiver test setup.
Modulate the RF generator with the channel guard tone to specified frequency deviation.

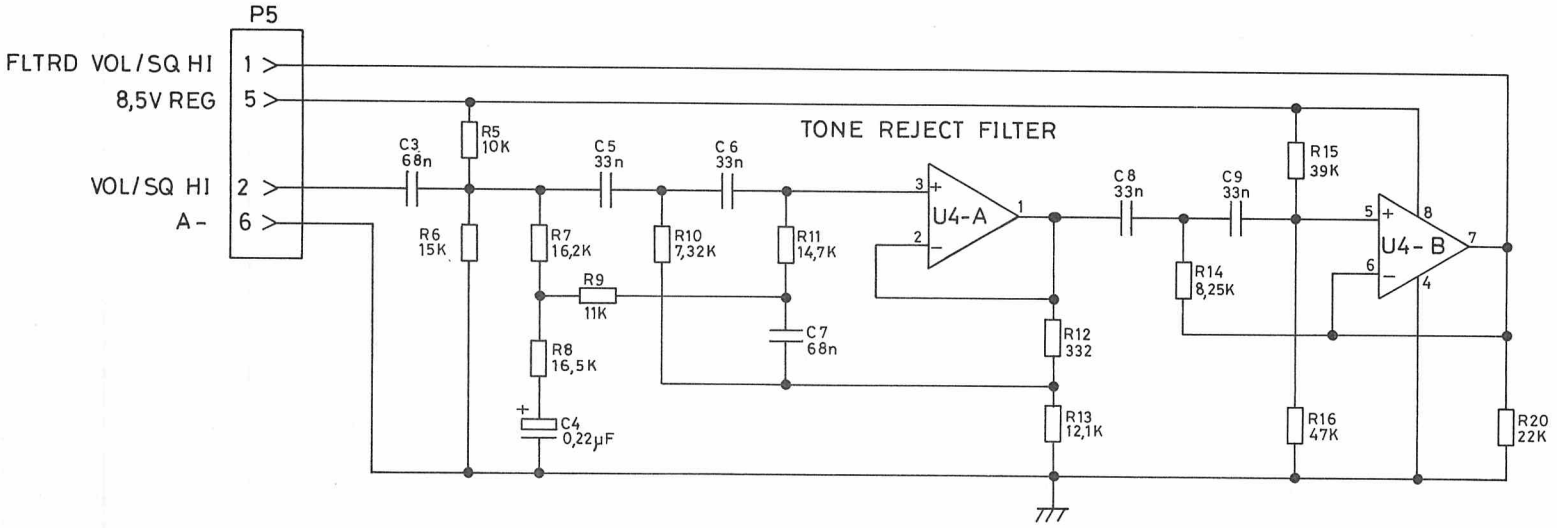
Check that the decoder opens the AF channel if and only if the channel guard tone is present.
Connect an AF voltmeter to the AF output load.

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.

Storno

Storno



NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
FOR COMPLETE DESIGNATION. PREFIX WITH 1000 SERIES.
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

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	50 V
C1009	19A700005P10	33 nF Polyester	50 V
P1005	19A134152P35	Connector	
R1005	19A700019P49	10 Kohm Resistor	0.2 W
R1006	19A700019P51	15 Kohm Resistor	0.2 W
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	0.2 W
R1016	19A700019P57	47 Kohm Resistor	0.2 W
R1020	19A143400P52	20 Kohm Resistor Depos	
U1004	19A134511P2	Int. Circuit	

Storno

Nº	CODE	DATA

CHANNEL GUARD TONE REJECT FILTER FN5002

X403.019

Storno

CONTROL HEAD

CP5003

DESCRIPTION

The control head CP5003 is a moulded plastic front with a 15-button keyboard cluster in the right side. Ten buttons are used for the digits 0-9 and five of them are spares for future options. The keyboard is illuminated by two lamps built into the upper ridge above the buttons. In the left side are 4 buttons, the ON/OFF , the SQUELCH, the TONE KEY, and the LOUDSPEAKER IN/OUT buttons. Two indicators, a green CALL and a red TRANSMIT, the CHANNEL SELECTOR and the VOLUME CONTROL are placed in the middle.

The control head is used in systems with tone switching facillities allowing up to four tones of the sequential tone transmitter combinations to be variable by entering the corresponding digits on the keyboard.

The front has no loudspeaker and therefore an external loudspeaker type LS701 must be connected to the rear connector, refer to the installation drawings.

OPERATING INSTRUCTIONS

STANDBY

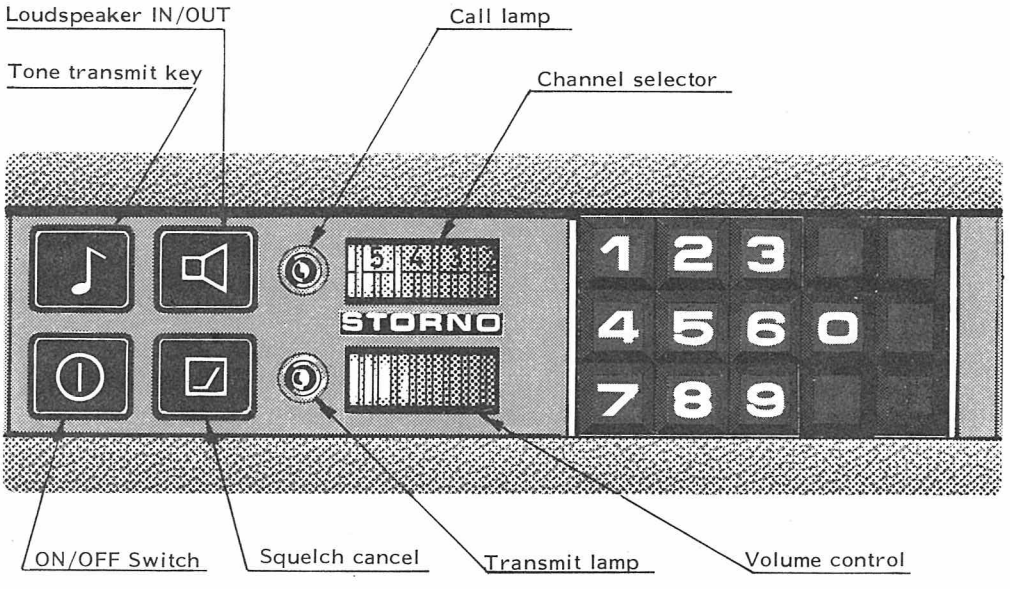
The radio is turned on by depressing the ON/OFF button. The standby condition is indicated by the keyboard being illuminated.

The thumb-wheel channel selector is accesible on multichannel radios and has the channel numbers on the rim. A lamp built into the selector illuminates the channel number from the inside.

When the channel selector is set to the desired channel the radio is ready for receive or transmit.

RECEIVE

Only calls whose number complies with the coding of the tone equipment will be heard in the loudspeaker. Reception of a call is indicated by the loudspeaker muting cancelled and a flashing green CALL indicator, until the conversation is terminated by pressing the loudspeaker in/out button. The loudspeaker will then again be muted and the CALL indicator goes off.



When receiving a group call or all call, the CALL indicator flashes during the message and stops when the RF carrier disappears.

TRANSMIT

Before transmitting the loudspeaker in/out button must be pressed to open the loudspeaker. The CALL indicator will then begin to flash, indicating that the loudspeaker in on.

Select the variable tones by entering the corresponding digits on the keyboard.
When the channel is clear the call is initiated by pressing the TONE TRANSMIT KEY button.

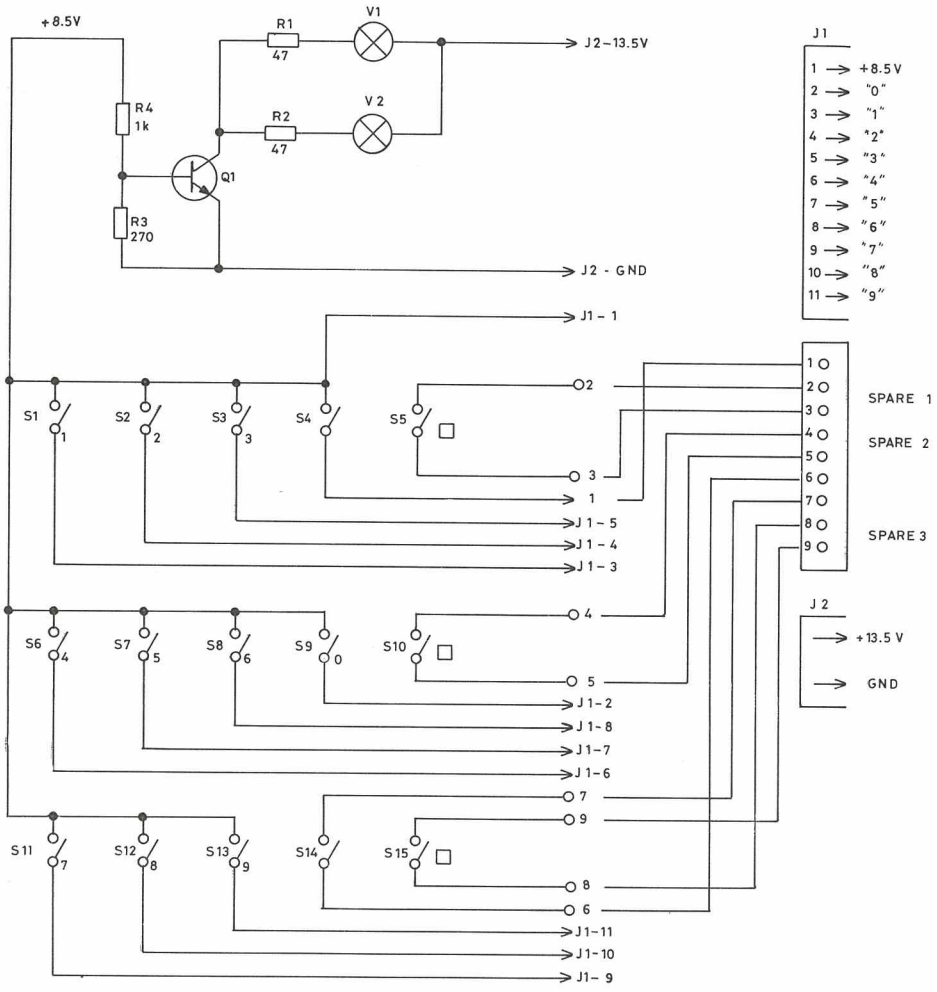
The tone combinations are now transmitted to the base station.

Wait for the base station to reply.

When contact is established the communication can continue by using the normal transmitter key button.

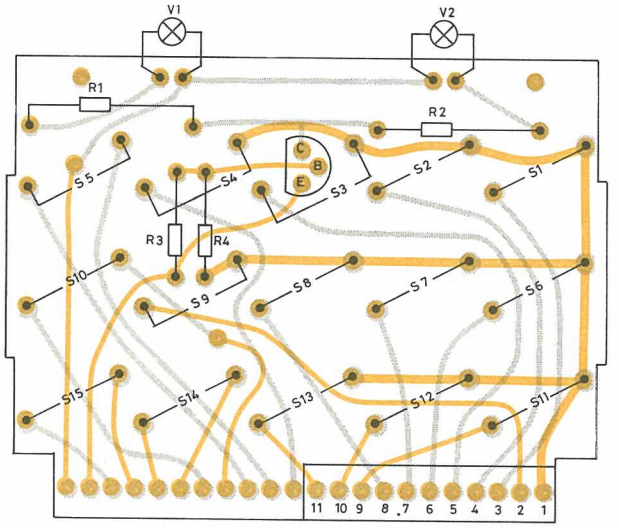
The communication is terminated by pressing the loudspeaker in/out button.

Storno



□ SPARE

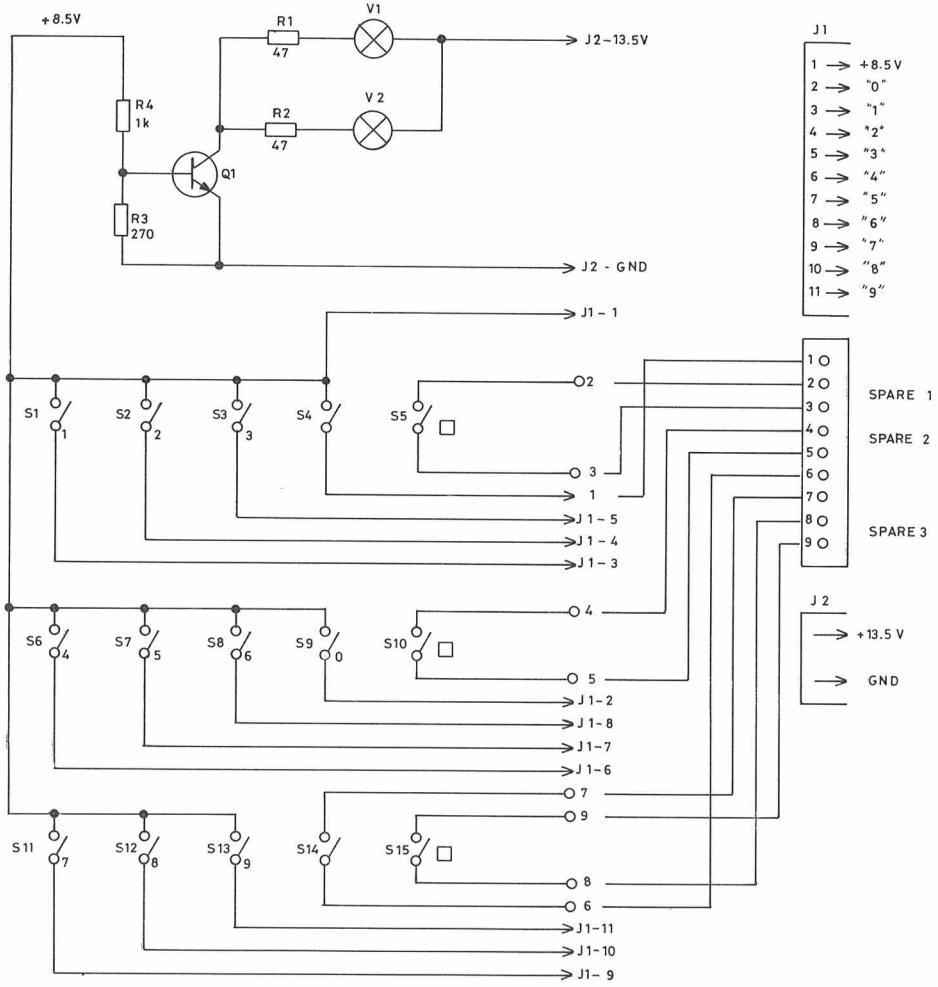
PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE (BACK)



NOTE: PUSHBUTTON S1-S15 MOUNTED ON FRONT

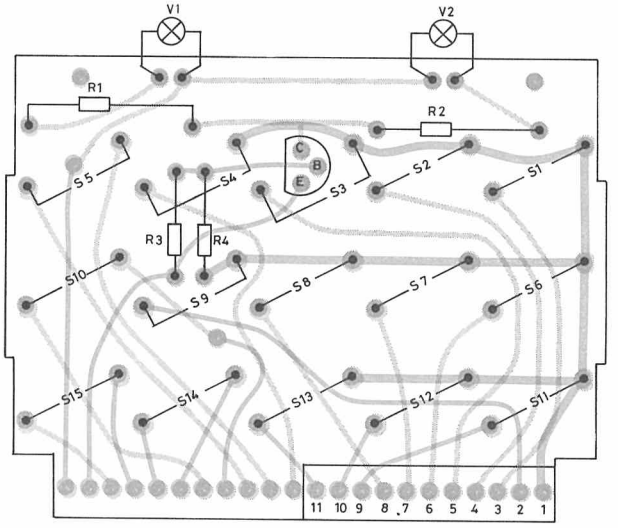
CONTROL HEAD CP5003
KEYBOARD D402.807

Storno



□ SPARE

PRINTED CIRCUIT VIEWED FROM COMPONENT SIDE (BACK)



NOTE: PUSHBUTTON S1-S15 MOUNTED ON FRONT

CONTROL HEAD CP 5003
KEYBOARD D402.807

Nº	CODE	DATA	
J01	41.5573	Male Connector	11 pos
J02	41.5566	Male Connector	2 pos
Q01	99.5333	BC337 Transistor	
R01	80.5433	47 ohm 5% Carbon film	0.25 W
R02	80.5433	47 ohm 5% Carbon film	0.25 W
R03	80.5242	270 ohm 5% Carbon film	0.125 W
R04	80.5249	1 Kohm 5% Carbon film	0.125 W
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	60 mA
V02	92.5120	12 V Lamp	60 mA

Storno

Nº	CODE	DATA

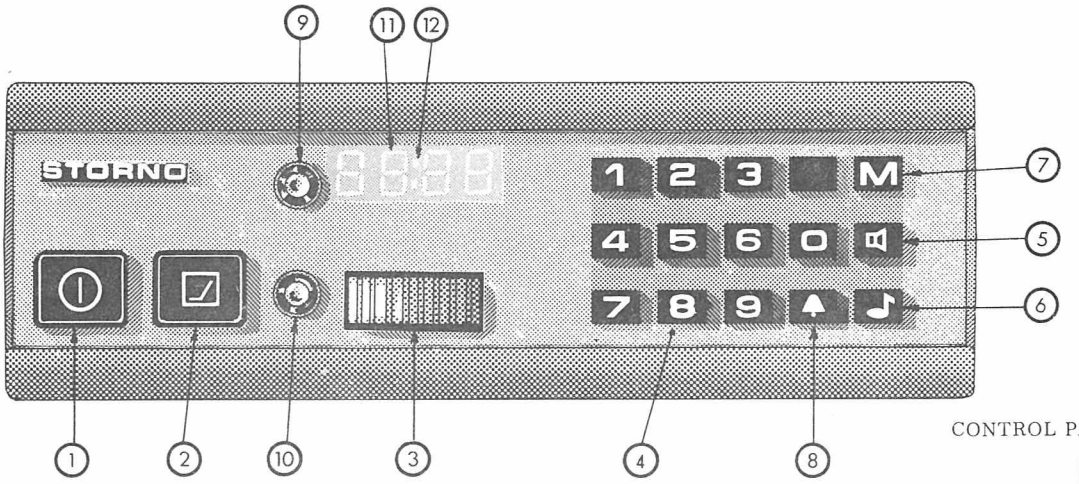
CONTROL PANEL CP5003

X403.000

CONTROL PANEL

CP5005

The Control Panel CP5005 is the interface between the operator and the radio set. It consists of a moulded plastic front which holds the 4-digit display and the keyboard.



CONTROL PANEL CP5005

M405.105

1. ON/OFF SWITCH
2. SQUELCH CANCEL SWITCH
3. VOLUME CONTROL
4. NUMERICAL KEYBOARD 0 - 9
5. LS ON/OFF (MONITOR)
6. TONE KEY
7. MODE, I.E. TONE/RF CHANNEL SELECTION
8. EXTERNAL ALARM SELECT
9. LS INDICATOR - YELLOW
10. TRANSMIT INDICATOR - RED
11. 4-DIGIT DISPLAY, TONE-/RF-CHANNEL NUMBER
12. COLON, BUSY/EXTERNAL ALARM - INDICATOR

When attached to the radio unit two connectors plug into sockets on the control logic board.

OPERATING CONTROLS

ON/OFF SWITCH (1)

This pushbutton switches the power supply to all radio circuits except the system memory. The system state is unchanged even after a period with power off.

SQUELCH CANCEL SWITCH (2)

Depressing the SQ-button will override the squelch circuit and if the tone receiver status is "LS-open", the noise of a free channel can be heard.

VOLUME CONTROL (3)

This potentiometer adjusts the AF amplifier's output level.

KEYBOARD (4)

The numerical keys of the keyboard are used for entering tone-call numbers and - if more than one RF channel is available - also the channel number.
Whenever a key is depressed a short alert tone is heard in the loudspeaker.

LS ON/OFF (5)

Depressing the LS button will alternately open and close the tone receiver's AF gate, i.e. switch the loudspeaker on and off.

If the Privacy option has been selected the button cannot open the AF gate.

TONE KEY (6)

Depressing the tone key will energize the transmitter during transmission of the tone telegram. Any attempt to transmit a tone call with the loudspeaker off only produces a warning tone in the loudspeaker. Upon termination of the tone transmission the loudspeaker will be turned on.

MODE BUTTON (7)

Depressing the Mode button alternately prepares the system logic for input of tone number or RF channel number. The display (11) shows which input mode has been selected by displaying a "0" followed by a blank as the two leftmost positions if in the channel mode.

A leading "0" followed by a blank is never displayed when a tone call number is being displayed.

EXTERNAL ALARM (8)

Pressing the External Alarm key causes an external alarm device - if installed - to sound for approx. 1 sec. whenever a correct tone telegram has been received. Selection of this function is indicated by the display being blank except for the colon being lit.
Pressing the key again makes the radio revert to its previous state, i.e. disables the alarm and turns the display on.

LS INDICATOR (9)

When lit the yellow LED indicates that the tone receiver's AF gate is open (LS ON). The indicator can either flash or show constant light. Flashing light indicates that a call has been received but not yet been answered. When a call is answered either by pressing the tone key or the transmit key - the indicator shows constant light. The indicator also shows constant light when the loudspeaker is opened manually, i.e. pressing the LS button.

TRANSMIT INDICATOR (10)

When lit the LED indicates that the transmitter is on.

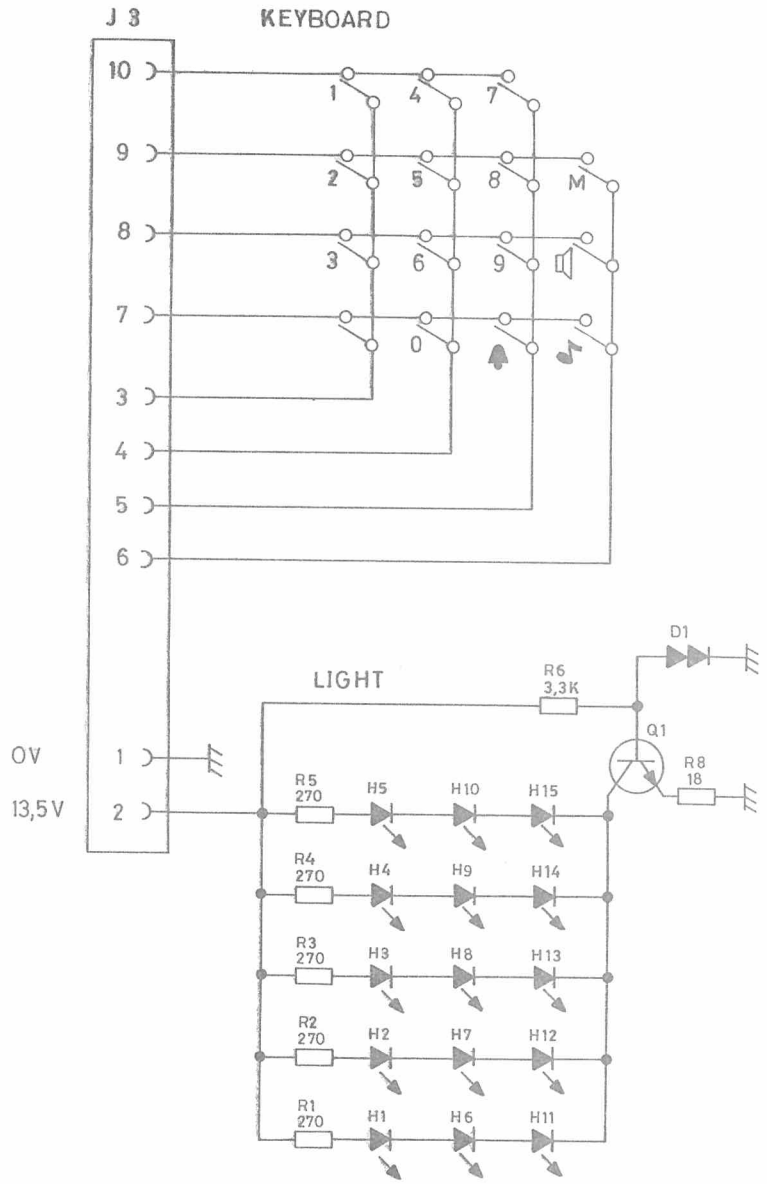
DISPLAY (11)

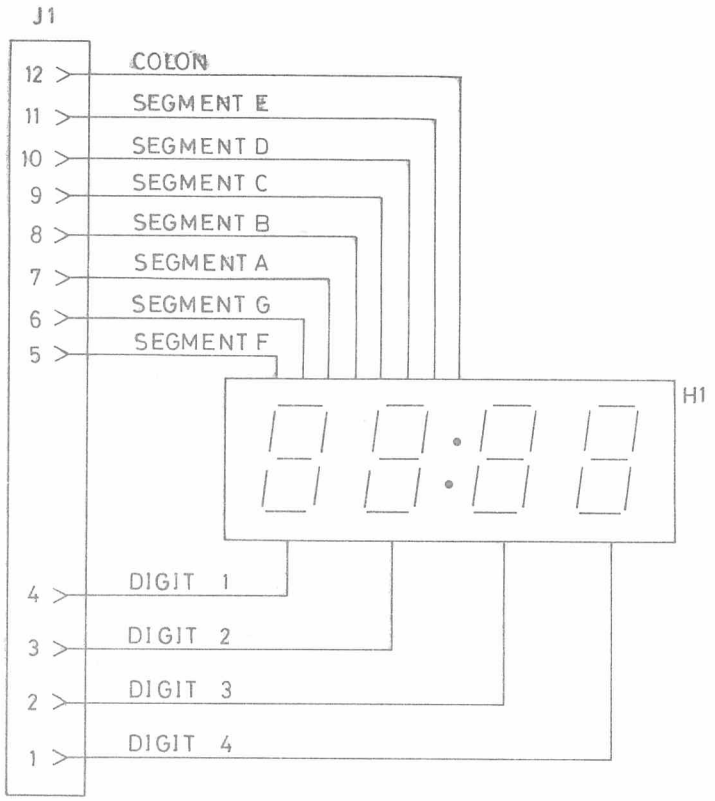
The 4-digit display shows the channel number or tone call number entered by the operator; refer to Mode button.

COLON (12)

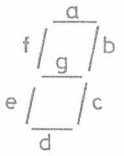
The display colon is used as squelch indicator (busy lamp) and will flash when the RF channel is occupied. A lit colon and the rest of the display being blank indicates that the external alarm has been selected.

Storno





SEGMENT OF DIGIT



CONTROL PANEL CP5005

D403.013/2

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

Storno

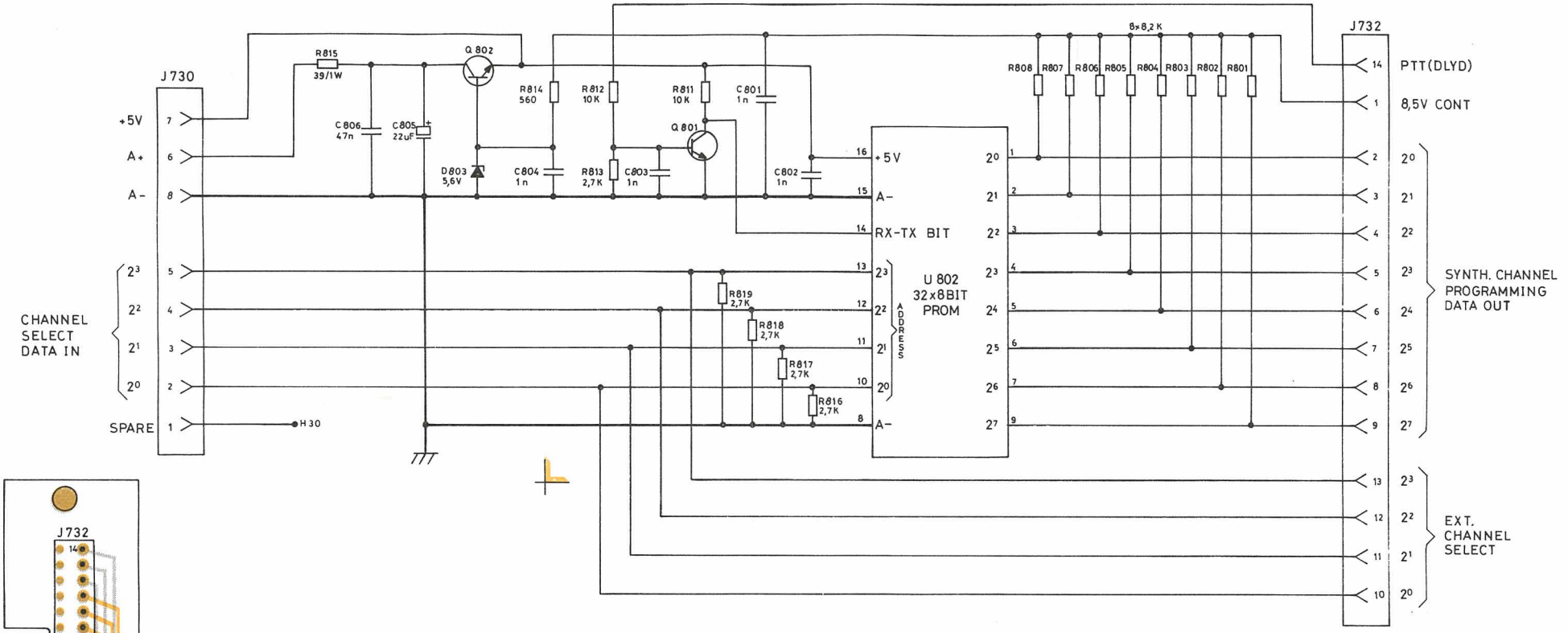
Nº	CODE	DATA

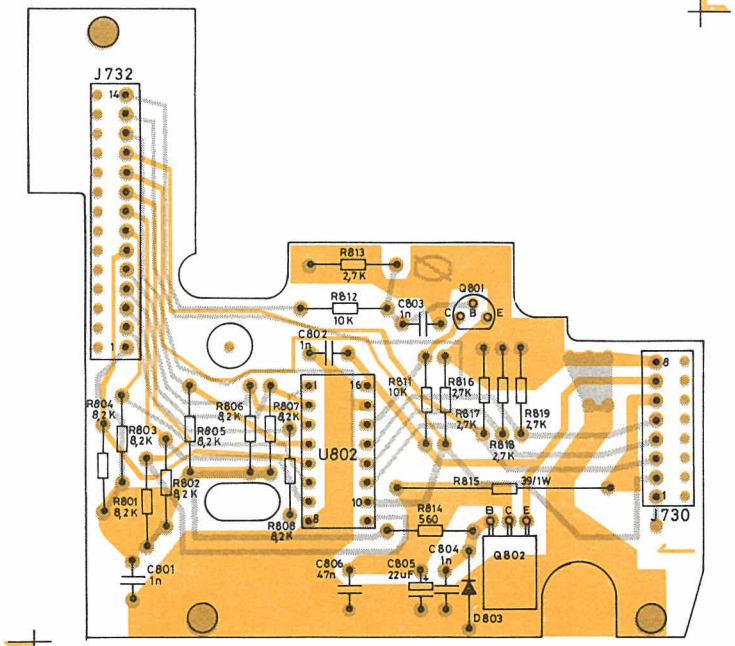
CONTROL PANEL CP5005

X403.053

Storno

Storno



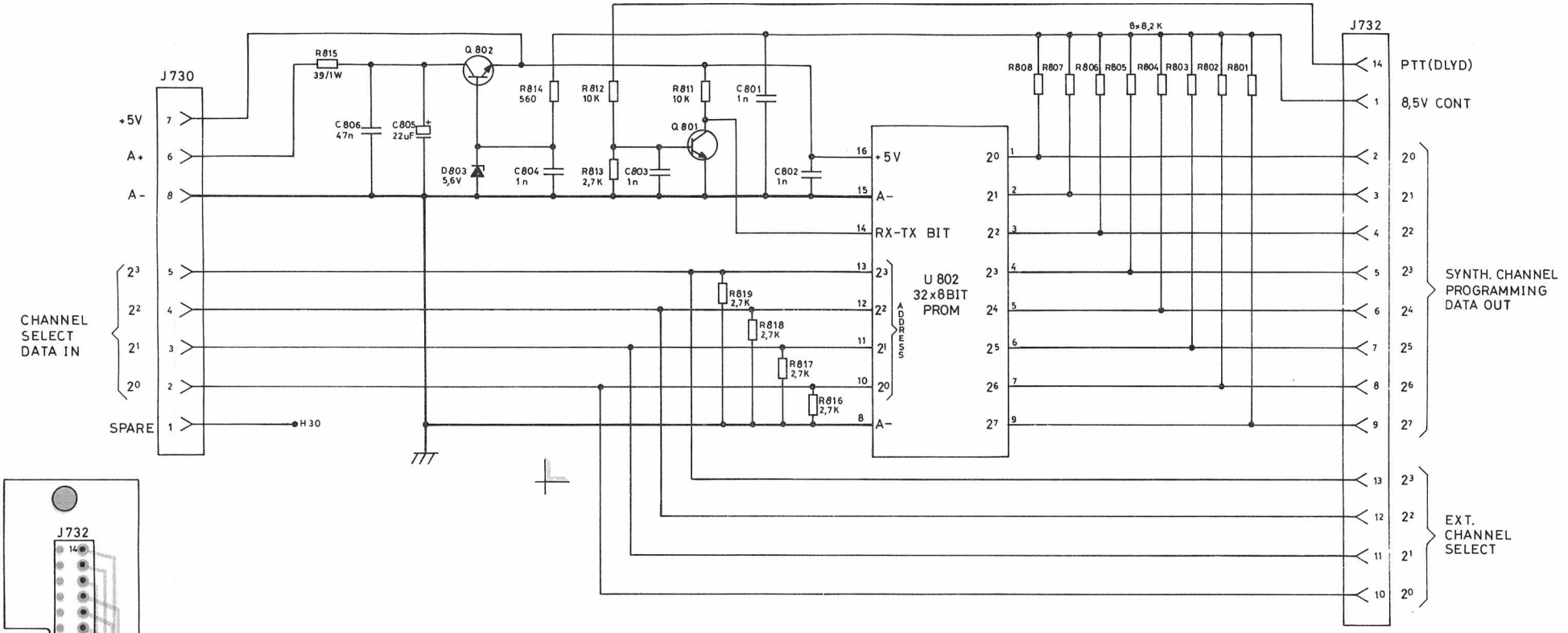


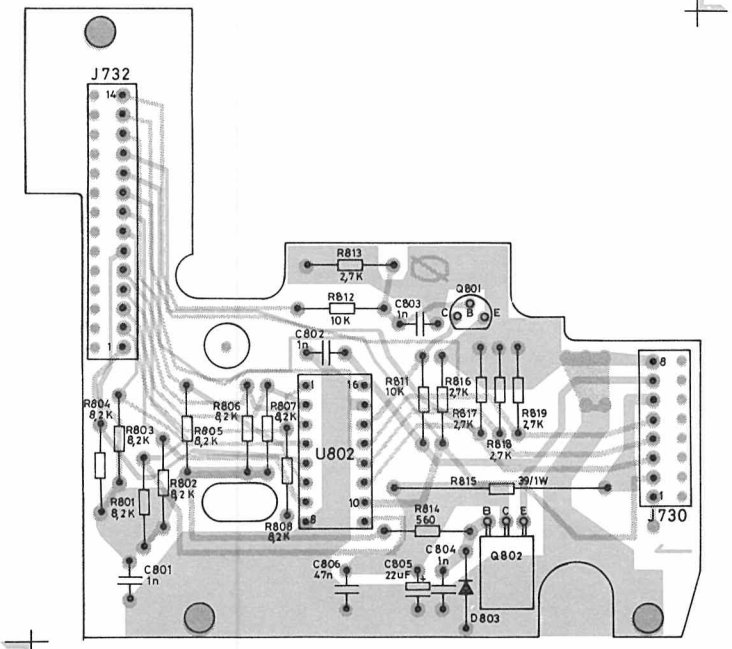
CHAN-NEL	J730 2^3	2^2	2^1	2^0
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	1
6	0	1	0	1
7	0	1	1	0
8	0	1	1	0
9	1	1	0	0
10	1	0	0	1
11	1	0	1	0
12	1	0	1	1

FREQUENCY CONTROL FC5001

D402. 885

Storno





CHAN-NEL	J730 2^3	2^2	2^1	2^0
1	0	0	0	0
2	0	0	0	1
3	0	0	1	0
4	0	0	1	1
5	0	1	0	1
6	0	1	0	1
7	0	1	1	0
8	0	1	1	0
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

Nº	CODE	DATA	
C801	19A700233P7	1 nF Ceramic	50 V
C802	19A700233P7	Ceramic	50 V
C803	19A700233P7	Ceramic	50 V
C804	19A700233P7	Ceramic	50 V
C805	19A700003P8	Tantal	16 V
C806	19A700005P11	Polyester	50 V
D803	19J706270P1	Zener Diode	5.6 V
J731	19A700041P7	Connector	8 pos
J732	19A700041P13	Connector	14 pos
Q801	19A700017P1	BC548 Transistor	
Q802	19J706250P1	BD135 Transistor	
R801	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R802	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R803	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R804	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R805	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R806	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R807	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R808	19A700019P48	8.2 Kohm Resistor Depos.	0.25 W
R811	19A700019P49	10 Kohm Resistor Depos.	0.25 W
R812	19A700019P49	10 Kohm Resistor Depos.	0.25 W
R813	19A700019P42	2.7 Kohm Resistor Depos.	0.25 W
R814	19A700019P34	560 ohm Resistor Depos.	0.25 W
R815	19J06251P20	39 ohm Resistor Depos.	1 W
R816	19A700019P42	2.7 Kohm Resistor Depos.	0.25 W
R817	19A700019P42	2.7 Kohm Resistor Depos.	0.25 W
R818	19A700019P42	2.7 Kohm Resistor Depos.	0.25 W
R819	19A700019P42	2.7 Kohm Resistor Depos.	0.25 W

Storno

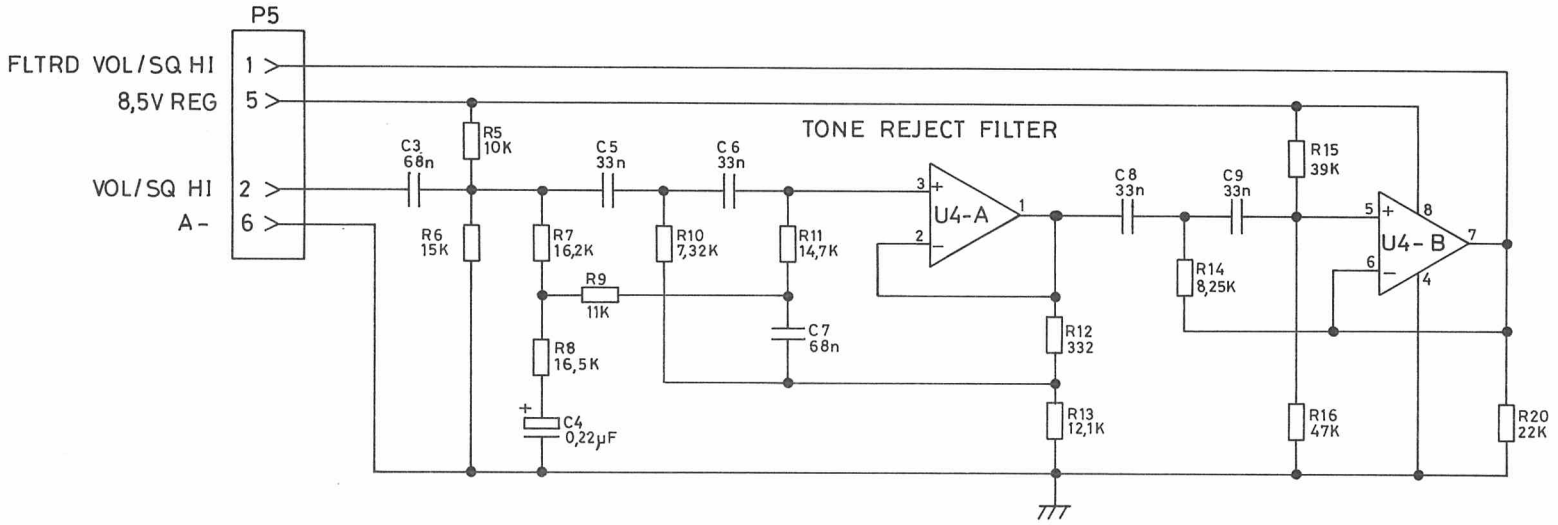
Nº	CODE	DATA

FREQUENCY CONTROL FC5001

X402.899

Storno

Storno



NOTES:
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN.
FOR COMPLETE DESIGNATION. PREFIX WITH 1000 SERIES.
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

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	50 V
C1009	19A700005P10	33 nF Polyester	50 V
P1005	19A134152P35	Connector	
R1005	19A700019P49	10 Kohm Resistor	0.2 W
R1006	19A700019P51	15 Kohm Resistor	0.2 W
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	0.2 W
R1016	19A700019P57	47 Kohm Resistor	0.2 W
R1020	19A143400P52	20 Kohm Resistor Depos	
U1004	19A134511P2	Int. Circuit	

Storno

Nº	CODE	DATA

CHANNEL GUARD TONE REJECT FILTER FN5002

X403.019

BUSY LAMP UNIT

SU5004

The busy lamp is a timer unit designed for application in CQM5000 with a TQ unit. SU5004 makes the transmit control lamp start flashing, when the channel is occupied and the loudspeaker is blocked by the TQ module.

SU5004 is a printed board with a timer circuit and 5 wires. It is mounted above the S601 and S602, push button switches, in the RF board, on a spacer. The 5 wires are soldered as follows on the RF board:

black	ground
orange	8.5 V RX
brown	D606 anode
red	Q604 collector
yellow	Q603 collector

MODE OF OPERATION

The timer goes on when Q1 is off, both inputs must be negative.
Input 1 (yellow) wired to Q603 collector is negative when a noise signal is applied to the squelch circuit.

Input 2 (red) wired to Q604 collector is negative when RX mute is not activated.
When either input 1 or input 2 goes positive, Q1 goes on, timer U1 ceased working and the transmit control lamp D606 stops flashing.

TECHNICAL SPECIFICATIONS

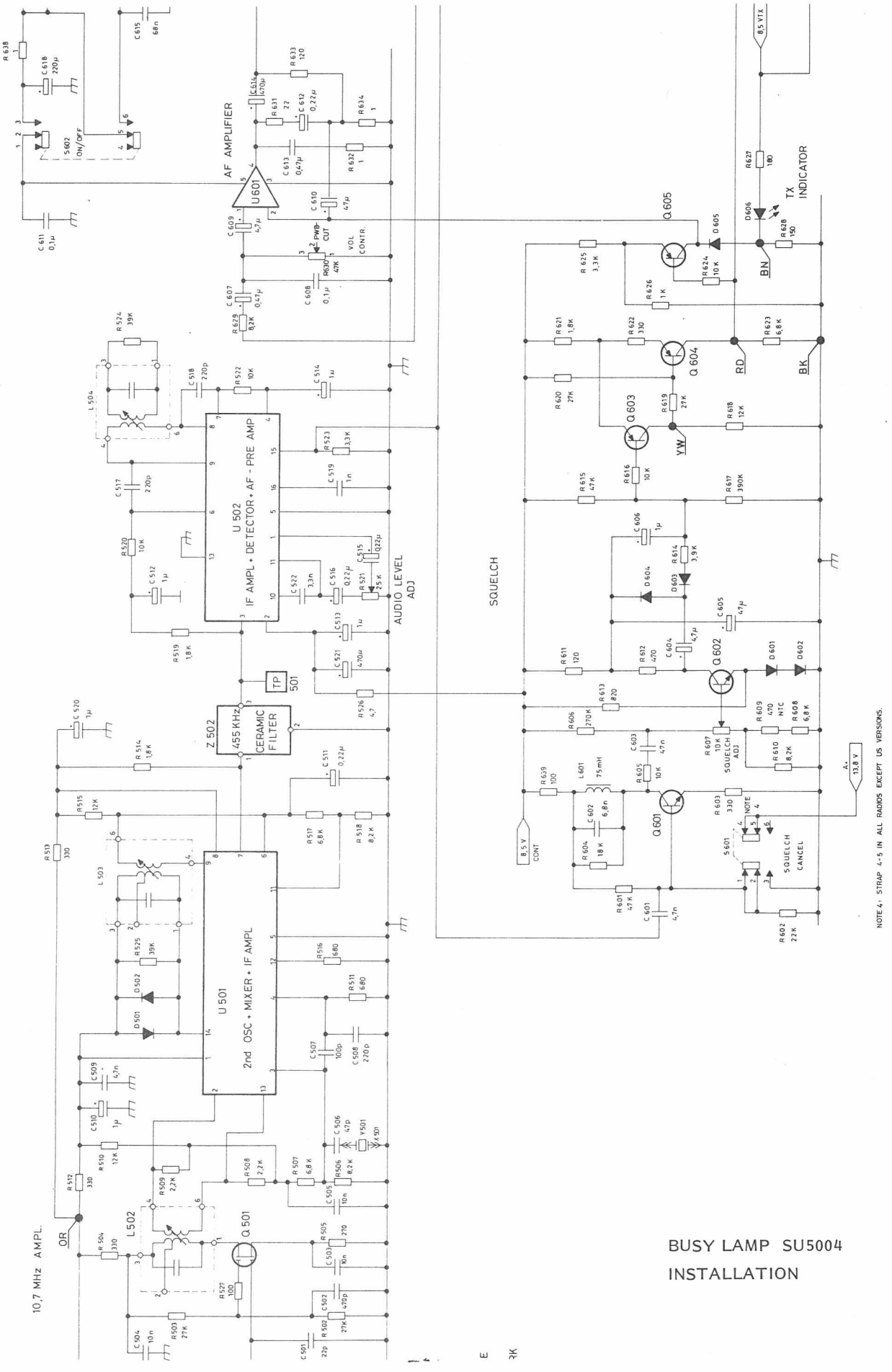
Supply Voltage
8.5 V ± 150 mV

Curent Drain
Standby: 14 mA
Engaged: 25 mA

Temperature Range
$-30^{o}C$ to $+60^{o}C$

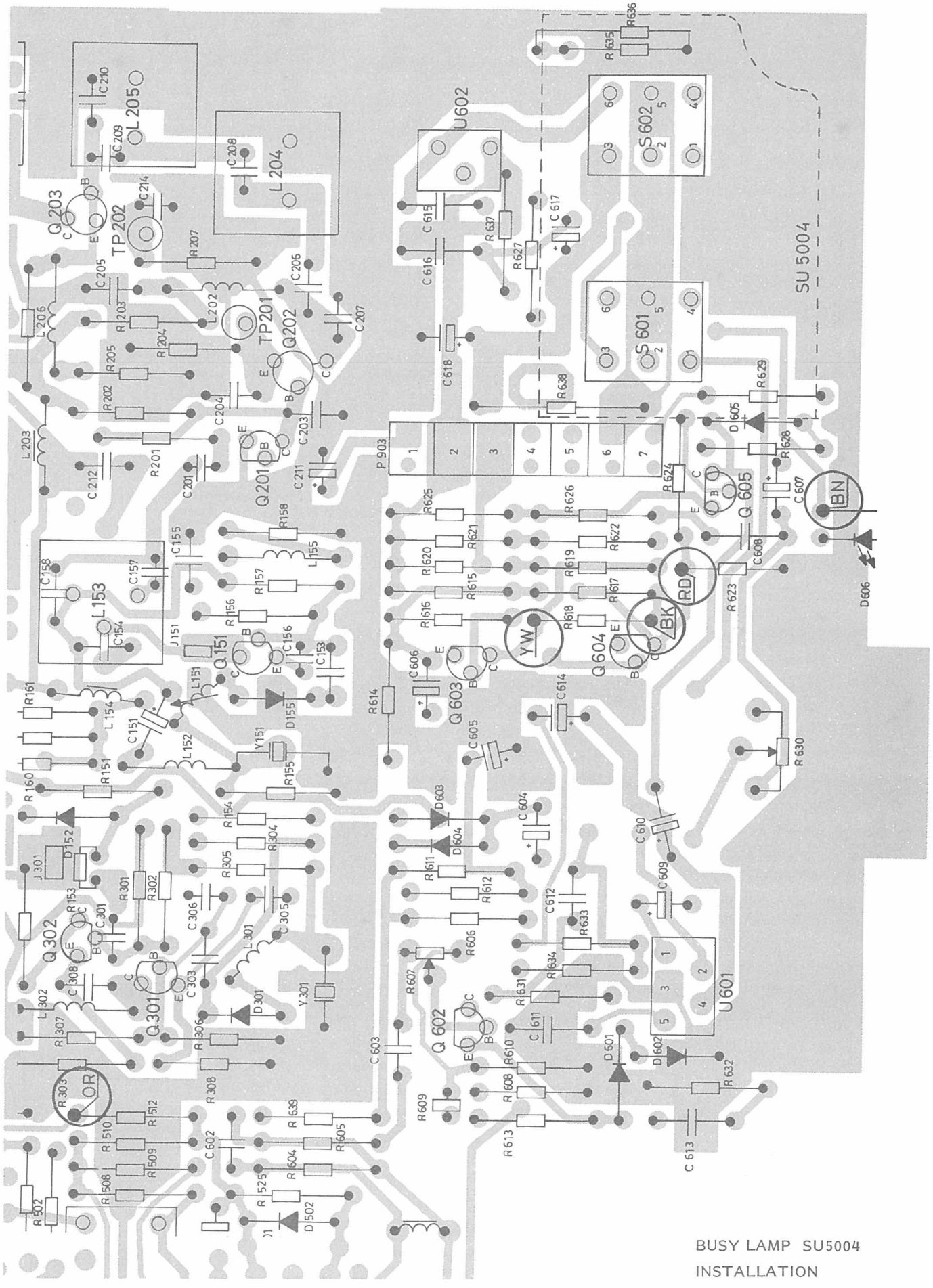
Output functions
Channel occupied and RX mute off makes the TX control lamp flashing.

Storno



BUSY LAMP SU5004
INSTALLATION

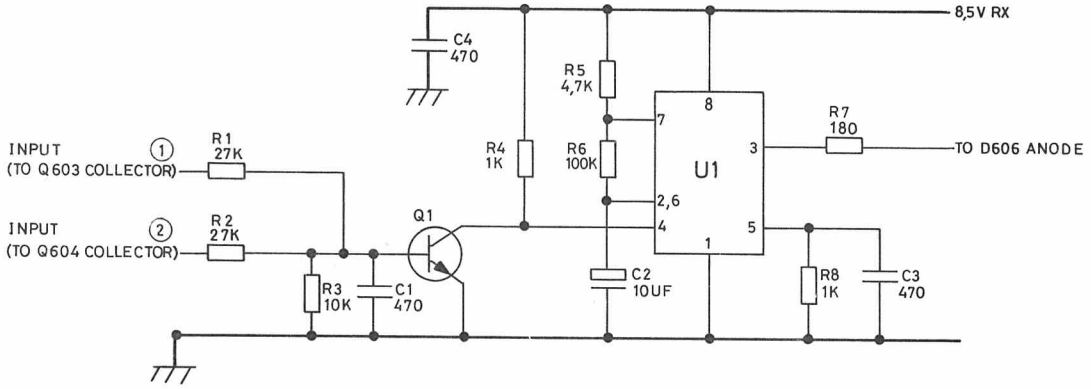
Storno

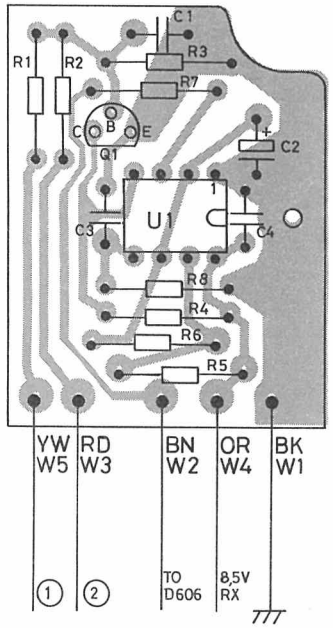


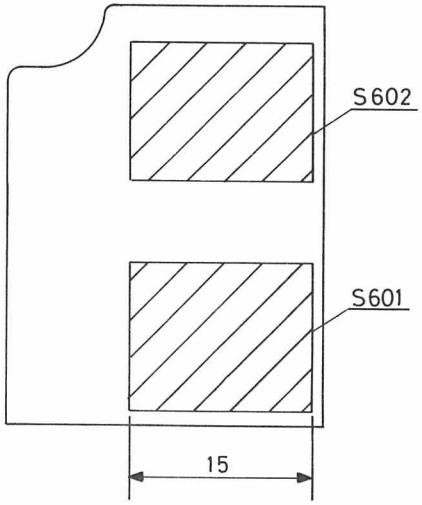
BUSY LAMP SU5004
INSTALLATION

Storno

Storno







BUSY LAMP UNIT
SU5004

D402.916

Storno

Nº	CODE	DATA	
C1	19A700233P5	470 pF Ceramic	50 V
C2	19A700003P7	10 uF Tantal	16 V
C3	19A700233P5	470 pF Ceramic	50 V
C4	19A700233P5	470 pF Ceramic	50 V
Q1	19A70001P1	BC548 Transistor	
R1	19A700019P54	27 Kohm Depos	0.25 W
R2	19A700019P54	27 Kohm Depos	0.25 W
R3	19A700019P49	10 K Depos	0.25 W
R4	19A700019P37	1 Kohm Depos	0.25 W
R5	19A700019P45	4.7 Kohm Depos	0.25 W
R6	19A700019P61	100 Kohm Depos	0.25 W
R7	19A700019P28	180 Kohm Depos	0.25 W
R8	19A700019P37	1 Kohm Depos	0.25 W
U1	19A701865P1	NE555 Timer	

Storno

Nº	CODE	DATA

BUSY LAMP UNIT SU5004

X403.001

Storno

10-TONE CODE SELECTOR

SU5005

The SU5005 is an optional board for transmitting up to 10 tone codes. The module is used in conjunction with tone modules TQ5001 and TQ5002 interconnect boards XS5003 or XS5005, and utilises the channel selector to select the tone codes. When the SU5005 is installed the radiotelephone can only be fitted with 1 RF channel.

MOUNTING

Disconnect the colour coded tone wires from the tone coil tap (10 pcs), terminal 1 through 14.

Mount the SU5005 board on switch S101 by soldering it to the unused terminals.

Put the wires that was unsoldered into the slot on the board except the GRAY, the BLUE and the VIOLET wire.

Solder wires to W12 to the taps on the tone coil as follows:

BROWN to tap 3	BLUE to tap 8
RED to tap 4	VIOLET to tap 9
ORANGE to tap 5	GRAY to tap 10
YELLOW to tap 6	WHITE to tap 11
GREEN to tap 7	BLACK to tap 12

Connect W11 from terminal R to tap 13.
Connect W12 from terminal A to tap 14.
For 12.5 kHz channel spacing systems the taps 1 and 2 are used instead of 13 and 14 respectively.

CODING

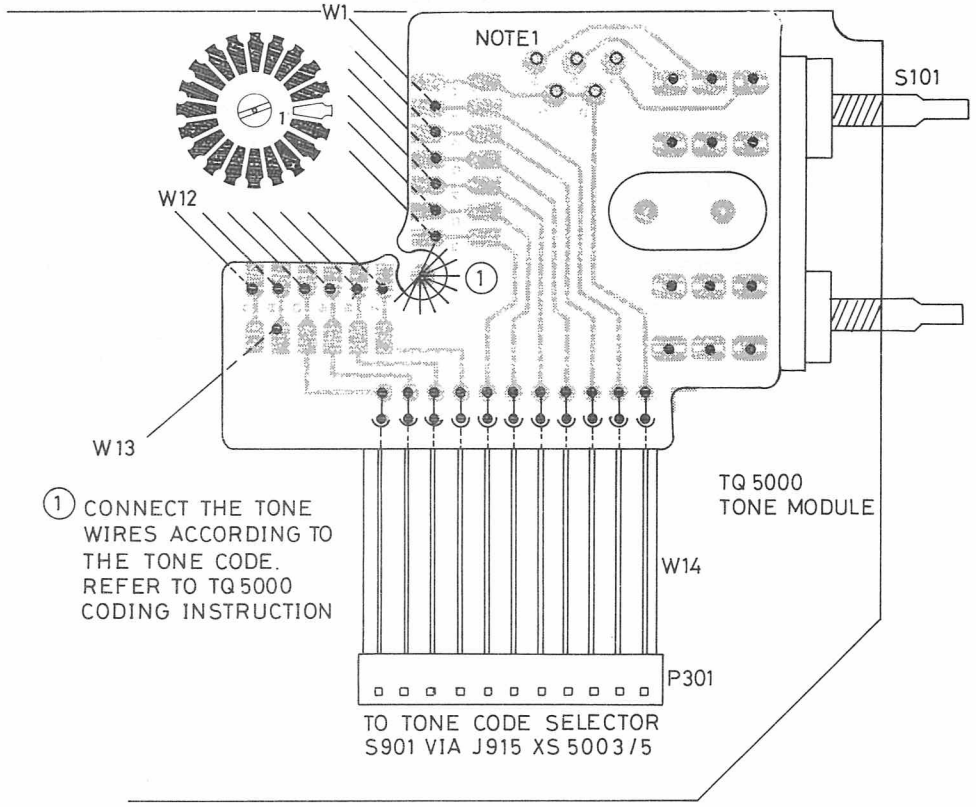
The coding of the tones is performed by soldering the free wires in the slot to the terminals near the edge of the SU5005 board.
When coding the tone transmitter the wire representing the variable tone digit (V) is connected to terminal V.
Principally each of the five digits in the tone code can be chosen as variable but some limitations have to be considered.
If the tone code digits are designated A, B, C, D and E, the repeat tone R, and the variable digit V following combinations are not valid:

V - B - C - D - E	when V= B
A - V - C - D - E	when V= C
A - B - V - D - E	when V= D
A - B - C - V - E	when V= E
	when V is followed by R (repeat tone)

When the repeat tone R is used to replace a digit in the variable part of the tone code the printed conductor between the terminals carrying the replaced digit is cut. Terminal R is then connected to the terminal farthest from the printed wiring board edge.
When the repeat tone R is used in the fixed part of the tone code the wire is connected directly to terminal R.

CODING TWO TONE TELEGRAMS

The coding described above results in the tone call and auto receipt (acknowledge) codes being identical. If the tone module is coded according to the note on the tone module diagram the two functions are separated so that f.ex. acknowledge is a fixed code and the tone call is variable, or vice versa.
The tone button S101 is used directly to switch these functions and hence must be depressed during the sequence of transmitting a tone call, i.e. as long as the TX indicator is on.



NOTE 1

COMBINATION

1.1 SELECTABLE ACKNOWLEDGEMENT CODE-
SELECTABLE TONE CODE: CONNECT 2-4.

1.2 SELECTABLE ACKNOWLEDGEMENT CODE -
FIXED CALL CODE: CONNECT 1-5, 4-5, 3 TO FIXED DIGIT

1.3 FIXED ACKNOWLEDGEMENT CODE-
SELECTABLE CALL CODE: CONNECT 2-3, 4-5, 3 TO FIXED DIGIT

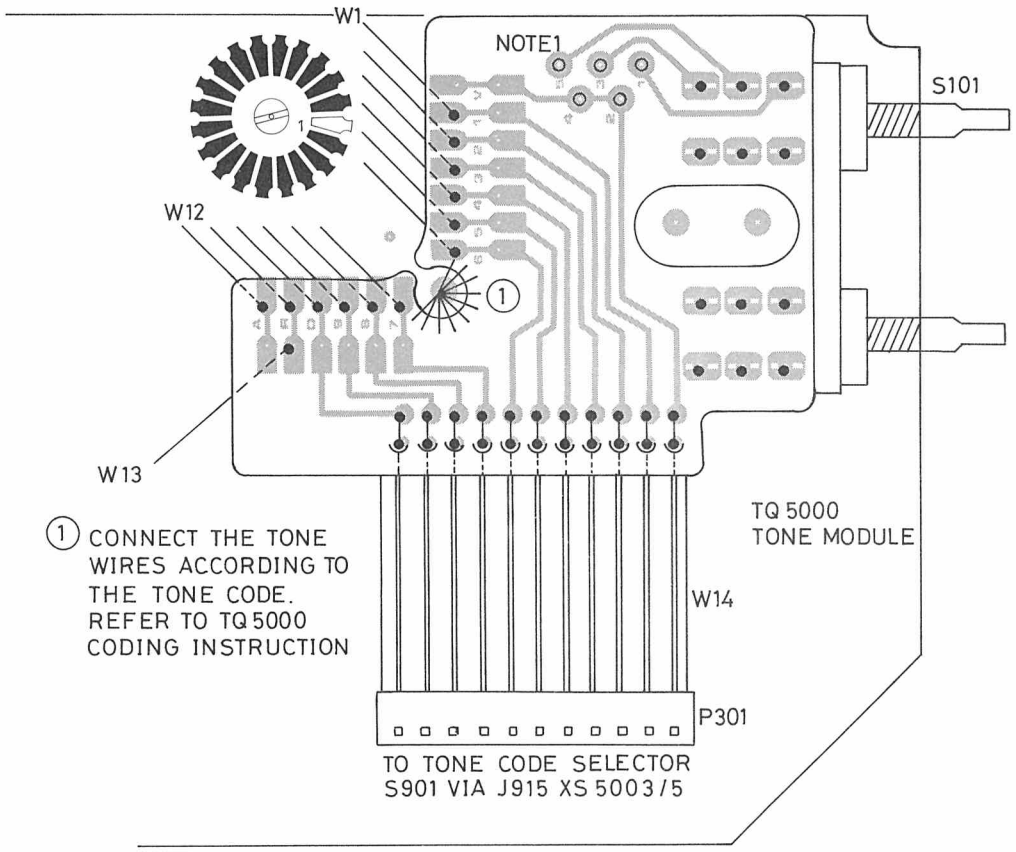
CUT PRINTED WIRE BETWEEN 2 AND 4
WHEN USING COMBINATION 1.2 OR 1.3.

10-TONE CODE SELECTOR SU5005
CODING INSTRUCTION

D403.120

Storno

Storno



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CUT PRINTED WIRE BETWEEN 2 AND 4
WHEN USING COMBINATION 1.2 OR 1.3.

10-TONE CODE SELECTOR SU5005
CODING INSTRUCTION

D403.120

CHANNEL GUARD UNIT

TQ5003 - TT5001 - TR5001 - FN5001

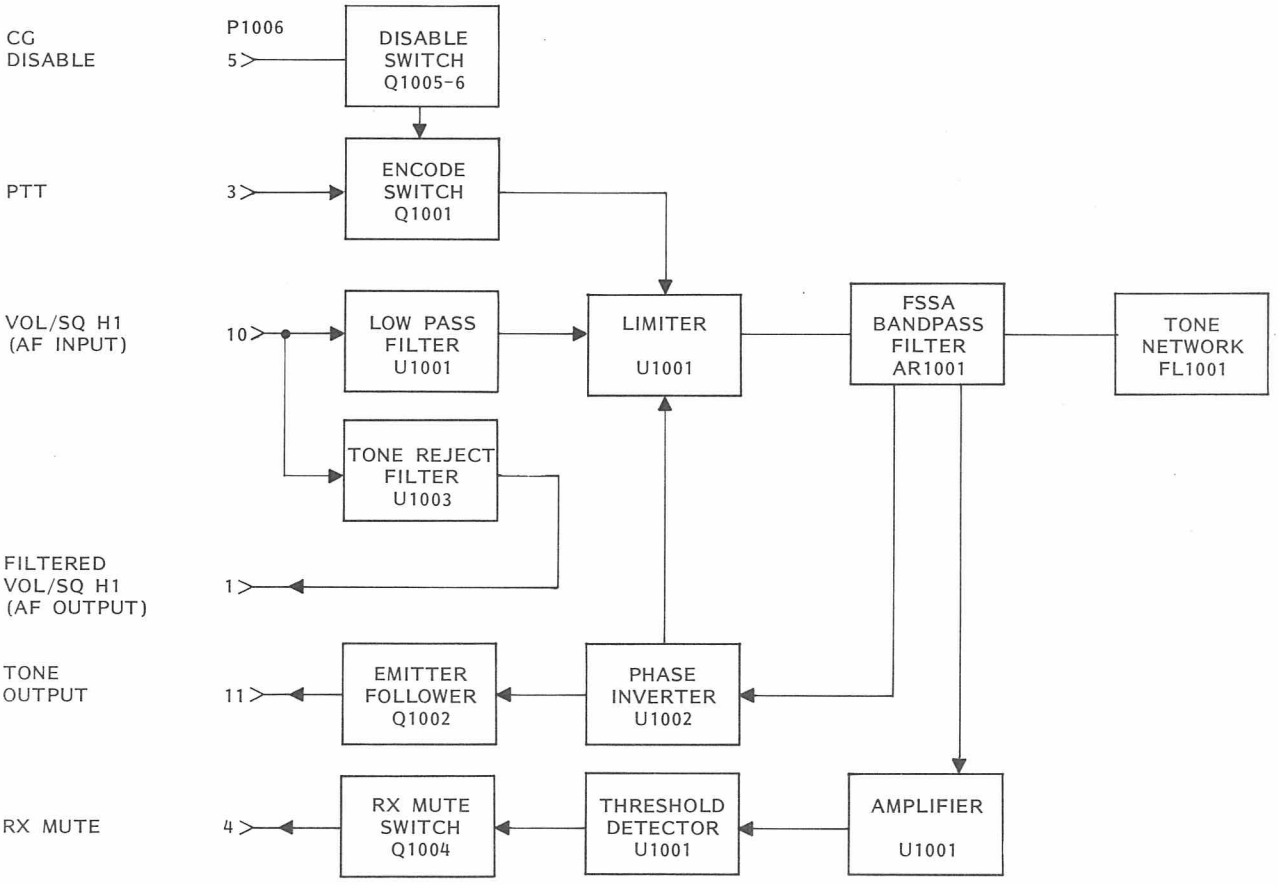
GENERAL

The Channel Guard (Pilot Tone) module is a continous tone encoder/decoder for operation on tone frequencies in the 71.9 Hz to 210.7 Hz range. The encoder provides tone-coded modulation to the transmitter and the decoder operates in conjunction with the receiver to inhibit all calls that are not tone-coded with the proper Channel Guard frequency.

Four versions of the Channel Guard module are available:

TQ5003 Single tone encode/decode
TR5001 Single tone decode only
TT5001 Single tone encode only
FN5001 Single tone reject filter

The Channel Guard circuitry consists of discrete components for the Encode disable, PTT switch, and receiver mute switch; four thick-film integrated circuit modules consisting of Decode Module U1001, Encode Module U1002, Frequency Switchable Selective Amplifier (FSSA) AR1001, and plug-in Versatone Network FL1001 and monolitic IC U1003 in the tone reject filter.



CHANNEL GUARD FUNCTIONAL DIAGRAM FIG. 1.

For a functional diagram of the Channel Guard encoder/decoder refer to fig. 1.

Typical diagrams of the Versatone Network, Phase Inverting Amplifier, Encoder Limiter, Low Pass filter, Decode limiter, Amplifier and Threshold detector are provided in Figures 3 through 8. References to symbol numbers mentioned in the following text are found on the Schematic Diagram, Outline Diagram and Parts List.

OPERATION

A Channel Guard MONITOR switch located on the microphone hookswitch, controls the operation of the Channel Guard decode circuitry. When the switch is moved to the MON position, the Channel Guard decode function is disabled, allowing all calls to be heard. The encode function is controlled by the PTT switch and is enabled only when the PTT switch is operated. All transmitted calls are tone coded with the channel Guard frequency.

CIRCUIT ANALYSIS

FREQUENCY SWITCHABLE SELECTIVE AMPLIFIER

Frequency Switchable Selective Amplifier (FSSA) AR1001 is a highly stable active bandpass filter for the 71.9 Hz to 210.7 Hz frequency range. The selectivity of the filter is shifted across the bandpass frequency range by switching Versatone Networks in the filter circuit (See Figure 2.).

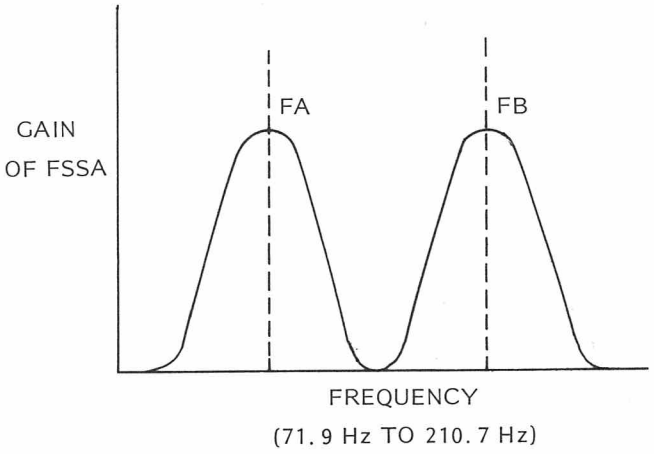


Figure 2 - Gain vs Frequency

In Figure 2, the gain of the FSSA is shown as a function of the tone frequency. The Tone Frequency is determined by the Tone Network connected in the FSSA circuit. When Tone Network A is in the circuit, the maximum gain occurs at FA. When Tone Network B is in the circuit, the maximum gain occurs at FB.

TONE NETWORK

Versatone Network FL1001 is a precision resistor network with associated switching transistors. A typical Versatone Network is shown in Figure 3. Pins 3, 4 and 5 of the network are connected to ground.

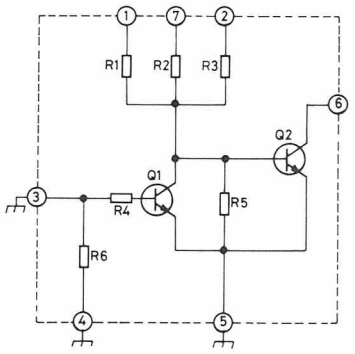


Figure 3 - Typical Versatone Network

ENCODE

When PTT switch is operated the Channel Guard encode tone is generated by coupling the output of FSSA bandpass filter AR1001 back to its input through a phase inverting amplifier circuit and limiter circuit. The output of the FSSA is coupled from AR1001-1 to the input of the phase inverting amplifier at U1002-9. A typical phase inverting amplifier circuit is shown in Figure 4.

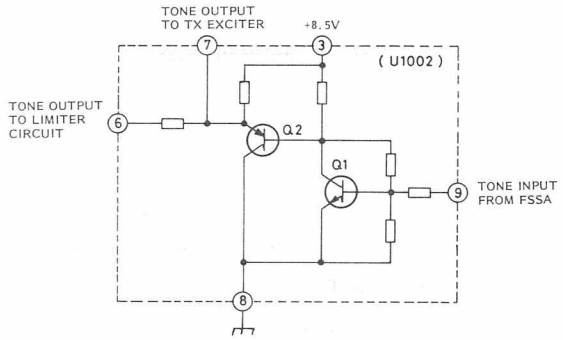


Figure 4 - Typical Phase Inverting Amplifier

Amplifier Q1 provides 180^{o} phase shift of the tone frequency at the output of emitter follower Q2. The output of the phase inverting amplifier circuit is coupled from U1002-6 to the input of the limiter circuit at U1002-5. A typical limiter circuit is shown in Figure 5.

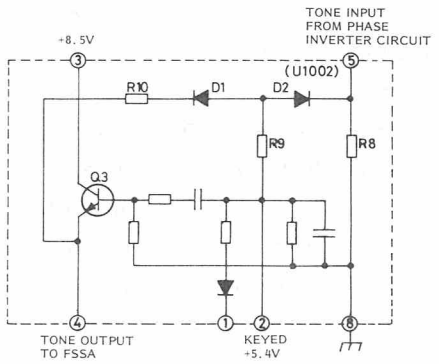


Figure 5 - Typical Encode Limiter Circuit

Limiting network D1, D2, R8, R9 and R10 sets the tone output coupled from U1002-4 to the input of the FSSA (AR1001-12) at 53 milivolts peak to peak.

The limiter circuit is also used as an encode switch. Keying the transmitter applies +5.4 Volts to U1002-2. This forward biases Limiter diodes D1 and D2 and momentarily turns Q3 on. Forward biasing D1 and D2 allows the circuit to oscillate.
Momentarily turning Q3 on starts the circuit oscillating. The tone frequency is determined by the tone network connected in the FSSA circuit.
The tone output of the encoder circuit is taken from U1002-7 and coupled through tone output amplifier Q1002 and modulation adjustment R1015 to the audio processor on the transmitter/receiver board.

DECODE

Audio, containing the correct frequency from P1006-10 (Volume Hi), is coupled to pin 1 of Decode Module U1001. Pin 1 of U1001 is the input of an active, three stage, low pass filter. The low pass filter attenuates frequencies over 210.7 Hz. A typical low pass filter is shown in Figure 6. The output of the low pass filter at U1001-15 is applied to U1001-14. U1001-14 is the input of a limiter circuit, limiting the output at U1001-13 to 55 milivolts peak to peak. A typical limiter circuit is shown in Figure 7. The output from the limiter is coupled to Pin 12 of FSSA AR1001. Since the tone is the proper frequency the FSSA will allow it to pass. The output of the FSSA is coupled from AR1001-1 to U1001-3. U1001-3 is the input to an amplifier circuit. The output of the amplifier at U1001-4 is coupled to the input of a threshold detector at U1001-6. A typical amplifier and threshold detector circuit is shown in Figure 8. When a tone is present, Q6 will conduct causing Q7 to conduct and +8.5 VDC to appear on the output of the threshold detector circuit (U1001-10).

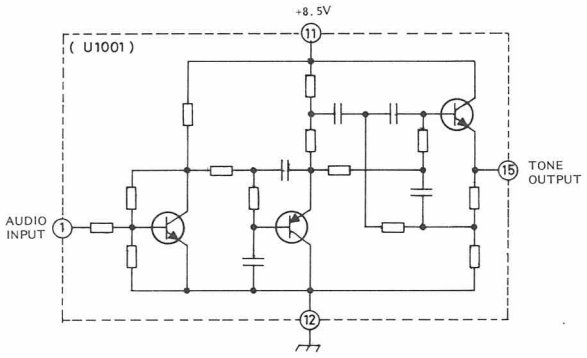


Figure 6 - Typical Low Pass Filter

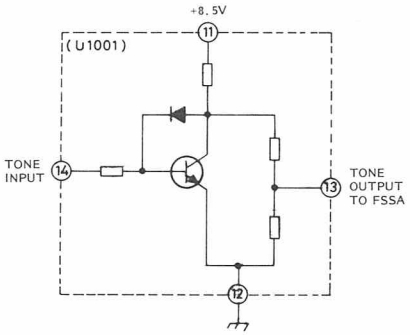


Figure 7 - Typical Decode Limiter Circuit

In the decode mode, when the tone decoder in U1001 detects the channel guard frequency, Q1003 turns Q1004 off. This unmutes the receiver audio. In the squelch mode, Q1004 is operating, grounding the RX MUTE lead and muting the receiver audio.

Audio from VOL/SQ HI is connected to the tone reject filter via P1006-10. The tone reject filter is an active filter consisting of U1003 and associated circuitry. All frequencies from 70 to 210.7 Hz are rejected by the filter, while passing all other audio frequencies via P1006-1 back to the receiver audio circuits.

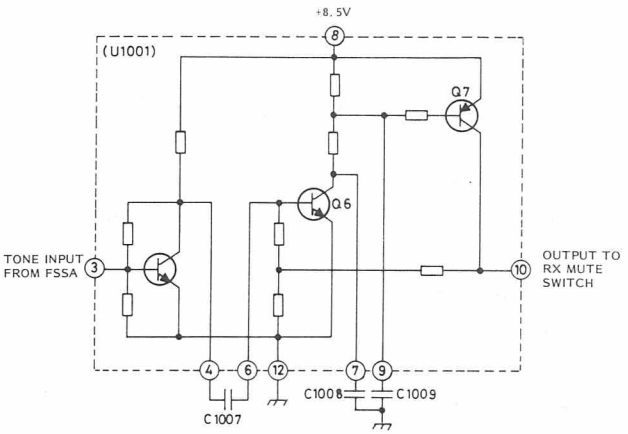


Figure 8 - Typical Amplifier and Threshold Detector Circuit

ENCODE DISABLE

SERVICE HINT

The Encode Disable circuit has been incorporated as a maintenance aid for the serviceman. This circuit disables the Channel Guard encode circuit and allows the serviceman to make transmitter distortion and modulation checks without removing the cover from the radio.

The Encode Disable circuit is comprised of Q1005 and Q1006 and operates when a positive voltage (+8.5 - 14 VDC) is applied to P910-5 (Molex connector) on rear of radio. (Accomplished by temporarily jumpering P610-5 and P910-11). This positive voltage is applied to the base of Q1005 through the Interconnect/Multi-Frequency board, turning both Q1005 and Q1006 on. Q1006 applies +8.5 VDC to the base of PTT Switch Q1001, forcing it off. With Q1001 off, the operating voltage for the encoder IC U1002 and Encode Tone Output Stage transistor Q1002 is removed, preventing any tone output.

CAUTION

When using the Encode Disable circuit do not remove microphone from mic hanger or put GC MON Switch in MON position. Damage to equipment will result.

INSTALLATION

The Channel Guard module is installed as shown on the installation diagram and jumpers are added or deleted as specified. The module is fastened to the chassis by 4 screws and plug P1006 is inserted in socket J906.

ADJUSTMENTS

ENCODER ADJUSTMENTS, TQ5003, TT5001

Turn the channel guard modulation potentiometer R1015 fully counterclockwise to remove the channel guard modulation.

Apply 1 V, 1000 Hz to the MIC-INPUT (J911-4/3) and adjust the Δf_{max} potentiometer(s) for normal peak deviation minus the channel guard peak deviation.

Example:

Normal peak deviation= 5 kHz
Channel guard peak deviation= 750 Hz
Adjust deviation for 4250 Hz peak

Note

If the transmitter modulation distortion is checked at this stage, the test modulation must be reduced from the normal 70% of Δf_{max} by a factor proportional to the actually maximum deviation for which the station was adjusted.

Remove the test modulation and adjust the channel guard potentiometer, R1015, to the required peak deviation.

Channel Guard deviation:

The channel guard deviation shall be requested by the customer, but if this information is not available a preliminary setting of 15% of maximum normal deviation may be used.

DECODER CHECKING, TQ5003, TR5001

The function of the decoder is checked by applying an RF carrier to the antenna input.

Set the RF level to correspond with the normal squelch threshold.

Modulate the signal generator with the channel guard tone to approx. 500 Hz deviation.

Check that the audio channel is open only when the channel guard modulation is applied.

TONE REJECT FILTER CHECKING, FN5001

The function of the tone reject filter is checked by applying an RF carrier to the antenna input.

Set the signal generator level to 1000 uV and modulate the signal with the channel guard tone to approx. 500 Hz.

Set the volume control to maximum and listen to the loudspeaker. The channel guard tone shall barely be audible.

TECHNICAL SPECIFICATIONS

STANDARD TONE FREQUENCIES (Hz)				
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	186.2
85.4	103.5	127.3	156.7	192.8
				203.5
				210.7

Frequency Stability

±0.5%

Supply Voltage

+8.5 V (RX or TX)

Current Drain

25 mA

Temperature Range

$-30^{o}C$ to $+60^{o}C$

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 independant 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 circuits boards, a TONE BOARD and a LOGIC BOARD, which mount together to a sandwich units with the soldering sides facing each other. The unit fits mechanical 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 (Programable 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.

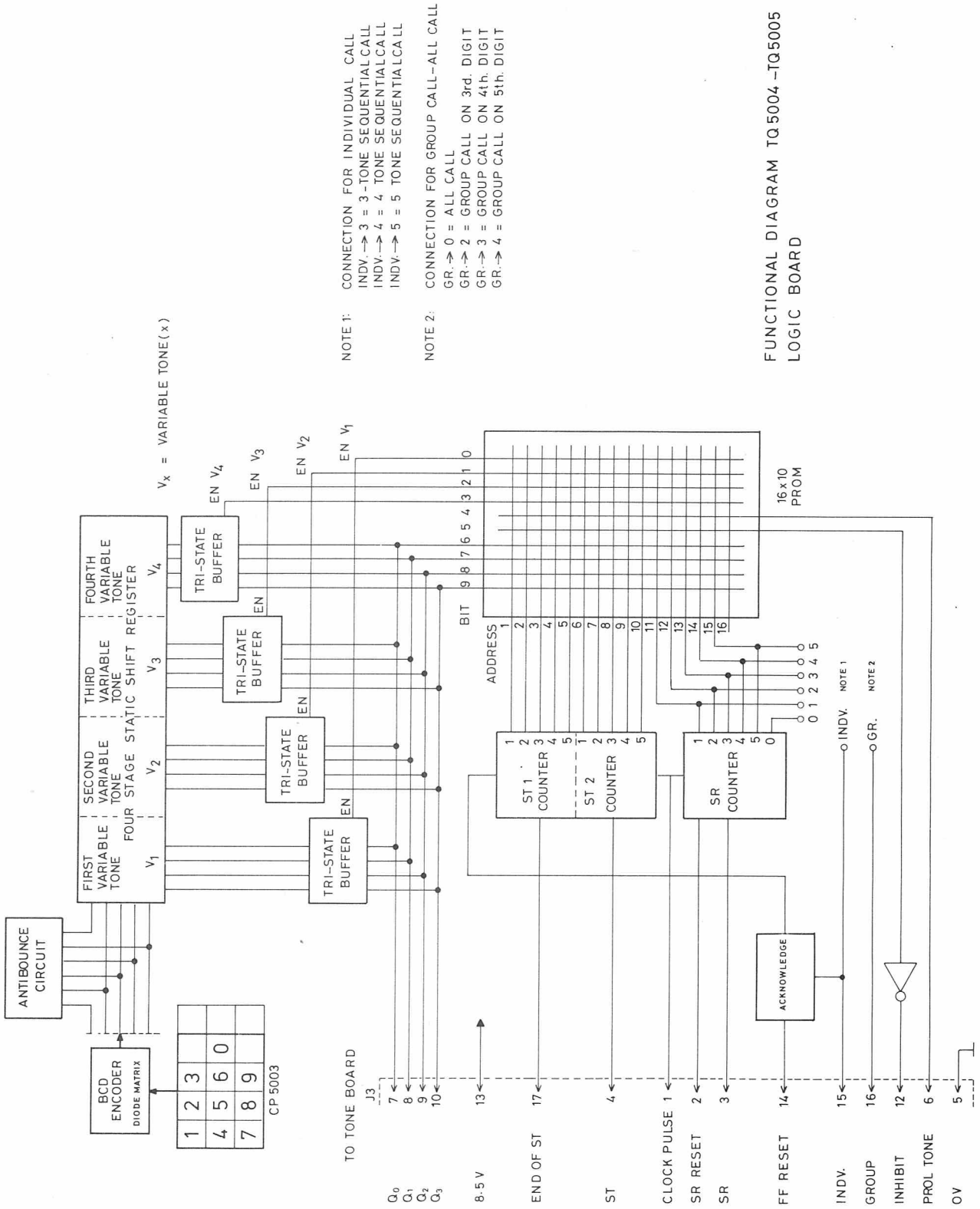


FIG. 1. LOGIC BOARD FUNCTIONS

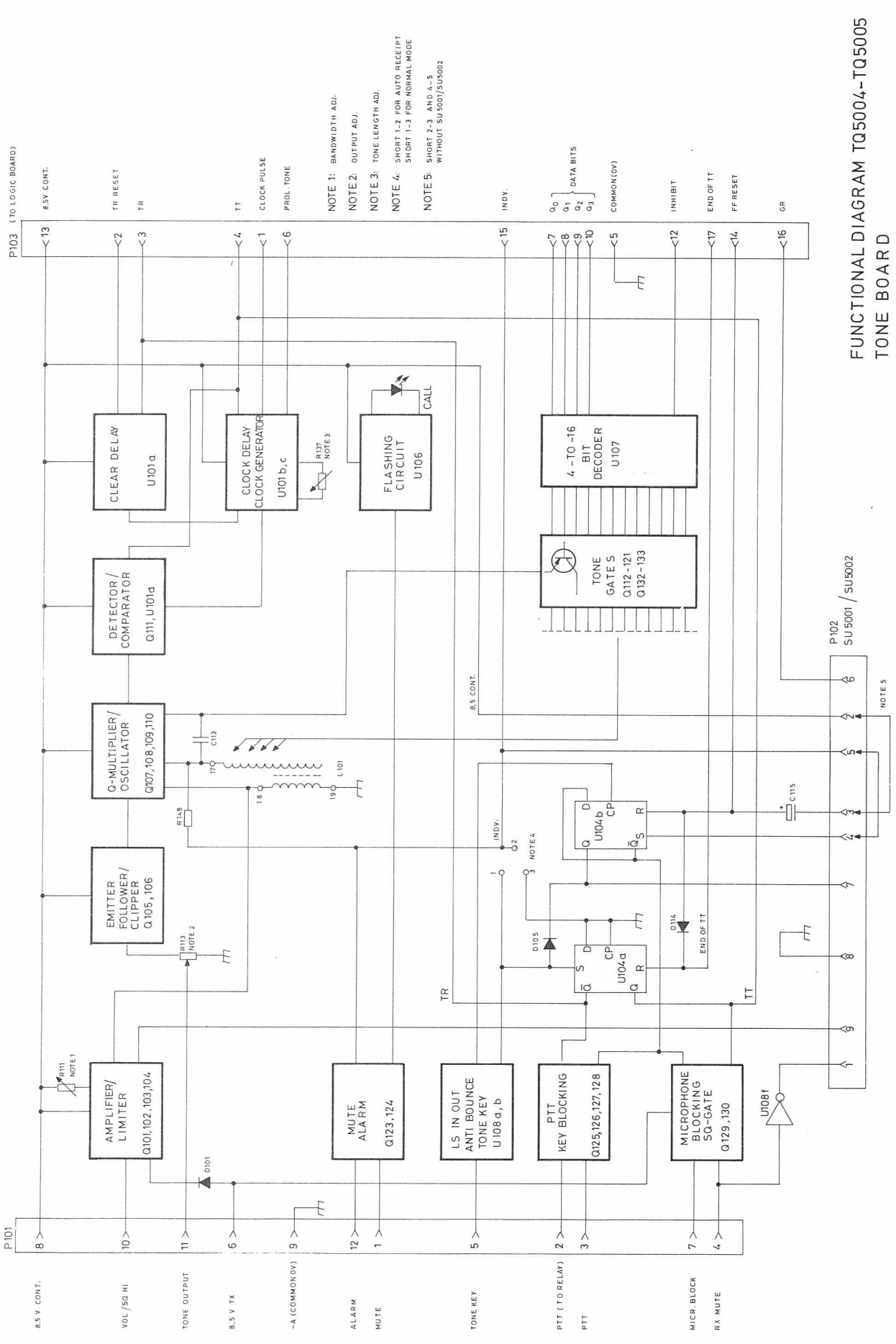


FIG. 2. TONE BOARD FUNCTIONS

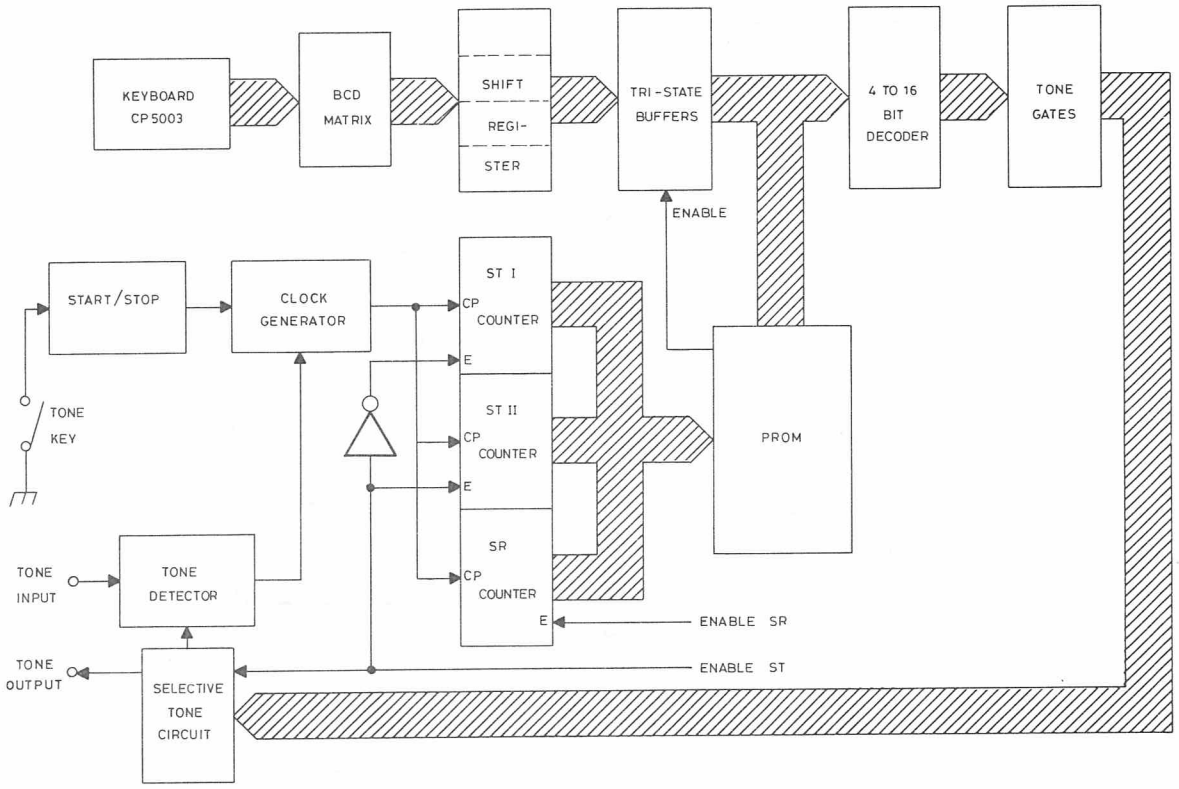


FIG. 3. DATA FLOW CHART

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:

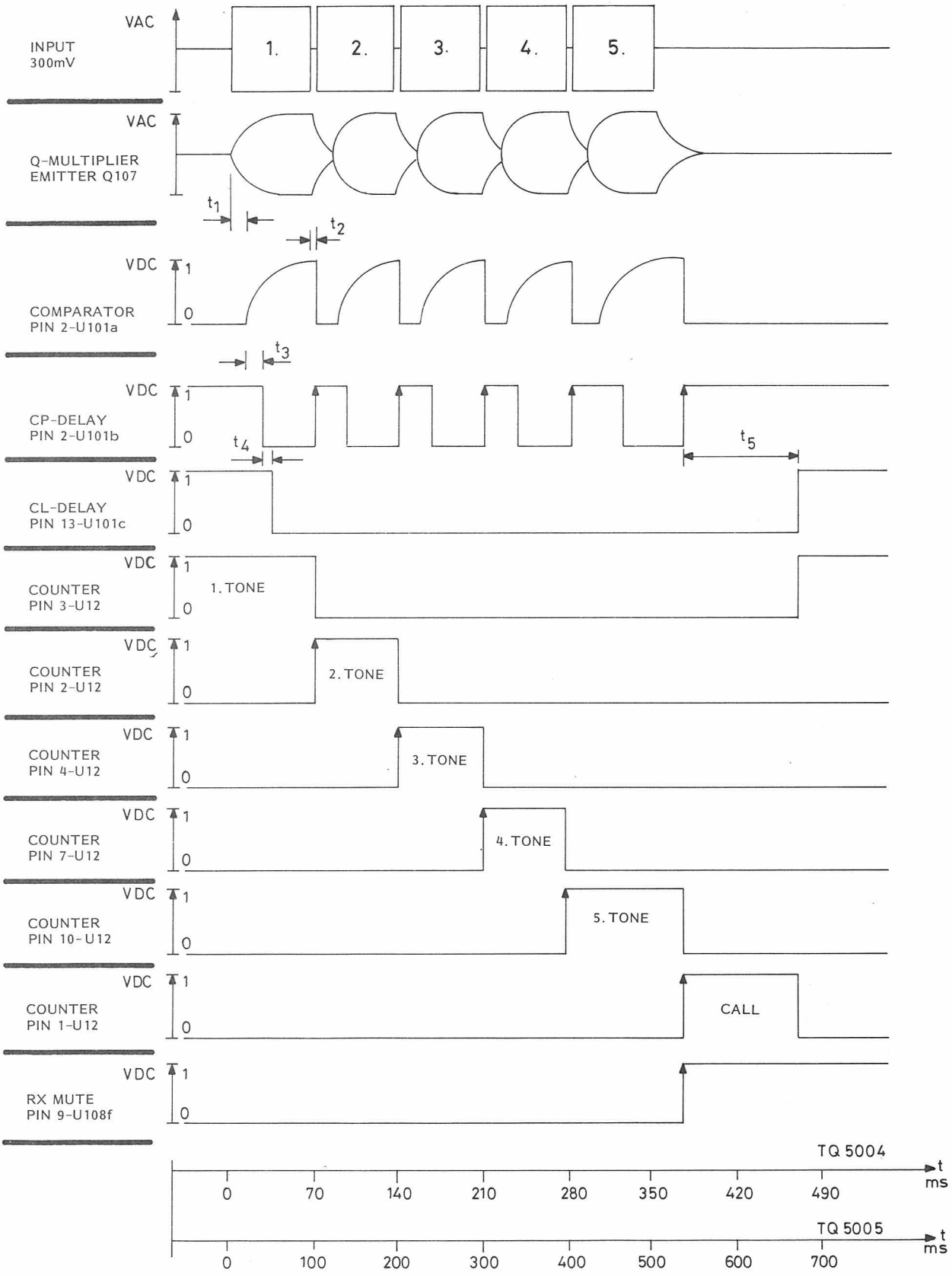
"1" = ~8.5 V
"0" = ~0 V

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

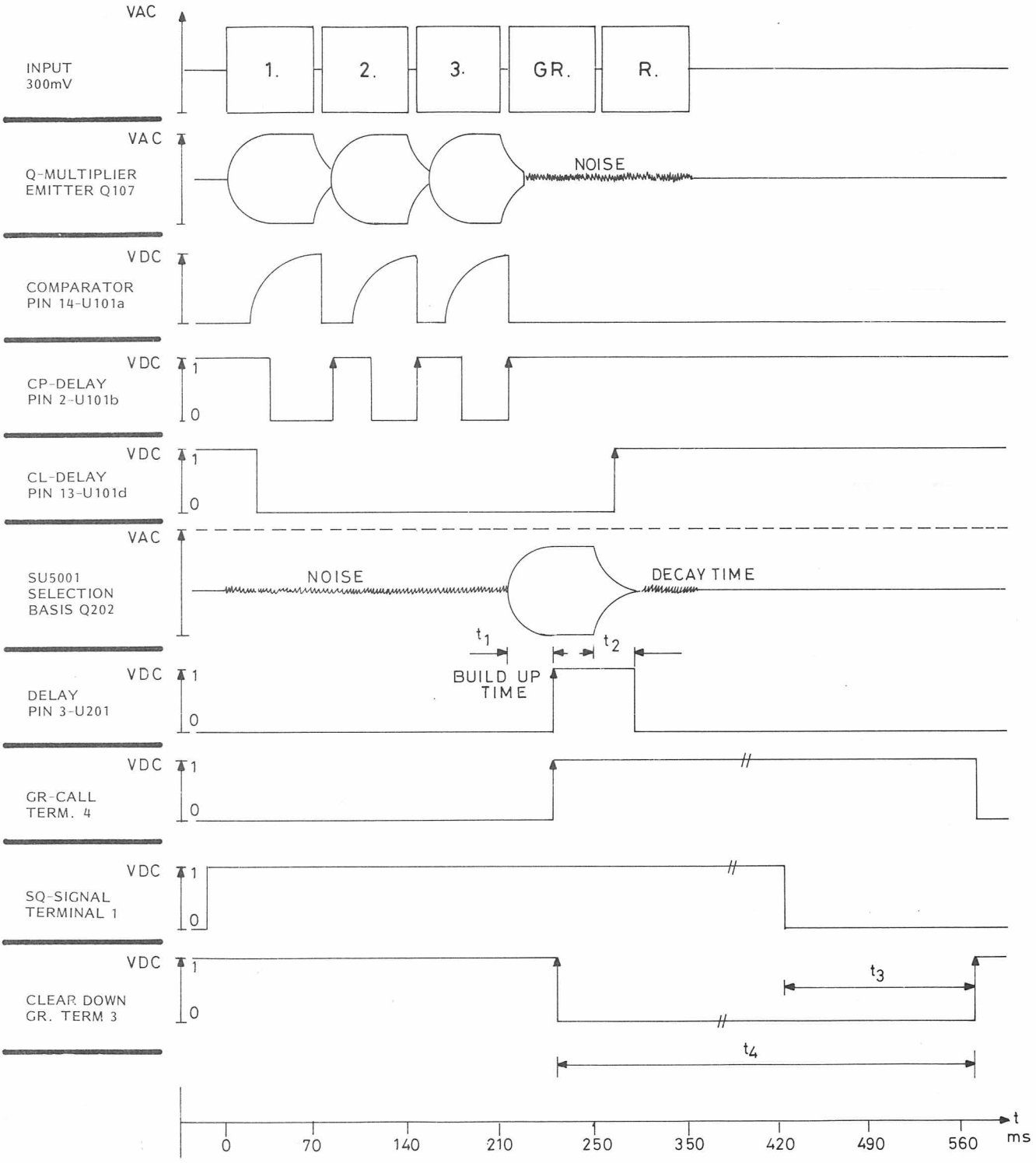
PULSE-TIME DIAGRAM FOR 5-TONE, SEQUENTIAL TONE RECEPTION IN TQ5004 AND TQ5005



t_1 = SELECTIVE CIRCUIT BUILD-UP TIME
t_2 = DECAYTIME
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 oscilator 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 preceeding 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 lach 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

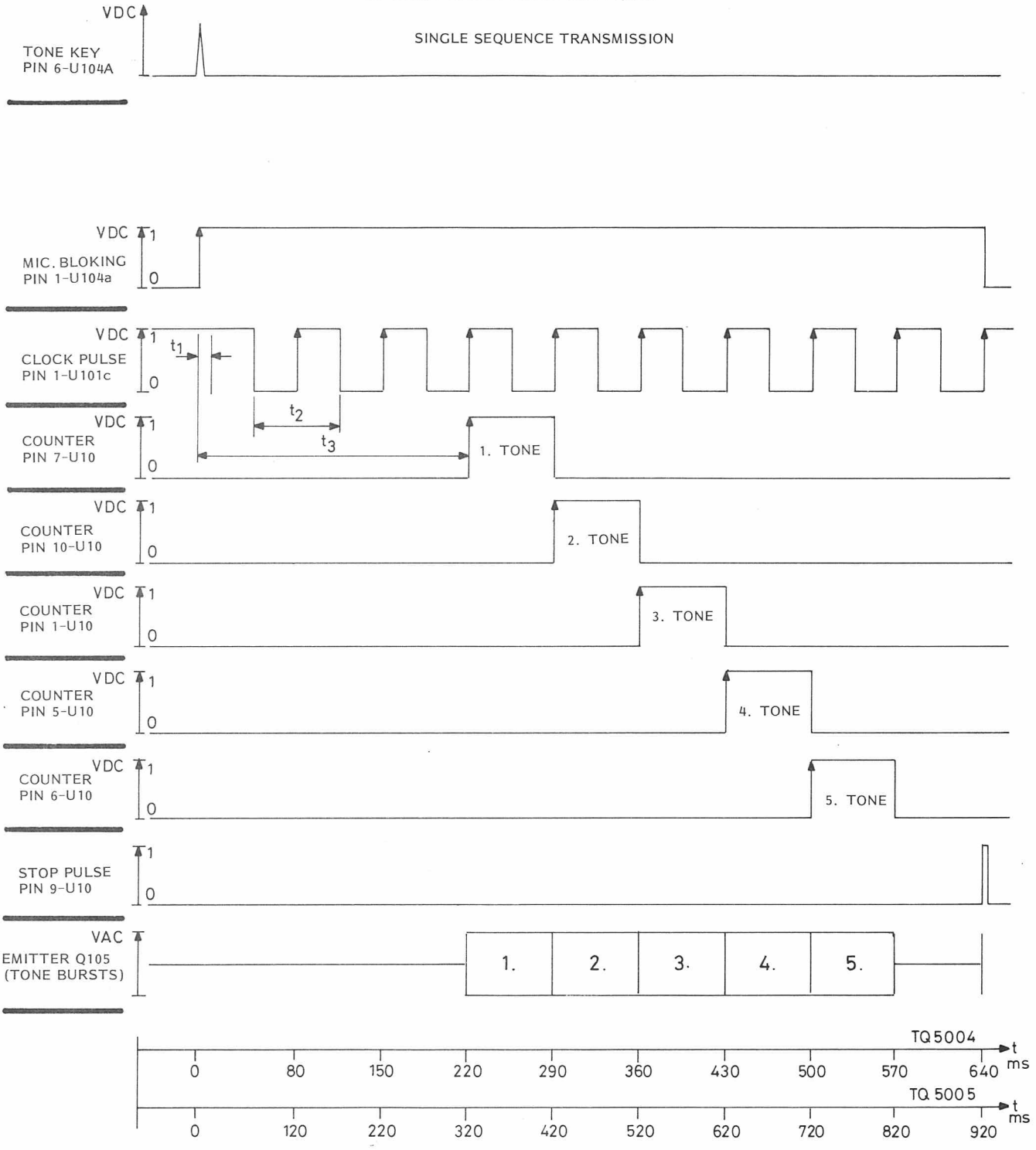
All tones used in the tone transmitter codes are programmed in the PROM.

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 $\overline{Q}$ 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 $\overline{Q}$-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 LENGHT)

t_3 UNMODULATED PULSES BEFORE THE 1 ST TONE

FIG. 6. 5-TONE SEQUENTIAL TRANSMISSION

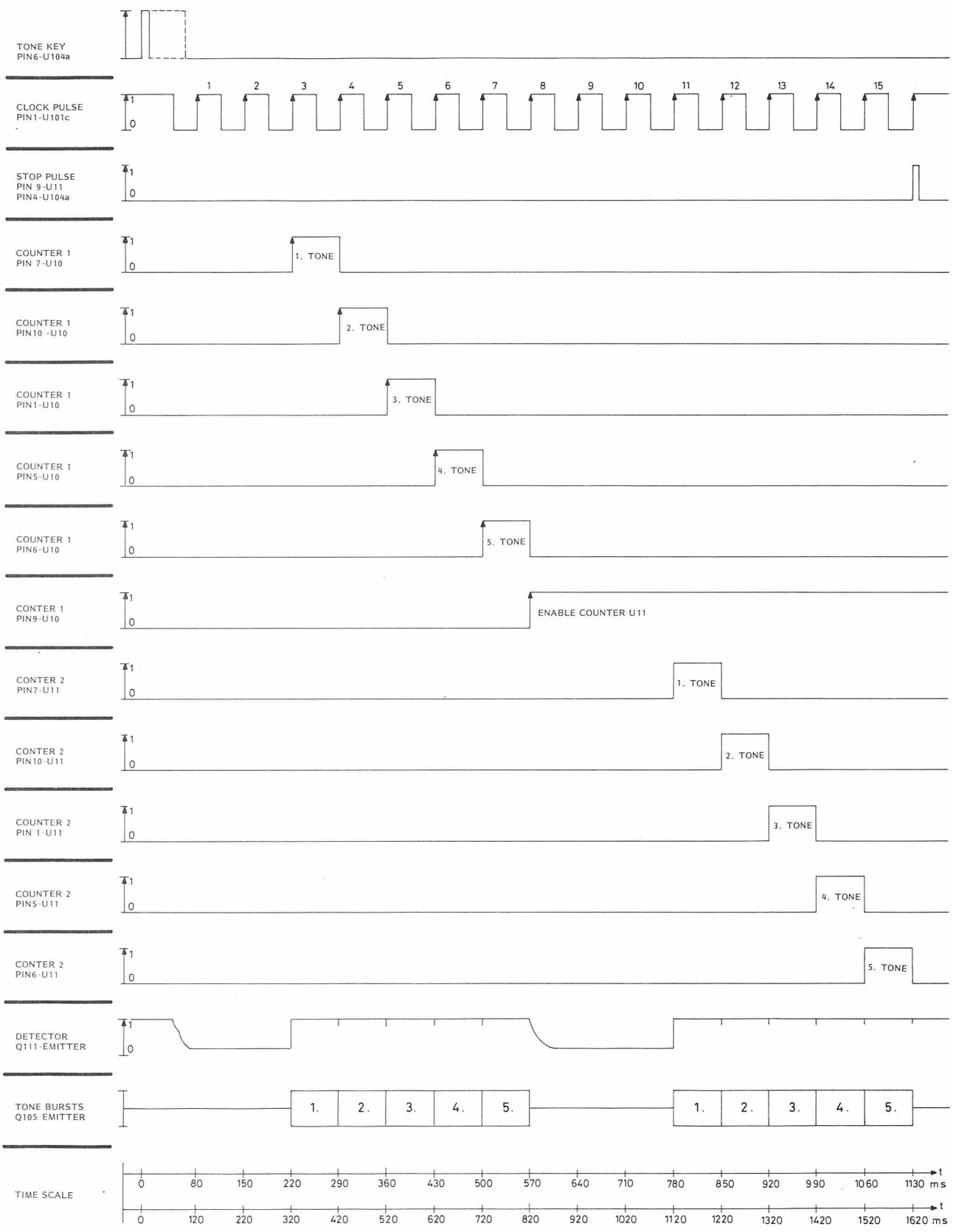


FIG. 7. DUAL SEQUENCE TRANSMISSION

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 of 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 exeeds 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 transistion 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.

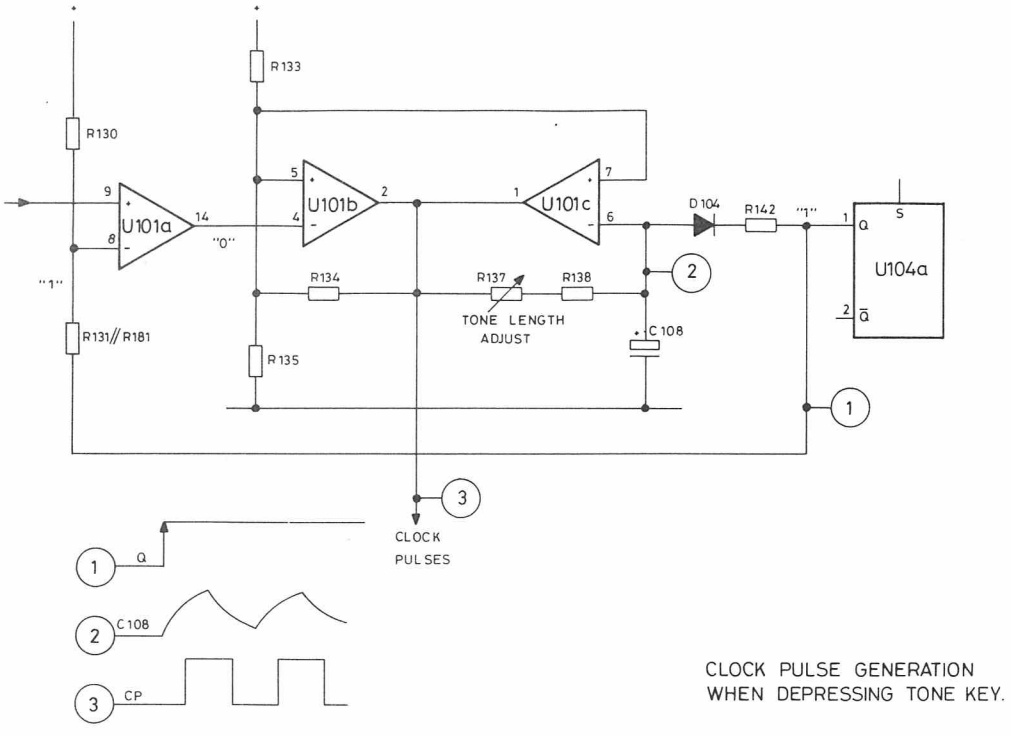
The positive pulses so appearing of the outputs of U101b and U101c are used as clock input to the counters U10 and U11. The period time is adjusted by means of resistor R137 to 70 ms for TQ5004 or 100 ms for TQ5005.

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

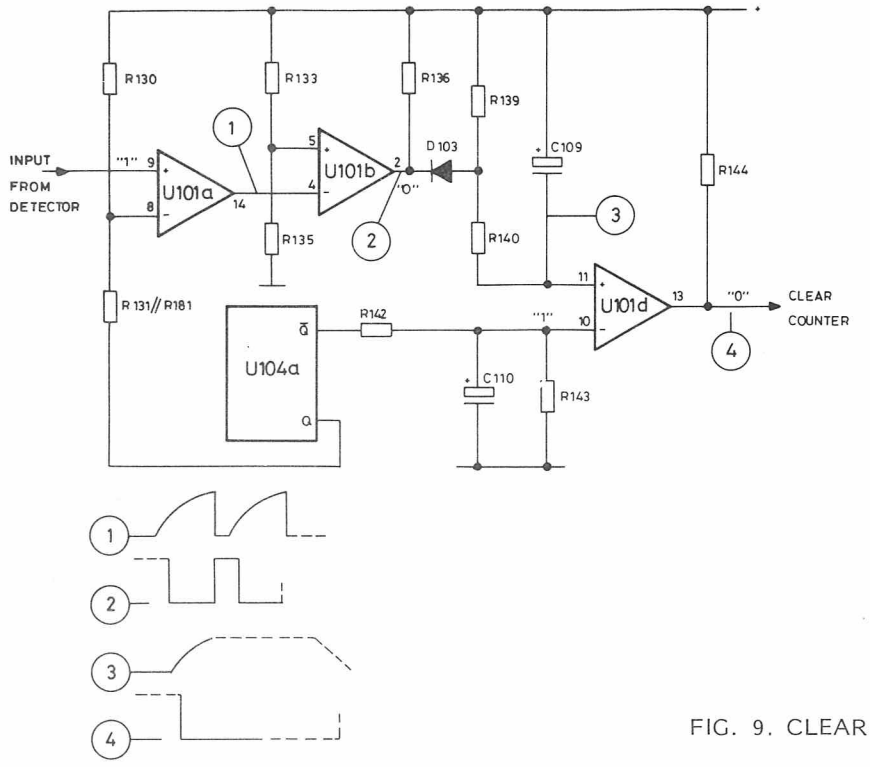


FIG. 9. CLEAR DELAY CIRCUITRY

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

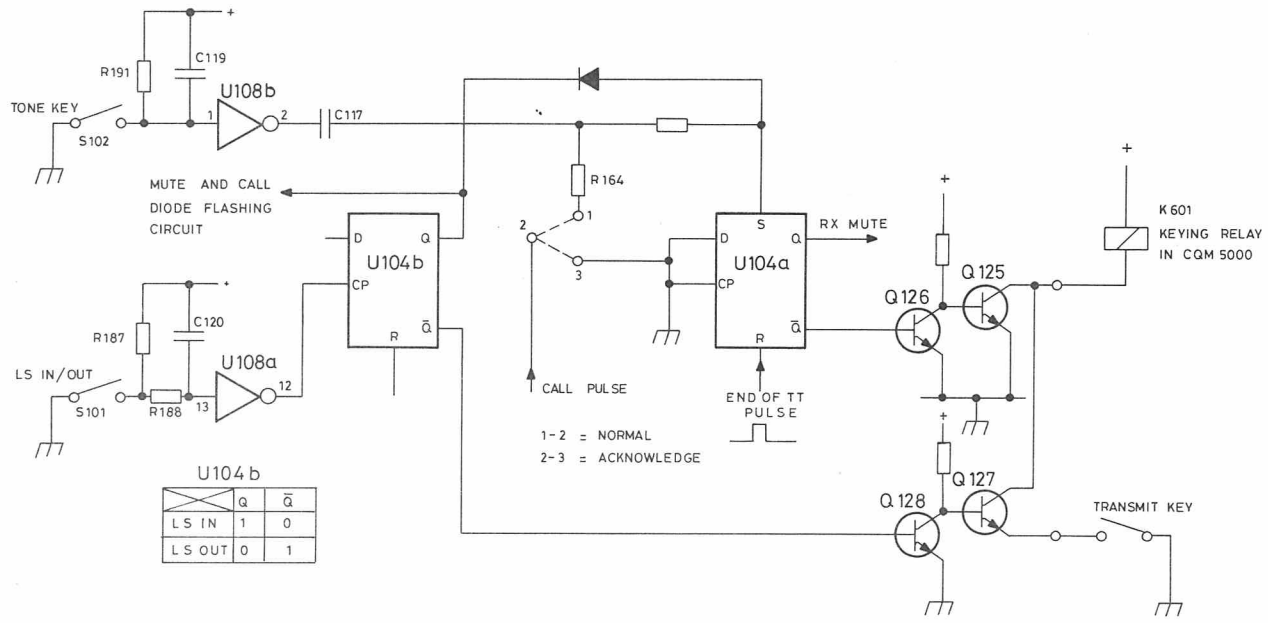


FIG. 10. LS IN/OUT AND TONE CIRCUITRY

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 $\overline{Q}$-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.

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 desides whether the audio channel is open or not.

LOGIC BOARD CIRCUIT DESCRIPTION

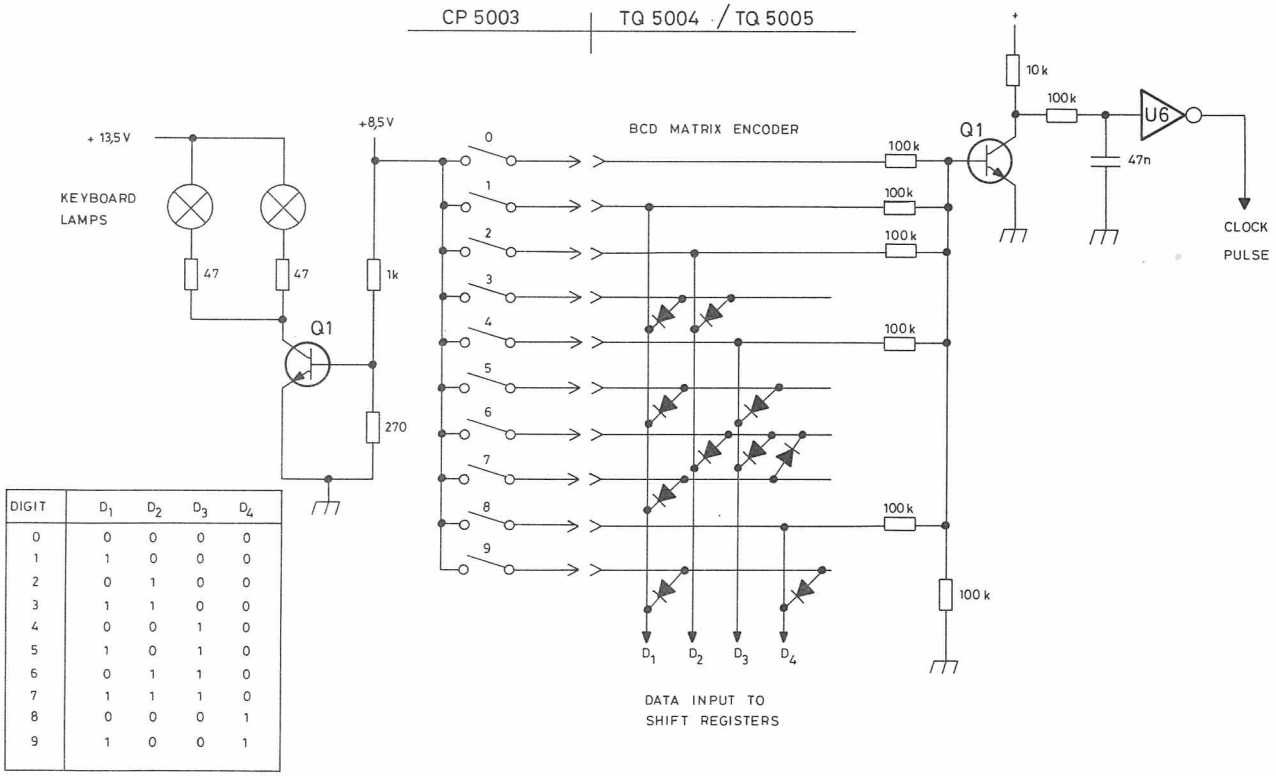
KEY BOARD, DECIMAL TO BCD ENCODING AND ANTIBOUNCE

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

SHIFT REGISTERS AND DATA BUFFERS

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

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



DIGIT	D_1	D_2	D_3	D_4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

FIG. 11. BCD ENCODER - CLOCK PULSE CIRCUITRY

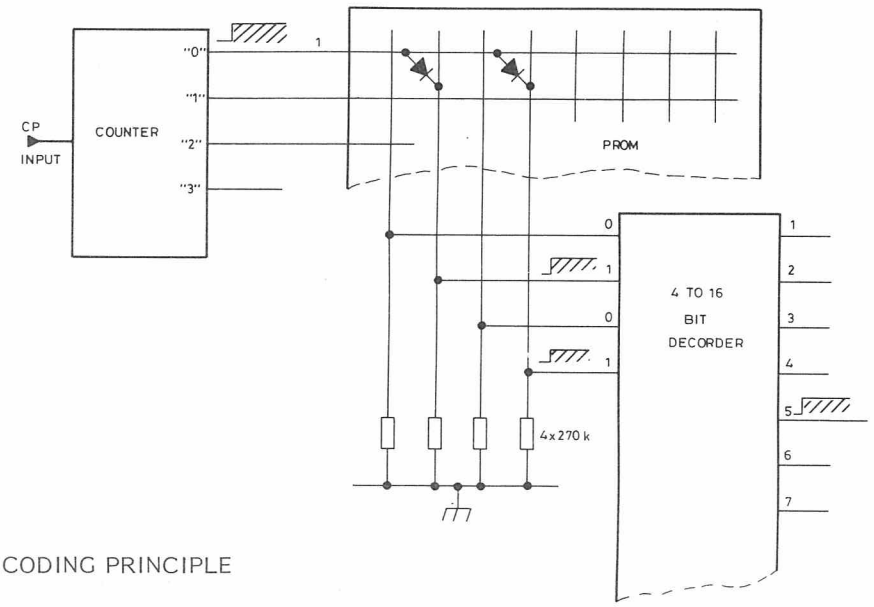


FIG. 12. PROM DECODING PRINCIPLE

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 $\overline{Q}$ 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 $\overline{Q}$ 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

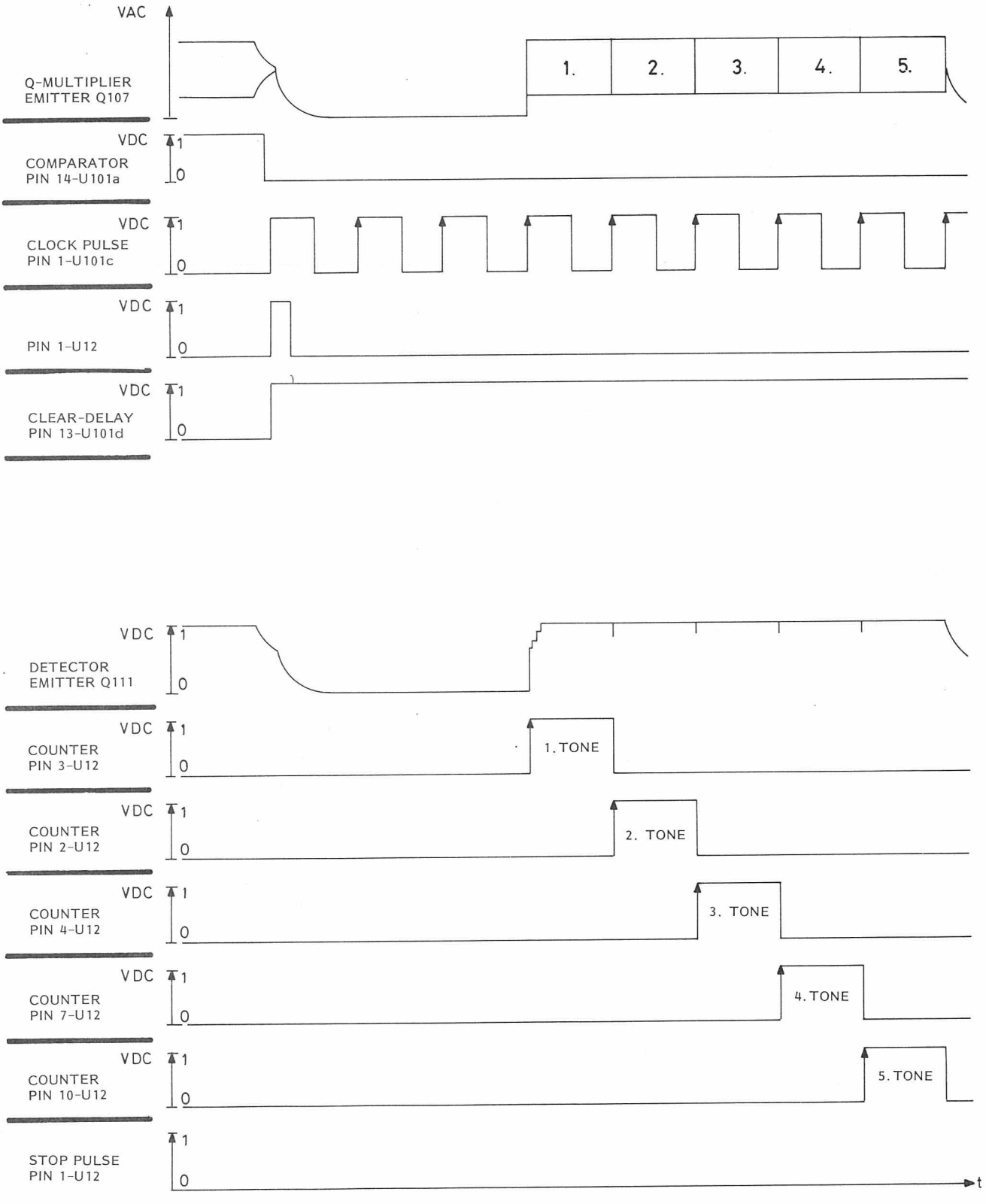


FIG. 13. ACKNOWLEDGE TRANSMISSION

TECHNICAL SPECIFICATIONS

SPECIFICATIONS COMMON TO TQ5004 AND TQ5005

Supply Voltage
8.5 V ±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
$-30^{o}C$ to $+60^{o}C$

SEQUENTIAL TONE TRANSMITTER

Signal Output Level
Max. 600 mV EMF (Adjustable)

Frequence Response
Flat ±1 dB

Signal Distortion
<5%

Tone Frequency Acceracy

Max. diviation:	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 speach channel of the CQM5000.

Input Frequency Response
Deemphasis according to an RC function with F_c= 2900 Hz

Activating Input Level
300 mV ±6 dB

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

Tone Frequency Accuracy
±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 ± 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 ± 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.

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. Frequences 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 sequencies. 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.

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).

The tone transmitter codes and the tone receiver code are independant 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.

ADDRESS	BIT	9	8	7	6	5	4	3	2	1	0
	TQ5004 TQ5005 PROM CODE SPECIFICATION	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
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										

Total number of variables in system	
1 Variable	V_1
2 Variables	V_2 V_1
3 Variables	V_3 V_2 V_1
4 Variables	V_4 V_3 V_2 V_1

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

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
R= repeat tone.
100 CALLS.

EX. B

1	2	R	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2.
90 CALLS.

EX. C

1	2	3	V_1	V_2

Limitation, V_1 cannot be selected equal to V_2 and V_1 cannot be selected equal to 3.
81 CALLS.

EX. D

V_1	R	V_2	R	V_3

No limitations in the variable digits, V_1, V_2 and V_3. R= repeat tone.
1000 CALLS.

EX. E

1	R	V_1	R	V_2

No limitation in the variable digits V_1 and V_2.
Prolonged 1st-tone max 1.2 sec.

FORMAT 2.

- Transmission of two consecutive sequential tone signals.

1	2	3	4	5				6	7	8	9	10

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

1	2	3	4	V_1				V_2	R	V_3	R	V_4

$V_1 = V_2$ 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 accomodate 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).

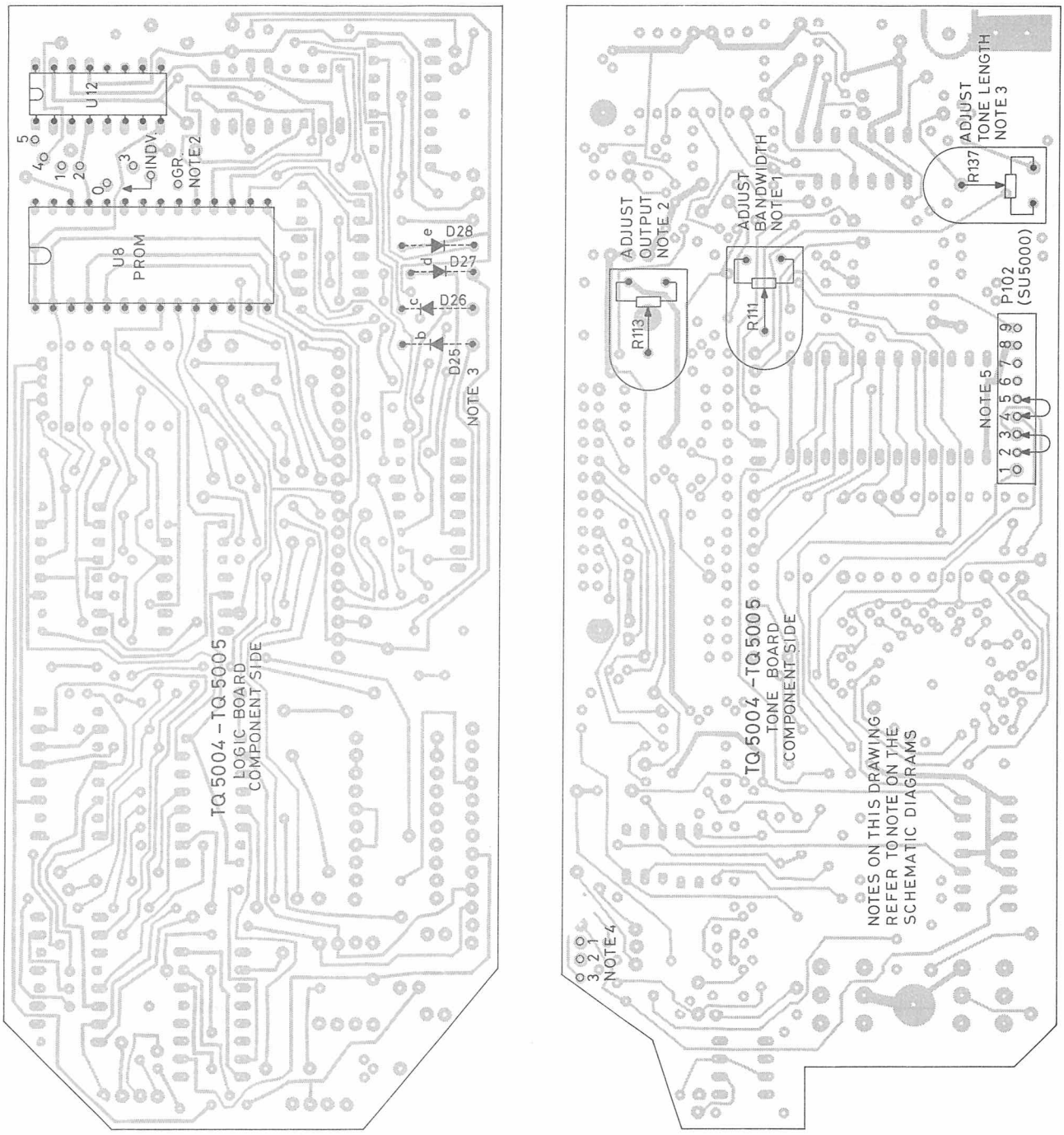


FIG 2. CIRCUIT BOARD LAYOUT TQ5004-TQ5005.

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

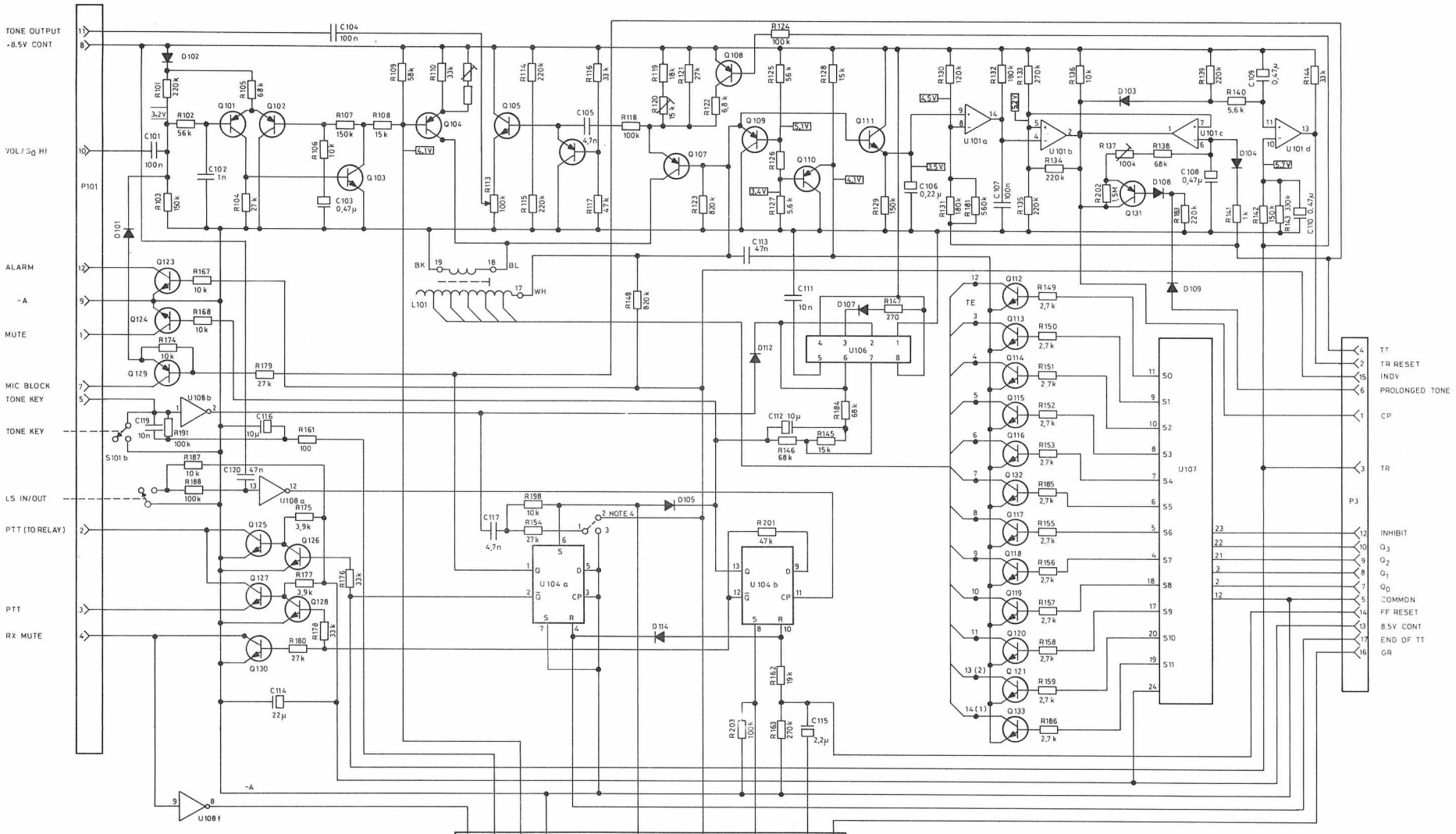
A variable tone is inserted in the code when the bit= 1.

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

Storno



NOTE 1 BANDWIDTH ADJUST
NOTE 2 OUTPUT ADJUST
NOTE 3 TONELENGTH ADJUST
NOTE 4 SHORT 1-2 FOR AUTO RECEIPT
SHORT 1-3 FOR NORMAL MODE
NOTE 5 SHORT 2-3 AND 4-5
WITHOUT SU5001 OR SU5002

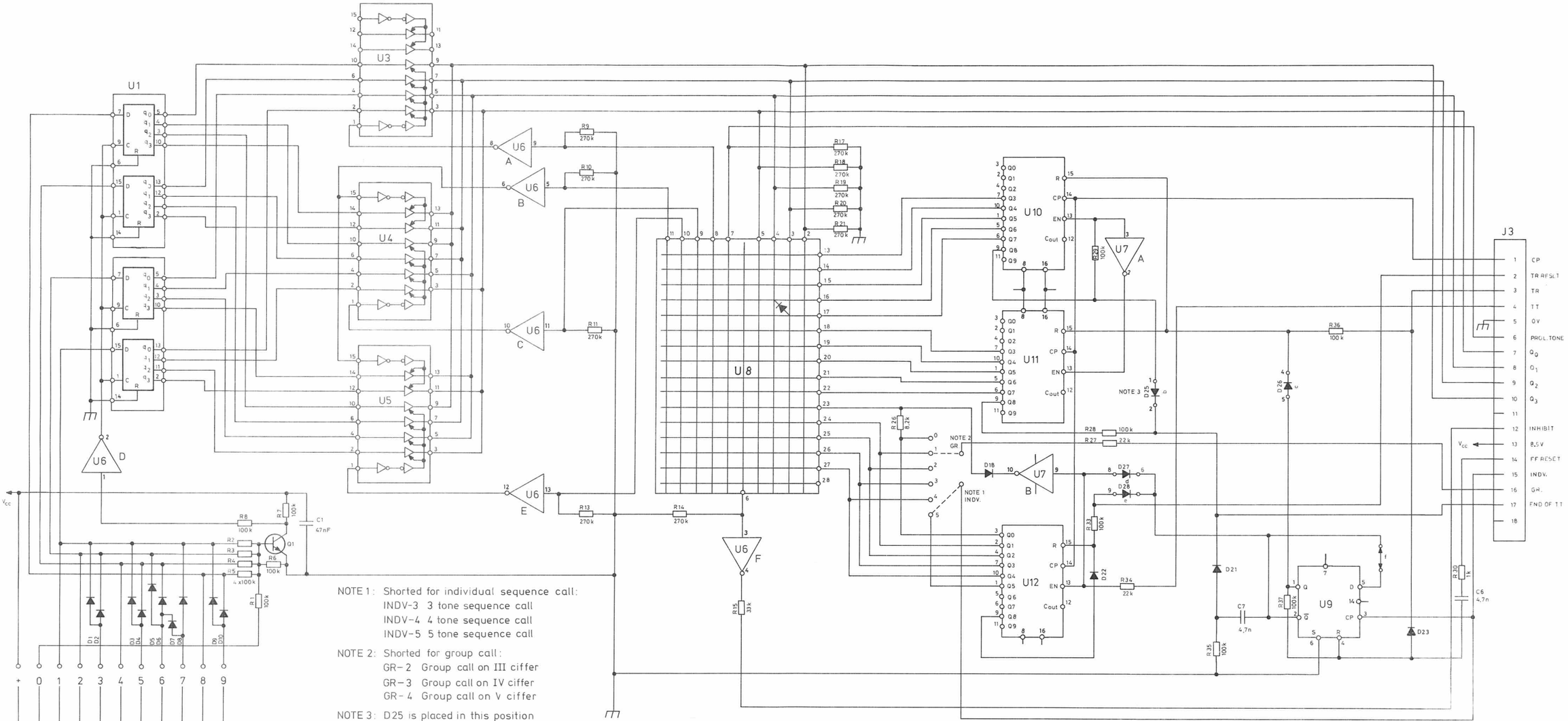
IC	V_{CC}	0V
101	3	12
104	14	7
106	4-8	1
107	24	12
108	14	7

SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402. 848 / 2

Storno

Storno



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 ciffer
GR-3 Group call on IV ciffer
GR-4 Group call on V ciffer

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

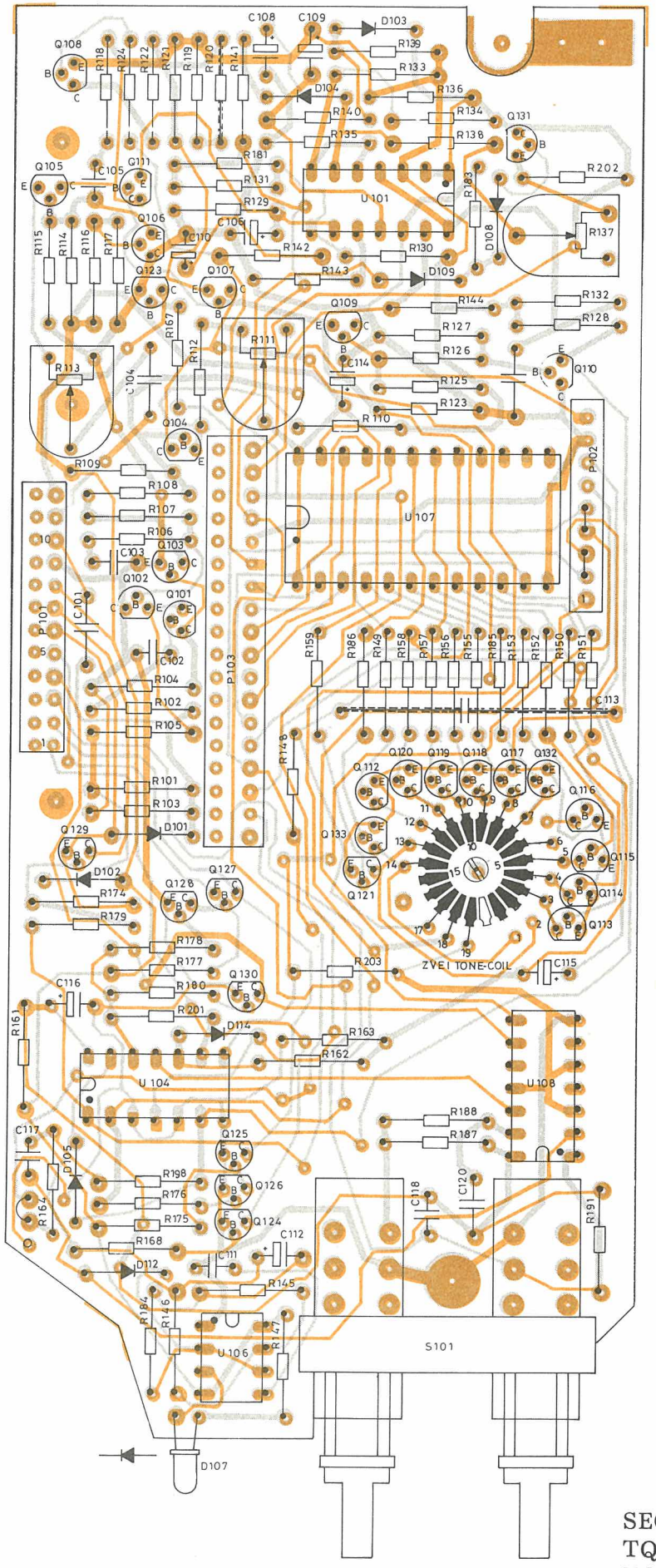
TYPE	V_{CC}	0V
U1-U2 = 4015	16	8
U3-U4-U5 = 40097	16	8
U6 = 40106	14	7
U7 = 4049	1	8
U8 = PROM	—	1
U9 = 4013	14	7
U10, U11, U12 = 4017	16	8

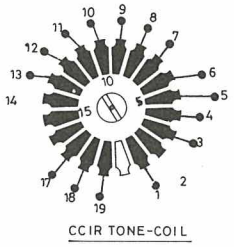
SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
LOGIC BOARD

D402.849/2

Storno

Storno



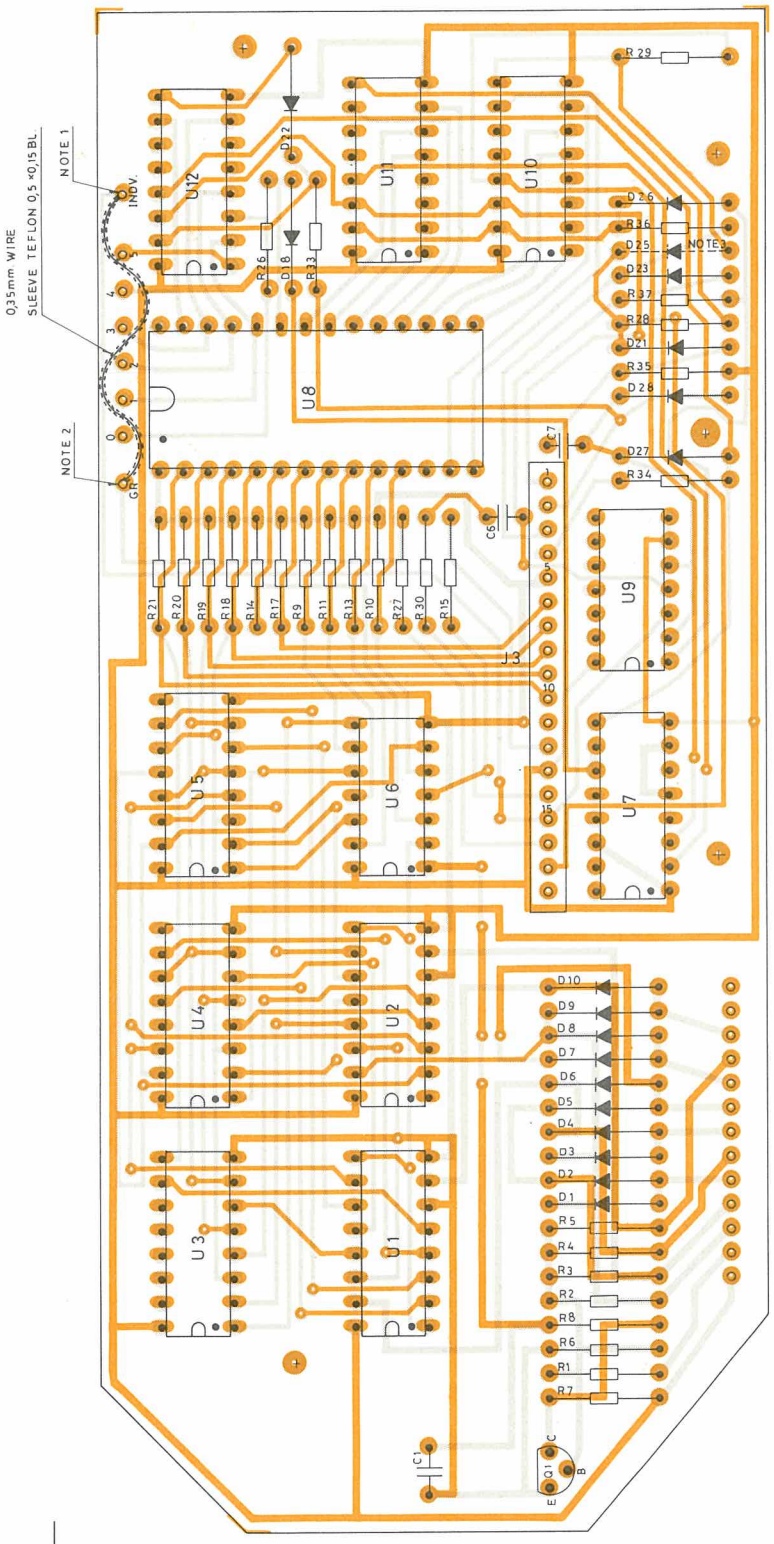


SEQUENTIAL TONE UNIT
TQ5004 AND TQ5005
TONE BOARD

D402. 831/2

Storno

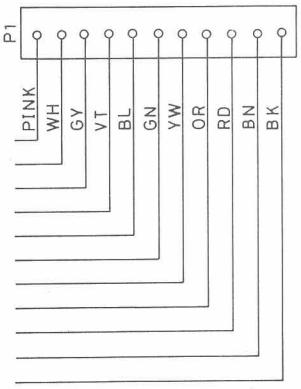
Storno



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

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



SEQUENTIAL TONE UNIT TQ5004 AND TQ5005 LOGIC BOARD

D402.832/2

Storno

TYPE	Nº	CODE	DATA	
	C 1	76.5139	47 nF 10% Polyester FL	50 V
	C 6	76.5133	4.7 nF 10% Polyester FL	50 V
	C 7	76.5133	4.7 nF 10% Polyester FL	50 V
	C101	76.5144	0.1 uF 10% Polyester FL	63 V
	C102	76.5129	1 nF 10% Polyester FL	50 V
	C103	73.5169	0.47 uF 20% Tantal	35 V
	C104	76.5144	0.1 uF 10% Polyester FL	63 V
	C105	76.5133	4.7 nF 10% Polyester FL	50 V
	C106	73.5168	0.22 uF 20% Tantal	35 V
	C107	76.5144	0.1 uF 10% Polyester FL	63 V
	C108	73.5170	1.0 uF 20% Tantal	35 V
	C109	73.5169	0.47 uF 20% Tantal	35 V
	C110	73.5169	0.47 uF 20% Tantal	35 V
	C111	76.5135	10 nF 10% Polyester FL	50 V
	C112	73.5173	10 uF 20% Tantal	16 V
	C113	76.5123	47 nF 2.5% Polyester TB	63 V
	C114	73.5174	22 uF 20% Tantal	16 V
	C115	73.5171	2.2 uF 20% Tantal	35 V
	C116	73.5173	10 uF 20% Tantal	16 V
	C117	76.5133	4.7 nF 10% Polyester FL	50 V
	C118	76.5135	10 nF 10% Polyester FL	50 V
	C120	76.5139	47 nF 10% Polyester FL	50 V
	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	
	D 27	99.5237	1N4148 Diode	
	D 28	99.5237	1N4148 Diode	
	D101	99.5237	1N4148 Diode	
	D102	99.5237	1N4148 Diode	
	D103	99.5237	1N4148 Diode	
	D104	99.5237	1N4148 Diode	
	D105	99.5237	1N4148 Diode	
	D107	99.5325	LED Yellow	
	D108	99.5237	1N4148 Diode	

Storno

TYPE	Nº	CODE	DATA	
	D109	99.5237	1N4148 Diode	
	D112	99.5237	1N4148 Diode	
	D114	99.5237	1N4148 Diode	
	J 3	41.5568	Male Connector	18 pos
TQ5004	L101	61.1421	Tone coil ZVEI	
TQ5005	L101	61.1422	Tone coil CCIR	
	P 1	41.5570	PROM socket	
	P101	41.5549	Female connector	12 pos.
	P102	41.5548	Female connector	9 pos.
	P103	41.5569	Female connector	18 pos.
	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 Transistor	
	Q113	99.5324	BC338 Transistor	
	Q114	99.5324	BC338 Transistor	
	Q115	99.5324	BC338 Transistor	
	Q116	99.5324	BC338 Transistor	
	Q117	99.5324	BC338 Transistor	
	Q118	99.5324	BC338 Transistor	
	Q119	99.5324	BC338 Transistor	
	Q120	99.5324	BC338 Transistor	
	Q121	99.5324	BC338 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	
	Q131	99.5115	BC309 Transistor	
	Q132	99.5324	BC338 Transistor	

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

TYPE	Nº	CODE	DATA	
	Q133	99.5324	BC338 Transistor	
	R 1	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 2	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 3	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 4	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 5	80.5273	100 Kohm 5% Carbon film	1/8W
	R 6	80.5273	100 Kohm 5% Carbon film	1/8W
	R 7	80.5261	10 Kohm 5% Carbon film	1/8 W
	R 8	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 9	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 10	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 11	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 13	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 14	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 15	80.5267	33 Kohm 5% Carbon film	1/8 W
	R 17	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 18	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 19	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 20	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 21	80.5278	270 Kohm 5% Carbon film	1/8 W
	R 26	80.5260	8.2 Kohm 5% Carbon film	1/8 W
	R 27	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 28	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 29	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 30	80.5249	1 Kohm 5% Carbon film	1/8 W
	R 33	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 34	80.5265	22 Kohm 5% Carbon film	1/8 W
	R 35	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 36	80.5273	100 Kohm 5% Carbon film	1/8 W
	R 37	80.5273	100 Kohm 5% Carbon film	1/8 W
	R101	80.5277	220 Kohm 5% Carbon film	1/8 W
	R102	80.5270	56 Kohm 5% Carbon film	1/8 W
	R103	80.5275	150 Kohm 5% Carbon film	1/8 W
	R104	80.5266	27 Kohm 5% Carbon film	1/8 W
	R105	80.5271	68 Kohm 5% Carbon film	1/8 W
	R106	80.5261	10 Kohm 5% Carbon film	1/8 W
	R107	80.5275	150 Kohm 5% Carbon film	1/8 W
	R108	80.5263	15 Kohm 5% Carbon film	1/8 W
	R109	80.5271	68 Kohm 5% Carbon film	1/8 W
	R110	80.5267	33 Kohm 5% Carbon film	1/8 W
	R111	86.5036	47 Kohm 20% Trim carbon	0.05 W
	R112	80.5261	10 Kohm 5% Carbon film	1/8 W
	R113	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R114	80.5277	220 Kohm 5% Carbon film	1/8 W
	R115	80.5277	220 Kohm 5% Carbon film	1/8 W
	R116	80.5267	33 Kohm 5% Carbon film	1/8 W
	R117	80.5269	47 Kohm 5% Carbon film	1/8 W

Storno

TYPE	Nº	CODE	DATA	
	R118	80.5273	100 Kohm 5% Carbon film	1/8 W
	R119	80.5264	18 Kohm 5% Carbon film	1/8 W
	R120	89.5010	15 Kohm 20% NTC	0.5 W
	R121	80.5266	27 Kohm 5% Carbon film	1/8 W
	R122	80.5259	6.8 Kohm 5% Carbon film	1/8 W
	R123	80.5284	820 Kohm 5% Carbon film	1/8 W
	R124	80.5273	100 Kohm 5% Carbon film	1/8 W
	R125	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R126	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R127	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R128	80.5263	15 Kohm 5% Carbon film	1/8 W
	R129	80.5275	150 Kohm 5% Carbon film	1/8 W
	R130	80.5274	120 Kohm 5% Carbon film	1/8 W
	R131	80.5276	180 Kohm 5% Carbon film	1/8 W
	R132	80.5276	180 Kohm 5% Carbon film	1/8 W
	R133	80.5278	270 Kohm 5% Carbon film	1/8 W
	R134	80.5277	220 Kohm 5% Carbon film	1/8 W
	R135	80.5277	220 Kohm 5% Carbon film	1/8 W
	R136	80.5261	10 Kohm 5% Carbon film	1/8 W
	R137	86.5074	100 Kohm 20% Trim carbon	0.1 W
	R138	80.5266	27 Kohm 5% Carbon film	1/8 W
	R139	80.5277	220 Kohm 5% Carbon film	1/8 W
	R140	80.5258	5.6 Kohm 5% Carbon film	1/8 W
	R141	80.5249	1 Kohm 5% Carbon film	1/8 W
	R142	80.5275	150 Kohm 5% Carbon film	1/8 W
	R143	80.5279	330 Kohm 5% Carbon film	1/8 W
	R144	80.5267	33 Kohm 5% Carbon film	1/8 W
	R145	80.5263	15 Kohm 5% Carbon film	1/8 W
	R146	80.5271	68 Kohm 5% Carbon film	1/8 W
	R147	80.5242	270 ohm 5% Carbon film	1/8 W
	R148	80.5284	820 Kohm 5% Carbon film	1/8 W
	R149	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R150	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R151	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R152	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R153	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R155	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R156	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R157	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R158	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R159	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R161	80.5237	100 ohm 5% Carbon film	1/8 W

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

TYPE	Nº	CODE	DATA	
	R162	80.5261	10 Kohm 5% Carbon film	1/8 W
	R163	80.5278	270 Kohm 5% Carbon film	1/8 W
	R164	80.5266	27 Kohm 5% Carbon film	1/8 W
	R167	80.5261	10 Kohm 5% Carbon film	1/8 W
	R168	80.5261	10 Kohm 5% Carbon film	1/8 W
	R174	80.5261	10 Kohm 5% Carbon film	1/8 W
	R175	80.5256	3.9 Kohm 5% Carbon film	1/8 W
	R176	80.5267	33 Kohm 5% Carbon film	1/8 W
	R177	80.5256	3.9 Kohm 5% Carbon film	1/8 W
	R178	80.5267	33 Kohm 5% Carbon film	1/8 W
	R179	80.5266	27 Kohm 5% Carbon film	1/8 W
	R180	80.5266	27 Kohm 5% Carbon film	1/8 W
	R181	80.5282	560 Kohm 5% Carbon film	1/8 W
	R183	80.5277	220 Kohm 5% Carbon film	1/8 W
	R184	80.5271	68 Kohm 5% Carbon film	1/8 W
	R185	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R186	80.5254	2.7 Kohm 5% Carbon film	1/8 W
	R187	80.5261	10 Kohm 5% Carbon film	1/8 W
	R188	80.5273	100 Kohm 5% Carbon film	1/8 W
	R191	80.5273	100 Kohm 5% Carbon film	1/8 W
	R198	80.5261	10 Kohm 5% Carbon film	1/8 W
	R201	80.5269	47 Kohm 5% Carbon film	1/8 W
	R202	80.5287	1.5 Mohm 5% Carbon film	1/8 W
	R203	80.5273	100 Kohm 5% Carbon film	1/8 W
	S101	47.0642	Switch assembly	
	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 PROM	
	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	14.5019	MC3302P Quad comparator	
	U104	14.5098-01	CD4013B Dual D-FF	
	U106	14.5134	555 Timer	
	U107	14.5145	4514B Encoder	
	U108	14.5146	CD40106B Hex Schmitt trigger	

Storno

TYPE	Nº	CODE	DATA

SEQUENTIAL TONE UNIT TQ5004, TQ5005

X402.810

PROGRAMMABLE CHANNEL GUARD

TQ5006

The Channel Guard modules TQ5006 are field programmable, synthesized single tone Channel Guard encoders/decoders for use with STORNOPHONE 5000 mobile radios.
The encode function provides continuous tone-coded modulation for the transmitter. The decode function is used with the receiver to eliminate all calls that are not tone coded with the proper Channel Guard (CG) frequency.
A tone reject filter is available for use in non-Channel Guard mobiles and stations that receive tone modulated calls.

Four different Channel Guard boards are available:

TQ5006 - single tone encode/decode (includes tone reject filter).
TT5002 - single tone encode only.
TR5002 - single tone decode only (includes tone reject filter).
FN5002 - tone reject filter only.

OPERATION

In mobile Channel Guard applications, a microphone hookswitch is supplied with the radio. The CG hookswitch is equipped with a CG disable switch.
Placing the CG switch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the receive Channel Guard is disabled when the microphone is removed from the hookswitch.

CIRCUIT DESCRIPTION

Channel Guard is a continuous-tone controlled squelch system that provides communications control in accordance with EIA standard RS-220-A. The basic Channel Guard system utilizes standard tone frequencies from 67 to 210.7 Hz with both the encoder and decoder operating on the same frequency. The standard Channel Guard tone frequencies are shown in the following chart.

STANDARD TONE FREQUENCIES, Hz

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	186.2
85.4	103.5	127.3	156.7	192.8
				203.5
				210.7

The Channel Guard circuitry consists of frequency synthesizer U1003, encoder/decoder U1001, tone programming switch S1001, tone reject (high pass) filter integrated circuit (IC) U1004 and associated discrete circuitry.
Frequency synthesizer U1004/U1003 includes the synthesizer IC and a 32.768 Hz reference crystal that provides the clock inputs for the encoder/decoder module (U1001). The clock inputs are required to produce the tone frequency and the digitally generated time delays for the DELAYED PTT and squelch tail elimination (STE) circuits. Tone frequency programming is accomplished by setting the 10 station switch (S1001) for the proper binary input to the synthesizer. The switch can be set to produce any CG tone from 67 Hz to 210.7 Hz in 0.25 Hz increments.
Encode/decode hybrid U1001 contains the encoder and decoder, a voice reject filter, STE circuit and the interface circuitry.

The interface circuitry provide:
Increased output drive for RX MUTE, PTT DLYD (Delayed Push-To-Talk) and other functions.

ENCODE MODE

Depressing the PTT switch (Push To Talk) applies a low (A-) to PTT lead P1005-7.
This causes the PTT DLYD lead (P1005) to go low, keying the transmitter.

The encoder then generates the CG tone which is applied to a low pass filter to remove any tone or clock harmonics. The filter output is then applied to CG MODULATION control R1004 and CG HI lead (P1005-4) to the transmit audio processor on the transmit/receive (TX/RX) board.
When the PTT button on the microphone is released (transmitter unkeyed), the DELAYED PTT circuit in U1001 keeps the transmitter keyed for an additional 160 milliseconds. During the 160 milliseconds delay time, the encoder shifts the phase of the CG tone output 135^{o}. This combination of 160 milliseconds delay and the 135^{o} phase shift causes the CG decoder in other receivers to squelch the audio before the loss of RF signal, eliminating the receiver noise burst (squelch tail elimination STE).

DECODE MODE

In the receive mode, receiver audio from VOLUME/SQUELCH HI lead P1005-2 is applied to a voltage divider (R1002 and R1003) and then to a voice reject filter in the decode circuit. The filter removes any voice information to prevent blocking or clipping.
The digital decoder compares the frequency of the incoming tone to a reference clock input produced by the synthesizer. If the correct tone is detected, the decoder circuit causes the RX MUTE lead at P1005-9 to go high, unsquelching the receiver. RX MUTE lead P1005-9 is normally held at a low voltage condition when the correct CG tone is not detected.
After the CG tone is decoded, the decoder then waits for a phase shift in the tone to occur. When the phase shift occurs, the STE delay circuit in the decoder pulls the RX MUTE lead to a low voltage state. This squelches the receiver for 200 milliseconds and keeps the receiver squelched until the RF carrier applied to the receiver is removed.

TONE REJECT FILTER

A tone reject filter is connected in parallel with the VOLUME control to attenuate the tone level reaching the receiver audio circuits. The filter consists of operation al amplifier U1004 and associated circuitry.
Audio from VOL/SQ HI is connected to the tone reject filter through P1005-2. The filter circuit rejects all tone frequencies from 70 to 210.7 Hz, and passes all other audio frequencies. The filtered and amplified audio is applied to the receiver audio circuits through P1005-1 (FLTRD VOL/SQ HI).

ENCODE DISABLE

The Encode Disable circuit has been incorporated as a maintenance aid for the serviceman. This circuit consists of Q1001, C1010, R1018 and R1019, and can be used to disable the CG encode circuit to allow the serviceman to make transmitter distortion and modulation checks without removing the cover from the radio. Temporarily shorting P910-9 (CG DISABLE) to P910-11 (A+) at the rear of the radio applies A+ to ENCODE/DECODE DISABLE lead P1005-10. The A+ is dropped across voltage dividers R1018 and R1019, applying approximately 1.7 volts to the base of Q1001. This base voltage turns on Q1001, causing the collector voltage to go low (near ground potential). This low potential is applied to Pin 11 of the encoder/decoder hybrid and disables the encode circuit.

CAUTION

DO NOT remove the microphone from the CG hookswitch or press the desk microphone MONITOR switch while using the encode disable jumper. To do so will short the 8.5 volt regulator on the TX/RX board to ground through the hookswitch (or desk mic.), and damage to the equipment will result.

TROUBLESHOOTING PROCEDURE

Before starting the TROUBLESHOOTING PROCEDURE, check to see that 8.5 volts and A- are present at P1005.

SYMPTOM:

No Encode Tone

Check the PTT all the CG ENCODE/DECODE leads at P1005 for a "low" (0.7 volt or less). If a "low" is not present, check the microphone and hookswitch circuits. If a "low" is present, check the DELAY CLOCK output at U1003-9 for 64 Hz, and the TONE CLOCK output at U1003-8 for being 256 times the Channel Guard (CG) frequency.

EXAMPLE:
If the CG frequency is 100 Hz, the TONE CLOCK output should be 25,600 Hz.
If either clock output is not present, replace U1003. If both clock outputs are correct, check U1001-5 for a tone output. If no tone is present, replace U1001.

Encode Disable (Tone present when CG disabled)

Key the microphone and check for a tone output at P1005-4. If no tone output, make the checks listed for "No Encode Tone". If tone is present, apply a "high" (approx. 8 VDC) to the CG ENC/DEC DISABLE lead (P1005-10). Tone should not be present at CG HI lead (P1005-4). If tone is present, check for a low of approx. 0.2 VDC at the collector of Q1001. If the collector is low and tone is still present at P1005-4, replace U1001. If the collector voltage is over 1.0 VDC, check Q1001 and associated circuitry.

No Decode (Receiver won't unsquelch)

With the correct CG tone applied and the CG ENC/DEC Disable lead high, RX MUTE (P1005-9) lead should be "high" (8 VDC) or open. If not, check the clock outputs at U1003-8 (256 x CG Freq.) and U1003-9 (64 Hz). If clock outputs are incorrect, replace U1003. If clock outputs are correct, replace U1001.

Decode Disable (Receiver won't unsquelch with CG disabled)

With the correct CG tone applied to VOL/SQ HI (P1005-2), the RX MUTE lead should go "high". Next, ground the CG ENC/DEC DIS input and check to see that the RX MUTE lead goes "low" (<0.2 V). If not replace U1001.

Wrong Encode or Decode Tone

Check that S1001 is programmed for the correct CG frequency (refer to the FREQUENCY PROGRAMMING INSTRUCTIONS).

If S1001 is set correctly, check the tone programming pins at U1003-2 through -7 and -10 through -13.

NOTE:

Logic "1" is approx. supply voltage and logic "0" is approx. A-. If logic readings correspond to S1001 settings, replace U1003. If readings do not correspond to S1001 settings, replace S1001.

No Tone Reject Filter Output

With no filter output, apply a 1000 Hz 300 millivolt signal to P1005-2. If the reading at Pin 1 of U1004-A is the same as the input signal, check U1004-B and associated components. If there is no output at Pin 1, check U1004-A and associated components.

Audio output of filter contains excessive noise (motorboating, rumble, etc)

Check CG MODULATION control R1004. The modulation should be no greater than 1 kHz deviation.

Apply 100 Hz to P1005-2. Check at P1005-1 for more than 30 dB of attenuation. If output is not attenuated by at least 30 dB, check U1004 and associated circuitry.

Apply 100 Hz and then 1000 Hz to P1005-2 and compare the RMS output reading. The 100 Hz input should be attenuated at least 30 dB (or greater) compared to the 1000 Hz input.

Squelch Tail Present (no STE)

When the PTT lead is "low", P1005-8 should be "low". When the PTT lead goes "high" (PTT released), the PTT DELAYED lead should remain "low" for an additional 160 milliseconds. If not, replace U1001.

TECHNICAL SPECIFICATIONS

Input Voltage
8.5 V DC

Current Drain
40 mA Max.

Frequency Range
67-210.7 Hz

Maximum Frequency Error
±0.2%

Encode Output Level

67 Hz	- 0.7 V RMS Mininum
156.7 Hz	- 0.35 V RMS Minimum
210.7 Hz	- 0.15 V RMS Minimum

Encode Tone Distortion
2% Max.

Programming Increments
0.25 Hz

Decode Level
35 Millivolts RMS Minimum

Decode Response Time
250 Milliseconds Max.

PTT Delay
160 Milliseconds

STE Phase Shift
135°

Temperature Range
-35°C to + 60°C

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:

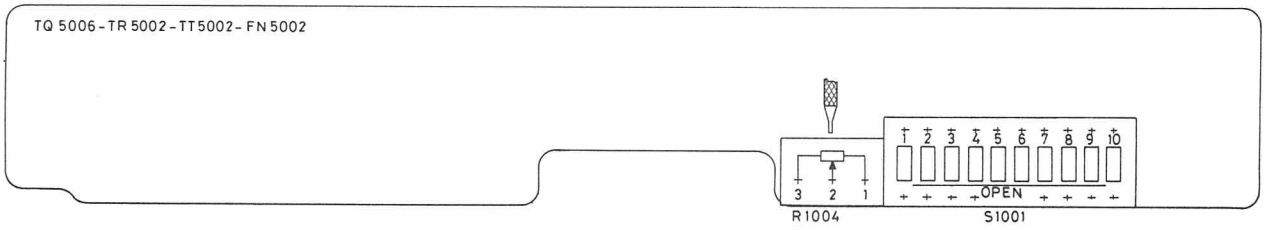
For TQ5006 - cut H7-H8 and H9-H10
For TT5002 - cut H9-H10
For TR5002 - cut H7-H8
For FN5002 - cut H7-H8

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

105.5= 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 to156.75 Hz)

157.75= 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 pulled "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} ±0.2%

CHANNEL GUARD DECODING CHECK

Use receiver test setup.
Modulate the RF generator with the channel guard tone to specified frequency deviation.

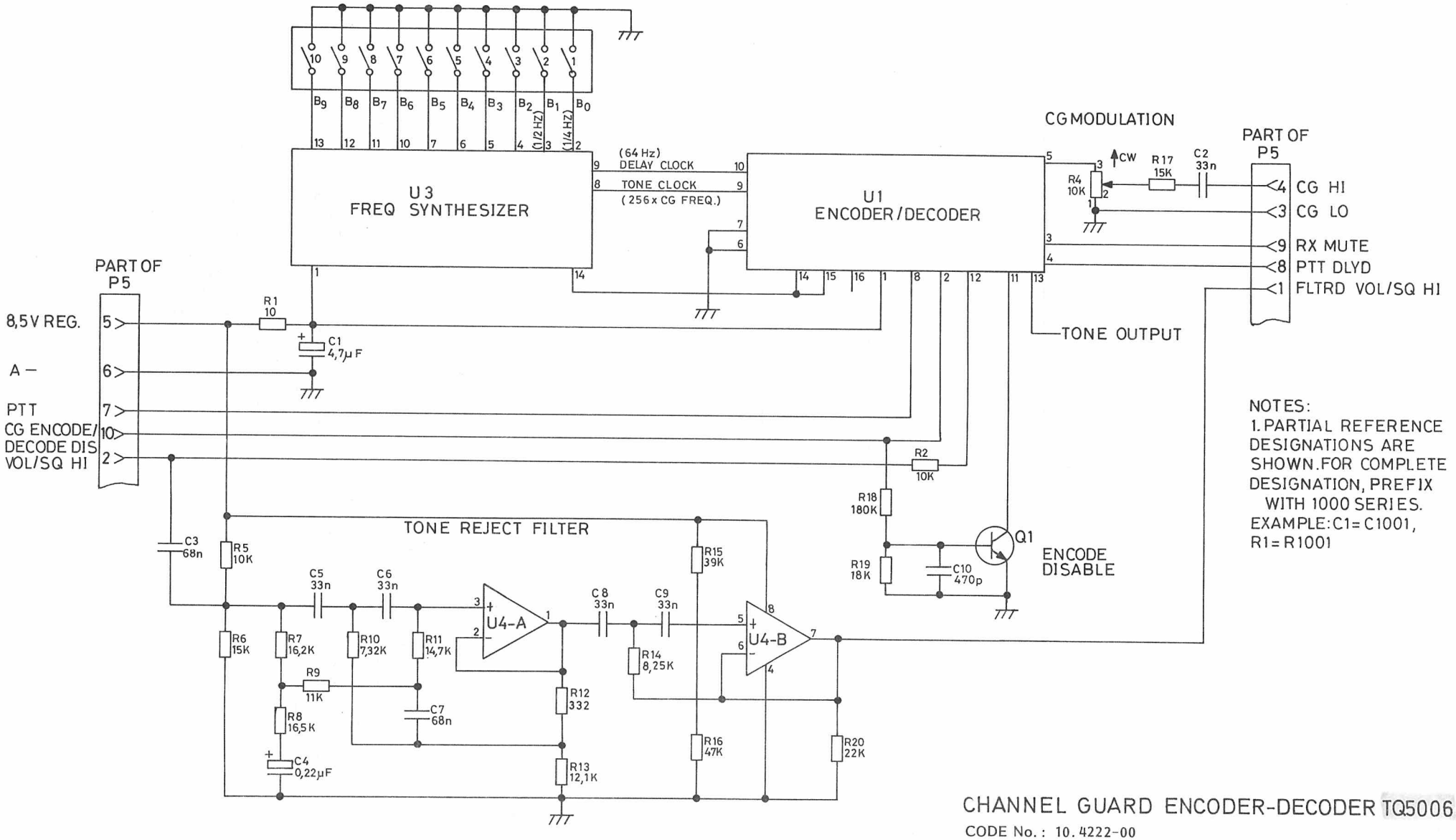
Check that the decoder opens the AF channel if and only if the channel guard tone is present.
Connect an AF voltmeter to the AF output load.

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.

Storno

Storno



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

Nº	CODE	DATA	
C1001	19A134202P5	3.3 uF Tantal	
C1002	19A700005P10	33 nF Polyester	50 V
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	50 V
C1009	19A700005P10	33 nF Polyester	50 V
C1010	19A116192P2	470 pF Ceram capacitor	
P1005	19A134152P35	Connector	
Q1001	19A115910P1	Transistor	
R1001	19A700019P13	10 ohm Resistor	0.2 W
R1002	19A700019P49	10 Kohm Resistor	0.2 W
R1003	19A700019P42	2.7 Kohm Resistor	0.2 W
R1004	19A116559P206	10 Kohm Resistor var.	
R1005	19A700019P49	10 Kohm Resistor	0.2 W
R1006	19A700019P51	15 Kohm Resistor	0.2 W
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	0.2 W
R1016	19A700019P57	47 Kohm Resistor	0.2 W
R1017	19A700019P51	15 Kohm Resistor	0.2 W
R1018	19A700019P61	100 Kohm Resistor	0.2 W
R1019	19A143400P52	20 Kohm Resistor Depos	
R1020	19A143400P52	20 Kohm Resistor Depos	
R1021	19A700019P34	560 ohm Resistor	0.2 W
S1001	19B800010P1	Switch	
U1001	19D430412G1	Int. Circuit	
U1003	19D430393G1	Int. Circuit	
U1004	19A134511P2	Int. Circuit	

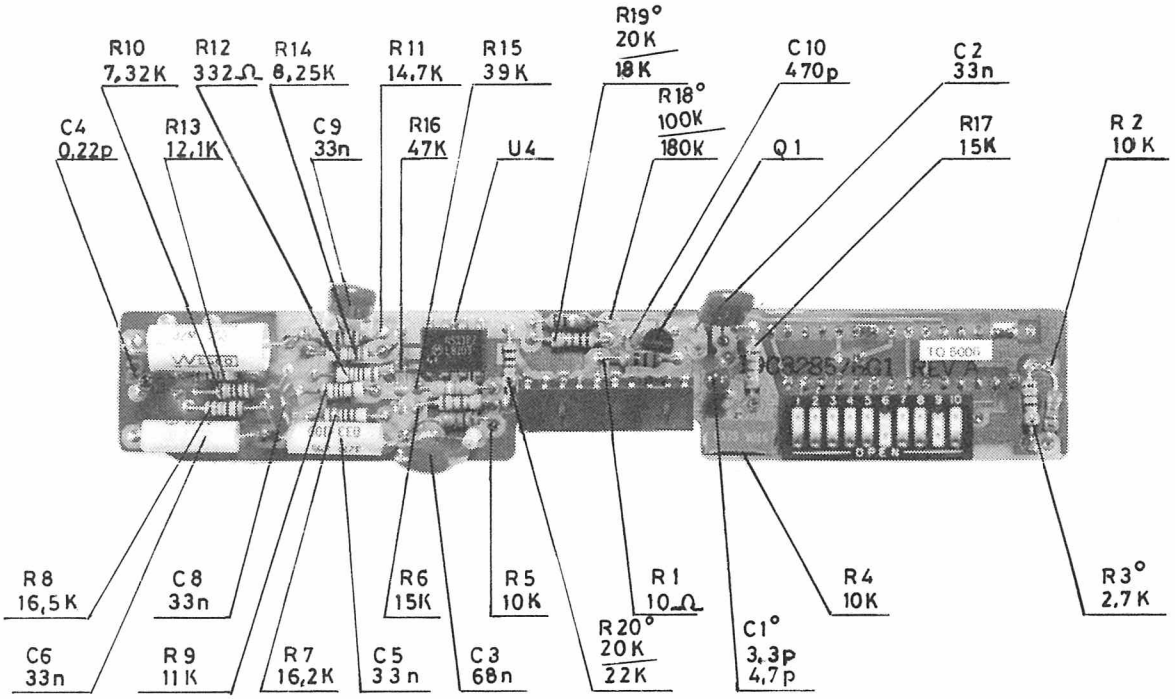
Storno

Nº	CODE	DATA

CHANNEL GUARD ENC/DEC TQ5006

X403.022

Storno



COMPONENT LAYOUT
TQ 5006 D403.361

PROGRAMMABLE TONE BOARDS

TQ5007/5008

The tone boards TQ 5007/5008 are combined tone transmitter - tone receiver units, universal programmable. TQ 5007/8 are used in connection with Control Logic board CL 5001 or a similar board which is able to program the units, to control the transmitter and to handle the detected outputs.

The TQ unit is built up around a DTD-chip, Digital Tone Decoder, placed on a thick film substrate.

The peripherical circuits are:

a limiter which shapes the input signals to the DTD

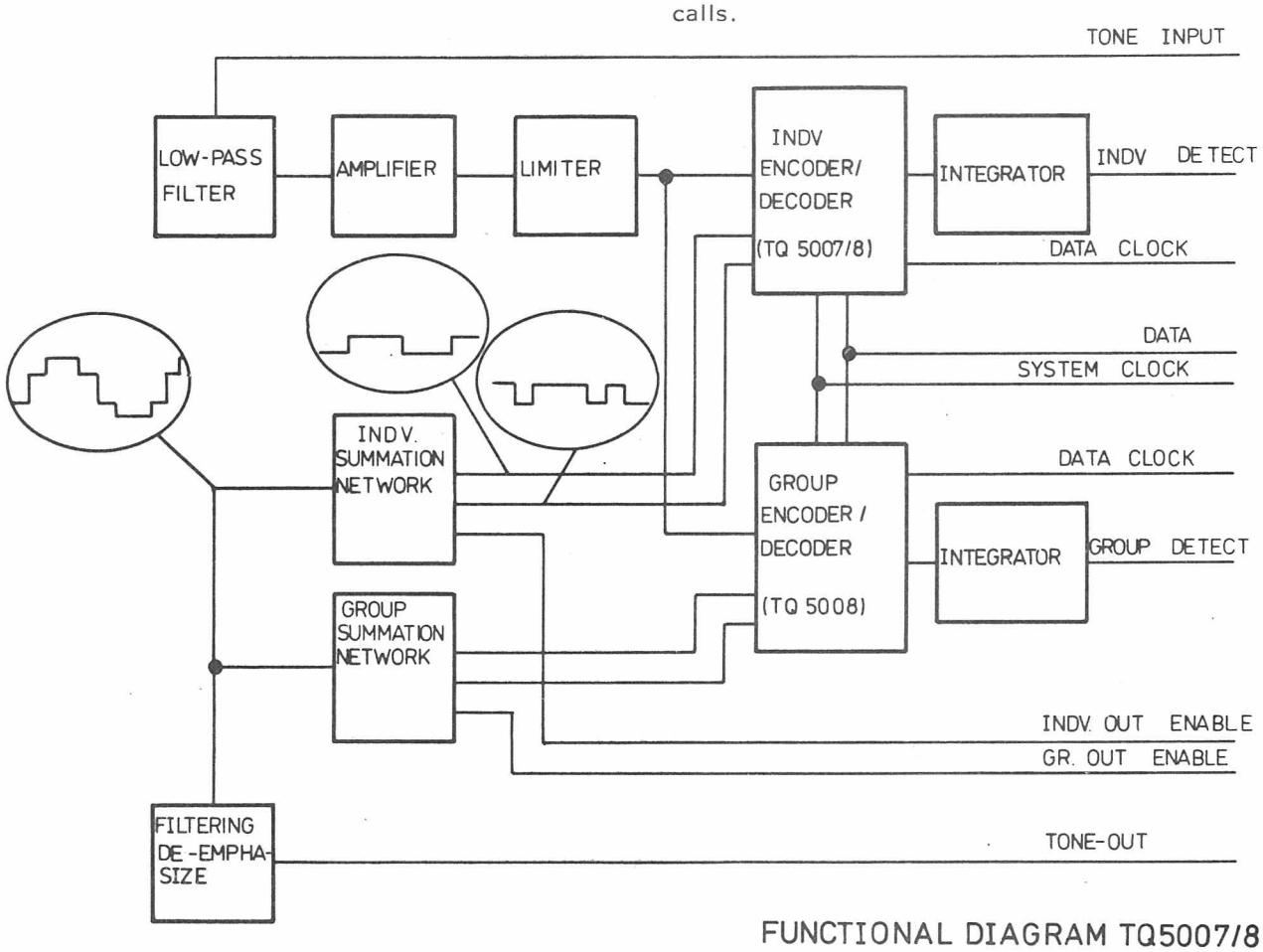
an integrator which ensures proper detection of the detected output.

In tone generator mode a summation network generates the output signal from two square waves sent out from the DTD. This summation network is enabled from the control logic by two three-state buffers when the TQ is used as a tone transmitter.

After being filtered and deemphasized, the final signal is applied to the microphone amplifier.

TQ 5007 has only one DTD-substrate, A101, which detects and/or transmits tone signal for individual calls.

TQ 5008 has two DTD-substrates, A101 and A102, which detect and/or transmit tone signals for individual calls, group calls and all calls.



FUNCTIONAL DIAGRAM TQ5007/8

D403.066

TQ-LOADING

All connections on the TQ take place through connector J101 which is connected to P801 on the Control Logic board CL 5001.
A system clock, output from the counter U814 on the CL board is fed to the circuit through pin 2 at the connector. The system clock is 223,72 KHz which is the microcomputer's clock frequency divided by 16.
To set up a tone, the DTD is loaded with 15 bits serially clocked in by a data clock.
The first 5 bits determine the circuit Q-value (see programming manual, add. 32H in the personality prom.)
The last 10 bits program the tone frequency either to be received or to be transmitted by the TQ unit (see programming manual add. 08-13H)
These bits and the data clock are sent to the TQ unit from the microcomputer on CL 5001 via pin 1 and 5/6 on connector J101 (via pin 5 to be loaded on DTD chip A101, via pin 6 to be loaded on DTD chip A102).

TONERECEPTION

As soon as the radio is turned on, the system clock starts the TQ unit and the Control Logic board CL 5001 loads the 15 bits corresponding to the first tone synchronuously with the data clock in A101. When a tone call is received, the first tone of the sequence enters pin 9 at connector J101.
The sinusoidal signal passes through a 2 pole active low-pass filter built around the operational amplifier U101a. The signal is then amplified by a factor 10 in the ampliflier U101b and finally limited by the comparator (Schmitt-trigger) U101c.
The obtained square-waved signal is sent to the detect input (7) of the DTD, A101 (and A102 if TQ5008).
The DTD, which is to be considered as a programmable digital filter, compares the signal with the programmed tone cloked in by the data clock. The detect output of A101 (or A102 if group/all call) goes HIGH if the entered signal is accepted. To ensure a reliable detect aknowledge, the detected output is processed by the integrator U101d or U103. The delayed output of U101d is connected to pin 11, the delayed output of U103 (in connection with A102 in TQ5008) is connected to pin 12 on J101.
Both detect outputs are active LOW.
Note: The data clock inputs must be LOW in receiver mode, otherwise the detect outputs are inhibited.

TONE TRANSMISSION

When the tone key is depressed, pin 7 on connector J101 goes LOW and enables U102 which is an hex non-inverting tri-state buffer. The 15 programming bits are loaded into the DTD chips synchronuously with the data clock. The DTD chip generates two square wave signals at the outputs 13 and 15. These two different signals are loaded into U102 and summed, but differently weighted by the resistors R12 and R13. This output signal is then filtered and deemphasized to become a sinusoidal signal which is sent via pin 10 at connector J101 to the microphone amplifier on the RF-board.

TECHNICAL SPECIFICATIONS

Voltage supply
5.0 V

Current consumption
TQ 5007: 25 mA ±5 mA
TQ 5008: 50 mA ±5 mA

Temperature range (ambient)
-30°C to +60°C

Weight
60 g.

Dimensions
150 x 40 x 10 mm

TONE TRANSMITTER

Output impedance
typical 25 Kohm

Signal output voltage
min. 250 mV e.m.f., 1060 Hz
typical 280 mV

Frequency response
De-emphasized, Fc= 500 Hz
Tolerance:
± 1 dB

Distorsion
< 5 %

Frequency error
< 0,01 %

TONE RECEIVER

Input impedance
> 30 kohm

Input response
Low-pass, Fc= 3100 Hz

Activating level
300 mV ±6 dB

Distorsion
The tone receiver will accept tones with up to 20% distortion.

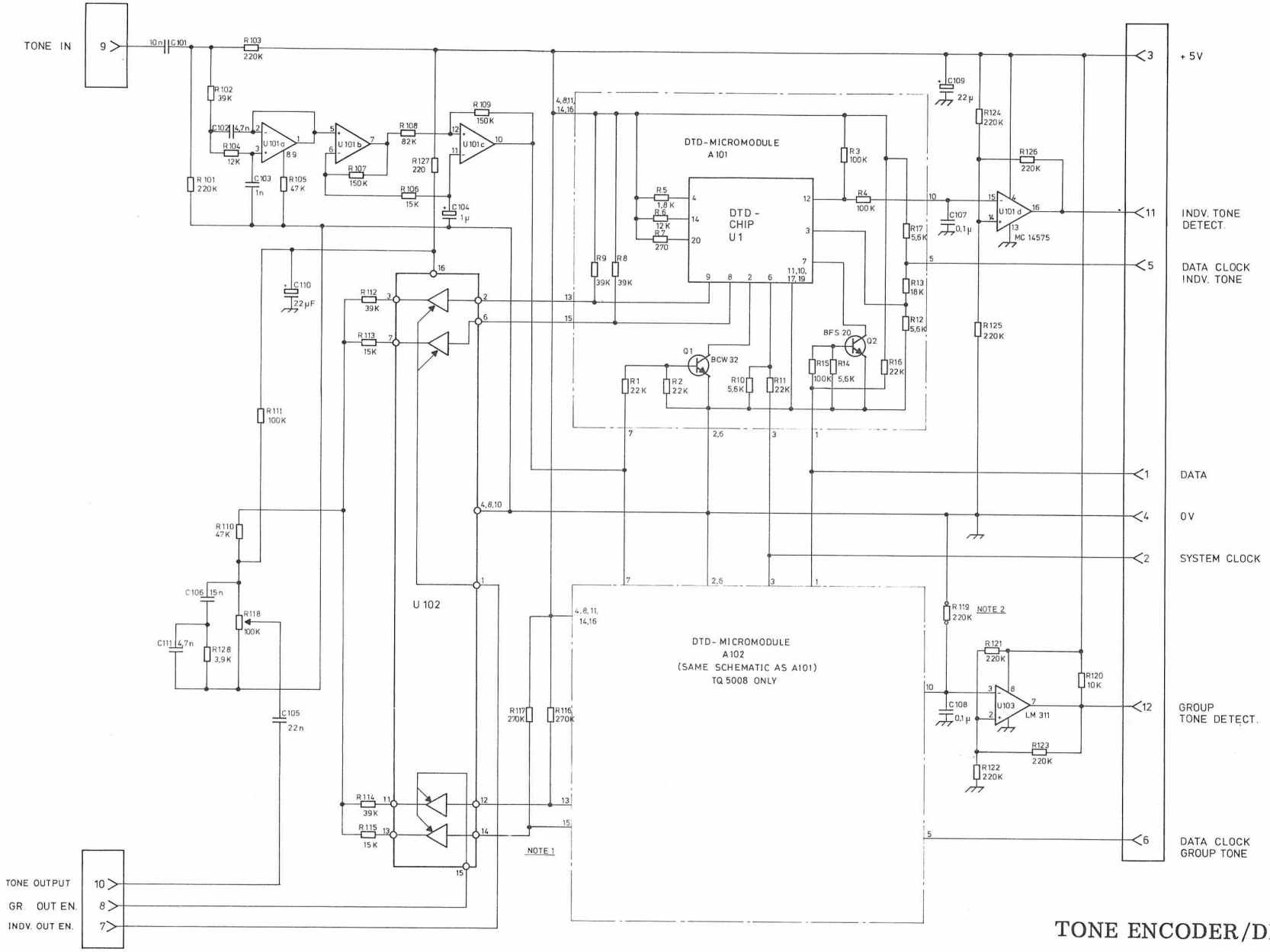
Selectivity
With Q-value= 32, TQ 5007/8 is not sensitive to adjacent tones or other tones of the same standard series.

Reaction time
20 ms < r < 45 ms

Signal to noise conditions
Tone receiver accepts a noise level:
SINAD= 5 dB.

Storno

Storno



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
	M905144G1	TQ5007
	M905144G2	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

Storno

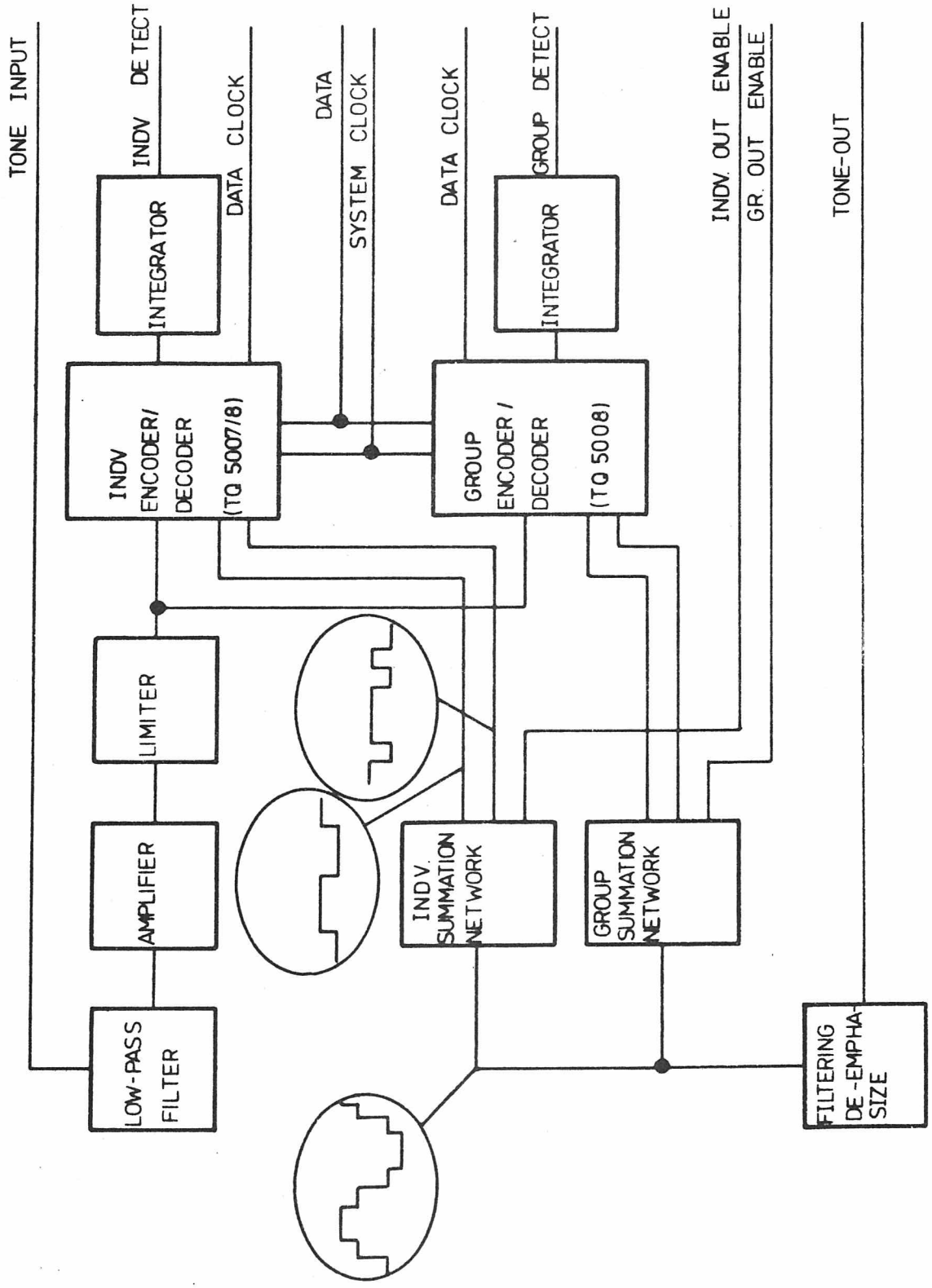
Nº	CODE	DATA
R111	A700019P61	100 Kohm 5%, Resistor, carb. film 0,25 W
R112	A700019P56	39 Kohm 5%, Resistor, carb. film 0,25 W
R113	A700019P51	15 Kohm 5%, Resistor, carb. film 0,25 W
R114	A700019P56	39 Kohm 5%, Resistor, carb. film 0,25 W
R115	A700019P51	15 Kohm 5%, Resistor, carb. film 0,25 W
R116	A700019P65	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
R119o	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.

TONE ENCODER/-DECODER TQ5007 and TQ5008

X403.208

NOTES: + used in TQ5008 only
o used in TQ5007 only.

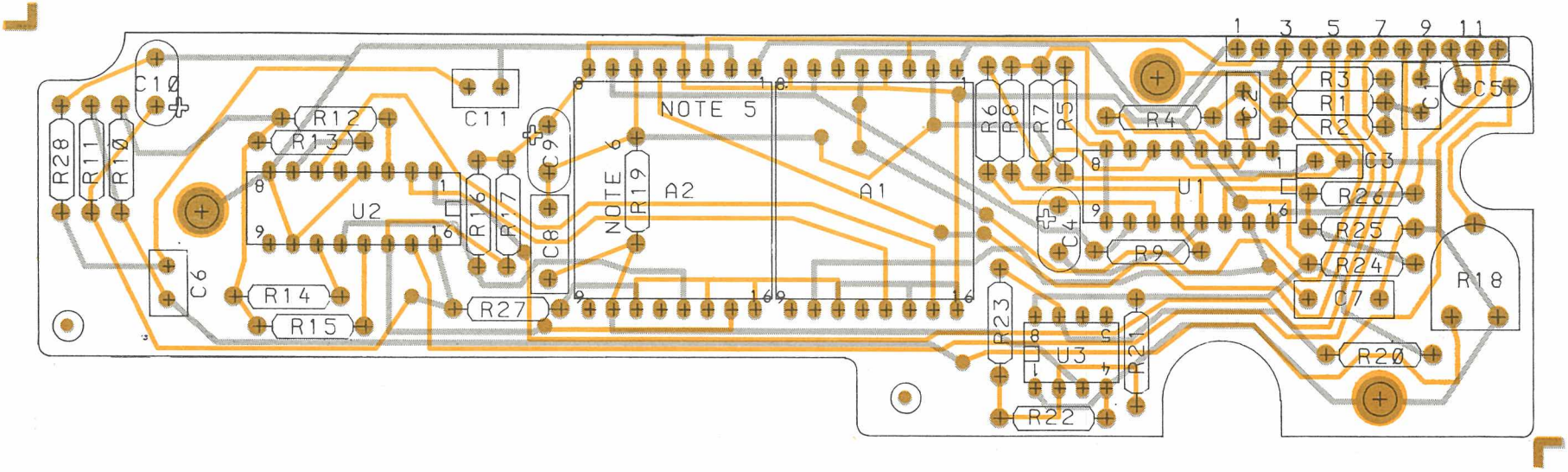
Storno



FUNCTIONAL DIAGRAM TQ5007, TQ5008

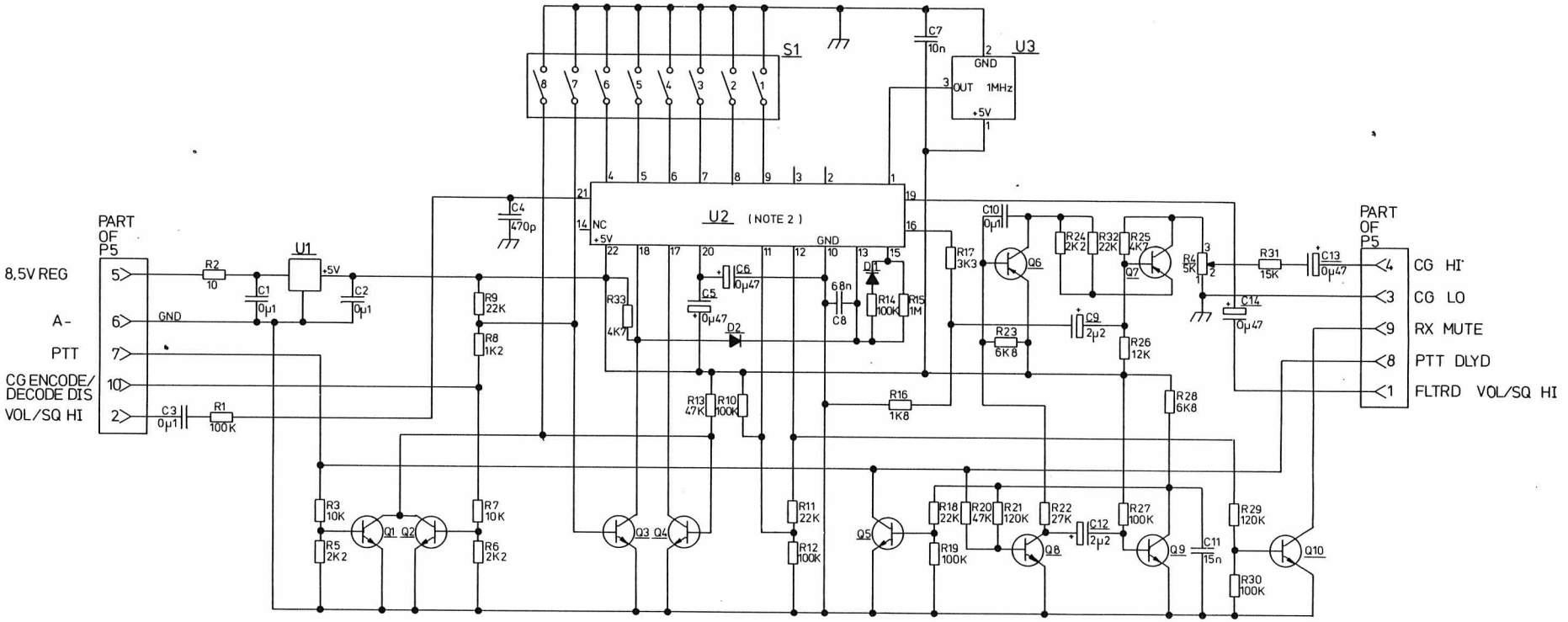
D403.040

Storno



TONE MODULE TQ5007-5008

D403.038

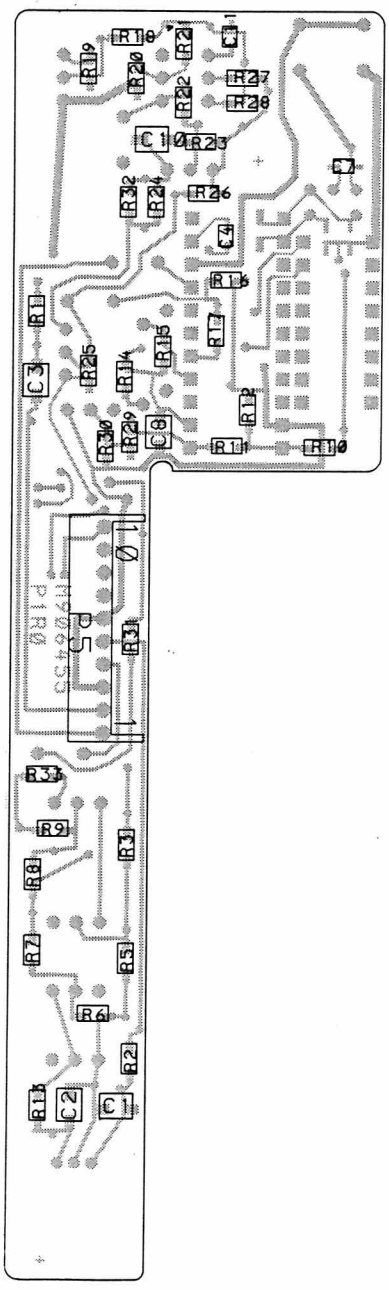


COMPONENTS MARKED RXX ARE PLACED ON NO SOLDERING SIDE.

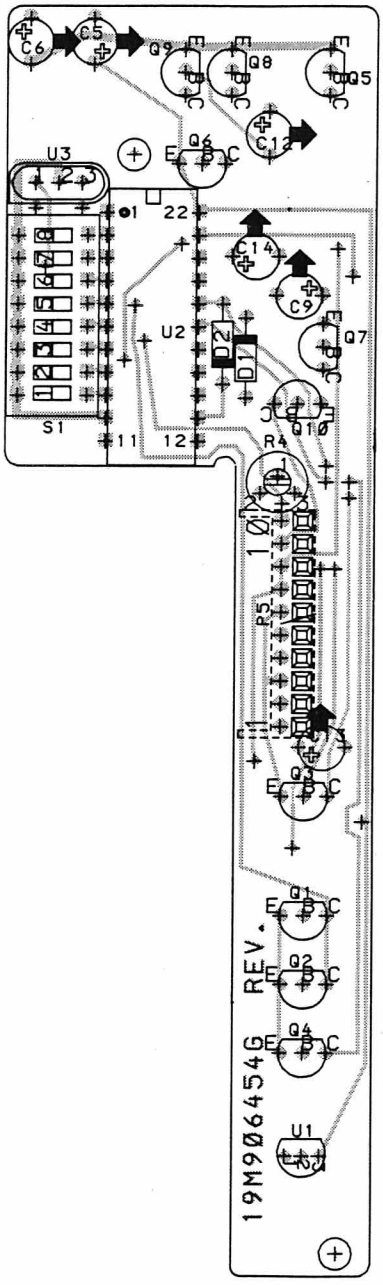
CHANNEL GUARD MODULE TQ5009

CODE NO. M906454G1 | **D404.846**

CHIP SIDE



COMPONENT SIDE



CHANNEL GUARD MODULE TQ5009
COMPONENT LAYOUT

CODE NO. M906454G1 | **D404.849**

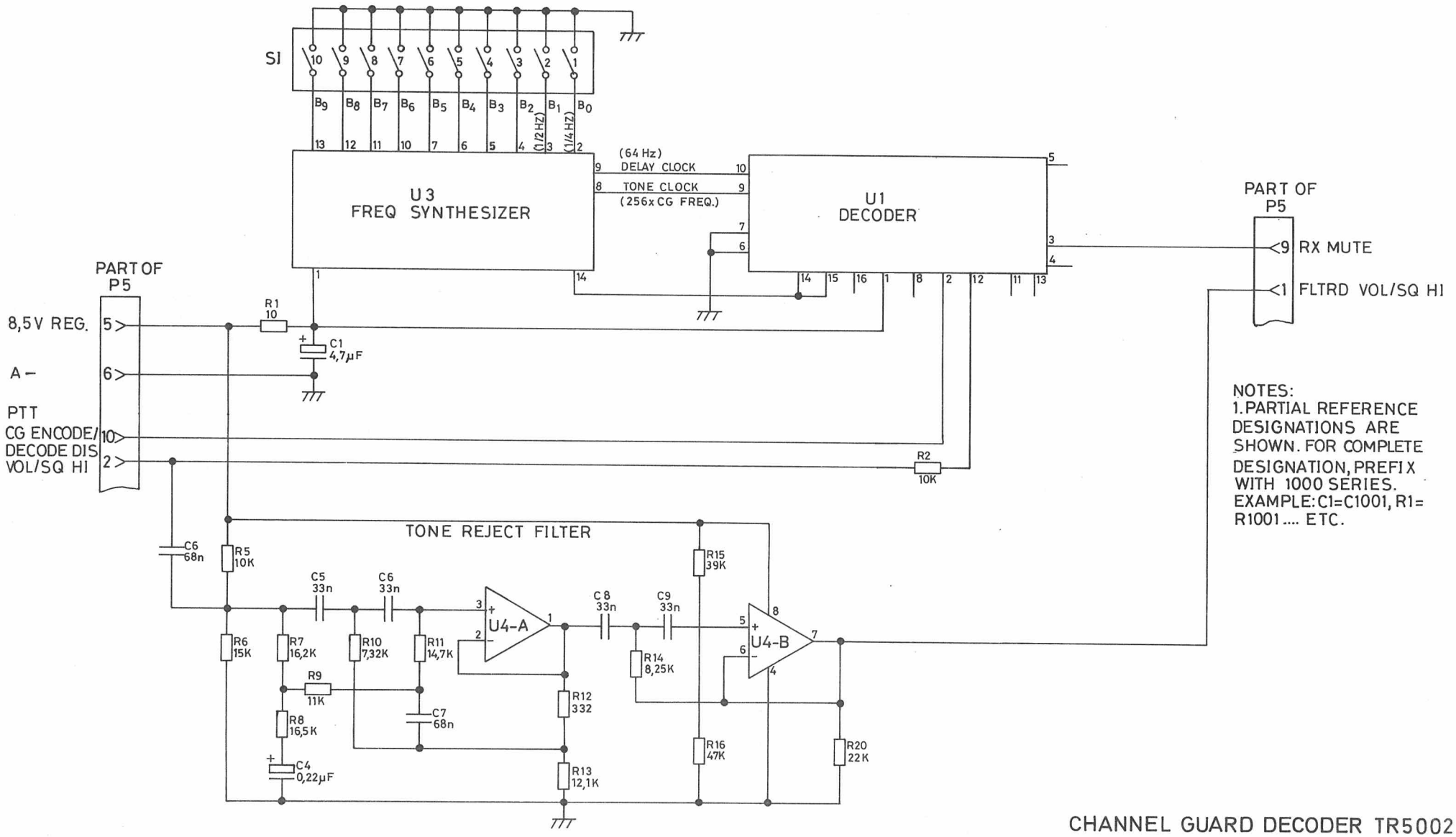
DATE: 10/ 9/1987

Pos	Code No	Description	Qt
C001	J707438P26	CAP CER CL2 100N 10%	1
C002	J707438P26	CAP CER CL2 100N 10%	1
C003	J707438P26	CAP CER CL2 100N 10%	1
C004	J707438P3	CAP CER CL2 470P 10%	1
C005	J707444P3	CAP TA SOL 0U47 35V	1
C006	J707444P3	CAP TA SOL 0U47 35V	1
C007	J707438P14	CAP CER CL2 10N 10%	1
C008	J707438P24	CAP CER CL2 68N 10%	1
C009	J707444P5	CAP TA SOL 2U2 35V	1
C010	J707438P26	CAP CER CL2 100N 10%	1
C011	J707438P16	CAP CER CL2 15N 10%	1
C012	J707444P5	CAP TA SOL 2U2 35V	1
C013	J707444P3	CAP TA SOL 0U47 35V	1
C014	J707444P3	CAP TA SOL 0U47 35V	1
D001	A700028P1	DIO SI SIG 1N4148	1
D002	A700028P1	DIO SI SIG 1N4148	1
P005	J708673P10	CONN PWB FEM10-CKT	1
Q001	J707511P1	TSTR NPN SI BC 548A/B	1
Q002	J707511P1	TSTR NPN SI BC 548A/B	1
Q003	J707511P1	TSTR NPN SI BC 548A/B	1
Q004	J707511P1	TSTR NPN SI BC 548A/B	1
Q005	J707511P1	TSTR NPN SI BC 548A/B	1
Q006	J707674P1	TSTR PNP SI BC 558A/B	1
Q007	J707674P1	TSTR PNP SI BC 558A/B	1
Q008	J707511P1	TSTR NPN SI BC 548A/B	1
Q009	J707511P1	TSTR NPN SI BC 548A/B	1
Q010	J707511P1	TSTR NPN SI BC 548A/B	1
R001	J707385P104	RES MFLM 1/8W 100K 5%	1
R002	J707385P100	RES MFLM 1/8W 10R 5%	1
R003	J707385P103	RES MFLM 1/8W 10K 5%	1
R004	A700016P3	RES VAR CERM 5K0 10%	1
R005	J707385P222	RES MFLM 1/8W 2K2 5%	1
R006	J707385P222	RES MFLM 1/8W 2K2 5%	1
R007	J707385P103	RES MFLM 1/8W 10K 5%	1
R008	J707385P122	RES MFLM 1/8W 1K2 5%	1
R009	J707385P223	RES MFLM 1/8W 22K 5%	1
R010	J707385P104	RES MFLM 1/8W 100K 5%	1

Pos	Code No	Description	Qt
R011	J707385P223	RES MFLM 1/8W 22K 5%	1
R012	J707385P104	RES MFLM 1/8W 100K 5%	1
R013	J707385P473	RES MFLM 1/8W 47K 5%	1
R014	J707385P104	RES MFLM 1/8W 100K 5%	1
R015	J707385P105	RES MFLM 1/8W 1M0 10%	1
R016	J707385P182	RES MFLM 1/8W 1K8 5%	1
R017	J707385P332	RES MFLM 1/8W 3K3 5%	1
R018	J707385P223	RES MFLM 1/8W 22K 5%	1
R019	J707385P104	RES MFLM 1/8W 100K 5%	1
R020	J707385P473	RES MFLM 1/8W 47K 5%	1
R021	J707385P124	RES MFLM 1/8W 120K 5%	1
R022	J707385P273	RES MFLM 1/8W 27K 5%	1
R023	J707385P682	RES MFLM 1/8W 6K8 5%	1
R024	J707385P222	RES MFLM 1/8W 2K2 5%	1
R025	J707385P472	RES MFLM 1/8W 4K7 5%	1
R026	J707385P123	RES MFLM 1/8W 12K 5%	1
R027	J707385P104	RES MFLM 1/8W 100K 5%	1
R028	J707385P682	RES MFLM 1/8W 6K8 5%	1
R029	J707385P124	RES MFLM 1/8W 120K 5%	1
R030	J707385P104	RES MFLM 1/8W 100K 5%	1
R031	J707385P153	RES MFLM 1/8W 15K 5%	1
R032	J707385P223	RES MFLM 1/8W 22K 5%	1
R033	J707385P472	RES MFLM 1/8W 4K7 5%	1
S001	J706340P3	SW DIP 08-CKT	1
U001	J706031P1	IC LIN VR FIX 78L05	1
U002	J710538P1	IC CODEC 335	1
U003	J710535P2	OSC CRY CMOS 1.0000MHZ	1
	M906455P1R0	BD PW	1
		NON ELECTRONICAL PARTS	
	A700036P422	SCR PAN HD M-3.0X22.0	2
	J706593P313	SPACER	2

Storno

Storno



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

Nº	CODE	DATA	
C1001	19A134202P5	3.3 uF Tantal	
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	50 V
C1009	19A700005P10	33 nF Polyester	50 V
P1005	19A134152P35	Connector	
R1001	19A700019P13	10 ohm Resistor	0.2 W
R1002	19A700019P49	10 Kohm Resistor	0.2 W
R1003	19A700019P42	2.7 Kohm Resistor	0.2 W
R1005	19A700019P49	10 Kohm Resistor	0.2 W
R1006	19A700019P51	15 Kohm Resistor	0.2 W
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	0.2 W
R1016	19A700019P57	47 Kohm Resistor	0.2 W
R1020	19A143400P52	20 Kohm Resistor Depos	
R1021	19A700019P34	560 ohm Resistor	0.2 W
S1001	19B800010P1	Switch	
U1001	19D430412G1	Int. Circuit	
U1003	19D430393G1	Int. Circuit	
U1004	19A134511P2	Int. Circuit	

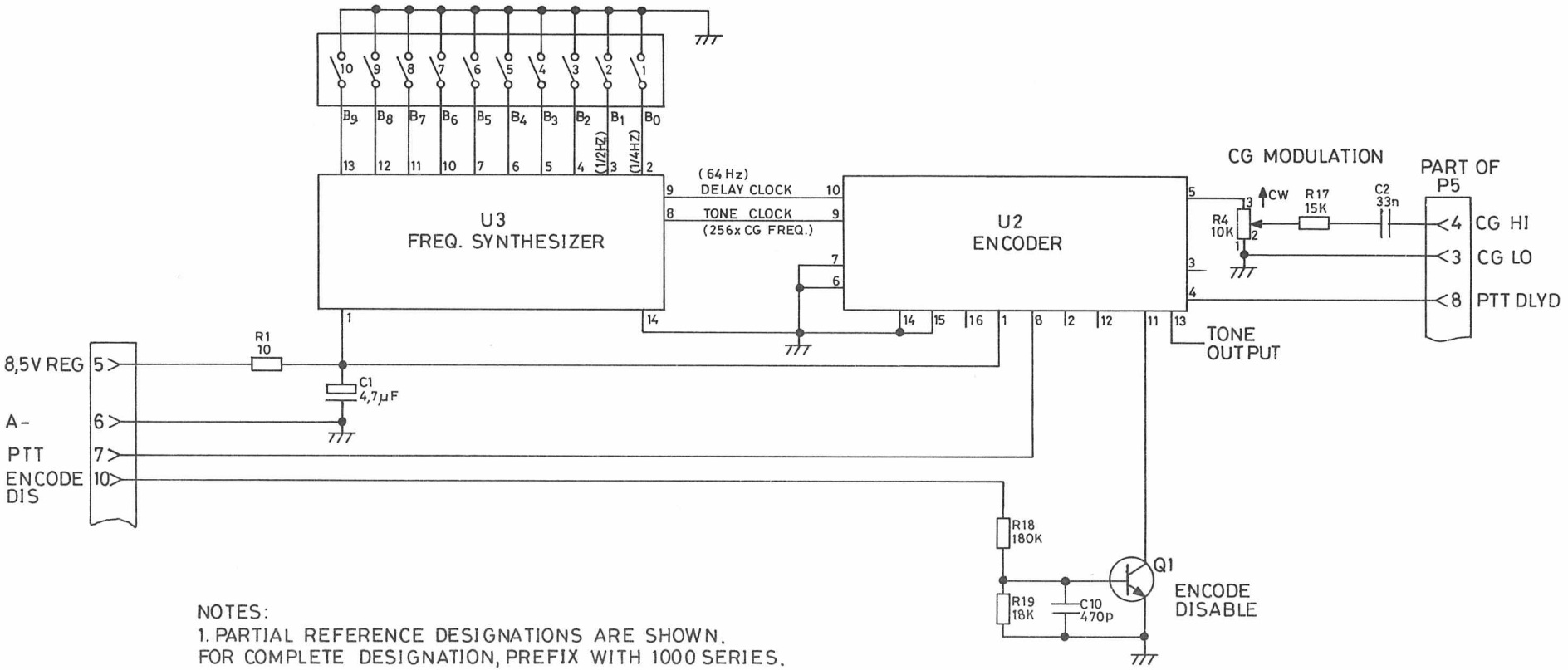
Storno

Nº	CODE	DATA

CHANNEL GUARD DEC TR5002

X403.020

Storno



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

Nº	CODE	DATA	
C1001	19A134202P5	3.3 uF Tantal	
C1002	19A700005P10	33 nF Polyester	50 V
C1010	19A116192P2	470 pF Ceram capacitor	
P1005	19A134152P35	Connector	
Q1001	19A115910P1	Transistor	
R1001	19A700019P13	10 ohm Resistor	0.2 W
R1004	19A116559P206	10 Kohm Resistor var.	
R1017	19A700019P51	15 Kohm Resistor	0.2 W
R1018	19A700019P61	100 Kohm Resistor	0.2 W
R1019	19A143400P52	20 Kohm Resistor Depos	
S1001	19B800010P1	Switch	
U1002	19D430412G2	Int. Circuit	
U1003	19D430393G1	Int. Circuit	

Storno

Nº	CODE	DATA

CHANNEL GUARD ENC TT5002

X403.021

Storno

TOUCH TONE GENERATOR

TT5003

The TT5003 is a Touch Tone ® generator for STORNOPHONE 5000.
The unit is mounted on the Control Panel and consists of three sub-units:
- a 15-button keyboard
- a touch tone encoder board
- a timing and switching circuit

	Col. 1 1209 Hz	Col. 2 1336 Hz	Col. 3 1477 Hz	Col. 4 1633 Hz
Row 1 697 Hz	1	2	3	A
Row 2 770 Hz	4	5	6	S
Row 3 852 Hz	7	8	9	M
Row 4 941 Hz	*	0	#	(Blank)

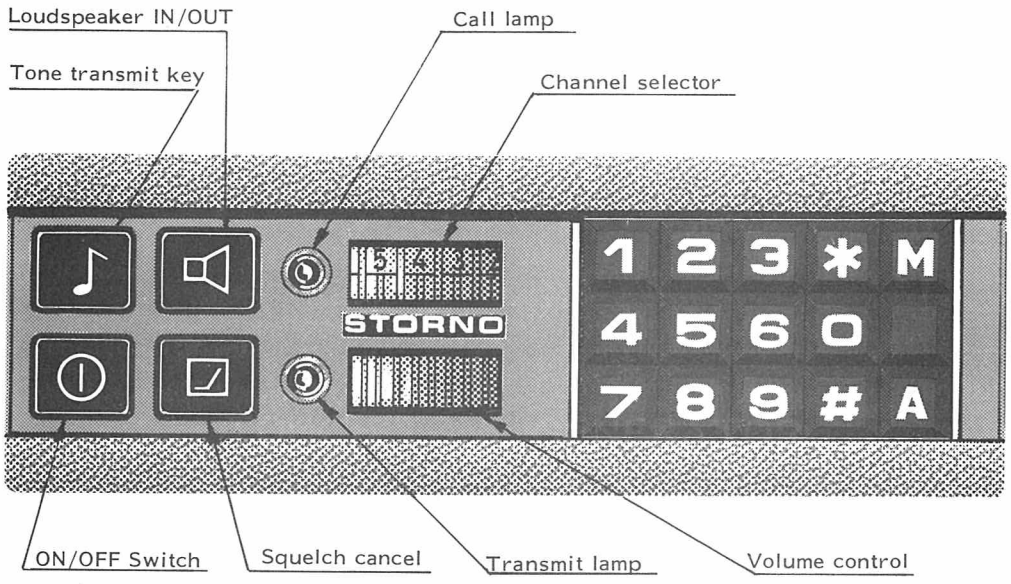
Keyboard matrix

® Trade Mark registered by Bell Telephone Co.

KEYBOARD

The keyboard is a 3x5 button cluster with two illuminating lamps. The current for the lamps flow through a transistor which is turned on by +8.5 V.

The keyboard is terminated in a connector which is connected to the touch tone encoder.



TOUCH TONE ENCODER

The touch tone encoder is an integrated circuit mounted on a board together with a 5 millisecond anti-bounce circuit, a busy indicator circuit and part of a circuit for extended "Clear Down" (#).

The tone encoder U201 is a 2 of 8 SINE WAVE GENERATOR which consists of a high frequency oscillator, two separate programable frequency dividers, a digital-to-analogue converter and a high level output driver. The reference frequency generator is fully integrated except for the 3.579545 MHz crystal. This fre-

quency is divided by 8 and then gated into two divide-by-N counters which provide the correct division ratios for the upper and lower band of frequencies. The output from these two counters are further divided by 8 to provide the time sequencing for a 4-voltage-level synthesis of each sine wave. Both sine wave signals are added and buffered to a high current output driver. C211 and C212 are external capacitors for low pass filtering which reduce the harmonic distortion of the output signal.
When depressing a keyboard button a logic "1" is available at the disable output of U201 tone encoder as long as the button is depressed. This output is used to trigger the delay circuit U202c to provide a delayed trigger pulse to the timing circuit.

The Busy Indicator circuit is triggered by the squelch and drives a LED on whenever a carrier is received. The circuitry consists of transistor Q201, amplifier U202d and transistor Q202. Capacitor C217 and amplifier U202d causes a delay of approx 11 seconds before turning the indicator off after the carrier has disappeared.

TIMING AND SWITCHING CIRCUITS

The trigger pulse from the tone encoder triggers two monostable flip-flops, U301a which has a delay time of approx. 100 milliseconds, and U301b which has a delay time of approximately 22 milliseconds. U301a controls the CG disable function (Q303), the microphone blocking function, the PTT (Push-To-Talk) function (Q304) and AF gate transistor Q305.
U301b controls the time between pressing a button and generation of the tone modulation.

Transistor Q307 is an amplifier for the touch tone modulation and its output is set with potentiometer R322. A transistor Q306 is an amplitude limiter connected to the base of Q307.

The delay time of U301a may be extended to approx. 560 milliseconds by using the extended "Clear Down" function Q301. Transistor Q302 disables the touch tone generator whenever the RX mute output (connected to the touch tone disable input) goes low. This prevents that any attempt to operate the generator while receiving will energize the transmitter.

TECHNICAL SPECIFICATIONS

Supply voltage (+A)
13.2 V ±2.4 V

Supply voltage (8.5 V)
8.5 V ±0.15 V

Current drain (+A)
less than 130 mA

Current drain (8.5 V)
Busy indicator on: less than 37 mA
Quiecent: less than 12 mA

Anti-bounce delay
5 ms ±1 ms

PTT delay time
Normal: 100 ms ±20 ms
Extended: 560 ms ±100 ms

Touch tone delay
22 ms ±4 ms

Busy indicator off delay
11 sec. ±2 sec.

Crystal frequency
3.579545 MHz
Tolerance: 50×10^{-6}
Specification: S98-5038

Tone frequencies

Key	Low band Hz	High band Hz
1	697	1209
2	697	1336
3	697	1477
4	770	1209
5	770	1336
6	770	1477
7	852	1209
8	852	1336
9	852	1477
*	941	1209
0	941	1336
#	941	1477
A	697	1633
S	770	1633
M	852	1633

Maximum frequency deviation
f_{nom} ± 1%

Touch output levels
R322 set to max:
Low band: greater than 250 mV RMS
High band: greater than 400 mV RMS
Low + high band: greater than 450 mV RMS
Variation between two combinations:
less than 1.5 dB

Distortion (THD)
Low band: less than 5%
High band: less than 3%

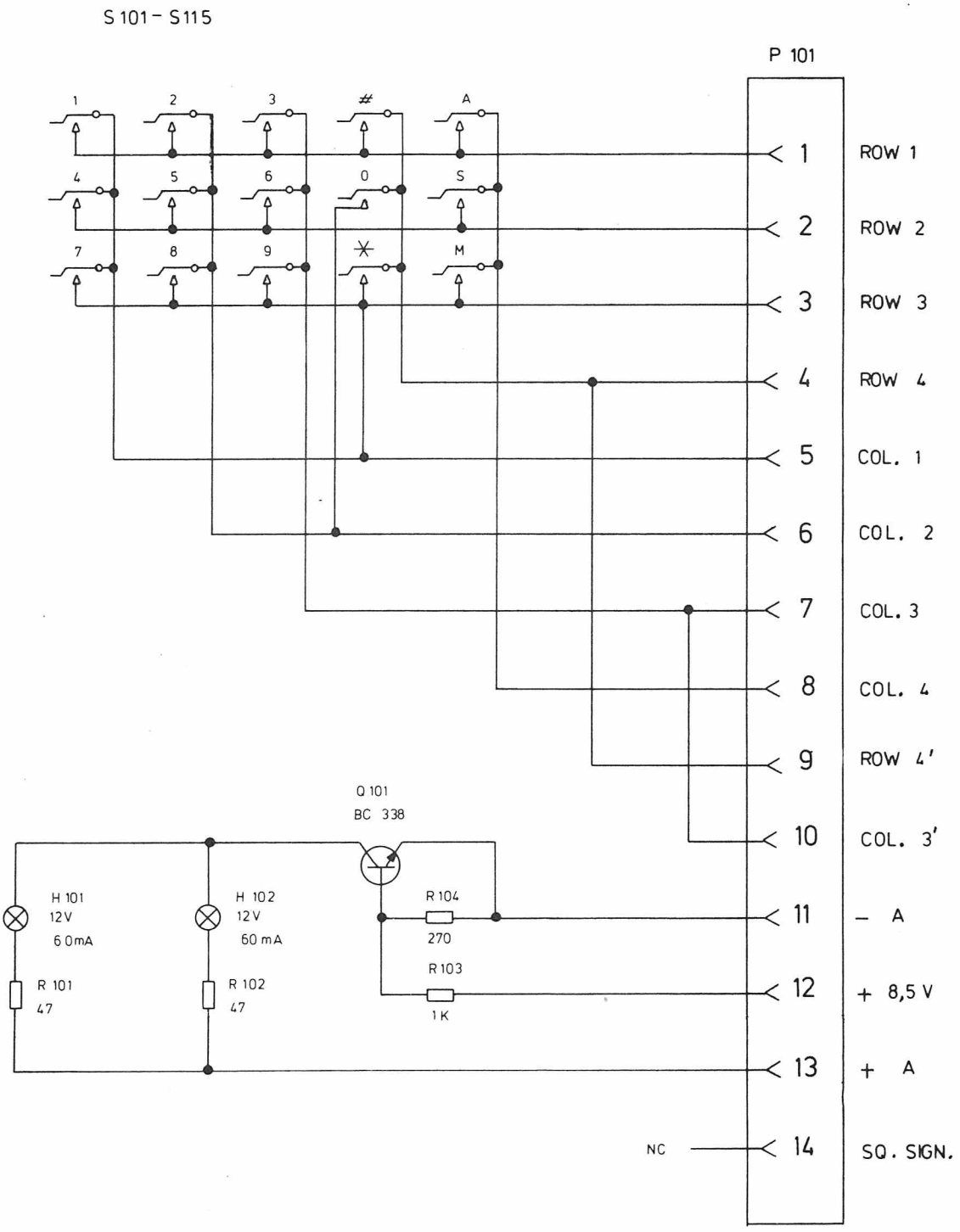
Output impedance
Higher than 15 Kohm

DC output loading
PTT (J307-7)
MIC. Block (J302-8) I_{sink} less than 100 mA

CG disable (J302-10) I_{source} less than 10 mA
TT disable (J302-9) I_{source} less than 1.7 mA

Temperature range
$-30^{o}C$ to $+60^{o}C$

Storno

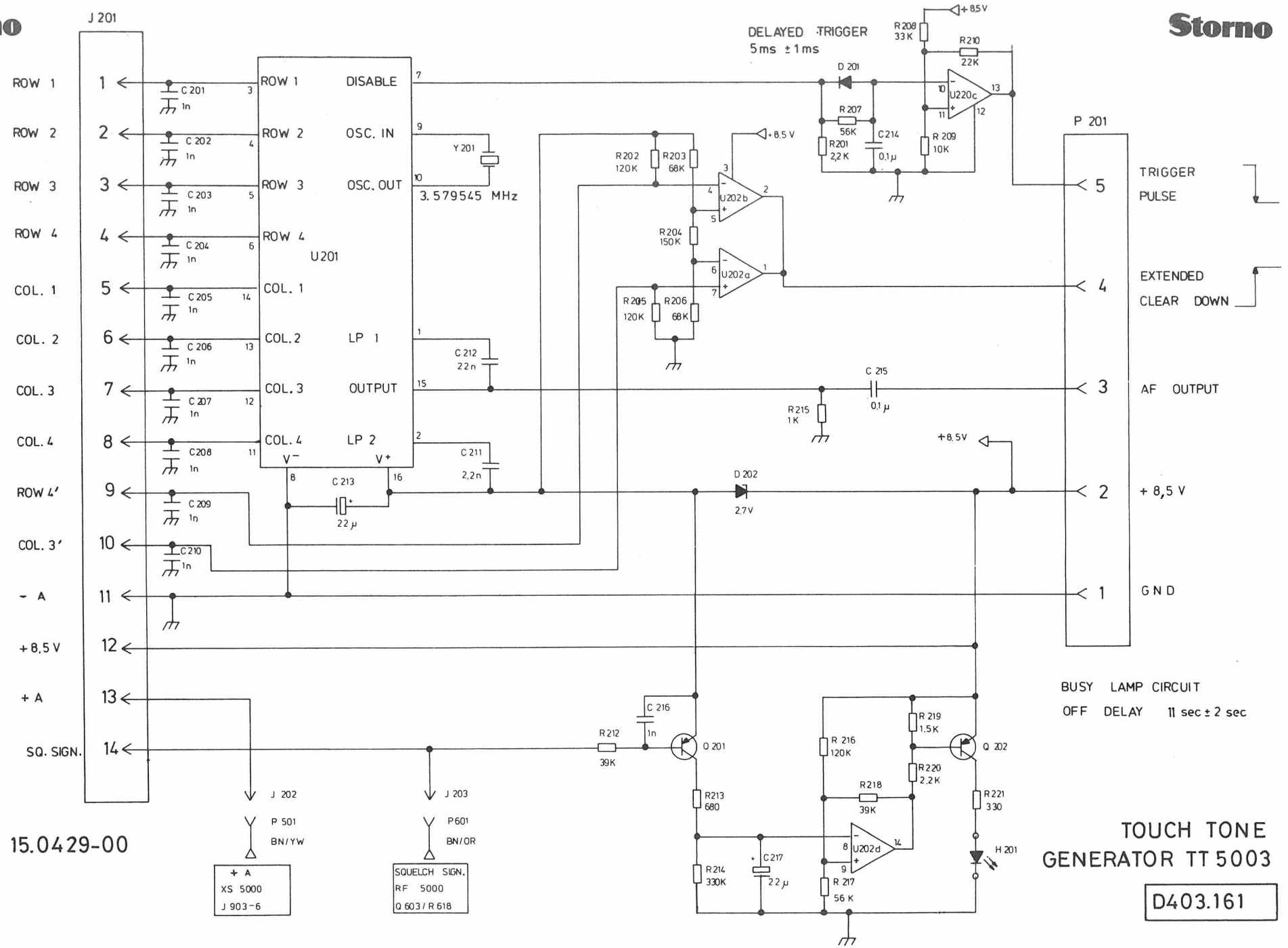


15.0428-00

TOUCH TONE GENERATOR TT5003
KEYBOARD

D403.160

Storno

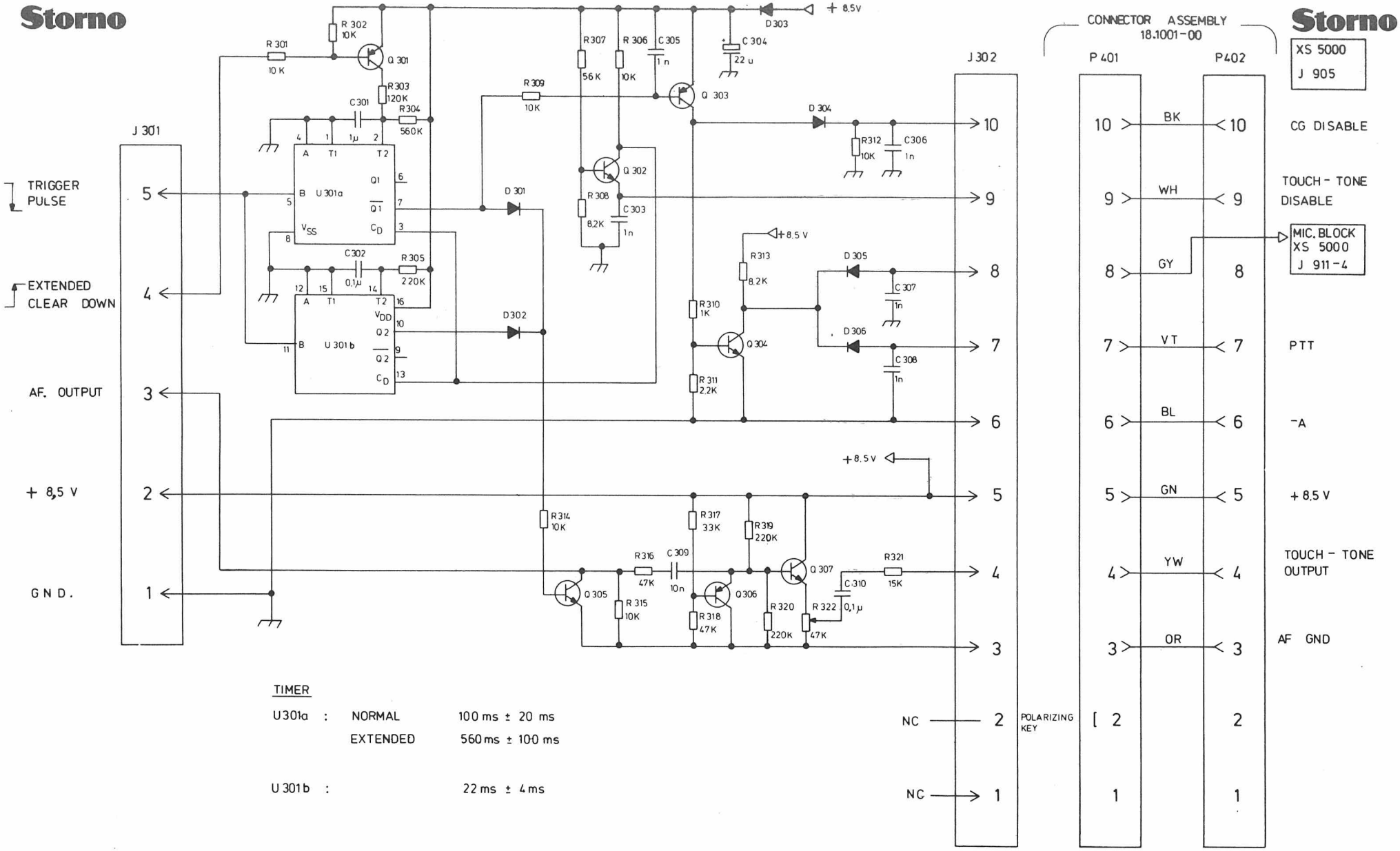


15.0429-00

TOUCH TONE GENERATOR TT 5003

D403.161

Storno



Storno

XS 5000
J 905

TIMER

U301a : NORMAL 100 ms ± 20 ms
EXTENDED 560 ms ± 100 ms

U 301b : 22 ms ± 4 ms

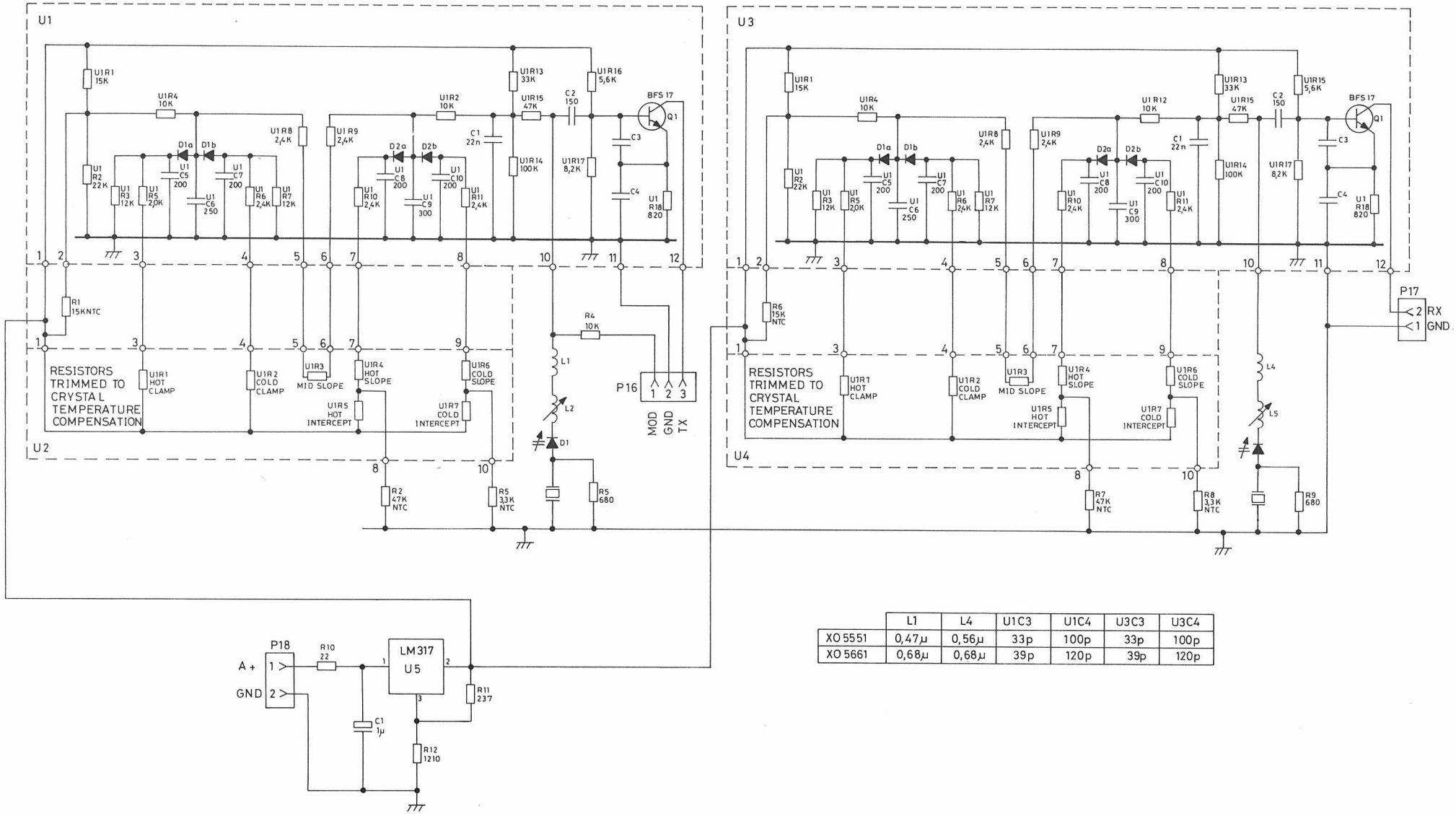
15.0430-00

TOUCH TONE GENERATOR TT 5003
TIMER

D403.162

Storno

Storno

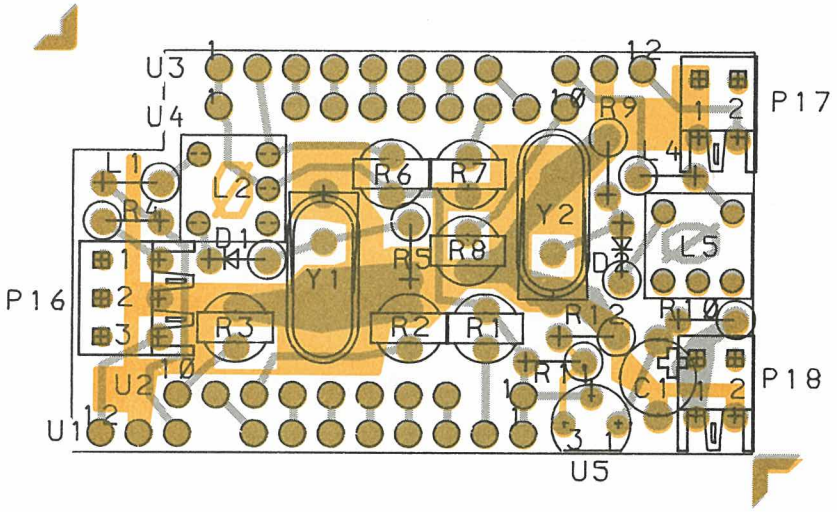


	L1	L4	U1C3	U1C4	U3C3	U3C4
XO 5551	0,47µ	0,56µ	33p	100p	33p	100p
XO 5661	0,68µ	0,68µ	39p	120p	39p	120p

CRYSTAL OSCILLATOR XO5551, XO5661

D403.104

Storno

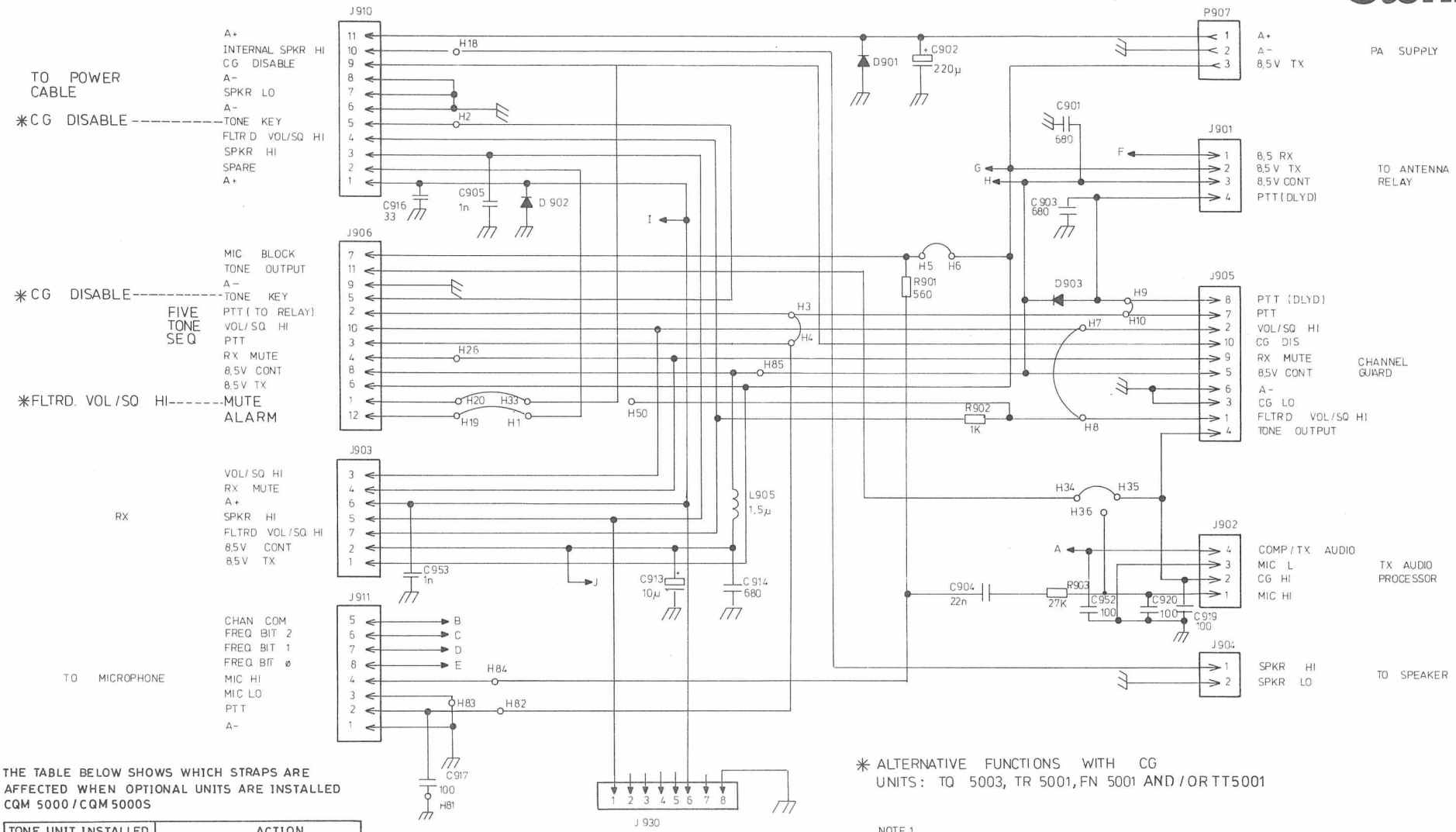


COMPONENT LAYOUT XO5551,XO5661

D403.119

Storno

Storno



THE TABLE BELOW SHOWS WHICH STRAPS ARE AFFECTED WHEN OPTIONAL UNITS ARE INSTALLED CQM 5000/CQM 5000S

TONE UNIT INSTALLED	ACTION	
TQ 5001 TQ 5002 TQ 5004 TQ 5005	CUT	H3-H4, H5-H6
TQ 5006	CUT	H7-H8, H9-H10, H20-H33
TR 5002 FN 5002	CUT	H7-H8, H20-H33
TT 5002	CUT	H9-H10, H20-H33
TQ 5007 TQ 5008 CL 5001	CUT INSERT	H34-H35 H34-H36

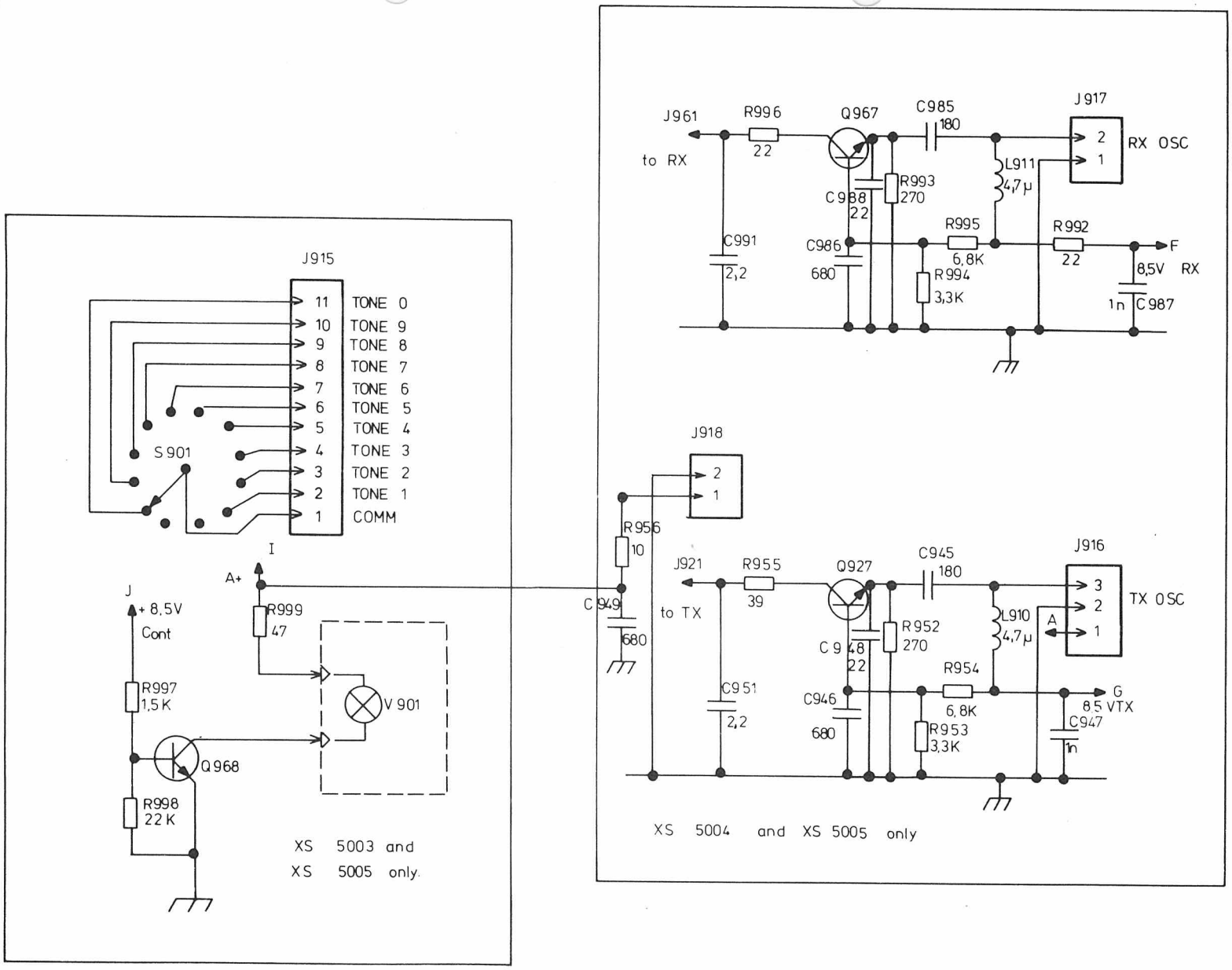
✳ ALTERNATIVE FUNCTIONS WITH CG UNITS: TQ 5003, TR 5001, FN 5001 AND/OR TT 5001

NOTE 1
IF THE PREVIOUSLY USED CG UNITS TQ 5003, TR 5001 OR FN 5001 ARE USED, H20-H33, H7-H8 SHALL BE OMITTED AND H20-H50 INSTALLED.

INTERCONNECT BOARD XS5002, XS5003, XS5004, XS5005
PAGE 1 OF 2

D 402.994/3

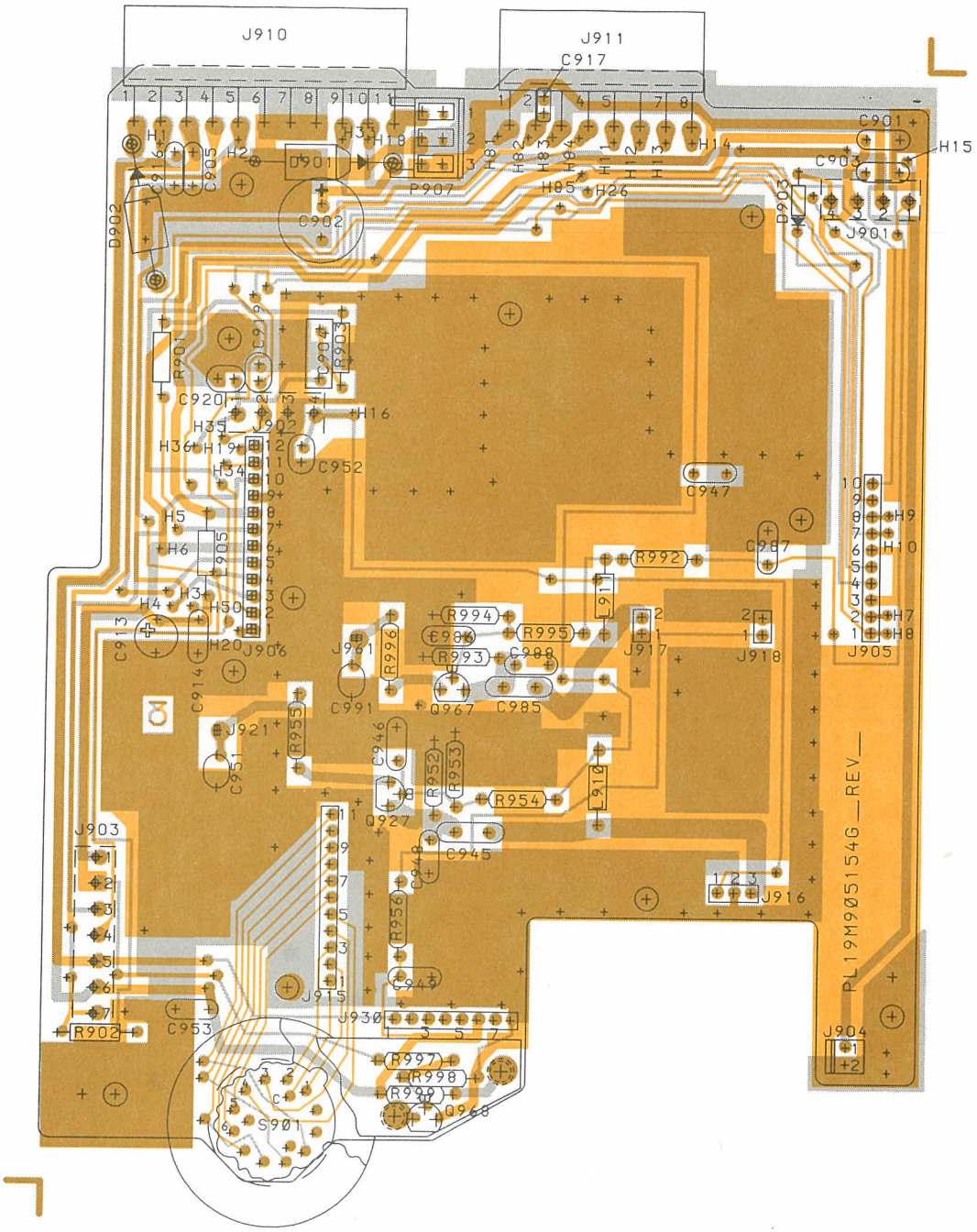
Storno



INTERCONNECT BOARD XS5002, XS5003, XS5004, XS5005
PAGE 2 OF 2

D402.995/2

Storno



COMPONENT LAYOUT XS5002, XS5003, XS5004, XS5005

D 402.996/2

Storno

Nº	CODE	DATA		
	M905154G1	XS5002		
	M905154G2	XS5003		
	M905154G3	XS5004		
	M905154G4	XS5005		
C901	A700233P6	680 pF 20%	Ceram.	50 V
C902	J706005P10	220 µF -10, +100%,	ELCO	25 V
C903	A700233P6	680 pF 20%	Ceram.	50 V
C904	J706261P1	22 nF 5%	Polyest.	100 V
C905	A700233P7	1 nF 20%	Ceram.	50 V
C913	A700003P7	10 µF 20%	Tantal.	16 V
C914	A700233P6	680 pF 20%	Ceram.	50 V
C916	A700235P19	33 pF 5%	Ceram.	50 V
C917	A700001P1	100 pF 20%	Ceram.	50 V
C919	A700001P1	100 pF 20%	Ceram.	50 V
C920	A700001P1	100 pF 20%	Ceram.	50 V
C945+	A700235P28	180 pF 5%	Ceram.	50 V
C946+	A700233P6	680 pF 20%	Ceram.	50 V
C947+	A700233P7	1 nF 20%	Ceram.	50 V
C948+	A700235P17	22 pF 5%	Ceram.	50 V
C949+	A700233P6	680 pF 20%	Ceram.	50 V
C951+	A700235P5	2,2 pF ±0,25 pF	Ceram.	50 V
C952	A700001P1	100 pF 20%	Ceram.	50 V
C953	A700233P7	1 nF 20%	Ceram.	50 V

+XS5004 and XS5005 ONLY

oXS5003 and XS5005 ONLY

Storno

Nº	CODE	DATA		
C985+	A700235P28	180 pF 5%	Ceram.	50 V
C986+	A700233P6	680 pF 20%	Ceram.	50 V
C987+	A700233P7	1 nF 20%	Ceram.	50 V
C991+	A700235P5	2,2 pF ±0,25 pF,	Ceram.	50 V
D901	J706026P1	Diode	1N5401	
D902	J706026P1	Diode	1N5401	
D903	A700028P1	Diode	1N4148	
J901	J706214P4	Connector 4 Pin, Male		
J902	J706214P4	Connector 4 Pin, Male		
J903	J706214P7	Connector 7 Pin, Male		
J904	A700072P28	Connector 2 Pin, Male		
J905	A700072P9	Connector 10 Pin, Male		
J906	A700072P11	Connector 12 Pin, Male		
J910	J706223P11	Connector 11 Pin, Male		
J911	J706223P8	Connector 8 Pin, Male		
J915o	A700072P10	Connector 11 Pin, Male		

CHANNEL SELECTOR UNIT

XS5002, XS5003, XS5004, XS5005.

Nº	CODE	DATA		
J916+	A700072P2	Connector 3 Pin, Male		
J917+	A700072P1	Connector 2 Pin, Male		
J918+	A700072P1	Connector 2 Pin, Male		
J921+	J706219P1	PIN		
J930	J706215P108	Connector 8 Pin, Male		
J961+	J706219P1	PIN		
L905	A700024P15	Coil 1,5 µH 10%, 535 mA		
L910+	A700024P21	Coil 4,7 µH 10%, 280 mA		
L911+	A700024P21	Coil 4,7 µH 10%, 280 mA		
P907	A700102P10	Connector 3 Pin, Female		
Q927+	J706283P1	Transistor BFR54		
Q967+	J706283P1	Transistor BFR54		
Q968o	A700017P1	Transistor BC548		
R901	A700019P34	560 ohm 5%	Carb. film	0,25 W
R902	A700019P37	1 Kohm 5%	Carb. film	0,25 W
R903	A700019P54	27 Kohm 5%	Carb. film	0,25 W

Storno

Nº	CODE	DATA		
R952+	A700019P30	270 ohm 5%	Carb. film	0,25 W
R953+	A700019P43	3,3 Kohm 5%	Carb. film	0,25 W
R954+	A700019P47	6,8 Kohm 5%	Carb. film	0,25 W
R955+	A700019P20	39 ohm 5%	Carb. film	0,25 W
R956+	A700019P13	10 ohm 5%	Carb. film	0,25 W
R992+	A700019P17	22 ohm 5%	Carb. film	0,25 W
R993+	A700019P30	270 ohm 5%	Carb. film	0,25 W
R994+	A700019P43	3,3 Kohm 5%	Carb. film	0,25 W
R995+	A700019P47	6,8 Kohm 5%	Carb. film	0,25 W
R996+	A700019P17	22 ohm 5%	Carb. film	0,25 W
R997o	A700019P39	1,5 Kohm 5%	Carb. film	0,25 W
R998o	A700019P53	22 Kohm 5%	Carb. film	0,25 W
R999o	A700019P21	47 ohm 5%	Carb. film	0,25 W
S901	J706322G1	Assembly, Channel switch		
V901	K805090G1	Lamp, assembly.		

CHANNEL SELECTOR UNIT

XS5002, XS5003, XS5004, XS5005.

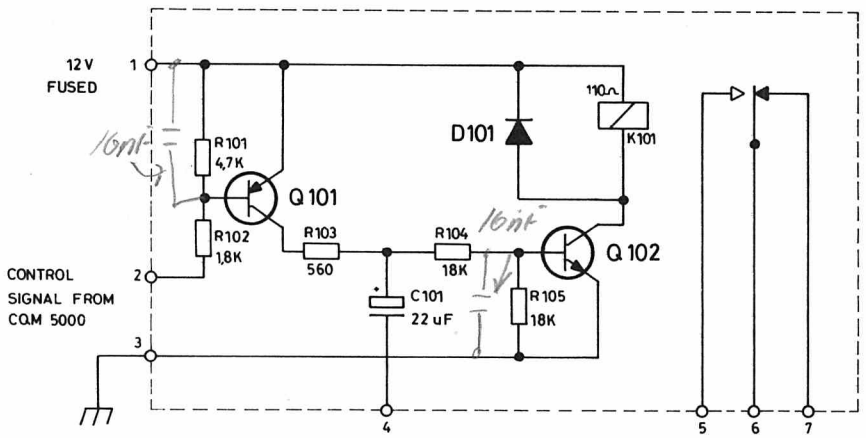
X403.205

STORNOPHONE 5000
Maintenance Manual
Section 9

CONTENTS

Service Coordination
11 - 79

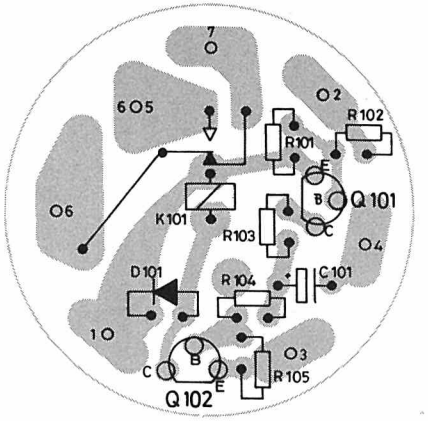
Storno



GROUND FOR DELAY

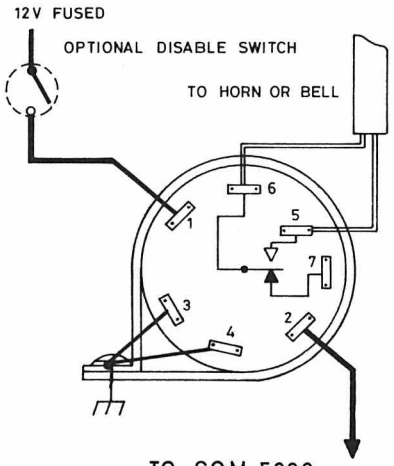
BOTTOM VIEW

Storno



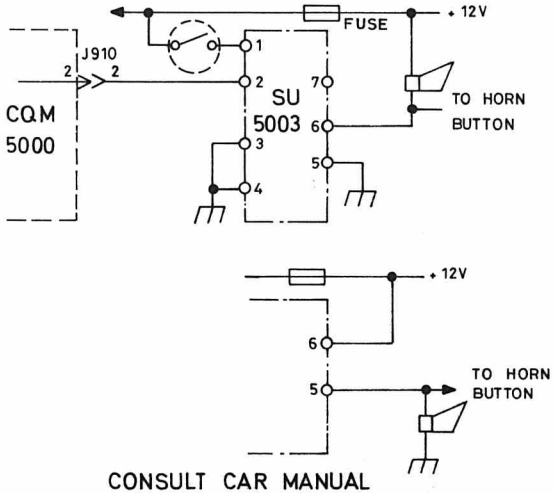
PRINTED CIRCUIT VIEWED FROM
SOLDER SIDE

ALARM (HORN, BELL)



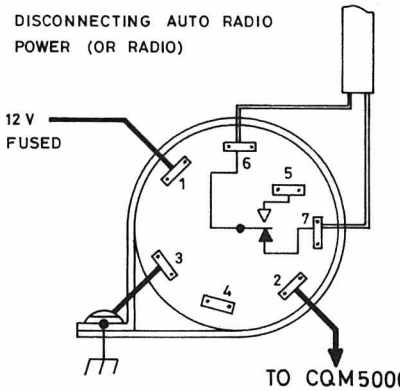
TO CQM 5000
CONNECTOR J910 - PIN 2

NOTES: STRAP H1 - H19 ON XS5000.
THE HORN ALARM MAY BE
SWITCHED OFF BY A SWITCH
IN SERIES WITH 12V FUSED



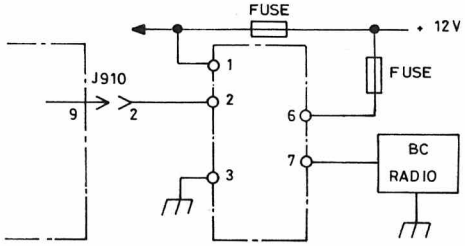
CONSULT CAR MANUAL
FOR HORN SCHEMATIC

DISCONNECTING AUTO BROADCAST RADIO



TO CQM5000
CONNECTOR J910
PIN 9

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

TYPE	Nº	CODE	DATA		
		10.3791	Switching Unit W. timer SU5003		
	C101	73.5174	22uF 20%	Tantal	16V
	R101	80.5257	4.7Kohm 5%	Carbon film	0.125W
	R102	80.5252	1.8Kohm 5%	Carbon film	0.125W
	R103	80.5246	560ohm 5%	Carbon film	0.125W
	R104	80.5264	18Kohm 5%	Carbon film	0.125W
	R105	80.5264	18Kohm 5%	Carbon film	0.125W
	D101	99.5237	1N4148	Diode	
	Q101	99.5365	MPS-A13	Transistor	
	Q102	99.5251	BC307	Transistor	
	K101	58.5083	12V Relay, 110ohm		

Storno

TYPE	Nº	CODE	DATA

SWITCHING UNIT SU5003

X402.710

Storno

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 smothing 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
$-10^{o}C$ to $+50^{o}C$

Duty Cycle
as specified for CQM5000

Power - supply unit PS5001

Description

1. General

Ref. schematic diagr. D 26718

PS5001 is a mains power-supply, consisting of a mains transformer, rectifier, filter, switching regulator and another filter. It will supply 13,6V stabilized DC voltage when connected to 220V AC voltage.

2. Mains transformer

The mains transformer is a toroide type transformer with two windings.
A primary winding - 220/240V and a secondary winding - 24V.
A slow blow fuse is coupled in series with the secondary to protect the part of the circuit not already protected by the electronic protection circuitry in the switching regulator.

3. Switching circuit

The switching circuit is constructed as a normal "Switchmode" regulator with constant switch frequency (approx 32kHz) and variable duty cycle. The actual switching function is performed by the transistorcombination Q2, Q3 and Q4 and the fly-back diode D4, which keeps the input of the LC-filter L2, C8 at ground potential in the portion of the periode where the transistorswitch is off - the fly-back diode D4 being forced into conduction by the field energy in L2.

The output voltage is sensed across C8 by IC1a and compared with the refe-rencevoltage across D2/D3. IC 1b amplifies this signal which is used to control Q2 and thereby Q3 and Q4.

Output current limiting is achieved by measuring the voltage drop across R17 and feed this to IC 1d. The output fram IC 1d (pin 13) is "or - ed" with the voltage control signal on IC 1a output, and therefore overrides the voltage control when the output current be comes too high.

The two filters L1, C2, C3 and L3, C8, C9 are ripple/transientfilters on in-put and output. Their function is to keep the inherent switch noise from exceeding acceptable limits on the input- and output terminals and cables.

REVISED

Power supply PS5001

DATA

1. Supply voltage.
   220/240V, + 10, -15%, 50 - 60Hz

2. Power consumption.
   app. 6mA, 0 Amp. load
   app. 450mA, 6 Amp. load.

3. Output voltage.
   13,6V =, ± 1,0V

4. Output current.
   Max. 6 Amp. (short circuit protected)

5. Output voltage ripple.
   < 100m Vpp

6. Switch frequency.
   app. 32kHz.

7. Temperature
   -10, + 50°C.

REVISED
79-06-11

For internal use only

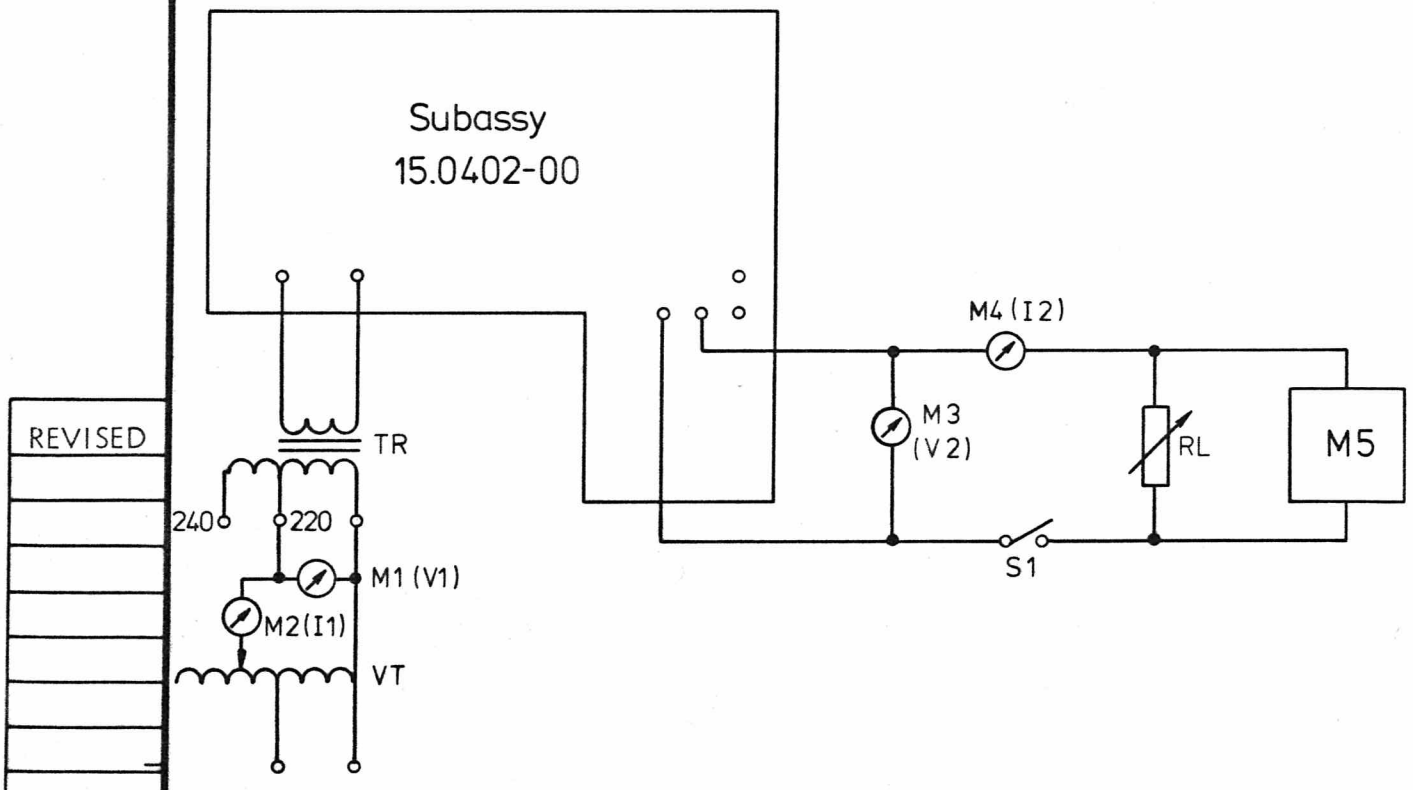
Powersupply PS5001

TEST PROCEDURE

1. Measuring equipment (recommended)

M1:	AC	Voltmeter, 250V.	(AVO - meter)
M2:	AC	Amp. - meter,	(AVO - meter)
M3:	DC	Voltmeter, 15V.	(AVO - meter)
M4:	DC	Amp. - meter, 10 Amp.	(AVO - meter)
M5:	Oscilloscope.		
S1:	Switch.		
R_L:	Variable resistor, 100Ω, 85W.		
VT:	Variable transformer, 0-250V		
TR:	Transformer, Storno part no. S 60.5170-00		

Test circuit



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Test procedure

Adjust the variotransformer to 220 Volt and connect it, S1 open. Check output voltage V_2 and input current I1 according to the values on the data sheet.
Switch on S1 and adjust R_L to I_2 = 6 Amp., check V_2 and I_1 according to the values in "DATA". Check with the oscilloscope the switch frequency and the output voltage ripple, still with I_2 = 6 Amps., values shall be in accordance with the values in "DATA". Check the short circuit protection with S1 switched on. Slowly turn R_L towards 0Ω and notice highest reading on M4.
This max. current shall be approx. 7,5 Amps.

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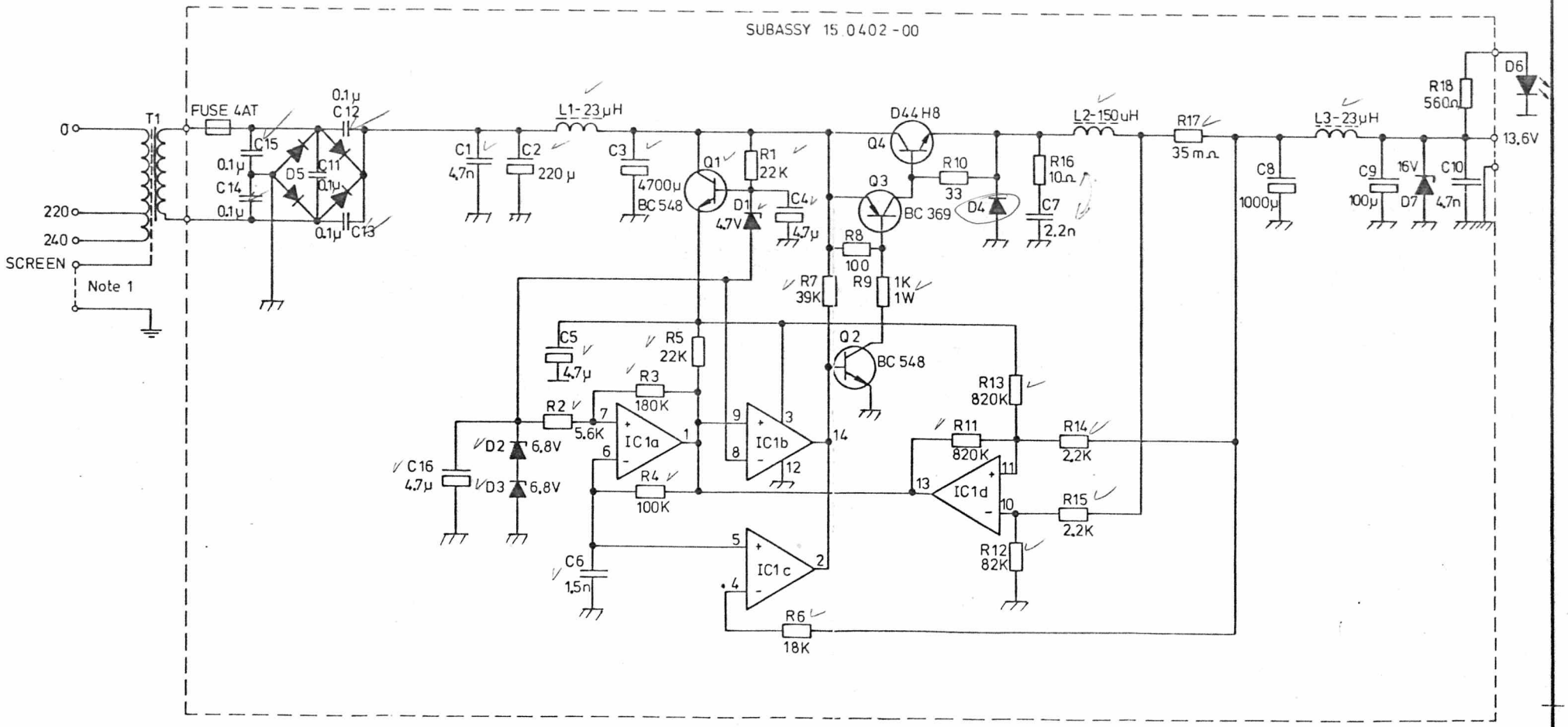

Note 1.
Connection i UK only.

f				workpiece	finish	approved for	sign. date
e						inform.	
d						tooling	
c						A pilot prod.	Jørgensen 01
b						P production	
a				dim.			
	revisions	sign.	date	weight g/piece			

MRPD first made for: Storno

designer: Jo/LSø 79 Ap 05

DIAGRAM PS 5001

MRPD no. | STORNO no.

draw. no. D26718

Storno

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 smothing 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.

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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 ± 1,0V

Output Current
Maximum 6 Ampere (short circuit protected)

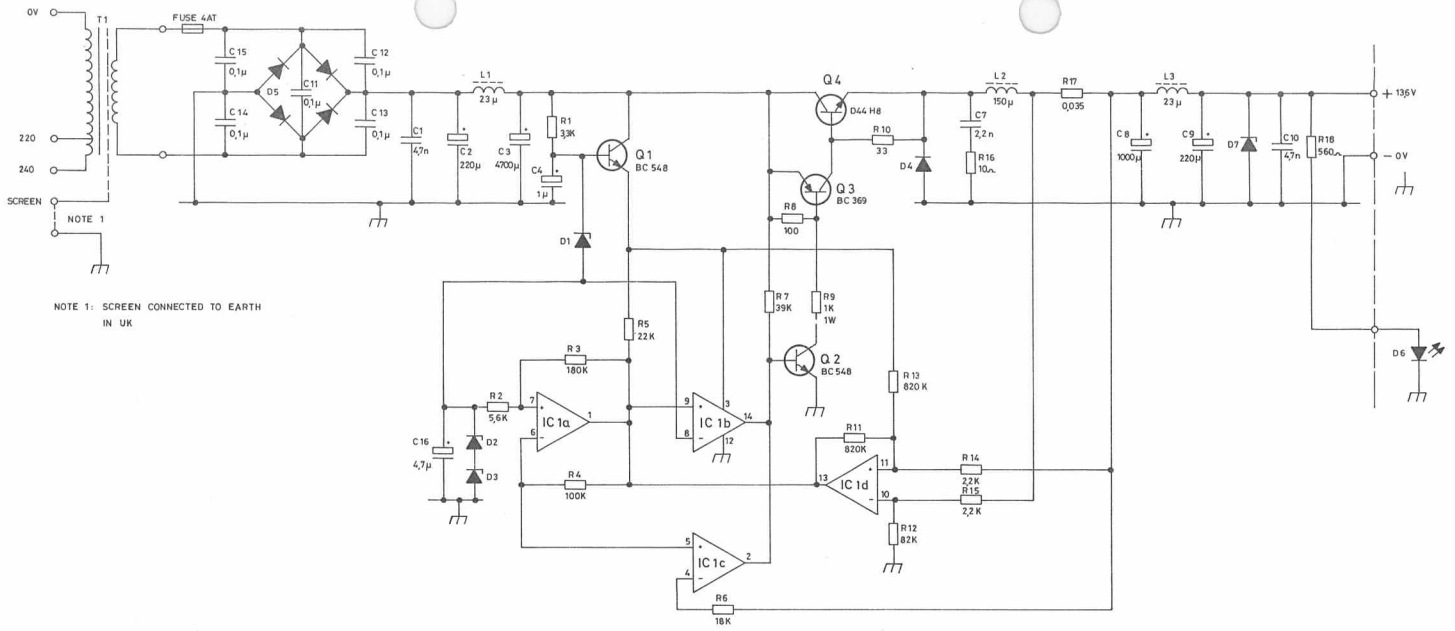
Output Voltage Ripple
Less than 100mV pp (peak to peak)

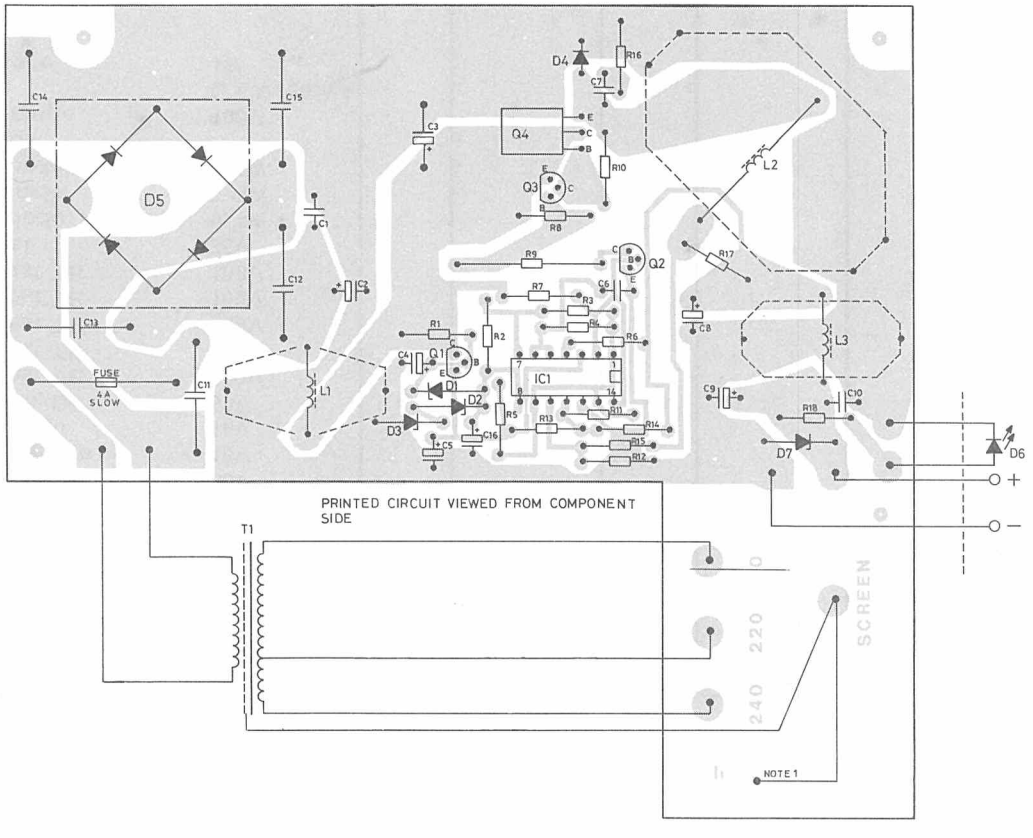
Switching Frequency
approx. 32KHz

Temperature Range
$-10^{o}C$ to $+50^{o}C$

Duty Cycle
as specified for CQM5000

Storno





POWER SUPPLY PS5001

D402.713

Storno

TYPE	Nº	CODE	DATA	
	C 1	74.5401	4700pF 10% Ceram DI	50V
	C 2	73.5178	220uF -10 +100% Elco	40V
	C 3	73.5155	4700uF -10 +50% Elco	40V
	C 4	73.5126	4.7uF 20% Tantal	35V
	C 5	73.5126	4.7uF 20% Tantal	35V
	C 6	76.5130	1.5nF 10% Polyester FL	50V
	C 7	74.5399	2200pF 20% Ceram DI	50V
	C 8	73.5179	1000uF -10 +100% Elco	16V
	C 9	73.5151	100uF -10 +50% Elco	16V
	C 10	74.5401	4700pF 10% Ceram DI	50V
	C 11	76.5073	0.1uF 10% Polyest TB	100V
	C 12	76.5073	0.1uF 10% Polyest TB	100V
	C 13	76.5073	0.1uF 10% Polyest TB	100V
	C 14	76.5073	0.1uF 10% Polyest TB	100V
	C 15	76.5073	0.1uF 10% Polyest TB	100V
	C 16	73.5126	4.7uF 20% Tantal	35V
	D 1	99.5224	4.7V 5% Zenerdiode	0.4W
	D 2	99.5146	6.8V 5% Zenerdiode	0.4W
	D 3	99.5146	6.8V 5% Zenerdiode	0.4W
	D 4	99.5371	BYW29-150 Diode	
	D 5	99.5174	10A Rectifier bridge	100V
	D 6	99.5303	LED red	1.6 V/20 mA
	D 7	99.5334	16V 5% Zenerdiode	1W
	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	1/8W
	R 2	80.5258	5.6Kohm 5% Carbon film	1/8W
	R 3	80.5276	180Kohm 5% Carbon film	1/8W
	R 4	80.5272	82Kohm 5% Carbon film	1/8W
	R 5	80.5265	22Kohm 5% Carbon film	1/8W
	R 6	80.5264	18Kohm 5% Carbon film	1/8W
	R 7	80.5268	39Kohm 5% Carbon film	1/8W
	R 8	80.5237	100ohm 5% Carbon film	1/8W
	R 9	82.5049	1Kohm 5% Carbon film	1W
	R 10	80.5231	33ohm 5% Carbon film	1/8W
	R 11	80.5284	820Kohm 5% Carbon film	1/8W
	R 12	80.5272	82Kohm 5% Carbon film	1/8W
	R 13	80.5284	820Kohm 5% Carbon film	1/8W
	R 14	80.5253	2.2Kohm 5% Carbon film	1/8W
	R 15	80.5253	2.2Kohm 5% Carbon film	1/8W
	R 16	80.5225	10ohm 5% Carbon film	1/8W

Storno

TYPE	Nº	CODE	DATA	
	R 17	178.5005	0.035ohm Resistor Constantan	
	R 18	80.5246	560ohm 5% Carbon film	1/8W
	T 1	60.5170	Main transformer	
	U 1	14.5019	MC3302P Quad comparator	

POWER SUPPLY PS5001

X402.821